

PEDESTRIAN SAFETY IN DHAKA MEGA CITY OF BANGLADESH: BEHAVIOUR, ATTITUDE AND RISK PERCEPTION

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ABSTRACT

Pedestrians are always the most vulnerable road victims in terms of crash involvement. In low-motorized developing countries like Bangladesh, this problem is disproportionately higher, particularly in an urban setting. Therefore, there is a need to develop a pragmatic strategy to arrest this problem with a proper understanding of their behavior, attitude, and perception. In this study, an attempt has been made to evaluate the risk perception, attitude, and behavior of pedestrians. A comprehensive questionnaire survey enabled the collection of pedestrian behavior, attitude, and risk perception data, which included different categories of users. From this analysis, it is evident that perception and attitude are closely related, and in most cases that is very positive. However, there is a huge gap between perception, attitude, and behavior. Many respondents have proven their accurate feelings, right understanding, or belief, but their behavior represents differently. The paper elaborates on these two confronting issues with the evidence and concludes with potential implications for improving pedestrian safety.

Keywords: Pedestrian, Safety risk, Behavior, Attitude, Perception

1. INTRODUCTION

No matter whether the primary mode of travel is the automobile including car, auto-rickshaw, non-motorized, or public transit; everyone must walk as a part of the trip, such as from their home to the shop or place of service, and/or to the transit stop. Therefore, walking is one of the main modes of transport all over the world, particularly in developing cities where the motorization rate is low and mixed land use with huge densification. According to different studies, walking is the single largest group of travel mode in Dhaka city catering to more than 50 % of all trips (Pasha, *et al.*, 2015; Hoque, Mahmud, and Qazi., 2008). This is mainly attributed to the trip length as 76% of all trips are under 5 km, and 50% are under 2 km in Dhaka city (Barkat, *et al.*, 2004) which makes walking a convenient mode of transport.

The risk of pedestrians as unprotected road users is also very high and comprises more than 50 percent of road traffic fatalities and injuries. According to police-reported statistics, a total of 26,464 accidents and 25,879 fatalities were reported in Bangladesh from 2010 to 2019. Around half of those road traffic fatalities are pedestrians alone. In case of crash type, 'hit pedestrian' is the dominant crash type both in urban and rural areas, representing 44 percent of total fatal crashes and 48 percent of total crashes. In an urban area, this share is much higher, varying between 60 and 74 %. In Dhaka city, it accounts for 74% of all traffic fatalities (Police, B., 2020).

There are a number of studies on the pedestrian safety problem. Those studies mainly focused on pedestrian crash and injury characteristics (Hoque, Mahmud, and Qazi., 2008; Zegeer and Bushell, 2012; Cuerden, and Richards, 2009), existing facilities for pedestrians, and their limitations (Mahmud, *et al.*, 2006; Leather, Fabian, and Gota, 2011), etc. Those studies pointed out that lack of walking and crossing facilities and adverse road and roadside environments are the principal reasons behind these deaths (Hoque, M.M., S.M.S. Mahmud, and A.S.

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Qazi., 2008; Mahmud, et al., 2006; Hoque, and Salehin, 2013; Hoque, Pervaz, and Paul., 2016). Some studies evaluated the level of satisfaction with the existing facilities and preference (Pasha, *et al.*, 2015), self-reported problems. Few studies also investigated and reported the crossing and walking behavior of pedestrians using observational techniques including video observation (Obaidat, et al., 2007). However, the study on pedestrian risk perception, attitude, and behavior is very minuscule. In the case of developing countries like Bangladesh, this type of inclusive study is still yet to be done. Whereas risk perception, attitude, and behavior of pedestrians could be highly attributed to the vulnerability and risk of crashes and injuries. Moreover, with a clear understanding of the users' level of satisfaction with providing facilities, the reason behind the dissatisfaction, preferences, attitude, and reception, it is important to have a deeper knowledge of action-oriented behavior to relate the different attributes for selecting a specific intervention.

This study attempts to evaluate the risk perception, attitude, and walking and crossing behavior of pedestrians to identify the factors that significantly affect risk perception and unsafe behavior of pedestrians. The study uses self-reported data obtained via a questionnaire survey. It is expected that the results of this study will lead to a better understanding of pedestrian expectation, risk perception, attitude, their behavior and to support policymakers in their decision-making regarding the improvement of pedestrian safety and injuries in urban areas in Bangladesh primarily in Dhaka city.

