

Research Article

The Effect of Speed Camera Warning Sign on Vehicle Speed in School Zones

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Abstract: Driving too fast is one of the most prevalent factors that contribute to traffic crashes. In school zones, staying alert and obeying the posted speed limit especially during the school period are imperative for public safety, particularly involving children. Encouraging motorists to travel at safe speeds through the installation of yellow transverse bars at Seri Sabak Uni School and Pintas Puding School was found to be ineffective. Drivers were observed to have violated the 30 km/h speed limit and more seriously, driven over the speed limits of adjoining roads. Consequently, speed camera warning signs were erected as a pre-emptive measure to curtail speeding problems in the school zones. From impact studies carried out to measure the effectiveness of these signs, it was found that the speed camera warning signs were also not able to change driver behavior.

Keywords: School zones, speed, speed camera sign

INTRODUCTION

Driving behavior in school zones is primarily influenced by various factors such as traffic volume, the presence of pedestrian activity and individual habitual behavior. In Malaysia, the posted speed limit of 30 km/h is applied in school zones at all times (24 h a day) with the aim of keeping children and pedestrians safe. However in Parit Raja, Johor, unsafe driving was found to be a contributory factor for road accidents in school zones. The Malaysian Royal Police (2011) reported that more than 20 accidents between 2009 and 2011 occurred within these zones. Vehicle speeds observed in these zones in 2011 and 2012 revealed that majority of drivers failed to comply with the school zone speed limit although sufficient speed warning signs were provided. Thus, speeding continues to be a problem in these areas and puts the lives of children and pedestrians at greater risk. This study aimed to assess whether speed camera warning signs can influence the speed behavior among drivers in school zones.

METHODOLOGY

Study site: Two school zones in Parit Raja were selected for case studies. The locations were; Seri Sabak Uni School (hereinafter referred to as Site 1) and Pintas Puding School (Site 2).

Site 1 and Site 2 are located along public schools for primary education, catering to students aged 7 to 12 years old. Majority of the students enrolled in these schools are either transported by their parents using

private automobiles or through hired transportation services, namely school vans. A small number of students walk to school. Sidewalks are available on both sides of the road and are located within the school zone. However, segregation via pedestrian guardrails that can protect the children from traffic is not available. To cross the road, students use the pedestrian footbridge that is located near to school's main entrance.

The school zones are located on a busy multi-lane arterial (two lanes in each direction). The arterial connects two towns, i.e., Ayer Hitam and Batu Pahat. The posted school zone speed limit in both directions is 30 km/h, while the speed limit for the adjoining road segments is 60 km/h. The busiest periods during school hours at both sites are 6:30 a.m. to 7:30 a.m. and 12:30 p.m. to 13:30 p.m.

Method of data collection: Speed camera warning signs were installed in both directions of the road at each study location. Each sign was erected 200 m from the school entrance. Apart from speed camera warning signs, schoolchildren crossing warning signs were already in place to alert drivers. Field observations before and after the installation of the speed camera warning signs were conducted. The post-installation data was collected one (1) month after the date of installation in order to allow drivers to take notice and adapt to the new signage.

A 10-h traffic count was conducted at Site 1 from 7:30 a.m to 5:30 p.m. However, due to a technical problem in the collection of data, an 8-h traffic count was obtained at site 2 from 7:30 to 3:30 p.m. The total

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vehicles counted during pre-installation for both directions at Site 1 and Site 2 was 15,663 and 12,966 respectively. Correspondingly, for post-installation, 14,516 and 18,313 vehicles was observed at Site 1 and Site 2, respectively.

RESULTS

Figure 1 to 4 show the distribution of speed observed before and after the installation of speed camera warning signs in both directions at the study sites. The distribution histograms are based on 5 km/h speed bin width, ranging between the maximum and minimum speeds observed. From these figures, overall speed distribution does show a good distribution of data.

Speed behaviour analysis at study sites: The descriptive analysis conducted using data collected at Site 1 showed that the speed distribution fell in the range

of 5 km/h and 149 km/h. Before the installation of speed camera warning sign, speed at this site peaked between 60 to 65 km/h (Fig. 1 and 2). However, after the speed camera warning sign was erected the speed in the Batu Pahat to Ayer Hitam direction peaked between 70 to 75 km/h. The mean of speed observed in the Ayer Hitam to Batu Pahat direction was 59.6 km/h and in the Batu Pahat to Ayer Hitam direction was 60.55 km/h. The mean speeds significantly increased by 1.4 and 7.7% ($p < 0.05$), respectively one month after the sign was put up (Table 1 and 2).

