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ASSESSING PEDESTRIAN SAFETY IN CONSIDERATION OF EXISTING PEDESTRIAN FACILITIES

Farzana Rahman*[1], Md. Fazle Rabby[2] and Kazi Safiqul Islam[3]

[1] Professor, University of Asia Pacific, Bangladesh, e-mail: farzana-ce@uap-bd.edu
[2]Research Assistant, University of Asia Pacific, Bangladesh, e-mail: fazlerabby.ce@gmail.com
[3]Research Assistant, University of Asia Pacific, Bangladesh.

***Corresponding Author**

ABSTRACT

The population is growing at a fast rate in Dhaka city. To fulfill various purpose everyday a great number of trips are made by this continuously growing population. Generally every trip starts and ends up with a walk trip. So, the roads of Dhaka city are daily used by a considerable number of pedestrians along with vehicles. But pedestrians are among the most vulnerable of all the road users. In fact majority of the road accidents involve pedestrians. Hence ensuring safety of pedestrians and to improve the facilities has become a major concern. This paper aims to explore the existing pedestrian facilities and evaluate pedestrians' safety. An indistinct questionnaire survey was conducted at four major pedestrian generation locations in Dhaka city to 210 pedestrians. The questionnaire was divide in three major parts which represents the existing pedestrian facilities and pedestrians' safety. Findings from the survey indicate that existing pedestrian facilities are poor and safety measures for pedestrians are inadequate. According to 78% of the respondents the roads are unsafe for pedestrians. Also, people are unlikely to use pedestrian facilities due to presence of hawkers, inadequate facilities, vehicle parking on road and so on. The study also reveals that for ensuring pedestrian safety improvement of traffic rule is required alongside with the improvement of footpath. The outcomes of this study can be utilized by the city officials to ensure safety of pedestrians through improving the existing pedestrian facilities.

Keywords: *Dhaka city, pedestrian safety, existing facility*

1. INTRODUCTION

Dhaka, the capital of Bangladesh has turned into a megacity due to rapid growth of population and urbanization. Because of being the economical centre of the country and continuous development, it has now become one of the most densely populated cities in the world having a population of 41000 per square kilometer (Demographia, 2019). Moreover, Dhaka is one of the busiest cities in the world. Current road capacity of Dhaka is failing to support the increased number of vehicles. Therefore, the city is heavily suffering from traffic congestion which is spoiling passengers' valuable time. So, in purpose of saving both time and money, people tend to walk to nearby destination. But the existing pedestrian facilities are inadequate and unsatisfactory. Although Dhaka is developing day by day but the facilities for pedestrians are not improving up to that extent. In fact, the facilities for pedestrians are overlooked here. Pedestrian safety is a major concern in Dhaka city due to poor facilities provided to pedestrians. Due to poor safety, pedestrians are at considerable risk compared to all other road users. Usually pedestrians face great risk of road accident. The fatality rate in Bangladesh due to road accident is very high compared to other developed countries. Every year 85 deaths occur against per ten thousand registered motor vehicles in Bangladesh whereas in other developed countries the number of registered motor vehicles is much higher but the death rate is below 5. Among the total road accidents, 50% of the accident involves pedestrians (NRSSAP, 2011). In order to avoid accident risks, adequate safety should be provided to pedestrians through improving pedestrian facilities.

For a long time, transportation planners and engineers haven't paid concern to the non-motorized transportation system. Even in present time, the motorized transportation system is getting enormous importance compared to the systems that serve the needs of non-motorized users likewise pedestrians and bicyclists. Due to increase in motor vehicle growth, most attention is given for traffic regulation of motor vehicles only and the pedestrian regulation is totally neglected. But the accident rate of pedestrians shows that it is necessary to give importance to non-motorized transportation system. An important consideration is required for non-motorized modes of transportation by provision of suitably designed walkways, crosswalks, sidewalks and so on (Kadali and Vedagiri, 2016). Requirements of all users should be considered by planners, designers, and policy makers so that it can be used by pedestrians and those with disabilities to move along or cross a roadway.

In spite of being an important issue pedestrian facility have always been neglected. It is urgently required to asses and improve existing pedestrian facilities in Dhaka to make the city pedestrian friendly and livable.

