The trend of road traffic crashes at urban signalised intersection

IOP Conf. Series: Materials Science and Engineering **342** (2018) 012015 doi:10.1088/1757-899X/342/1/012015

The trend of road traffic crashes at urban signalised intersection

Nurul Farhana Nasarrudin and Intan Suhana Mohd Razelan

Faculty of Civil Engineering and Earth Resources, Universiti Malaysia Pahang, Kuantan

E-mail: ana_nasarrudin@yahoo.com

Abstract. Road traffic crash is one of the main contributing factors for deaths in the world. Intersection is listed as the second road type which road crashes occurred frequently. Hence, the traffic light was installed to minimise the road crashes at intersection. However, the crashes are still occurring and arising. The objective of this study was to exhibit the trend of road crashes at the signalised intersections. The data of road crashes for the past 6 years were analysed using descriptive analysis. The results showed that the road traffic crashes at three- and four-legged signalised intersection recorded the increasing trend. In conclusion, this finding shows that the road traffic crashes for these types of signalised intersection in Malaysia is rising. It is also one the contributors to the increasing number of crashes in Malaysia. This finding will encourage the local authority to conduct awareness programs on the safety at the signalised intersection.

1. Introduction

Road traffic crash is one of the main contributing factors for deaths in the world [1]. It is estimated that almost 1.20 million lives were lost due to road traffic crashes. These days, road accidents are the common issues to be reported in the newspaper. In Malaysia, road traffic crashes are becoming a severe problem. According to the statistics from the Royal Malaysia Police, the total number of road traffic crashes in Malaysia was increasing from the year of 2006 to 2015, where 341,252 crashes were reported in 2006 and it increased to 489,606 crashes in 2015. The increasing number of road traffic crashes in Malaysia emerged as one of the big and unsolved problems, since according to Mustafa [2] this problem has been considered as the Malaysian Government's responsibility.

There are five types of road in Malaysia which are the straight road, bend, roundabout, interchanges, and intersections. As mentioned by the previous studies, the straight road was listed as the most common type of road where the crashes frequently occurred. As indicated in Figure 1, about 67 % of road traffic crashes occurred at the straight road. It is the highest when compared with other road types.

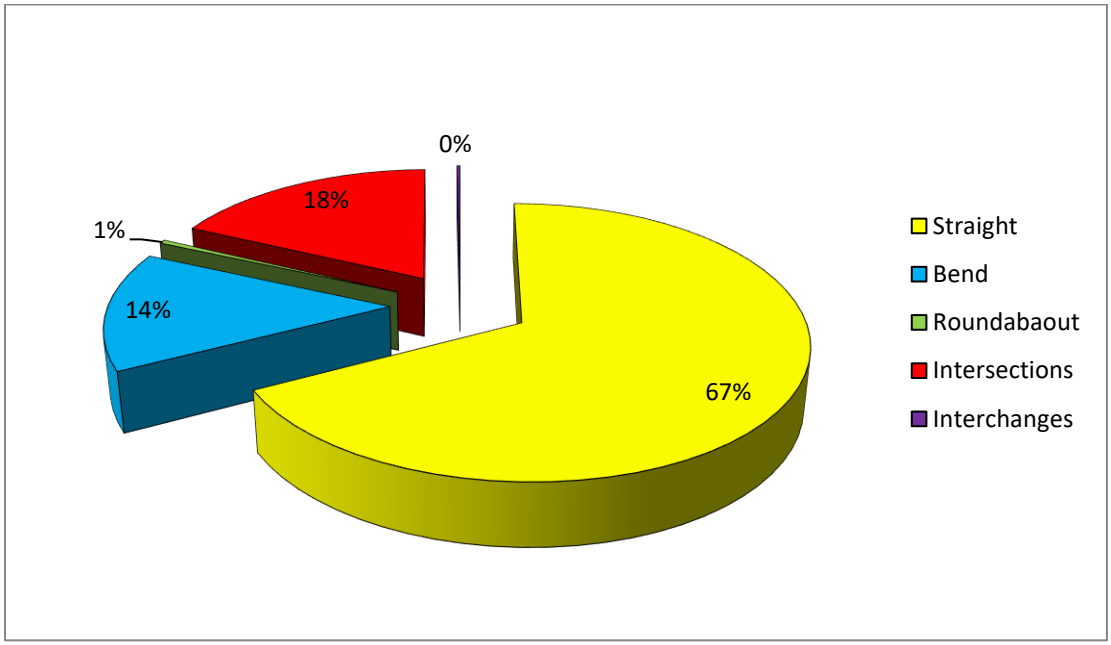

Figure 1. Road traffic crashes according to the different road types.

