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Analysis of Speed Variations at Different Distances from a Road Crossing Facility

Soumik Nafis Sadeek[1], Md. Mosabbir Pasha[2], Shakil Mohammad Rifaat[1], Sk. Redwan Ferdous[1], Iktier Ahmed Farhad[1],

[1]Department of Civil and Environmental Engineering, Islamic University of Technology, Gazipur, Bangladesh

[2] School of Civil Engineering, University of Queensland, Brisbane, Australia

Email for correspondence: m.pasha@uqconnect.edu.au

Abstract

Intermingle between vehicles and crossing pedestrians leads to pedestrian crashes which required investigation for developing proper countermeasures particularly in the context of developing country like Bangladesh. Various factors have significant effects on the speed of a vehicle on a highway when pedestrians are seen crossing the road. Considering the factors, speed study has been performed regarding the speed behaviour of different types of vehicles at different distances from the crossing facility when pedestrians are seen crossing a particular road section. From the outcomes, it has been found some relationship between the crossing pedestrians and the different types of vehicles that expedites worse situation. Most of the vehicles of different categories tend to decelerate 30 meters ahead of the crossing when a pedestrian or a group of pedestrians starts crossing the road. There is very little significant gradual speed reduction from 40 meters to 30 meters from the crossing place. Unusual behaviour was found for the drivers of buses as they show increase of speed from 40 meters to 30 meters and decelerate from 30 meters. Statistically significant speed differences have also been found between light and heavy vehicles. Regarding the abrupt behaviour of the public transport such as sudden increasing or decreasing of speed and the overall management and safety of the site, some recommendations are suggested. Foot over bridge, speed bump, traffic police deployment in the starting and ending hours of educational institutions**,** serviceable footpath and zebra crossing**,** etc. are advised that can be an effective way to control the vehicle speed and enhance road safety.

Keywords: Crossing, Pedestrians, Facility, Speed, Safety

1. Introduction

When pedestrian safety is of concern, speed comes as a major interest in road safety point of view. Carelessness of both the drivers and pedestrians in a road crossing, especially in the non-signalized sections, lessens the safety and increases the rate of incident occurrence (Viallon and Laumon, 2013). Earlier studies revealed that heavy vehicles i.e. trucks, buses, are major contributors to road crashes. This group of vehicles are particularly over involved in pedestrian casualty accounting for about 37% for trucks and 44% for buses in Bangladesh (Hoque et al., 2007). When a pedestrian or a group of pedestrians have a motive to cross a road section, in most of the cases, both driver and pedestrians are in a dilemma zone. This confusion often leads to serious road incidents. From the study of Hoque (2004), it was found that during 1993 to 2000, pedestrians were involved in about 70% of road accidents in Bangladesh. From a pedestrian survey it was revealed that majority of the pedestrians prefer to cross on level ground and medians (Mfianga, 2014). Often it is observed that pedestrians are not well educated and aware of traffic rules. Sometimes they do not use the facilities (e.g. overpass/ underpass) provided for them to cross the road (Pasha et al., 2015). In an

investigation results showed that pedestrians are at fault in 59% of the crashes, drivers in 32%, and both are found at fault in 9% (Gudmundur et al., 2010). Some studies pointed out that male pedestrians are most frequently involved in pedestrian crashes, and elderly and children are identified as the most vulnerable pedestrians (Al-Madani and Al-Janahi, 2006). A weak tendency is found for female pedestrians to have more discordance between observed and declared crossing behaviour on residential roads, and the same is the case for young pedestrians in all road and traffic conditions (Papadimitriou et al., 2016). Demiroz et al. (2015) explored that pedestrians feel safer at the advent of crossing when the vehicle speed is low. Moreover, pedestrian crossing through the roads is always discouraged by both the authority and drivers as they create disturbance to the free flow traffic. Pedestrian interference makes the intersection performance worse that results lower transportation efficiency, more energy consumptions and higher safety risk (Li and Sun, 2016). Fu and Zou (2016) conducted an experiment that showed children who crossed the road alone had more violation and adventure crossing behaviour than those had companions. Boys were found more likely to run crossing than girls. Pawar and Patil (2014) found that the speed of the conflicting vehicle was found to be significant in spatial gap but not in temporal gap acceptance. The gap acceptance decision was also found to be affected by the type of conflicting vehicles. Some studies were also conducted determining the dilemma zone of a pedestrian while crossing a road (Pawar et al., 2016). Speed reduction management of the vehicles at the pedestrian crossing zone perhaps is highly needed for ensuring road safety. There may have some significant factors that affect the amount of risks for the pedestrians while crossing the roads in a developing country like Bangladesh where transportation system is far more different and less efficient than others. The objective of the study is to find out the speeding behaviour of the drivers of different vehicles in front of a pedestrian crossing area. Specifically the research will answer the following question:

1) Does average speed difference exists between different vehicles at certain distances from a pedestrian crossing location?

2) Any differences lies between the average speed of a same type of vehicle at different distances from a pedestrian crossing location?

This study will help to understand the pedestrian-driver relationship in terms of speed and distance in context of developing countries. The result is expected to give a direct overview of the vulnerability of pedestrian crossing zone and the characteristic of the drivers of different vehicles.

2. Literature Review

Speed and speed variation plays an important role on the occurrence of pedestrian crashes. Several literatures are observed where the effects of speed variations as well as driver's behaviour are investigated and their effects on pedestrian crashes are explored. Some of these studies are highlighted below.

Studies on speed variations are explored to investigate older drivers' driving skills (Chevalier et al., 2016; Yan et al., 2007), comparison of educated and less educated drivers (Newnam et al., 2014), driver's distraction (Sullman, 2012), and weather condition (Yan et al., 2014; Hassan and Abdel-Aty, 2011). Some studies have been carried out on pedestrian's behaviour and driver's attitude towards pedestrian's activity on the road. From these studies it is found that the pedestrian-pedestrian interactions and pedestrian-vehicle interactions are inconsistent, in terms of conflict and the level of risk. The pedestrian acts as an anticipator of the situation of safety margins about collision time with a vehicle (Airault and Espie, 2005). Pedestrian crossing event does not always follow the first communication of intention. Crossing depends on additional factors such as the structure of the street, the driver's reaction to the communication or collision time (Rasouli et al., 2017). Horvath et al. (2011) found that intentions of speeding were found to be higher in the "no passenger" than "passenger present" conditions. Wang et al. (2016) found that drivers are more likely to

decelerate 30m-37m ahead of crosswalk at a speed of 40-50 km/h, and decelerate 23m-30m ahead of crosswalk at a speed of 30-40 km/h. An average distance is about 25m away from the crosswalk; pedestrian behaviour significantly affects the speed choice of a driver. Sun et al. (2015) found that pedestrians can estimate time interval accurately for crossing that vary by weather conditions. When the speed of the oncoming vehicle exceeded the upper bound of the accurate interval, pedestrians are likely to misjudge the vehicle speed that increases their risk of incorrectly deciding to cross when it is not safe to do so. Even a pedestrian's logical anticipation affects the speed choice by the drivers. Lubbe and Davidsson (2015) found pedestrian speed has a statistically significant influence on brake onset. For pedestrian speeds of 1m/s, 90% of drivers braked before 2.6s. Also, a driver can be influenced and reacted in a positive way even by body language and facial expressions of a pedestrian. It was found that a smile increases the number of drivers who stop. The same effect was observed when the pedestrian tries to cross outside the pedestrian crossing. Finally, this study showed that motorists drive slower after they see a pedestrian smile, suggesting that a smile can induce a positive mood. Besides, speed choice is affected by route familiarity. Speed increases with the repetition of travels on the same route (Colonna et al., 2015). Paolo and Sar (2012) analysed the speed of vehicles approaching work zones aiming to understand the drivers' speed behaviour. This work showed that drivers do not obey the temporary speed limit and that they reduce speed only when the lane width is reduced, resulting in high deceleration rates. Drivers are more likely to stop at locations where enforcement cameras or flashers are present. Stopping was also more prevalent at intersections where pedestrian crosswalks are present (Savolainen et al., 2015).