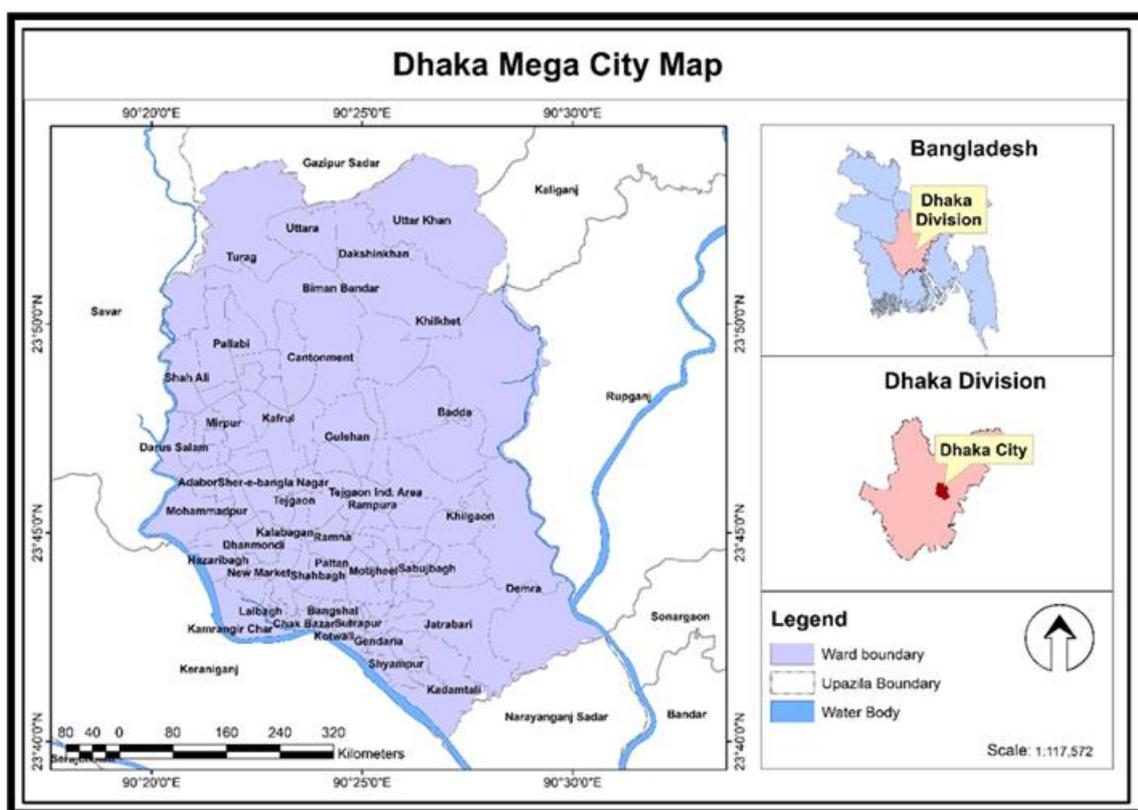


Figure 1: Study Area Map of Dhaka Mega City.

2. METHODOLOGY

2.1 Questionnaire Development

After an inclusive literature review on the design and formation of the questionnaire, a preliminary questionnaire was drafted. The preliminary questionnaire was tested to see whether the questions are correctly understood, and meaning are properly interpreted by the responders to avoid possible bias due to misinterpretation or misunderstanding. Reliability and level of acceptability of the questions are also assessed to see whether the questionnaire is adequate enough to evaluate the target objective. Moreover, the questionnaire is shared with several experts to get their opinions and suggestions for further improvement. Finally, after necessary modification with the incorporation of test feedback, experts' comments, and suggestions, the final questionnaire is fixed for the online survey. The questionnaire comprises in total of 40 questions. The entire questionnaire has been divided into five different groups including demography of the participants, pedestrian

satisfaction with different existing facilities, pedestrian risk perception, pedestrian attitude, and pedestrian behaviour.

2.2 Survey Design

In the beginning, it was planned to organize a face-to-face questionnaire survey. However, due current adverse situation of the fallout of the COVID-19 pandemic, the study used an online platform for the survey. After completion of the questionnaire, the survey has been designed on Google form. The questionnaire was discriminated against the respondent through different online platforms including email, social media etc. Secondary communication via text and telephone was also made to some target respondents to stimulate the survey as a reminder as well as to get a quick response. All the participants of the study are from Dhaka city, the capital of Bangladesh. Figure 1 illustrates the survey area of this study.