The intersections were categorised as the second road type where the road traffic crashes frequently occurred, followed by the bend road and roundabout with 14 and 1 %, respectively. However, the road traffic crashes at intersections cannot be neglected. Malaysia is one of the developing countries, where the road traffic crashes are commonly involved the intersections, especially at the urban areas [3].

Therefore, the traffic signal was implemented to reduce the road traffic crashes and improve the traffic safety at urban intersection. Nevertheless, severe road traffic crashes are still occurring and arising at the urban signalised intersection [4]. This resulted in listing the urban signalised intersection as the most dangerous and risky location of road network [5]. According to [6] there were four primary factors that caused the road traffic crashes to occur, which were the human, vehicles, weather condition, and roadway factors.

There are two types of signalised intersection that mostly located in the urban areas, which are the three- and four-legged signalised intersections. The road traffic crashes at both signalised intersections contribute to the increasing number of road traffic crashes in Malaysia. However, both of the signalised intersections have different rate or number of road crashes. Many previous research stated the difference in term of the rate of road traffic crashes between the three- and four-legged signalised intersection. A research done by Abdel-Aty and Wang [7] stated that the three-legged signalised intersection had lower road traffic crash rate as compare to four-legged signalised intersection.

Therefore, there is a need to study about the trend of road traffic crashes for different types of signalised intersections. It is important to researchers find out about the trend road traffic crashes at the three- and four-legged signalised intersections in Malaysia. Other than that, it is also important to find out about the different rate of road traffic crashes at both signalised intersections. The main purpose of this study was to exhibit the trend of road traffic crashes for different types of signalised intersections.

2. Methodology

Pahang was chosen to represent Malaysia in this study since Pahang was ranked the fifth out of thirteen states in Malaysia, with the highest number of death from the year of 2007 until 2016. Pahang consists of 11 districts which are Kuantan, Pekan, Temerloh, Jerantut, Raub, Bentong, Lipis, Cameron

Highlands, Rompin, Maran, and Bera. From these 11 districts of Pahang, Kuantan was selected to represent Pahang. This is because Kuantan recorded the highest number of road traffic crashes in 2015 and 2016.

The 6 years data on road traffic crashes at the signalised intersections in Kuantan (from 2010 until 2015) were collected from the Royal Malaysian Police of Kuantan branch. The data of road traffic crashes were sorted based on the type of signalised intersections which were three- and four-legged signalised intersections.

The descriptive analysis was done using the Statistical Package for Social Science (SPSS) in this study. The descriptive analysis analysed the trend of road traffic crashes for both types of urban signalised intersections. The analysis consisted of the summarisation, collection, and presentation of data obtained from the sample. Other than that, the histogram, measures of central tendency, and measures of variation (dispersion) were also included.

The measures of central tendency involved the value of mean, median, and mode. From these three values, the data distribution can be decided as whether symmetry distribution, positive skewed distribution, or negative skewed distribution. Meanwhile, the measures of variation involved the value of range, variance, and standard deviation. The measures of variation provided a complete overview of the dataset distribution.

3. Results and Discussion

Descriptive analysis provides the value of mean, median, mode, standard deviation, sample variance, maximum, minimum, range, kurtosis, and skewness as depicted in Table 1.

Table 1. Descriptive analysis.

