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STUDY ON PEDESTRIAN CROSSING BEHAVIOUR AT UN-SIGNALIZED INTERSECTION IN CHITTAGONG CITY

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ABSTRACT

Constant conflicts between the pedestrian and vehicle in limited space occur due to inadequate facilities for pedestrians on the existing roadway condition. Pedestrian crossing behavior is even more complex at the intersection since the vehicle has very little response time to control the vehicles in urban areas. All these issues leading towards the research work required for studying the road crossing behavior of pedestrians at urban intersections. To provide necessary infrastructure and for enhancing pedestrian safety at the un-signalized intersection a clear understanding of pedestrian crossing behavior under mixed traffic conditions is needed. Chittagong city is the second-largest city in Bangladesh. This paper attempts to analyze the general crossing behavior of pedestrians and find out the pedestrian's perception of using road crossing facilities at the un-signalized intersection in Chittagong City under mixed traffic conditions. A Field survey was completed at Agrabad intersection in Chittagong city which has four approaches. All approaches are of two way four lanes. Video observation and a questionnaire survey were conducted among the pedestrians who cross the studied area. 5472 pedestrians at Agrabad intersection have been observed through the video graphic method. A questionnaire survey has been done on 550 pedestrians at Agrabad intersection. Different parameters like gender, age, crossing patterns, educational status, and income of the pedestrian were excreted from the questionnaire survey. From this observation, it is found that 84.01% of pedestrians at Agrabad intersection do not use existing road crossing facilities. Among them, 87.16% male and 73.54% female at Agrabad intersection do not use existing road crossing facilities. The reasons for pedestrians not to use road crossing facilities are lack of awareness (40.75%), time-consuming (41.00%), unsuitable locations (7%), etc. From scrutinizing the study, it would be proposed that roadside barriers must be constructed, and the median barrier should be improved to separate the pedestrian movements from vehicular traffic. As well as, the construction of foot over bridge and the surrounding environment of the crosswalk should be improved along with people's awareness. This study can help researchers and practitioners to understand pedestrian crossing behavior at both signalized and un-signalized intersections.

Keywords: *Un-signalized intersection, Crossing behavior, Mixed traffic conditions.*

1. INTRODUCTION

Due to high population density, rapid urbanization, and lack of adherence to traffic regulations by both drivers and pedestrians, traffic accidents involving pedestrians have become a major safety problem all over the world, particularly in developing countries. Lack of adherence to traffic regulations at pedestrian crossings particularly by drivers creates an example in which pedestrians may become bold and force approaching vehicles in the traffic stream to break in order to gain priority at the pedestrian crossing. On the other hand, pedestrian crossings with heavy pedestrian flow are likely to cause an unacceptable vehicular delay.

There has been extensive research on pedestrian behavior including estimation of accident risks in various environments (Lassarre et al., 2007), the effects of land use on pedestrian safety (Wedagama et al., 2006), the differences between the behaviors of young and old pedestrians (Oxley et al., 1997), and the resulting injury outcomes associated with accidents (Derlet et al., 1990). The World Health Organization estimates that nearly half of global fatalities are vulnerable road users (WHO, 2009). In an investigation, results show that pedestrians are found at fault in 59% of the crashes, drivers in 32%, and both are found at fault in 9% (Hoque, 2004). Another paper has been found, Foot-travelers who expend more time waiting to cross from one side of the street to the median are likely to have a greater risk of ending the waiting time than when they cross from central refuge to the other side of the street (Hamed, 2001). The location of pedestrian crossing facilities also plays an important role in crash occurrences and crash-related injuries. In Israel a detailed analysis of pedestrians' accidents in 2006-2007, with an emphasis on the infrastructure characteristics involved, was performed; it was found that 75% of the fatalities and 95% of the injuries occurred in urban areas, the majorities of cases occurring on-road sections (not at the junction). When a pedestrian crossed the road, about 80% of the accidents took place and the majority of them at non-crosswalk locations or at non-signalized crosswalks (Gitelman et al., 2012). It has also been found around 38.2% of the crashes occur at non-crosswalk locations, while proportionately more 61.8% of the pedestrian accidents occur at non-crosswalk locations (Kim et al., 2008).

In view of different studies, it has been found that many studies have been done for other countries, but few studies have been done for Bangladesh. No study has been done in the context of crossing behavior of the pedestrian in Chittagong city. The overall objective is to study the behavior of pedestrians when they crossed the road. The following main objectives have been set for this study:

- to identify the general crossing behavior of pedestrians,
- to find out the pedestrians' perception of using road crossing facilities, and
- to suggest improvement measures.