3. ANALYSIS AND RESULTS

3.1 Responded profile

A total of 192 responders completed the online survey. Regarding the demographical characteristics, of the total 192 respondents, 117 men accounted for 61% of the test population, while 74 women accounted for 39 and the remaining 1 person (0.5%) prefers not to comment on this gender issue. From those 53.6% respondents are inside of Dhaka city and else 46.4% respondent are outside of Dhaka city. In age analysis, below 18 years is 3%, from 18 to 24 years are 70%, from 24 to 30 years are 24%, from 30 to 36 years are 1%, from 36-42 years are 2%, from 42 to 48 years is null number, from 48 to 54 years are 0.5%, and above 54 years are 0.5%. In terms of education status, we can see which have no formal education are 0 percentage. Up to primary 0%, up to secondary school 2.1% and up to higher secondary school 9.9% and graduate respondents are 72.4%. 15.6% have the degree of post-graduations. 85.9% of respondents have monthly income less than 20 thousands, 7.3% have twenty to forty thousand monthly income, 4.2% have forty to sixty thousands monthly income, 2.1% have sixty to eighty thousands monthly income, none have eighty thousands to one lakh monthly income and 0.5% have more than one lakh monthly income in BDT. In analysis of current profession of respondents Govt. employee 6.77%, Private employee 6.77%, Self-employed (Business) 1.04%, Student 78.65%, Other 0.52%. When evaluating the major purpose of walking, 11.46% respondents walk for job, 2.08% walk for shopping, 55.73% walk for education, 0.52% walk for drop-off and pickup, 16.15% walk for Recreation/exercise/prayer and 14.06% walk for others purpose respectively. In case of average walking time per day, 5.7% of pedestrians spent less than 15 minutes, 29.2% pedestrians spent 15-30 minutes, 26.6% pedestrians spent 30-45 minutes, 12.5% pedestrians spent 45-60 minutes, 17.2% pedestrians spent 1-1.5 hours and remaining 8.9% pedestrians spent more than 1.5 hours in walking. Over the past one year, 67 (35%) respondents have experienced traffic injury one to two times while walking, 15 respondents have faced three to five injury crashes and 6 respondents have face more than five injury crashes.

3.2 Pedestrian Satisfaction in Different Existing Facilities

Table 1 presents the overview of the level of satisfaction of the respondents on the walking and crossing facilities in Dhaka city.

In regard to the walking facilities, around 49.33 percent expressed they are not satisfied with the existing walking facilities (31.33% not much satisfied or fairly dissatisfied and 18% not at all satisfied or very dissatisfied). In the case of crossing facilities, this figure is more than that of the walking facilities. Around 52.33% of respondents are dissatisfied with the crossing facilities (35% are not much satisfied or fairly dissatisfied and 17.33% are not at all satisfied or very dissatisfied). Only 6.66% of users among respondents are very satisfied and 35.33% of respondents are fairly satisfied with the existing walking facilities. In the case of crossing facilities, these values are 5.33% and 31.66% respectively. In both cases, an average level of satisfaction goes below the neutral/median level i.e., fall under the dissatisfactory level, 2.813 for walking facilities and 2.726 for crossing facilities.

In walkway/footpath physical condition i.e., width, height shows that 6% of respondents are very satisfied, 31.66% of respondents are fairly satisfied, 10% of respondents are neither satisfied nor dissatisfied, 26.66% of respondents are not much satisfied, or fairly dissatisfied and 25.66% are not at all satisfied or very dissatisfied.

In the case of aesthetic condition of walkway/footpath i.e., the texture of surface shows that 4.33% of respondents are very satisfied, 31.33% of respondents are fairly satisfied, 10.66% of respondents are neither satisfied nor dissatisfied, 27% of respondents are not much satisfied or fairly dissatisfied and 26.66% are not at all satisfied or very dissatisfied.

With regards to the walkway/footpath environmental condition i.e., cleanliness and free from obstacles shows that 2% of respondents are very satisfied, 23% of respondents are fairly satisfied, 7.66% of respondents are neither satisfied nor dissatisfied, 27.66% of respondents are not much satisfied or fairly dissatisfied and 40% are not at all satisfied or very dissatisfied.

The proper location of the foot overbridge is one of the important factors which encourage pedestrians to use this facility. However, in the case of Dhaka city, only 40.33% are satisfied with the location of the foot overbridge (9% of respondents are very satisfied, 31.33% of respondents are fairly satisfied), whereas 41.66% are not satisfied with the present location of a foot overbridge (28.66% fairly dissatisfied and 13% very dissatisfied). In the case of the number and placement of on-road crossing facilities like a zebra crossing, 7% of respondents are very satisfied, 31% of respondents are fairly satisfied, 16.33% of respondents are neither satisfied nor dissatisfied, 26.33% of respondents are not much satisfied or fairly dissatisfied and 19.33% are not at all satisfied or very dissatisfied. The mean value of satisfaction number and placement of on-road crossing facilities is 2.8.