Thus, from the above discussion, it is clear that there is sparse knowledge regarding the speed variation towards the crossing facility in context of developed countries, however, there is not enough study observed in developing countries' condition. This research can fill this gap, in many cases, that will bring light on pedestrian and driver's behavior, perception, and also it is expected to contribute in proactive pedestrian safety management while the pedestrians are in the crossing loop.

3. Methodology

3.1 Site Selection

Speed characteristics of a driver can be captured more accurately when speed measurement of a same vehicle is taken at successive sections on a certain highway at different situations. However, due to the limitation of resources, a single location is considered on a highway assuming same category vehicle's driver possesses same understanding of speeding ahead of pedestrian crossing. The selected site is placed on the highway and it is non-signalized, no over bridge, no traffic control for pedestrian crossing. A typical such kind of road is shown in Figure 1(a & b).

Figure 1: Crossing of vehicles and pedestrians

(a) Vehicle Crossing at a road section

(b) Intermingling between pedestrian and vehicles while crossing

3.2 Data Collection

Data has been collected at a particular time of a day and these data has been taken at weekday and weekend using the speed gun which is used to measure speed of different vehicles. The work has been carried in 3 different days in a week, two of them are weekdays and the rest is weekend. Both weekdays and weekend are considered for data collection to capture the scenario of the whole week's condition at a particular time period. The morning time (6.30-8.00) has been chosen for data collection because this time is the opening hour of educational institutions in that area, so the density of the pedestrian is high at that time. Readymade garments workers' also cross the road at that time.

3.3 Modelling Method

t-test has been used to differentiate between two average speed. Both equal and unequal variances have been used in the analysis. Both cases are elaborately discussed in the following sub-sections.

3.3.1 Testing Differences between Two Means: Equal Variance

The null and the alternate hypothesis of two average speed μ_1 and μ_2 of two population are as follows:

H_o: $\mu_1 - \mu_2 = 0$ (1)

H_1: $\mu_1 - \mu_2 \neq 0$ (2)

A test statistic for a difference between two population means with equal variances is given by

$$t^* = \frac{(\overline{x_1}-\overline{x_2})-(\mu_1-\mu_2)}{\sqrt{s_p^2\left(\frac{1}{n_1}+\frac{1}{n_2}\right)}} \quad (3)$$

where, the term ($\mu_1 - \mu_2$) is the difference between μ_1 and μ_2 under the null hypothesis. The sample size of population 1 and population 2 are n_1 and n_2 respectively. The degrees of freedom of the test statistic in this equation are ($n_1 - n_2 + 2$), which are the degrees of freedom associated with the pooled estimate of the population variance s_p^2.

$$s_p^2 = \frac{(n_1-1)s_1^2+(n_2-1)s_2^2}{n_1+n_1-2} \quad (4)$$

The confidence interval for a difference in population means is based on the t distribution with ($n_1-n_2 + 2$) degrees of freedom. A (1-α) 100% confidence interval for the difference between two population means ($\mu_1 - \mu_2$), assuming equal population variances is

$$\overline{x_1}-\overline{x_2} \pm \sqrt{s_p^2\left(\frac{1}{n_1}+\frac{1}{n_2}\right)} \quad (5)$$

3.3.2 Testing Differences between Two Means: Unequal Variance

As previous the null and the alternate hypothesis of two population means μ_1 and μ_2 are shown below:

H_o: $\mu_1 - \mu_2 = 0$ (6)

H_1: $\mu_1 - \mu_2 \neq 0$ (7)

A test statistic for a difference between two population means with unequal population variances is given by

$$t^* = \frac{(\overline{x_1}-\overline{x_2})-(\mu_1-\mu_2)}{\sqrt{(\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2})}} \quad (8)$$

where, $(X_1 - X_2)$ is the average sample difference between the observation 1 and observation 2, s_1 and s_2 is the sample standard deviations of these differences, and the sample size, n_1 and n_2 is the number of unpaired observations of sample 1 and sample 2 respectively. t-distribution with degrees of freedom given by

$$df = \frac{(\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2})^2}{\frac{(\frac{s_1^2}{n_1})^2}{n_1-1}+\frac{(\frac{s_2^2}{n_2})^2}{n_2-1}} \quad (9)$$