Further observations revealed that, more than 90% of the drivers violated the speed limit of 30 km/h at this site. The study also found that, over 50% of the drivers drove above the adjoining road segments' speed limit of 60 km/h. Moreover, drivers of Class 3 vehicles (trailers and buses) were found to have the highest average speed compared with other vehicle types (refer to Table 3).

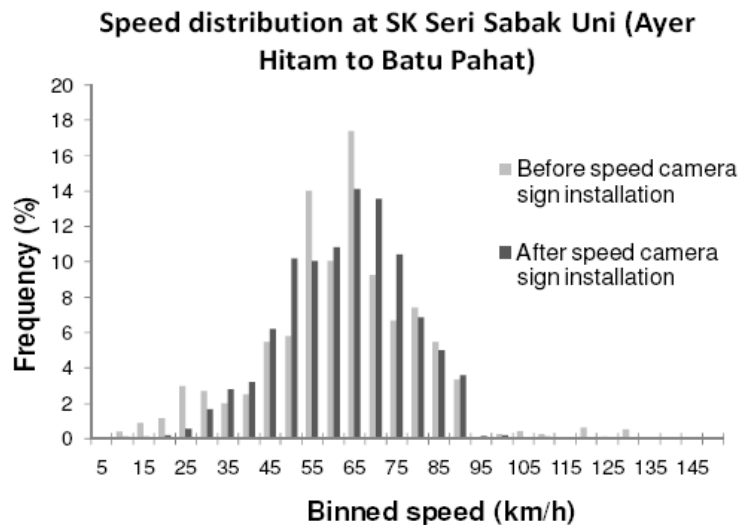


Fig. 1: Speed distribution at Seri Sabak Uni School (Ayer Hitam to Batu Pahat)

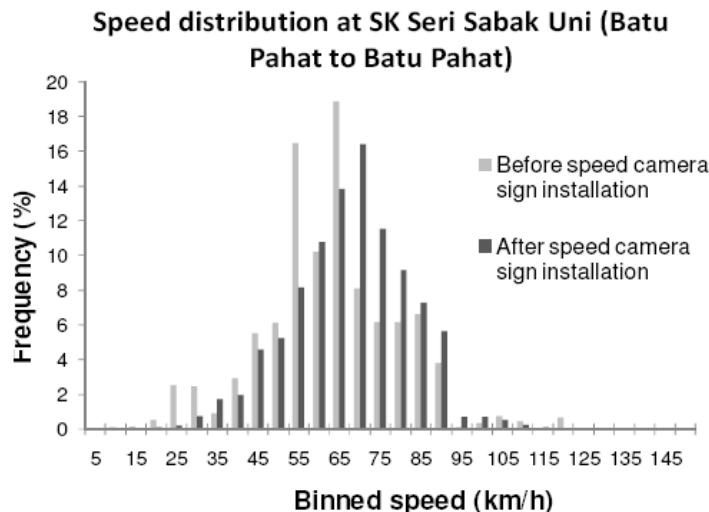


Fig. 2: Speed distribution at Seri Sabak Uni School (Batu Pahat to Ayer Hitam)

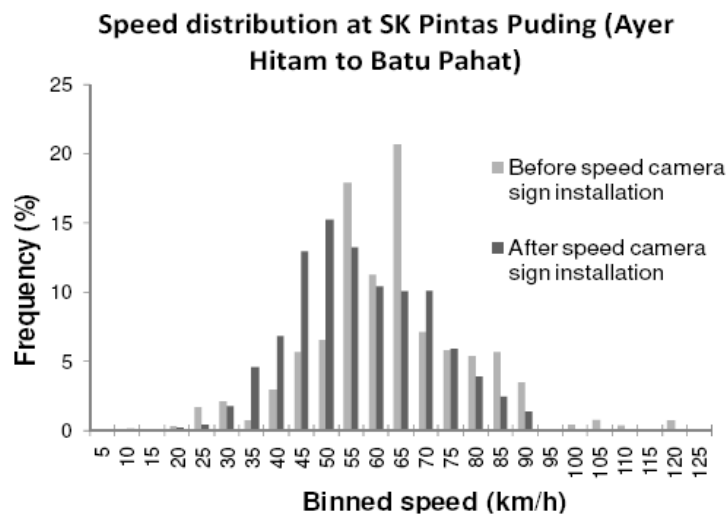


Fig. 3: Speed distribution at SK Pintas Puding (Ayer Hitam to Batu Pahat)