	Three-legged Signalised Intersection		Four-legged Signalised Intersection	
Descriptive	**Statistics**	**SE**	**Statistics**	**SE**
Mean	105.67	30.631	241.00	28.190
Median	95.00		219.00	
Mode	44		209	
Standard Deviation	75.030		69.051	
Sample Variance	5629.467		4768.000	
Minimum	44		185	
Maximum	248		377	
Range	204		192	
Kurtosis	1.712	0.845	2.071	0.845
Skewness	3.456	1.741	4.652	1.741

The measures of central tendency are also known as the measures of average. It includes the median, mode, and mean values. The values can be used to describe the data distribution. From Table 3.1, the values of mean, median, and mode for three-legged signalised intersection are 105.67, 95.00, and 44, respectively. Meanwhile, the values of mean, median, and mode for four-legged signalised

intersection are 241.00, 219.00, and 209, respectively. It can be concluded that the sample is positively-skewed distribution since the value of mean > median > mode.

Other than that, the skewness and kurtosis values indicate the distribution symmetriness. The skewness value for three- and four-legged signalised intersections sample indicate the positive skewness values which are 1.712 and 2.071, respectively. The positive value shows positively-skewed distribution which the scores clustered at the low values. The kurtosis values for three- and four-legged signalised intersections samples indicate the positive kurtosis values which are 3.456 and 4.562. Other than that, the data distribution is also illustrated in histogram.

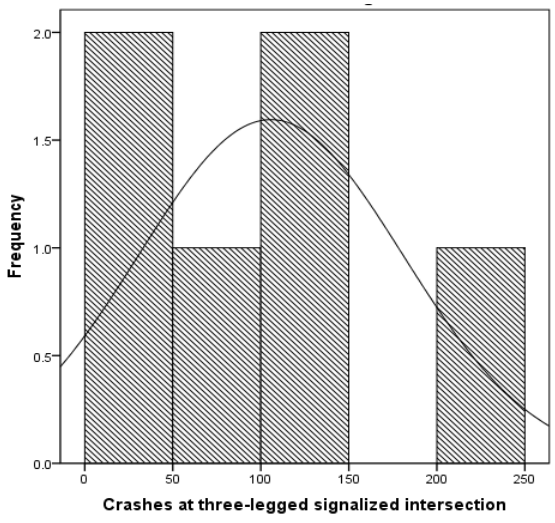

Figure 2(a). The data distribution histogram for crashes at three-legged signalised intersection

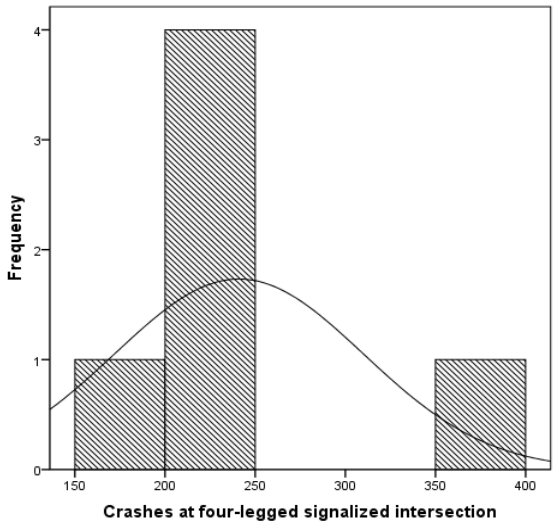

Figure 2(b). The data distribution histogram for crashes at four-legged signalised intersection

Figure 2(a) and Figure 2(b) indicate that the curve lines are skewed to the right and the peaks distribution are quite high. Hence, it can be explained that the data distribution for three- and four-legged signalised intersections are positively-skewed or right-skewed distribution and positive kurtosis. This indicates that there are a lot of signalised intersections with crashes of less than 150 crashes for three-legged signalised intersection and 250 crashes for four-legged signalised intersections. Other than that, it is also shows that the four-legged signalised intersection is more skewed than the three-legged signalised intersection. The four-legged signalised intersection is having higher number of crashes than three-legged signalised intersection. This is because the number vehicle conflict points at four-legged signalised intersection are higher than the three-legged signalised intersection [7]. This also can be explained by the need of drivers to pay more attention since the movements and attractions between vehicles at four-legged signalised intersection are higher.