A (1- α) 100% confidence interval for the mean difference $(\mu_1-\mu_2)$ is

$$\overline{x_1}-\overline{x_2} \pm t_{\frac{\alpha}{2}}\sqrt{(\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2})} \quad (10)$$

4. Data Analysis and Discussion

Based on the preceding analytical method the difference of the average speed of the six combination of vehicles are explored by t-test. Difference of speed are tested 20 meter, 30 meter, and 40 meter distances from the selected location. Speed difference is considered statistically significant when the p-value <0.05. Seven cases are found statistically significant and shown in Table 1. In Table 2, comparison of average speed of a particular type vehicle at 20m, 30m, and 40m distances from the pedestrian crossing are examined through t-test and 8 differences of average speed are found significant. t- tests were conducted for both equal and unequal variances. Total number of observation was 30 for each type of vehicle and 95% of confidence interval is taken for hypothesis testing.

4.1 Average Speed Comparison between Vehicles

From Table 1, it is observed that at 20 meter from the pedestrian crossing space, there is no significant speed difference between any categories of vehicles. At 20 meter, all the drivers of different vehicles reduce their speed at approximately same level when pedestrians are seen crossing the road, as a result there is no significant difference is observed while comparing speeds among the vehicles.

Table 1: Comparison of average speed between vehicles from 20m, 30m, 40m distance of a pedestrian crossing location

40 meter distance from crossing facility		
Vehicle 1 -Vehicle 2	**P-value (Equal variance)**	**P-value (Unequal variance)**
Truck – Mini Truck	0.1151	0.1152
Truck- Bus	0.1789	0.1789
Truck-Car	**0.0000**	**0.0000**
Mini Truck-Bus	0.8963	0.8963
Mini Truck-Car	**0.0012**	**0.0012**
Bus-Car	**0.0019**	**0.0019**

30 meter distance from crossing facility		
Truck – Mini Truck	**0.0167**	**0.0169**
Truck- Bus	0.3035	0.3036
Truck-Car	**0.0000**	**0.0000**
Mini Truck-Bus	**0.0014**	**0.0015**
Mini Truck-Car	0.0919	0.0920
Bus-Car	**0.0000**	**0.0000**
20 meter distance from crossing facility		
Truck – Mini Truck	0.5304	0.5306
Truck- Bus	0.7070	0.7071
Truck-Car	0.6328	0.6329
Mini Truck-Bus	0.8085	0.8087
Mini Truck-Car	0.2868	0.2868
Bus-Car	0.4107	0.4109

(The bold numbers represent the statistically significant value at 95% CI)

The probable reason may be that when pedestrians are seen crossing the road, all the drivers of different vehicles reduce their speed at same level at 20 meter distance. As a result there is no significant difference in speed variation among the vehicles.

At 30 meter distance from the pedestrian crossing, significant speed difference is found between car and other type of vehicles such as mini trucks, trucks and buses. Perhaps the drivers of the private car do not change their speed much and expect that the pedestrian would cross the road safely before they approach to them. Car being a lighter vehicle comparing with bus, mini truck, and truck, can reduce its speed rapidly to avoid collision when a pedestrian is noticed failing to cross the road safely. On the contrary, heavy vehicles (truck, mini truck) cannot reduce their speed rapidly due to their heavy mass and large size. Thus these vehicles maintain low speed comparing with that of cars. Buses often pick passengers from the selected pedestrian crossing location which is in front of a school and college. As students often get on/off from the bus at that location the speed of the bus is changing. Hence, the buses also maintain lower speed than cars at 30 meters from the crossing. Significant difference in speed is observed between car and truck, car and bus in front of 40 meters from the pedestrian crossing. This results infer that car being the lighter vehicle maintains high speed comparing with truck and bus.

4.2 Comparison of Average Speed of a Particular Vehicle from 20m, 30m, 40m distance of a pedestrian crossing location

While comparing the speed of all vehicles at 20m, 30m, and 40m distances from the crossing, significant differences are noticed between 20m and 30m, 20m and 40m. It can be explained that when pedestrians are seen crossing the roads, the speed of the vehicle is lower at closer distances (20m) comparing with the longer distances (30m and 40m). Same results are observed irrespective of vehicle types.