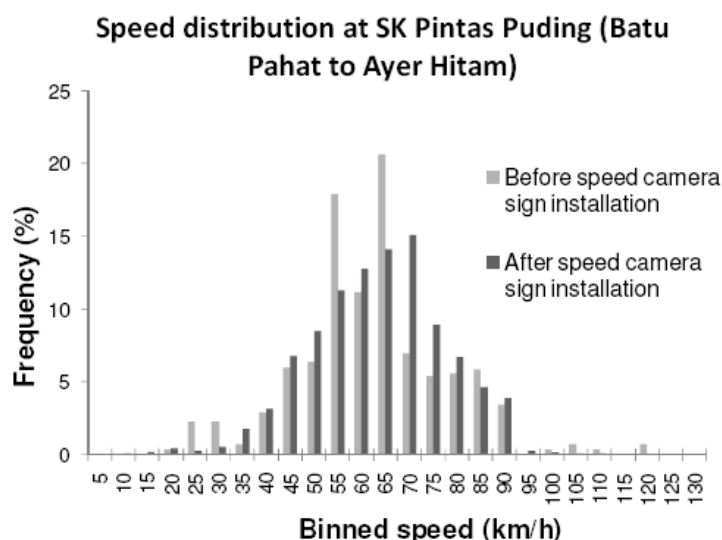


Fig. 4: Speed distribution at SK Pintas Puding (Batu Pahat-Ayer Hitam)

Table 1: Descriptive analysis of speed at Site 1 (Seri Sabak Uni School)

Road direction	Ayer Hitam to Batu Pahat		Batu Pahat to Ayer Hitam	
	Before	After	Before	After
Speed (km/h)				
Mean	59.60	60.45	60.55	65.22
Standard error	0.21	0.17	0.19	0.18
Median	60.76	61.55	60.83	65.61
Mode	54.00	67.50	54.00	65.17
Standard Deviation	18.69	14.90	16.62	14.71
Minimum	6.10	5.38	6.73	7.25
Maximum	148.83	134.27	127.19	141.60

Table 2: Descriptive analysis of speed at Site 2 (Pintas Puding School)

Road direction	Ayer hitam-Batu Pahat		Batu pahsat -Ayer Hitam	
	Before	After	Before	After
Speed (km/h)				
Mean	60.53	54.32	60.17	60.91
Standard Error	0.20	0.15	0.20	0.14
Median	60.13	52.84	60.12	61.60
Mode	54.00	45.00	54.00	65.97
Standard Deviation	15.66	14.01	15.91	14.20
Minimum	16.45	5.13	16.45	5.88
Maximum	117.83	119.22	117.83	129.21

At Site 2, speeds observed ranged between 5 km/h and 118 km/h in both directions before the installation of the speed camera warning sign. After the speed camera warning sign was installed, the speeds observed varied from 5 km/h to 129 km/h. The speed distribution for vehicles in the direction of Ayer Hitam to Batu

Pahat showed that most drivers had driven between 61 and 65 km/h before the installation of speed camera warning sign. However after the sign was installed, the peak speed reduced to between 46 and 50 km/h (Fig. 3). The average reduction in speed post-installation was about 10.3% ($p < 0.05$).

Table 3: Speed comparison before and after the installation of speed camera warning sign (Seri Sabak Uni School)

			Before the installation of speed camera warning sign		After the installation of speed camera warning sign	
			Average speed (km/h)	Percentage of vehicles violated adjoining road segment speed limit	Average speed (km/h)	Percentage of vehicles violated adjoining road segment speed limit
Seri Sabak Uni School	Batu Pahat to Ayer Hitam	Class 1-Cars/Small Vans/Utilities	55.5	36.95	64.6	65.5
		Class 2-Lorries/Large Vans	59.0	41.81	68.2	75.6
		Class 3-Trailers/Buses	66.7	74.39	72.4	84.7
		Class 4-Motorcycles	53.5	32.53	56.9	41.1
	Ayer Hitam to Batu Pahat	Class 1-Cars/Small Vans/Utilities	55.0	39.47	61.4	56.7
		Class 2-Lorries/Large Vans	58.7	43.47	62.3	59.3
		Class 3-Trailers/Buses	69.0	77.73	62.3	58.7
		Class 4-Motorcycles	44.0	22.53	53.1	33.6

Table 4: Speed comparison before and after the installation of speed camera warning sign (Pintas Puding School)