Meanwhile, the measures of variation (dispersion) explains about the spread of data values. The range is different between maximum and minimum values in one data set. From Table 3.1, the range for three-legged signalised intersection is 204. It can be concluded that the highest number of road traffic crashes at three-legged signalised intersection is 248 crashes and the lowest number of road traffic crashes at three-legged signalised intersection is 44 crashes. Meanwhile, the range for four-legged signalised intersection is 192. It can be said that the highest number of road traffic crashes at four-legged signalised intersection is 377 crashes and the lowest number of road traffic crashes at four-legged signalised intersection is 185 crashes. It can be seen that the range number of crashes at three-legged signalised intersection is higher than the four-legged signalised intersection.

Besides, from Table 1, the values of variance and standard deviation for three-legged signalised intersection is larger than those of four-legged signalised intersection. Hence, the data of the three-legged signalised intersection is more dispersed compared to the four-legged signalised intersection, since the S2 and S (three-legged signalised intersection) > S2 and S (four-legged signalised intersection). The larger values of variance and range for the three-legged signalised intersection explain that the data of road traffic crashes is more dispersed from the mean value where the number of road traffic crashes is different each year. Meanwhile, the number of road traffic crashes at four-legged signalised intersection is almost the same each year since the value of variance is smaller than three-legged signalised intersection. It is also can be confirmed in Figure 2, where the number of crashes at four-legged signalised intersection is almost the same, unlike the three-legged signalised intersection. This is presumably because of the situation at four-legged signalised intersection which is more controlled since the number of crashes is higher than three-legged signalised intersection. Meanwhile, the movements at three-legged signalised intersection is probably less controlled since the conflict point and number of crashes are fewer than four-legged signalised intersection.

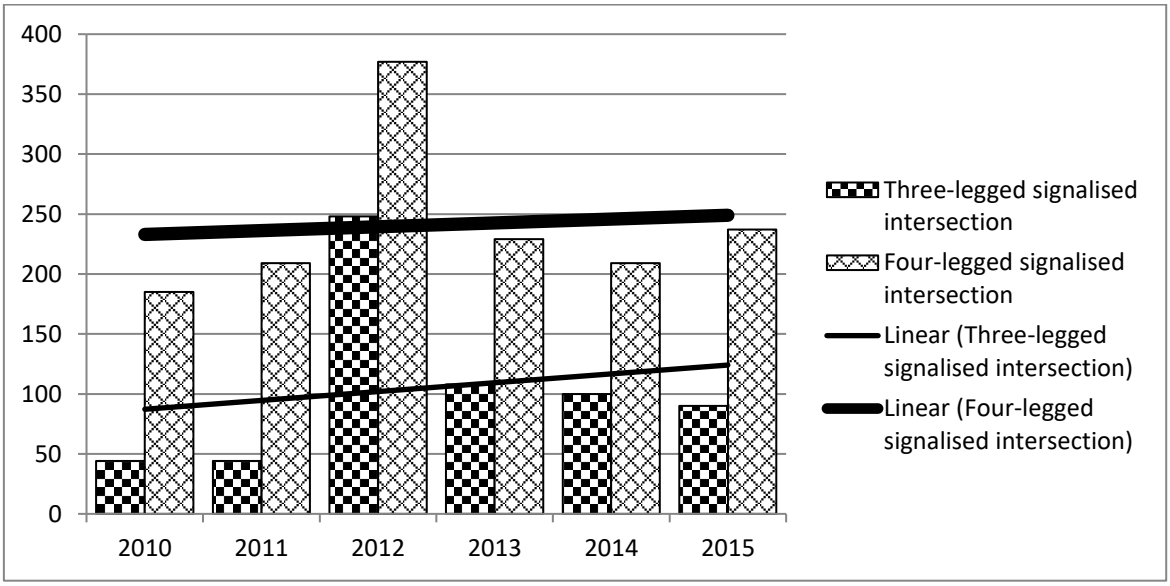

Figure 3. Trend of crashes at signalised intersections.