2. METHODOLOGY

Research methodology is a systematic way to solve a problem and it refers to what kinds of methods are applied or performed for research. It is a science of studying how research is to be carried out. This research is prepared by field survey (Questionnaire Survey and Video Observation) methods to identify the general crossing behavior of pedestrians and find out the pedestrians' perception of using road crossing facilities.

2.1 Research Instruments

Instrumentations refer to the tools that are used for data collection as well as interpretation. The instruments are used in the research according to the purpose of the research. The data was collected through questionnaires and videos. Mobile phones as a tape recorder, computer, internet, calculator, reference books were used to gather and interpret information.

2.2 Data Collection Procedure

Data was collected through videos and a questionnaire survey. In the questionnaire survey, interviews were made on the basis of age, gender, educational status, occupation, monthly income, and knowledge level of crossing facilities. The interviews were taken in formal and informal settings. The objectives of the research and the importance of data collection were explained to them so that they can give their consent. Pedestrians were instructed to provide a true and authentic answer. In case of any difficulty in understanding the questionnaire, the researcher was there to help them out. To collect the information at the selected area, a camera was sat up at an elevated place. Then the number of pedestrians who are used existing road crossing facilities and who are not determined through video graphic survey.

2.3 Data Analysis Procedure

Data analysis refers to the fact of analyzing data obtained from the pedestrians. After collecting data, they were checked, verified, cleaned and finally edited. Respective tables and graphs were prepared as required. And pedestrian responses were cross-checked. In this way, it has been tried to find out whether they had given the true answer because if they didn't, their responses would contradict. Data from different videos were also analyzed and compared in the same way. The tabulated and transcribed data were analyzed carefully and critically and then interpretations ware made accurately. All the data were analyzed in terms of the central research questions and objectives. Both qualitative and quantitative methods were used for analyzing them.

2.4 Study Area and Period

The City of Chittagong making is the second-largest city in Bangladesh. According to the Bangladesh Bureau of Statistics (2014), Chittagong has a population of more than 2.5 million. In this study, data collection was carried out at the Agrabad an un-signalized intersection as shown in the following figure. A video graphic survey data was recorded for one hour from each approach and 5472 pedestrians have been observed at Agrabad intersection. A questionnaire survey was done randomly selected respondent pedestrians during the period of August 15-25, 2018. The questionnaire data were collected from 550 nos. pedestrians at Agrabad intersection. The sample has been collected in two categories- (i) pedestrians who obey the rules and (ii) pedestrians who violate the rules.

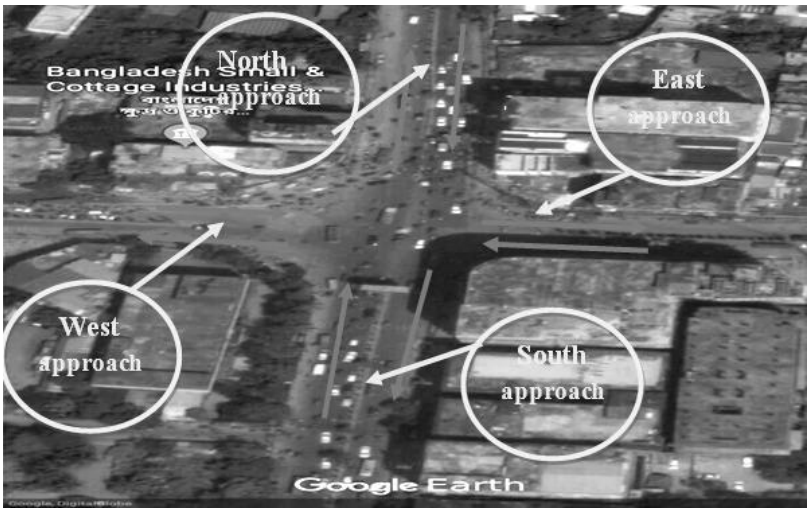

Figure 1: Agrabad Intersection (Google earth view)

3. DATA ANALYSIS AND INTERPRETATION

Data analysis and interpretation is the most important task of the work. The success of this study totally depends on the accuracy of the data analysis and interpretation. In this work, to analyze the collected data, graphical representations have been used.

3.1 Video Graphic Data at Agrabad Intersection

Initially, 5472 pedestrians are followed by a video graphic survey at Agrabad intersection, to determine the road crossing behavior of the pedestrians. Table-1 reveals that only 15.99% of pedestrians were following pedestrian crossing rules. Among them, 12.44% of males and 26.46% of females do not follow rules.