2. LITERATURE REVIEW

Walking is regarded as one of the ancient non-motorized mode of transport. Prior to the invention of any means of transport people used to travel by walking. According to Leong (2011), a pedestrian is someone who travels by walking and each pedestrian is an integrated part of road space. The likelihood of walking greatly depends upon the quality of the walkway (Jaskiewicz, 2000; Southworth, 2005; Xi and Son, 2012). Therefore, quality of pedestrian facilities directly influences pedestrians.

Safety is a great concern for pedestrians as they are usually vulnerable to accident risks, difficult weathers, thieves and others which discourage pedestrians to travel a considerable distance by walking. Unsafe facility causes conflict between the vehicles on the runway and the pedestrians, between pedestrians on footpath or roadway and between roadside development and parked vehicles (Laxman, Rastogi & Chandra, 2010). Therefore, unsafe facility is resulting in accidents. All over the world traffic accidents that involve cyclist and pedestrians have become a serious safety issue (Mei, Xiaobao & Bin, 2013). A developing country having a large population often faces problem associated with pedestrians as they often become a cause of traffic congestion and traffic accidents. In order to avoid these pedestrian emerged problems several facilities are offered to assist pedestrian to

cross road safely. People tend to use pedestrian facilities more frequently if adequate facilities are provided to them. Proper facilities like crossing, sidewalk etc. ensures pedestrian safety by separating pedestrians from motor vehicles temporally.

Sidewalk is one of the useful facilities offered to pedestrians as it ensures comfortable movement of pedestrians parallel to the vehicle traffic. According to Asadi-Shekari, Moeinaddini, & Zaly Shah (2012), sidewalks should be designed in order to serve all type of users like children, adolescent, adult, elderly people and people with disabilities. Sidewalks need to serve different type of users according to their needs with an appropriate environment which guarantees safety and comfort regardless of users' physical restriction (Khisty, 1994; Rakesh, 2010). Therefore, considering all types of pedestrians, assessment of existing pedestrian facilities should be done.

A guideline for pedestrian facilities (Indian Roads Congress, IRC: 103-1988) specifies the importance of crosswalk for pedestrian at all essential intersections and at places where possibility of conflict exists between vehicles and pedestrians. It shows that footpaths should be at right angles to the runway wherever possible and should be properly marked so that the risk of accidents involving pedestrians can be minimized. Also, sidewalks or crosswalks should not increase walking distance for pedestrians. Adequately visible roadway, obstruction free and adequate waiting space are important prerequisites for determining the position of crosswalks according to IRC.

Pedestrians' road crossing behaviour is correlated to human behaviour factors. If adequate requirements are not met pedestrians may illegally cross road rather than utilizing crossing facilities. Environmental designs and urban forms can easily influence the complicated behaviour of pedestrians of different purpose. A proper design of facility can influence walking without damaging safety and convenience (Gue et al., 2014; Elvik, Sørensen & Nævestad, 2013). The main external factor that leads to unsafe crossing is waiting time and crossing distance. According to Kadali and Vedagiri (2013), lack of time forces pedestrians to cross the road without considering safety. Due to urgency people try to keep moving along the shortcut which is unethical. Further, the deficiency of implementation of traffic rules influences pedestrians and affects the quality of facilities offered to pedestrians in developing countries. Moreover, roadway characteristics such as road width, ramps, continuity, height, curb, median height, median width, median opening width, barricades at sidewalks and marks of zebra crossing at crosswalk locations are not designed considering the necessities of the minority having physical disabilities which is another reason behind not using offered facilities by pedestrians (Kadali and Vedagiri, 2016).

Different studies have been done by different researchers all around the world related to pedestrian. A study be Muraleetharan, Adachi, Hagiwara & Kagaya (2005) defined the factors which affects pedestrian level of service at intersections. The study also proposed an estimation method for measuring pedestrian level of service at intersections. The study concluded that turning vehicle has larger influence on pedestrian level of service than other factors. Also, factor like waiting at signals has been found to be significant factor in determining pedestrian level of service at intersections. In order to find factors influencing pedestrians' road crossing behaviour, several models has been developed by researchers. Yannis, Papadimitriou & Theofilatos (2013) developed a binary logit model and a log normal regression for mid-block street crossings in urban areas. The study examined pedestrian gap acceptance and making of decision process to cross the street. In a divided mid-block crossing Kadali et al. (2014) examined the pedestrian gap acceptance behaviour using an artificial neural network model to understand the process of decision making. The results from the study were pedestrian speed condition, pedestrian rolling gap, vehicular gap size, frequency of attempt and vehicle speed had major role in pedestrian gap acceptance. A study by Pervaz and Newaz (2016) showed that illegally occupied footpath by hawkers, illegal on-street parking, garbage stock on road side, lack of authorized bus stops, violation of crosswalk rule by vehicles are hampering pedestrian facilities greatly. Also, ineffective pedestrian crossing control devices, competition among drivers, absence of footpath barrier are raising safety concern among pedestrians.