Table 1: Pedestrian Satisfaction in different existing facilities.

How satisfied are you with the following?	Very Satisfied	Fairly Satisfied	Neither satisfied nor dissatisfied	Fairly dissatisfied	Very dissatisfied	Mean Satisfactory level (Std. dev)
Walking facilities	20, 6.66%	106, 35.33%	26, 8.66%	94, 31.33%	54, 18%	2.813 (2.6)
Crossing facilities	16, 5.33%	95, 31.66%	32, 10.66%	105, 35%	52, 17.33%	2.726 (2.5)
Walkway/footpath physical condition i.e., width, height	18, 6%	95, 31.66%	30, 10%	80, 26.66%	77, 25.66%	2.656 (2.4)
Walkway/footpath aesthetic condition i.e., the texture of the surface	13, 4.33%	94, 31.33%	32, 10.66%	81, 27%	80, 26.66%	2.596 (2.41)
Walkway/footpath environmental condition i.e. cleanliness and free from obstacle	6, 2%	69, 23%	23, 7.66%	82, 27.33%	120, 40%	2.196 (2.0)
Location of the foot-over bridge	27, 9%	94, 31.33%	54, 18%	86, 28.66%	39, 13%	2.946 (2.7)
Number and placement on road crossing facilities like a zebra crossing	21, 7%	93, 31%	49, 16.33%	79, 26.33%	58, 19.33%	2.80 (2.6)
Visibility of zebra crossing	28, 9.33%	88, 29.33%	47, 15.66%	75, 25%	62, 20.66%	2.816 (2.6)
Mid-road pedestrian refuge	12, 4%	70, 23.33%	38, 12.66%	72, 24%	108, 36%	2.353 (2.2)
Street lighting	44, 14.66%	103, 34.33%	43, 14.33%	64, 21.33%	46, 15.33%	3.116 (2.9)
Overall pedestrian safety facilities	18, 6%	84, 28%	29, 9.66%	80, 26.66%	89, 29.66%	2.54 (2.4)

Note: Mean calculated considering Very Satisfied=5, Fairly Satisfied=4, Neither/nor=3, Fairly Dissatisfied =2, Very Dissatisfied=1

The visibility of zebra crossing is also an important issue for its functionality. Study shows that 9.33% of respondents are very satisfied, 29.33% of respondents are fairly satisfied, 15.66% of respondents are neither satisfied nor dissatisfied, 25% of respondents are not much satisfied or fairly dissatisfied and 20.66% are not at all satisfied or very dissatisfied with this issue. In the case of mid-road pedestrian refuge, it shows that 4% of respondents are very satisfied, 23.33% of respondents are fairly satisfied, 12.66% of respondents are neither satisfied nor dissatisfied, 24% of respondents are not much satisfied or fairly dissatisfied and 36% are not at all satisfied or very dissatisfied.

Street lighting is the only facility that represents the mean satisfaction value above average (mean=3.116). As implied by the respondents, 14.66% of respondents are very satisfied, and 34.33% of respondents are fairly

satisfied with the existing street lighting condition. On the contrary, 21.33% of respondents are not much satisfied or fairly dissatisfied and 15.33% are not at all satisfied or very dissatisfied. Around 56.66% of respondents opined that they are not satisfied with the overall pedestrian safety facilities (26.66% of respondents are not much satisfied or fairly dissatisfied and 29.66% are not at all satisfied or very dissatisfied). In contrast, 34% are satisfied with the present pedestrian safety facilities. Around 9.66% of respondents are neither satisfied nor dissatisfied. The overall satisfaction level is significantly low, 2.54.

From this chart, we find that majority of the responders are not much satisfied on the different existing walking and crossing facilities in Dhaka city. The mean responses of all the questions related to satisfactory level vary from 2.196 to 2.946 except for street lighting which lies in between ‘neutral’ and ‘Fairly Dissatisfied’.

3.3 Pedestrian Risk Perception

In pedestrian risk perception, total of four parameters are analyzed with the Likert scale. Among them two are related to positive behavior and two are related to negative behavior. The respondents were asked “How much safe do they feel as a pedestrian when they cross the road through a running vehicle”. Around 56.66% of the people consider crossing the road through a running vehicle as “Not at all safe or very unsafe”. Only 6.33% of respondents feel that it is safe. In the case of using a mobile while crossing, almost 75.33% considered crossing the road using a mobile phone, not at all safe or very unsafe. Only 2.33% considered it safe. The mean responses related to negative behaviour questions are 1.636 and 1.386 which lie in between ‘fairly unsafe’ and ‘very unsafe’. This implies that the respondent is very much concerned about their risk.