Table 1- Total Pedestrian and Their Behaviour at Agrabad intersection

Type		Agrabad Intersection	
		Total	**Results (%)**
Gender	Male	4206	76.86
	Female	1266	23.14
Total	Follow Rules	875	15.99
	Do not follow Rules	4597	84.01
Male	Follow Rules	540	12.84
	Do not follow Rules	3666	87.16
Female	Follow Rules	335	26.46
	Do not Follow Rules	931	73.54

3.2 Questionnaire Survey at Agrabad Intersection

The questionnaire survey on the basis of age, gender, educational status, occupation, monthly income, and knowledge level of crossing facilities has been done among the 550 pedestrians. Among them, 350 pedestrians were taken from road crossing rules violated group and 200 pedestrians were taken from road crossing rules obeyed group. From the questionnaire survey, the following demographic characteristics in pedestrian behavior are observed.

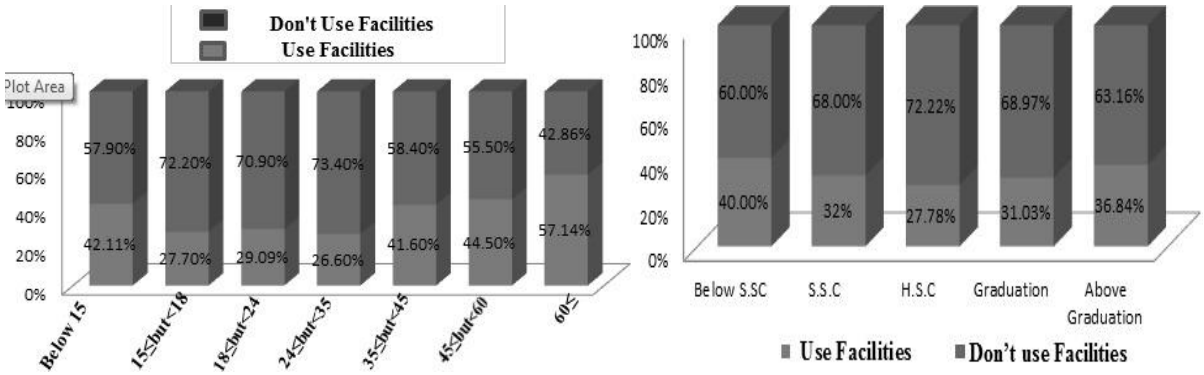

Figure 2: (a) Violation of existing rules in road crossing due to age group; (b) Violation of existing rules in road crossing due to education.

Fig. 2(a) shows that most of the rules violated group is 24-35 years old people. 73.40% of pedestrians do not obey the road crossing rules whose age is 24-35 years. 57.14% of pedestrians obey the road crossing rules whose age is above 60 years and 70.90% of pedestrians do not obey the road crossing rules whose age is 18-24 years. Fig. 2(b) shows that the group below S.S.C level pedestrians obey the traffic rules more, 60% of pedestrians have followed road crossing rules. Most of the rules violated group is the pedestrians who are studying at higher secondary certificate (H.S.C) and the value is 72.22%.

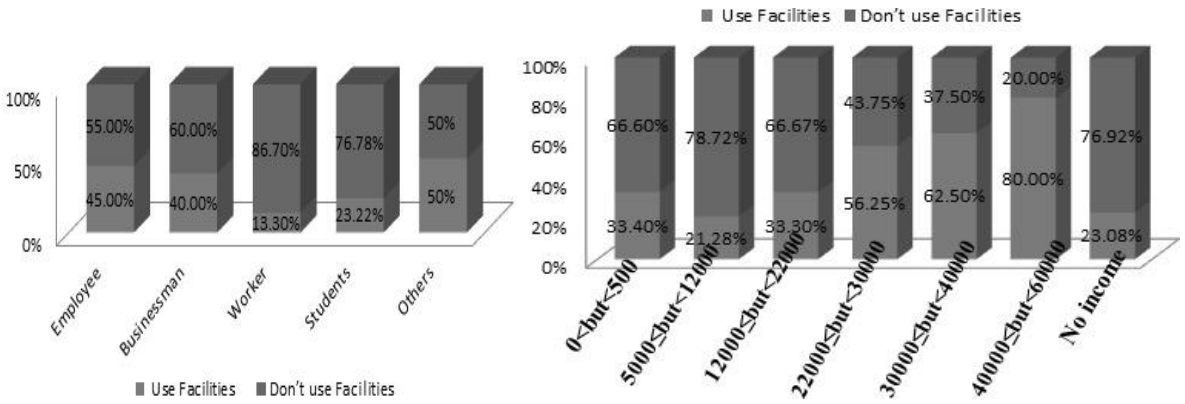

Figure 3: (a) Violation of existing rules in crossing according to occupation; (b) Violation of existing rules in crossing due to income (in BDT)