Figure 2 shows the trend of crashes at the three- and four-legged signalised intersection in Kuantan urban area from 2010 to 2015. The three-legged signalised intersection has recorded 44 crashes in 2010 and 2011. In 2012, the number of crashes increased to 248 crashes. Then, it decreased to 108 crashes in the year of 2013, followed by 100 crashes in 2014, and 90 crashes in 2015. Meanwhile, the number of road traffic crashes at four-legged signalised intersection has recorded 185 crashes in 2010 and it increased to 209 crashes in 2011. In the year of 2012, the number of crashes increased to 377 crashes. Then, it decreased to 229 crashes in 2013, followed by 209 crashes in 2014, and 237 crashes in 2015.

Other than that, Figure 3 depicts that the number of road traffic crashes at four-legged signalised intersection is higher than the three-legged signalised intersection. This is because the four-legged signalised intersection are having more vehicle conflict point as compared to the three-legged signalised intersection, which contributed to the higher number of movements [7]. Based on the trend observed, it also can be concluded that the trend of road traffic crashes at both signalised intersection is increasing from the year of 2010 to 2015, despite the irregular ups and downs. The increasing trend of road traffic crashes at both signalised intersections is probably due to the contribution of primary factors of road crashes such as the human, vehicle, and environment factors. This finding is also supported by Hawa and Akmalia [8], where the road traffic crashes at Malaysia signalised intersection

recorded the increasing trend because of road environment situation since the drivers have to deal with different task within the intersection area [9].

4. Conclusion

To sum up, according to the past 6 years recorded data (2010 – 2015), the trend of road traffic crashes at three- and four-legged urban signalised intersection shows increment. This kind of trend observed might be contributed by the previously mentioned four primary factors. Both types of signalised intersections show the positively-skewed data distribution. The three- and four-legged signalised intersections recorded the range number of 204 and 192 crashes, respectively. Besides, according to the obtained values of variance, it can be concluded that the number of crashes quite differ for each year at the three-legged signalised intersection, unlike the four-legged signalised intersection which shows similar pattern each year. For the past 6 years (2010 – 2015), it can be observed that there is an increased trend for the crashes at signalised intersection. Regardless of that, further investigations with longer period needed to be done since this study only consider the 6 years data so that the data of trend for road traffic crashes at signalised intersection obtained can be generalised to other location in Malaysia. The information obtained can be used by the local authority to organise campaigns and awareness programs on the prevention of crashes at signalised intersection.

Acknowledgements

The authors would like to express their gratitude to UMP for providing grant entitled 'Smart Traffic System for Universiti Malaysia Pahang Pekan Campus (RDU160363) that has enabled the authors to carry out research on the above issues

References

[1] Peden M, Scurfield R, Sleet D, Mohan D, Hyder A A, Jarawan E and Mathers C D 2004 World report on road traffic injury prevention
[2] Mustafa M N 2005 Overview of current road safety situation in Malaysia *Highw. Plan. Unit, Road Saf. Sect. Minist. Work.* 5–9
[3] Archer J and Vogel K 2000 The traffic safety problem in urban areas *Res. Rep.*
[4] Polders E, Daniels S, Hermans E, Brijs T and Wets G 2015 Crash patterns at signalized intersections *Transp. Res. Rec. J. Transp. Res. Board* 105–16
[5] Wang X 2006 No Title
[6] Munteanu P L, Roșu M, Panaitescu V and Pungă A 2014 Human and environmental factors contributing to fatal road accidents in a Romanian population *Rom J Leg Med* **22** 97–100
[7] Abdel-Aty M and Wang X 2006 Crash estimation at signalized intersections along corridors: analyzing spatial effect and identifying significant factors *Transp. Res. Rec. J. Transp. Res. Board* 98–111
[8] JAMIL H M and SHABADIN A 2012 A case study of the prevalence and characteristics of red light runners in Malaysia *Inj. Prev.* **18** A201–A201
[9] Wong S C, Sze N-N and Li Y-C 2007 Contributory factors to traffic crashes at signalized intersections in Hong Kong *Accid. Anal. Prev.* **39** 1107–13