According to Nelson & Zaly Shah (2010), pedestrian facilities are greatly neglected in urban transportation planning though it is undoubtedly important for pedestrians. For ensuring pedestrian safety it is required to pay attention to pedestrian facilities to improve and provide adequate facilities.

3. METHODOLOGY

3.1 Data Collection

A distinctive face to face questionnaire survey was conducted at four major parts of Dhaka city for data collection. The survey locations were Farmgate, New-market/ Science laboratory, Mirpur-10 and Gulistan. Locations were selected on the basis of number of pedestrian generations. Due to high pedestrian generation these locations were suitable to identify the existing condition of pedestrian facilities and safety measures. Data collection was conducted by 4 surveyors at two peak period during a day from 8:00 to 10:00 and 16:30 to 18:30 hours from August 11 to August 12, 2016. The questionnaire was prepared based on pedestrians' facility and safety. It consisted of three main parts where first part was about personal information of the respondent; second part was about existing facilities for pedestrians and the final part was about probable improvement areas for improving pedestrian facilities. Among total collected 210 samples, 200 samples have been considered for analysis. Rest of the samples have been ruled out due to incompleteness.

3.2 Data Analysis

Figure 1 shows that majority (42%) of the respondents are student while 22% respondents are office workers. 14% of the respondents are from various profession rather than the defined occupation here. Respectively 9%, 8% and 5% respondents are labours, housewife and garments employee. Respondents from all these professions shown in figure 1 have provided their opinion about the road safety for pedestrians as shown in figure 2. Majority (78%) of the respondents said that the roads are unsafe for pedestrians where 19% of the respondents found the roads sometimes safe and sometimes unsafe. Only 3% of the respondents said that the roads are safe for pedestrians.

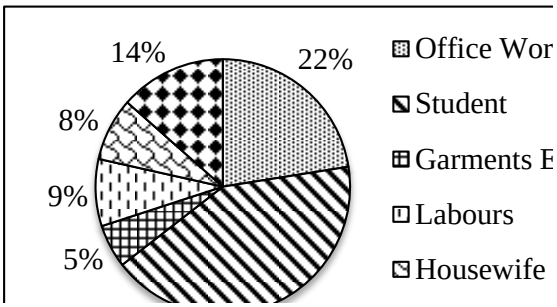

Figure 1: Occupation

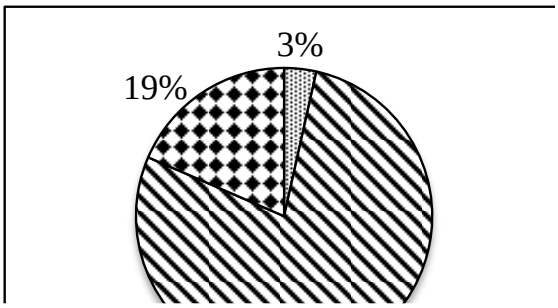

Figure 2: Road safety for pedestrians

Respondents who claimed that the roads are unsafe for pedestrians have mentioned same reasons due to which the roads seemed unsafe to them. Majority (39%) of the respondents have said that lack of pedestrian safety makes the road unsafe for pedestrians. Also, 32% and 22% of the respondents have accused "no application of traffic rules" and "uncontrolled traffic system" as the main reason behind the roads being not safe for pedestrians as shown in figure 3. Among the respondents only one-fourth (25%) uses footpath where 28% of the respondents uses footpath irregularly. Almost half (47%) of the respondents don't use footpath as shown in figure 4.