Fig.3(a) shows that 55% of employees obey the road crossing rules, but 86.70% of workers and 60% of businessmen do not follow the road crossing rules. Maximum students who come from various educational institutions do not use the zebra crossing. From research, it has been found that 76.78% of students do not use existing road crossing facilities at this intersection. Temporary workers who work beside the road, fully violence to the traffic rules and maximum time they cross the road for any purposes. Fig. 3-(b) shows that 80% of pedestrians obey the road crossing rules whose income is around 40,000 to 60,000 BDT per month. 66.67% of pedestrians are not using the road crossing facilities whose income rage is 30000 to 40000 BDT per month.

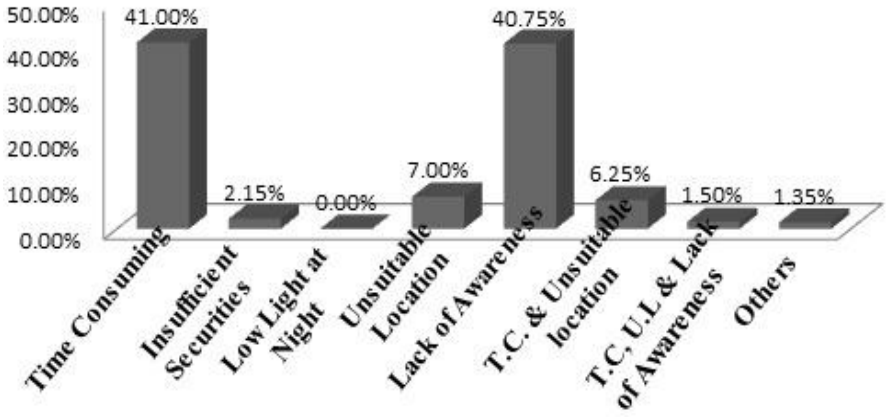

Figure 4: Causes for not using existing facilities during crossing the road (Field survey)

From the video graphics survey, we have known that most of the pedestrians (84.01%) of the selected area are not using the road crossing facilities. The possible reasons for not using the pedestrian's road crossing facilities identified from the field investigation. Based on a questionnaire survey it has been found that lack of awareness has been identified as the topmost reason for not using road crossing facilities. Fig. 4 shows that 41% of pedestrians assumed that obeying the road crossing facilities is time-consuming (T.C.). Lacking awareness is another important factor that discourages the pedestrians to use the road crossing facilities; 40.75% of pedestrians do not use the road crossing facilities due to lack of awareness. But only 7% of pedestrians assume that the crossing facilities are not properly placed and they violate the road crossing rules due to unsuitable location (U.L.) of crosswalk. The lighting problem is not found in the survey.

A zebra crossing is a type of pedestrian crossing used in many places around the world. The minimum width for a Zebra pedestrian crossing is 2.4 meters (Hamed, 2001). Fig- 5(a) & (b) shows that rules for constructing zebra crossings in all approaches of the studied intersection are not maintained properly. And, no pedestrian guardrails and pedestrians' barriers observed in all approaches of the

intersections. According to Bangladesh Road Transport Authority (2008), drivers must be able to see the various traffic signs from at least 75 meters away so that they have time to read the message and act on it. Unfortunately, traffic signs are not properly placed. Interruption due to illegal parking and business in front of pedestrians crossing ways has also been observed.

Figure 5: (a) Roadway marking conditions; (b) Parking on zebra crossing at Agrabad intersection

Figure 6: (a) Illegal parking & (b)Footpath condition & hawkers at Agrabad Intersection

It is very interesting that 100% of pedestrians make-believe violating the road crossing system is risk although they do not use the existing road crossing facilities. 79% of pedestrians know road crossing rules, only 21% of pedestrians are uneducated about road crossing systems. It is very interesting that 72% of pedestrians faced difficulties due to not using existing road crossing facilities at Bangladesh intersection shown by Fig. 5.