For car, mini truck, and truck, speed at 30 meters and 40 meters from the crossing is higher comparing with that of 20 meters as expected. Presence of pedestrians and some non-motorized vehicles perhaps creates the speed differential. Though cars, mini trucks and trucks often use outer lane for uninterrupted movement of the vehicle, however, due to the

U-turn of some vehicles near the location subsequently results decreasing of the speed of the vehicles behind.

Table 2: Comparison of average speed of a particular vehicle at 20m, 30m, and 40m from the pedestrian crossing location

Distance 1 -Distance 2	P-value (Equal variance)	P-value (Unequal variance)
Truck 20m – Truck 30m	**0.0000**	**0.0000**
Truck 30m – Truck 40m	0.6024	0.6026
Truck 20m – Truck 40m	**0.0000**	**0.0000**
Car 20m – Car 30m	**0.0000**	**0.0000**
Car 30m – Car 40m	0.9483	0.9487
Car 20m – Car 40m	**0.0000**	**0.0000**
Mini Truck 20m – Mini Truck 30m	**0.0001**	**0.0001**
Mini Truck 30m – Mini Truck 40m	0.3023	0.3031
Mini Truck 20m – Mini Truck 40m	**0.0000**	**0.0000**
Bus 20m – Bus 30m	**0.0009**	**0.0009**
Bus 30m – Bus 40m	**0.0223**	**0.0225**
Bus 20m – Bus 40m	0.1103	0.1103

(The bold numbers represent the statistical significant value at 95% of CI)

In case of bus, if analysed the results in Table 2, it can be inferred that speed at 30 meters is significantly different than that of 20 meters and 40 meters. This type of scenario indicates that drivers of buses travel at a significantly higher speed at 30 meters than that of 40 meters and suddenly reduce speed at 20 meters. Lack of consistent driving behaviour due to lack of proper safety knowledge may be the reason of this finding. Most bus drivers are younger in age and they are often disobeying traffic rules and regulations and thus picking passengers abruptly from road by sudden increase or decrease of speed.

5. Conclusion

Principal objective of our study was to find the speeding behaviour of different types of vehicles at 20m, 30m, 40m distances from a pedestrian crossing location. In order to achieve this objective speed measurements of different vehicles had been taken at the previously mentioned distances from a crossing location. To find significant difference in speed differential, “t test” has been executed with the collected data from the site. Our study found the interrelations between the speeding characteristics of different vehicles and distance of these vehicles from the pedestrian crossing area. Most of the vehicles of different categories, tend to decelerate at 30 meters ahead of the crossing at a speed of 40-45 km/hr when a pedestrian or a group of pedestrians starts crossing the road. There is no significant gradual speed reduction from 40 meters to 30 meters distances from the crossing area. Unusual behaviour was found for the drivers of buses as they show significant changes of speed from 40 meters to 30 meters. However, the shortcoming of the study is that the sample is limited and the speed data has been collected for only few days. The findings of the study would be much more strengthened if there were more observations. However, due

to limited manpower and budgetary constraint it was not possible to collect more data. By analysing the data and observed results, some recommendations have been drawn for the policy makers. Some general recommendations are discussed in Table 3 based on the key findings of the study to improve the safety scenario of that particular pedestrian crossing area. These recommendations are made based on some earlier studies done by the native researchers (Hoque, 2004; Anjuman and Siddiqui, 2007; Ahsan et al. 2012) and Road Transport and Traffic Act (RTTA), 2012 for Bangladesh. Bangladesh Road Transport Authority (BRTA) has some traffic laws on the violation of traffic rules and their punishment. It includes penalty for over speeding, driving being alcoholic, give horns unnecessarily, driving without license, pedestrian negligence on using foot over bridge.

Ministry of Law has Motor Vehicle Ordinance, 1983 where deprivation of driving license can be occurred is overtaking just before or on the pedestrian crossing or where over taking is prohibited.

For pedestrians in MVO, 1983 and RTTA, 2012 it is stated as rules and regulation that

1) Where a footpath is provided and its use is practicable, it shall be unlawful for any pedestrian to walk along and upon an adjacent roadway.
2) Every pedestrian shall, while passing across a carriage way, highway or roadway, make use of the pedestrian crossing (surface, tunnel or overhead).