Crossing the road on Zebra crossing, almost 67.66% considered it to be safe (23% very safe and 44.66% safe), which mean value is 3.703 falls in between neutral and safe. However, around 32.32% including users 15.66% neutral has a negative perception regarding this. Almost 75% of respondents opined that walking on footpaths is safe (34.66% very safe and 40.33% safe). The mean value risk perception level regarding this is 3.94, which lies in between neutral and safe (Table 2)

Table 2: Pedestrian Risk Perception.

How safe do you feel as a pedestrian when you are	Very safe	Fairly safe	Neither safe nor unsafe	Not much safe or fairly unsafe	Not at all safe or very unsafe	Mean Satisfactory level (Std. dev)
Crossing the road through a running vehicle	3, 1%	16, 5.33%	20, 6.66%	91, 30.33%	170, 56.66%	1.636 (1.32)
Crossing the road using a mobile phone or taking with someone	3, 1%	4, 1.33%	25, 8.33%	42, 14%	226, 75.33%	1.386 (1.02)
Crossing a road on Zebra crossing	69, 23%	134, 44.66%	47, 15.66%	39, 13%	11, 3.66%	3.703 (2.98)
Walk on footpath	104, 34.66%	121, 40.33%	36, 12%	31, 10.33%	8, 2.66%	3.94 (3.04)

Note: Mean calculated considering Very safe=5, Fairly safe=4, Neither safe nor unsafe=3, Not much or fairly unsafe =2, and Not at all safe or very unsafe=1.

4. PEDESTRIAN ATTITUDE

4.1 Crossing the Road

In pedestrian attitude i.e., their thinking/belief to cross the road-related section total of seven parameters are analyzed with a Likert scale. Table 3 presents an overview of responses on attitudes related to crossing the road with a mean and standard deviation of a Likert scale value.

The mean Likert Scale value of responses to all the questions varies from 1.456 to 4.52 which lies in between ‘neither/nor’ and ‘strongly disagree’. Respondents were asked about their thinking on ‘road crossing through the running vehicle is normal and acceptable and around 79.33% of respondents replied negative. On the other hand, when they were asked ‘driver should always yield to pedestrian’, around 72.32% were positive.

Table 3: Attitude Related to crossing the road.

Your thinking/belief to cross the road (Please rate your scale)	Strongly agree	Agree	Neither	Disagree	Strongly Disagree	Mean (Std. Dev.)
Road crossing through a running vehicle is normal and acceptable	14, 4.66%	23, 7.66%	25, 8.33%	79, 26.33%	159, 53%	4.153 (3.80)
Drivers should always yield to a pedestrian	70, 23.33%	83, 27.66%	64, 21.33%	54, 18%	29, 9.66%	2.63 (2.43)
It is acceptable to violate the rules while walking or crossing when I am in a hurry	10, 3.33%	25, 8.33%	23, 7.66%	71, 23.66%	171, 57%	4.226 (3.86)
If there is a foot-over bridge or underpass nearby, we can generally avoid that	7, 2.33%	1, 0.33%	7, 2.33%	92, 30.66%	193, 64.33%	1.456 (1.12)
It is ok to group cross even through running traffic	20, 6.66%	42, 14%	46, 15.33%	73, 24.33%	119, 39.66%	3.763 (3.47)
It is acceptable to cross the road while using mobile and earphones	8, 2.66%	6, 2%	19, 6.33%	56, 18.66%	211, 70.33%	4.52 (4.09)
There should be punishment for pedestrians who cross through running vehicles or do not use a footbridge for crossing despite having a good foot-over bridge/underpass	149, 49.66%	68, 22.66%	23, 7.66%	26, 8.66%	34, 11.33%	2.093 (2.05)

Note: Mean calculated considering Strongly Agree=1, Agree=2, Neither=3, Disagree=4 and Strongly Disagree=5.

Around 80.66% believe that violation of rules during walking or crossing is unacceptable in any circumstances. When it has asked if there is a foot-over bridge or underpass nearby, we can generally avoid almost 95% did not agree with that (64.33% strongly disagree and 30.66 disagree). Nearly 64% believe crossing through running traffic is not ok though they are in the group. Regarding crossing, while using a mobile phone or earphone, almost 90% stated that that is not acceptable. Regarding punishment 72.32% of attitude is positive. They believe the responsibility should be punished who are violating crossing rules or not using existing facilities. However, around 20% are not in favor of punishment. The average Likert scale attitudes value goes in between agree and neutral level, mean=1.456.