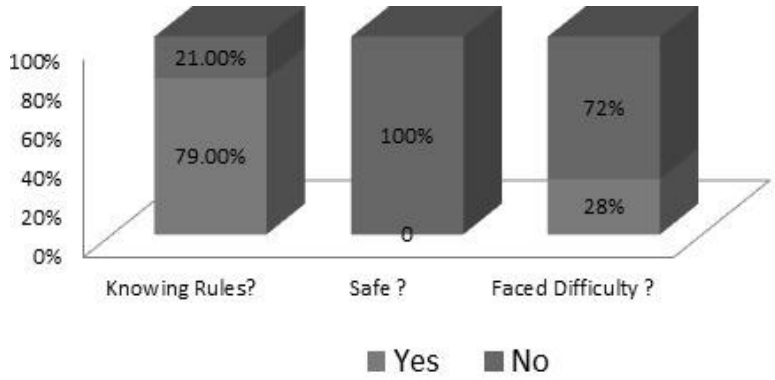

Figure 5**:** Pedestrians Opinions (Field Survey)

4. CONCLUSIONS AND RECOMMENDATIONS

From this research, some conclusions can be made out based on some parameters. At first, the studied area has shown that 41% and 40.75% of pedestrians violate the rules due to time-consuming and lack of awareness respectively whereas 79% of pedestrians know the road crossing rules. Again, male pedestrians (87.16%) more violate the rules comparatively than female pedestrians (73.54%). Besides, only 29.09% of young people obey the rules whose age limit is 18 years to 24 years. Further, educated and rich people more conform to the rules (36.84%) who have at least a graduation degree. On the other hand, below the S.S.C level, 40.00% of people only follow the rules. 7% of pedestrians assume that the crossing facilities are not properly placed, and they violate the road crossing rules due to the unsuitable location of the crosswalk. Moreover, 80.00% of pedestrians use facilities whose salary about 40000 to 60000 BDT.

To acquire more detailed information about pedestrian traffic violations, the research presented here studied the behavioral characteristics of pedestrians and the factors that affect their behavior at unsignalized intersections. Though some pedestrians are following the existing system they are facing so many problems in using the recommended system. These problems include mainly a lake of safety, security, comfort, and cleanliness, etc. Moreover, there is a lack of awareness among the pedestrians and the drivers. So the identified problems and the preference should be considered while proposing a new road crossing system whether it is zebra crossing, underpass crossing or overpass crossing. And the pedestrian issue should be integrated into the transport planning process to ensure safe, secure and convenient pedestrian movement in Chittagong city.

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REFERENCES

Bangladesh Bureau of Statistics. (2014). Bangladesh population and housing census 2011. National Report Volume 2. Union Statistics March 2014.

Derlet, R. W., Silva Jr, J., & Holcroft, J. (1989). Pedestrian accidents: adult and pediatric injuries. *The Journal of emergency medicine*, *7*(1), 5-8.

Gitelman, V., Balasha, D., Carmel, R., Hendel, L., & Pesahov, F. (2012). Characterization of pedestrian accidents and an examination of infrastructure measures to improve pedestrian safety in Israel. *Accident Analysis & Prevention*, *44*(1), 63-73.

Kim, K., Brunner, I. M., & Yamashita, E. (2008). Modeling fault among accident—Involved pedestrians and motorists in Hawaii. *Accident Analysis & Prevention*, *40*(6), 2043-2049.

Hamed, M. M. (2001). Analysis of pedestrians' behavior at pedestrian crossings. *Safety science*, *38*(1), 63-82.

Hoque, M. M. (2004). The road to road safety: issues and initiatives in Bangladesh. In *Regional Health Forum* (Vol. 8, No. 1, pp. 39-51).

Hoque, M. E., Sarker, T. K., Hoque, S. M. M., & Siddique, A. A. (2008). Rta annual report 2008. *BRTA, Bangladesh*, 12.

Lassarre, S., Papadimitriou, E., Yannis, G., & Golias, J. (2007). Measuring accident risk exposure for pedestrians in different micro-environments. *Accident Analysis & Prevention*, *39*(6), 1226-1238.

Oxley, J., Fildes, B., Ihsen, E., Charlton, J., & Day, R. (1997). Differences in traffic judgements between young and old adult pedestrians. *Accident Analysis & Prevention*, *29*(6), 839-847.

Wedagama, D. P., Bird, R. N., & Metcalfe, A. V. (2006). The influence of urban land-use on non-motorised transport casualties. *Accident Analysis & Prevention*, *38*(6), 1049-1057.

World Health Organization. Dept. of Violence, Injury Prevention, World Health Organization. Violence, Injury Prevention, & World Health Organization. (2009). *Global status report on road safety: time for action*. World Health Organization.