Table 3: Recommendations for the Policy makers

Interventions	Brief Description
Speed Bump	As in the early morning, density of pedestrian increases but traffic volume stays low, there is a possibility of some vehicles that fails to reduce speed at the crossing area and leads to serious accidents. Speed bump should be introduced in that place and thus excess speed of the vehicles can be controlled.
Foot Overbridge	Foot overbridge can be a feasible solution for both pedestrians and uninterrupted vehicle movement because with the aid of this structure, problems of intermingling between vehicles and pedestrians are nullified.
Traffic Police Deployment	For the overall management, proper monitoring and safe crossing of the pedestrian, traffic police can be deployed at the starting hour and ending hour of the educational institutions located near the crossing area.
Traffic Signs	Installing road crossing sign and speed limit message sign, celerity of the upcoming vehicle can be efficiently controlled ahead of the crossing area.
Serviceable Footpath and Zebra crossing	For the safe movement of pedestrian especially beside arterial roads footpath is necessary. Also, for safe crossing of pedestrian across a road effective zebra crossing may be introduced.
Dedicated narrow lane for slow moving vehicles	Slow-moving vehicles have a great effect on the vehicle flow and speed of entire road, it is necessary to manage their flow. A dedicated narrow lane for slow-moving vehicles can solve this problem.

Many factors could influence on speed variation such as type of intersection (or cross section), type of treatment, the land use, road type, road geometry and etc. However, these factors were not considered in this study which is another limitation of this study. Moreover, considering only one cross section with specific conditions limits the outcome of the study to a global solution of the mentioned problem from applicability perspective.

References

Ahsan, H.M., Mahmud, S.M.S., & Sarkar, M.S.H. 2012. Child road safety problems and their perceptions on road traffic safety in Dhaka City, 1st International Conference on Advances in Civil Engineering (ICACE), 12-14 December, 2012, CUET, Chittagong, Bangladesh.

Airault, V. & Espie, S. 2005. Behavioural model of the pedestrian interaction with road traffic, Association of European Transport and Contributors.

Al-Madani, H. & Al-Janahi, A. 2006. Personal exposure risk factors in pedestrian accidents in Bahrain. Safety Science, 44: 335–347.

Anjuman, T. & Siddiqui, C.K.A. 2007. The road safety situation for children in Bangladesh. ACRS Conference: Infants, Children and Young People and Road Safety, Dhaka, Bangladesh.

Chevalier, A. & Coxon, K. 2016. Exploration of older drivers' speeding behaviour, Transportation Research Part F: Traffic Psychology and Behaviour, 42, 532-543.

Colonna, P., Intini, P., Berloco, N. & Ranieri,V. 2016. The influence of memory on driving behavior: How route familiarity is related to speed choice. An on-road study. Safety Science, 82, 456–468.

Demiroz, Y.I., Onelcin, P. & Alver, Y. 2015. Illegal road crossing behavior of pedestrians at overpass locations: Factors affecting gap acceptance, crossing times and overpass use, Accident Analysis and Prevention, 80, 220-228.

Fu, L. & Zou, N. 2016. The influence of pedestrian countdown signals on children's crossing behavior at school intersections, Accident Analysis and Prevention, 94, 73-79.

Gudmundur, F., Ulfarsson, S. K. & Booth, K.M. 2010. Analysing fault in pedestrian -motor vehicle crashes in North Carolina. Accident Analysis & Prevention. 42(6): 1805–1813.

Hassan, H. & Abdel-Aty, M. A. 2011. Analysis of drivers' behaviour under reduced visibility conditions using a Structural Equation Modelling approach, Transportation Research Part F: Traffic Psychology and Behaviour,14(6), 614–625.

Hoque, M. M. 2004. The Road to Road Safety: Issues and Initiatives in Bangladesh. Regional Health Forum. 8(1): 39–51.

Hoque, M., Mahmud, S., Siddiqui, A. & Kawsar, C. 2007. Road safety in Bangladesh and some recent advances. Proceedings of the Road Safety on Four Continents Conference, 14, 12p-12p.