Table 4: Attitude Related to Walking along the Road.

Your thinking/belief to walk along the road (Please rate your scale)	Strongly agree	Agree	Neither	Disagree	Strongly Disagree	Mean
Even though there is a footpath, it is my choice to use it while walking	9, 3%	18, 6%	31, 10.33%	106, 35.33%	136, 45.33%	4.14 (3.75)
Even though there is a footpath on one side of the road, I can walk along any side	10, 3.33%	19, 6.33%	43, 14.33%	113, 37.66%	115, 38.33%	4.013 (3.63)
Without considering the footpath, one might walk together with a group	10, 3.33%	18, 6%	33, 11%	92, 30.66%	147, 49%	4.16 (3.78)
It is safe to walk wearing visible clothing at night	76, 25.33%	78, 26%	58, 19.33%	40, 13.33%	48, 16%	2.686 (2.55)

Note: Mean calculated considering Strongly Agree=1, Agree=2, Neither=3, Disagree=4, and Strongly Disagree=5

4.2 Walking along the Road

The responses related to attitude on walking along the road are presented in Table 4. Around 87% of responders believe that using a footpath is not a matter of choice, but it must. Moreover, 76% opined that they should use foot though there is a footpath on only one side. When they were asked if one might walk together with a group without considering a footpath, 80% disagreed. Mean Likert scale values regarding the no use of footpath in any circumstances varied between 4.013 to 4.16, which lies under strongly disagree. Attitude is also judged regarding the importance of visibility at night-time as a pedestrian. Around 75 believe they should be visible wearing visible clothing at night. On the contrary, 29.33% did not agree with that excluding 19.33% in between. The mean is 2.686 and lies in a neutral position.

5. PEDESTRIAN BEHAVIOUR

5.1 Crossing the Road

Table 5 presents responses on the behavioural i.e., what are they doing/practicing attributes related to crossing the roads. There are eight attributes presented with the Likert scale. The mean value of responses to all the questions varies from 1.55 to 2.863 which lies in between 'rarely' and 'often'.

Only 32% of responders stated that they never cross the road through running vehicles. Other 68% have the tendency to cross the road through the running vehicle. When they are asked about the crossing places, 80% mentioned they have practiced crossing roads other than the pedestrian crossing at a different level. On the other hand, 66% stated that they never cross the road outside the pedestrian crossing if there is a crosswalk or zebra crossing nearby. Moreover, 47.33% stated that they never avoid using pedestrian bridges or underpasses due to inconvenience. On the contrary, around 28% avoid using pedestrian bridges or underpasses due to inconvenience, even if that is located nearby.

Table 5: Behavior Related to Crossing the Road

Please mark how often you do the following things as a pedestrian	Never	Rarely	Often	Very often	Always	Mean (Std. dev)
Cross the road through running vehicle	96, 32%	107, 35.66%	75, 25%	19, 6.33%	3, 1%	2.086 (1.75)
Cross streets at places other than the pedestrian crossing	81, 27%	124, 41.33%	60, 22%	26, 8.66%	3, 1%	2.153 (1.81)
Use mobile/earphone during road crossing	198, 66%	60, 20%	28, 9.33%	7, 2.33%	7, 2.33%	1.55 (1.21)
By showing signal to drivers by hands I cross the road	42, 14%	86, 28.66%	88, 29.33%	39, 13%	45, 15%	2.863 (2.32)
Cross outside the pedestrian crossing even if there is a crosswalk or zebra crossing nearby	149, 49.66%	75, 25%	45, 15%	20, 6.66%	11, 3.66%	1.896 (1.60)
Avoid using pedestrian bridges or underpasses due to inconvenience, even if that is located nearby	142, 47.33%	75, 25%	45, 15%	23, 7.66%	15, 5%	1.98 (1.68)
Run across the street without looking because I am in a hurry	208, 69.33%	37, 12.33%	28, 9.33%	16, 5.33%	11, 3.66%	1.616 (1.35)
Follow group pedestrians who cross through running vehicle	119, 39.66%	92, 30.66%	57, 19%	20, 6.66%	12, 4%	2.046 (1.72)

Note: Mean calculated considering Never=1, Rarely=2, Often=3, Very often=4, and Always=5.