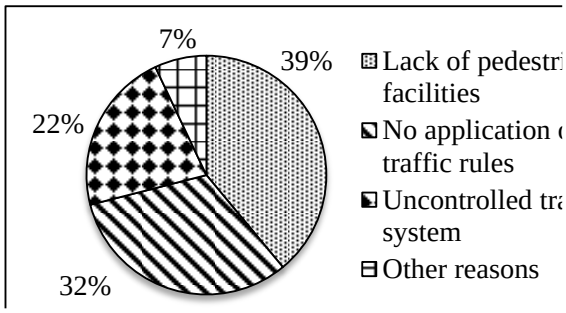

Figure 3: Reasons of roads being unsafe

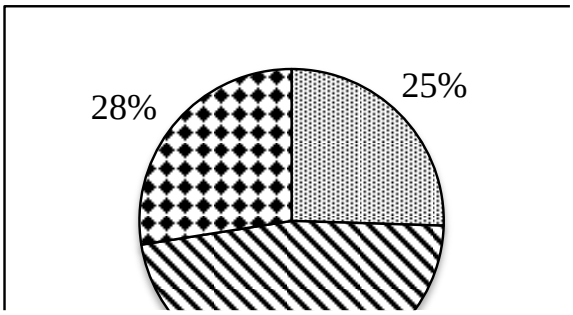

Figure 4: Users' response on using footpath

Majority (38%) of the respondents have said that they don't use footpath because of hawkers which makes walking in the footpath difficult. Also, 15% of the respondents don't use footpath due to its discontinuity where another 15% of the respondents are reluctant to use footpath due to insufficient space for walking as shown in figure 5. Figure 6 shows that more than half (67%) of the respondents don't use zebra crossing. Only 12% of the respondents abide by the law as they use zebra crossing for crossing the road.

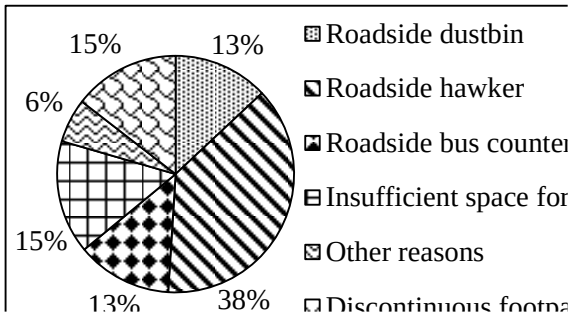

Figure 5: Reasons of not using footpath

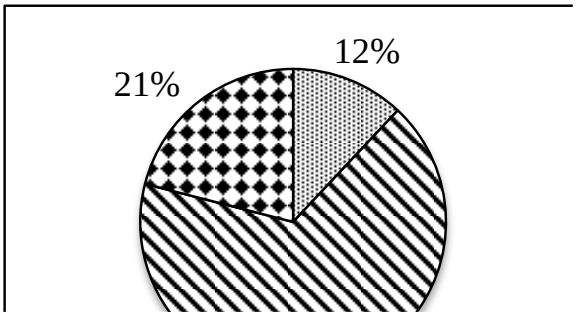

Figure 6: Users' response on using zebra crossing

Majority (35%) of the respondents claimed that it is difficult to understand the position of zebra crossing due to its faded colour while 22% of the respondents said that vehicles do not abide by the rules of zebra crossing which influences them to not use zebra crossing as shown in figure 7. Among different facilities provided for pedestrians, foot over bridge is the mostly used one. 37% of the respondents use foot over bridge to cross roads but majority (44%) of the respondents don't use foot over bridge. Yet, 19% of the respondents use foot over bridge sometimes as shown in figure 8.

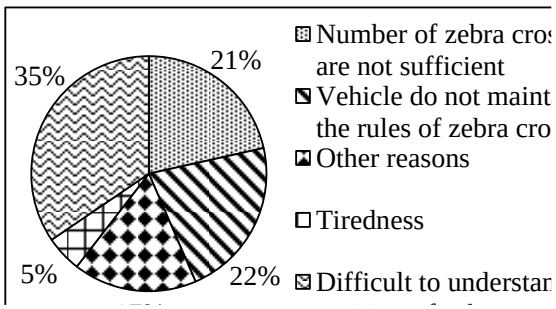

Figure 7: Reasons of not using zebra crossing

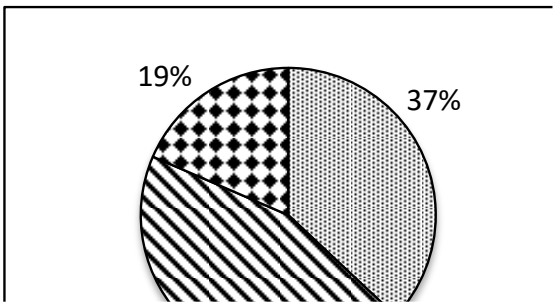

Figure 8: Users' response on using foot over bridge

More than half (51%) of the respondents avoid foot over bridge as climbing the stairs of foot over bridge makes them tired. Also, 8% of the respondents have claimed that due to lack of time they avoid foot over bridge as shown in figure 9. Roadside parking is another fact that is hampering pedestrian facilities. Majority (97%) of the respondents agreed that road side parking hampers pedestrian facilities while 2% of the respondents said that road side parking don't create problem for pedestrians.