Horvath, C.,Lewis, I. & Watson, B. 2011. Peer passenger identity and passenger pressure on young drivers' speeding intentions, Transportation Research Part F: Traffic Psychology and Behaviour, 15(1), 52–64.

Li, X. & Sun, J.Q.2016. Effects of vehicle-pedestrian interaction and speed limit on traffic performance of intersections, Physica A: Statistical Mechanics and its Application, 460, 335-347.

Lubbe, N. & Davidsson, J. 2015. Drivers' comfort boundaries in pedestrian crossings: A study in driver braking characteristics as a function of pedestrian walking speed, Safety Science,75, 100-106.

Mfianga, D. A. 2014. Implications of pedestrians stated preference of certain attributes ofcrosswalks. Transport Policy. 32:156–164.

Motor Vehicle Ordinance Act – 1983, Ministry of Law, Justice and Parliamentary Affairs, Bangladesh.

Newnam, S.,Mamo, W. G. & Tulu, G. S. 2014. Exploring differences in driving behaviour across age and years of education of taxi drivers in Addis Ababa, Ethiopia, Safety Science, 68, 1–5.

Paolo, P. & Sar, D. 2012. Driving Speed Behaviour Approaching Road Work Zones on Two-Lane Rural Roads, SIIV-5th International Congress - Sustainability of Road Infrastructures 201, Procedia - Social and Behavioral Sciences, 53, 672–681.

Papdimitriou, E., Lassarre, S. & Yannis, G. 2016. Pedestrian risk taking while road crossing: A comparison of observed and declared behaviour, Transportation Research Procedia, 14, 4354-4363.

Pasha, M.m Rifaat, S.M., Hasnat, A. & Rahman, I. 2015. Pedestrian's Behaviour on Road Crossing Facilities, Jurnal Teknology, 73:4, 77-83.

Pawar, D.S., Kumar, V., Singh, N. & Patil, G.R. 2016. Analysis of dilemma zone for pedestrians at high-speed uncontrolled midblock crossing, Transportation Research Part C: Emerging Technologies, 70, 42-52.

Pawar, D.S. & Patil, G.R. 2014. Pedestrian temporal and spatial gap acceptance at mid-block street crossing in developing world, Journal of Safety Reseach, 52, 39-46.

Rasouli, A., Kotseruba, I. & Tsotsos, J.K. 2017. Agreeing to Cross: How Drivers and Pedestrians Communicate, *arXiv preprint arXiv: 1702.03555.*

Road Transport and Traffic Act (RTTA) – 2012, Chapter: XIV, Page no: 315, Bangladesh Road Transport Authority (BRTA).

Savolainen, P.T.,Sharma, A. & Gates, T.J. 2015. Driver decision-making in the dilemma zone Examining the influences of clearance intervals, enforcement cameras and the provision of advance warning through a panel data random parameters probit model, Accident Analysis & Prevention,96, 351-360.

Sullman,M.J.M. 2012. An observational study of driver distraction in England, Transportation Research Part F: Traffic Psychology and Behaviour, 15(3), 272-278.

Sun, R., Zhuang, X., Wu, C, Zhao, K. & Zhang,K. 2015. The estimation of vehicle speed and stopping distance by pedestrians crossing streets in a naturalistic traffic environment", Transportation Research Part F: Traffic Psychology and Behaviour, 30, 97-106.

Viallon, V & Laumon, B. 2013. Fractions of fatal crashes attributable to speeding: evolution for the period 2001-2010 in France, Accident Analysis and Prevention, 52, 250-256.

Wang, T., Jiang, X.,Wang, W. & Cheng, Q. 2016. Analysis of Vehicle Speed Change at Non-signalized Crosswalks Based on Driving Behavior", Procedia Engineering, 137, 547-553.

Yan, X., Li, X., Liu, Y. &. Zhao, J. 2014. Effects of foggy conditions on drivers' speed control behaviors at different risk levels", Safety Science, 68, 275-287.

Yan, X., Radwan, E. & Guo, D. 2007. Effects of major-road vehicle speed and driver age and gender on left-turn gap acceptance, Accident Analysis & Prevention, 39, 843–852.