In case of use of mobile/earphones during road crossing, 66% behavior is positive, they never used during the crossing. However, about 85% admitted that they tried to stop drivers forcefully showing hands to cross the road. The mean value of a practice is 2.863. On the contrary, 69.33% stated that they never run across the street without looking though they are in a hurry. In regard to group crossing, 60.32% acknowledged that they followed group pedestrians though they cross through the running vehicle (30.66% rarely, 19% often, 6.66% very often and 4% always).

5.2 Walking along the Road

To evaluate the behaviour related to walking along the road, responders were asked three questions related to walking behaviour. They are questioned about how often they are practicing/following that behaviour and the answer were taken with a Likert scale.

Regarding the use of a footpath, 62.66% stated they use a footpath always or very often if there is a footpath at least on one side (29.33% always and 33.33% very often). The Likert scale value is 3.716 falls between often and very often. Regarding walking on the right side if there is no footpath, around 30% behaviour is negative i.e. never or rarely practice that. Around 27% of responders often do that. Moreover, 58.66% claimed that they consider using footpaths importantly though they walk in a group (Table 6).

Table 6: Behaviour Related to Walking along the Road.

Please mark how often you do the following things as a pedestrian	Never	Rarely	Often	Very often	Always	Mean (Std. dev.)
Use a footpath if there is one on one side	15, 5%	33, 11%	63, 21%	100, 33.33%	89, 29.33%	3.716 (2.91)
Walk on the right side of the road if there is no footpath	47, 15.66%	43, 14.33%	80, 26.66%	78, 26%	52, 17.33%	3.15 (2.60)
Don't use the footpath while walking in a group	175, 58.66%	40, 13.33%	39, 13%	16, 5.33%	30, 10%	1.953 (1.64)

Note: Mean calculated considering Never=1, Rarely=2, Often=3, Very often=4, and Always=5.

6. CONCLUSIONS

This study attempted to evaluate stated pedestrian behaviour, attitude, and perception in urban areas of Bangladesh using a questionnaire survey. Altogether 40 questions were asked including demography of the participants, pedestrian satisfaction with different existing facilities, reasons and stated preference for crossing, risk perception, attitude, and behaviour for both walking along and crossing the road. Levels of satisfaction, attitude, perception, and behaviour are measured using five scale points Likert scale. Due to the current COVID-19 pandemic, an online survey was made.

A total of 300 responses were analyzed ages ranging from 18 to 54+. Among them 56% are male and the remaining are female with different levels of education, income, and profession. The major trip purpose of the responders is education, accounting for 46% followed by other 17.66%, Recreation/ exercise/ prayer, 16.66%; Job, 14.33%. The average walking time of the majority of responders varies from 15 to 60 minutes. Regarding safety experience, 48.32% of responders were injured at least 1 time while walking within the last 1 year, 11.66% 3 and above times. From a safety point of view, it is a very alarming rate and concerning as well.

The majority of the pedestrians are dissatisfied with the existing walking and crossing facilities and the mean satisfactory level varies between neutral and fairly dissatisfied, except for street lighting. People are worst satisfied with the walkway/footpath environmental condition i.e., cleanliness and free from the obstacle (mean=2.196), this is followed by mid-road pedestrian refuge (mean 2.353), Walkway/footpath aesthetic condition i.e., texture of surface (mean=2.596), walkway/footpath physical condition i.e., width, height (mean=2.656). Reasons for not using footpaths or overbridges also demonstrate that the leading cause for not using these facilities is illegal occupancy. This is followed by aesthetic e.g., dirty, congested and geometric e.g., narrow, high, and planning problems e.g., foot overbridge is not in the proper place.

Therefore, priority initiatives should be taken to improve the environmental condition of the footpath/walkway of the city area e.g., getting rid of illegal activities like vendors, hawkers, and dumping on the footpath. Also, initiatives should be taken to make the walking facilities safe, comfortable, and environmentally friendly by improving physical and aesthetic conditions. For crossing, at grade signalized crossing (pedestrian green phase with push button) is the main choice. This is followed by a foot overbridge/underpass and zebra crossing with traffic calm measure. As the at-grade crossing facility is convenient for all types of pedestrians including people with disability or elderly people, augmentation of this type of facility with proper design is very important.