			Before the installation of speed camera warning sign		After the installation of speed camera warning sign	
			Average speed (km/h)	Percentage of vehicles violated adjoining road segment speed limit	Average speed (km/h)	Percentage of vehicles violated adjoining road segment speed limit
Pintas Puding School	Batu Pahat to Ayer Hitam	Class 1-Cars/Small Vans/Utilities	50.7	22.03	61.7	56.5
		Class 2-Lorries/Large Vans	59.1	41.38	65.3	68.8
		Class 3-Trailers/Buses	67.0	75.35	67.1	69.2
		Class 4-Motorcycles	53.1	23.53	54.7	35.7
	Ayer Hitam to Batu Pahat	Class 1-Cars/Small Vans/Utilities	51.3	22.18	54.5	33.0
		Class 2-Lorries/Large Vans	59.2	41.32	60.4	56.9
		Class 3-Trailers/Buses	67.1	75.31	55.4	36.2
		Class 4-Motorcycles	52.5	23.22	49.6	22.8

In the direction from Batu Pahat to Ayer Hitam, speed reduction was not demonstrated after the installation of the speed camera warning sign. This is reflected by the speed distribution presented in Fig. 4. The mean speed increased from 60.2 km/h to 60.9 km/h. Although the mean speed increased slightly, it was statistically significant, with $p < 0.005$ (refer to Table 2).

Prior to the speed camera warning sign installation, observations on compliance with the speed limit revealed that only 4.2 and 2.7% of drivers complied with 30 km/h speed limit in the Ayer Hitam-Batu Pahat and Batu Pahat-Ayer Hitam directions, respectively. It was also found that more than 50% of the drivers drove over the adjoining road segments' speed limit of 60 km/h before the installation of the speed camera warning sign (Table 4).

DISCUSSION AND CONCLUSION

The initial objective of the project was to investigate if the presence of speed camera warning signs can influence the speed of drivers in school zones. School zones are considered as areas of accident risk due to high pedestrian and motorist activity, especially during school hours. Drivers are alerted of school zones via the installation of school zone and schoolchildren

crossing warning signs, which are installed in accordance with local standards and specifications. Apart from these, speed control devices were also introduced to reduce traffic speed through the installation of yellow transverse bars. However, they were found to be not effective in reducing speeds, especially during the peak school periods. It should also be noted that the road along the study sites has been identified as an accident blackspot by the Ministry of Transportation (Mustakim and Fujita, 2011). Since the speeds observed during school hours were statistically indifferent during off-school hours, therefore the risk of accidents in school zones is high at all times.

The presence of speed camera warning signs was considered as a good way of encouraging drivers to comply with the speed limit. However, as found in this study, drivers did not obey the speed regulation. It is also a cause for concern that the speeds observed after the installation of speed camera warning signs were found to have significantly increased. In addition, more than 50% of the Class 1, 2 and 3 vehicles were found to have been driven over 60 km/h.

There are several possible explanations for these findings, the main reason being associated with the driver's own attitude and lack of awareness on safety in school zones. This is supported by Abdul Hanan *et al.* (2013) who studied about Malaysian drivers' intention

to comply with speed limit in school zones. Abdul Hanan *et al.* (2013) suggested that only drivers with positive attitudes towards school zone speed limits were likely to comply. Therefore, it can be said that the observed drivers did not possess acceptable attitudes and responsiveness towards road safety in school zones. It may also be concluded that the speed camera warning signs were ignored by drivers as they had realised that there were no speed surveillance operations conducted by the traffic police and that the speed camera warning sign was probably just a dummy. In addition, no summonses were given out as a result of speed violation.

The road characteristics may also be a contributing factor to the speed behavior of drivers at these study sites. Since the schools are located adjacent of the multi-lane arterial, drivers may have possibly over estimated their speed as they drove on the straight and wide lanes (3.30 m/lane). At the study sites, the effect of reduced effective road width due to parked vehicles during start and end of school session was not substantial. This was due to the existence of paved and unpaved shoulders of acceptable widths that were used for parking and waiting. Furthermore, vehicles were also parked at off-street locations. Since the road environment did not change much, drivers who drove at that particular time may have maintained or slightly reduced their speeds before entering the school zone. Besides, the drivers also could change lanes to avoid barriers that reduce their speed. This study produced results that corroborate the findings of a previous work by Martens *et al.* (1997), who reported that both lane width and effective road width can have impact on speed behavior.

To conclude, the findings of this study is of paramount importance that call for further action to ensure drivers are aware about safe operating speeds in school zones. In fact, pedestrian-related accidents are of great concern to the Malaysian government. It can be summed up that school zones in Malaysia with similar characteristics may also demonstrate similar of speed behavior. Drivers must be educated about the importance of speed reduction in school zones in order to reduce the risk of accidents.

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