The main objective of this study is to evaluate the risk perception, attitude, and behaviour of the pedestrian. Most of the responders perceived crossing through a running vehicle as unsafe (87%) and this perception reflects in their attitudes (crossing unacceptable, 79.33%). But when it comes to the behaviour, only 32% reply that they never cross through running vehicles. In the case of using a mobile phone or taking while crossing, imitate almost the same pattern between perception, attitude, and behaviour. Around 89.33% feels it is unsafe, the same percent disagree to cross the road while using mobile and earphone but only 66% practice this. Regarding the use of footpath or zebra crossing for walking and crossing, the majority perceived it as safe (75% and 67.66% respectively). Their attitude is even stronger on this issue. More than 75% disagreed that they can avoid footpath if it is available at least on the side. In the case of using designated crossing facilities including foot-over bridges or underpasses, the percentage goes to 90%. However, only 29.33% responded that they always use footpaths for walking. On the other hand, around 48% cross outside the crosswalk or avoid foot over-bridge or underpass even if it is nearby.

From this analysis, it is evident that perception and attitude are closely related, and in most of the cases that is very positive. But there is a huge gap between perception, attitude, and behaviour. Most of the people have right feelings, right understanding, or beliefs, but they are practicing differently. There are two issues, one is behavioural problem and the other is a problem with the infrastructure, but the platform might be different. So,

target-oriented engineering and behavioural i.e., education and enforcement measures need to be taken. In case of the use of crossing and walking facilities, obviously, there is a problem with the engineering or infrastructure. That is also evident from the first part of the analysis. Therefore, need proper engineering intervention to ensure adequate well-designed crossing and walking facilities. Enforcement is also needed to a certain extent to ensure proper use. In the case of using a mobile phone or group cross or walking or running, the problem is mainly related to the revealed behaviour. For this target-oriented education and enforcement, programs need to be taken.

This study mainly provides a preliminary analysis of pedestrian behaviour and attitude survey to understand pedestrians' attitudes towards the crossing, walking, and using different pedestrian facilities along with their usual walking and crossing behaviour. Like many other studies, this study has many limitations. Due to the current COVID pandemic situation and limited resources and time limitations, only a limited number of samples have been used for this study. Improved sample size may provide a better understanding and would be useful to confirm the results presented here. The analysis could be extended by using different statistical tests to see the influence of different attributes on the perception, attitude, and behaviour of users. In addition, the application of advanced modeling techniques e.g., the Structural Equation Model (SEM) to identify the factors significantly affect risk perception and unsafe behaviour of pedestrians as well as to explore the intrinsic causal relationships among the variables that affect walking and crossing behaviour could be a high potential future research avenue.

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REFERENCES

- Barkat, A., et al., After Study On The Impact Of Mirpur Demonstration Corridor Project: HDRC (Gabtoli-Russel Square) Prepared For Dhaka. Transport Coordination board on September, 2004.
- Cuerden, R. and D. Richards. On the Spot accident study—the characteristics of pedestrian accidents. in Behavioural Research in Road Safety 2007 Seventeenth Seminar. 2009.
- Hoque, M.M., S.M.S. Mahmud, and A.S. Qazi. Dealing with Vulnerable Road User (VRU) Safety and Mobility in Urban Areas of Bangladesh: A Critical Sustainable Transport Development Challenge. in Conference Proceedings, XIII CODATU. 2008.
- Hoque, M.M. and M.F. Salehin, Vulnerable Road Users (VRUs safety in Bangladesh. 16th Road Safety on Four Continents Conference. 2013: China.
- Hoque, M.M., S. Pervaz, and A.K. Paul. Safety ratings of complex pedestrian routes in Dhaka metropolitan city. 27th ARRB Conference. 2016. Melbourne, Victoria, Australia: ARRB Group.
- Leather, J., H. Fabian, and S. Gota, Walkability and pedestrian facilities in Asian cities state and issues. 2011. Mahmud, S.M.S., et al., Pedestrian Safety Problem, Existing Facilities and Required Strategies in the Context of Dhaka Metropolitan City, in International Conference on Road Safety in Developing Countries. 2006, ARC, BUET: BUET, Dhaka. p. 68-77.
- Obaidat, M.T., et al., A knowledge-based system for pedestrian's roadway crossing behavior through video cameras. Jordan Journal of Civil Engineering, 2007. 1(2).
- Pasha, M.M., et al., Pedestrian's Behaviour on Road Crossing Facilities. Jurnal Teknologi (Sciences & Engineering), 2015. 73(4): p. 77-83.
- Police, B., Police Reported First Information Record (FIR), Police Headquarter, Bangladesh Police, Dhaka, Bangladesh. 2020
- Zegeer, C.V. and M. Bushell, Pedestrian crash trends and potential countermeasures from around the world. Accident Analysis & Prevention, 2012. 44(1): p. 3-11.