Only 1% of the respondents said that sometimes road side parking hampers pedestrian facilities as shown in figure 10.

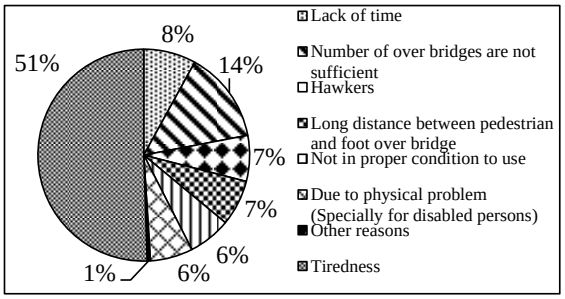

Figure 9: Reasons of not using foot over bridge

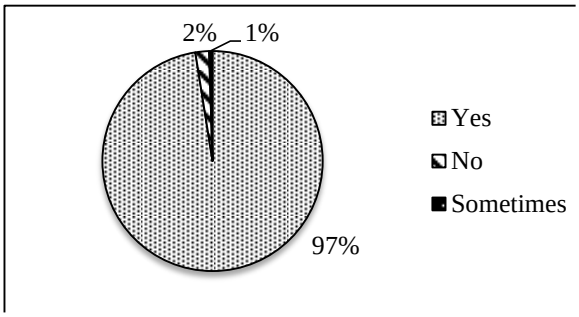

Figure 10: Road side parking hampering pedestrian facilities

But the thing that mostly annoys people and disturbs normal movement of pedestrians is motor bike riding on footpath. Figure 11 show that almost all of the respondents (99%) agreed that riding of motor bike on footpath disturbs pedestrians' normal movement. Only 1% said that motor bike rides on footpath and disturbs normal movement of pedestrians sometimes but none was found to deny this fact. 78% of the respondents said that unplanned water drainage system is causing pedestrians' movement problem as shown in figure 12. 22% of the respondents said it causes problem to pedestrians' sometimes. Also, none was found to decline this reason as a problem creator for pedestrians.

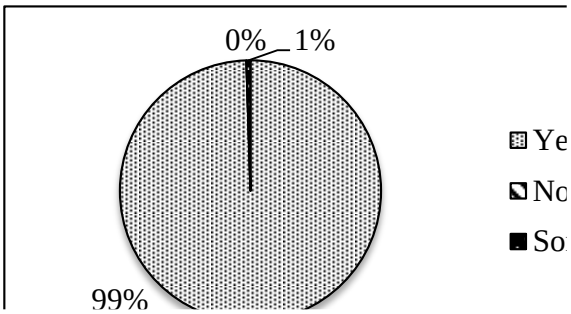

Figure 11: Motor bike riding on footpath disturbing pedestrians' normal movement

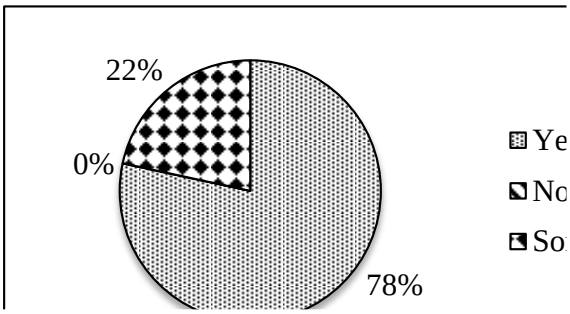

Figure 12: Unplanned water drainage system causing problem for pedestrians

Cutting and filling process on road is a common scenario in Dhaka. This process of cutting and filling greatly hampers pedestrian facilities. Majority (74%) of the respondents agreed that cutting and filling process on road disturbs pedestrian facilities where 25% respondents said that it hampers pedestrian facilities sometimes as shown in figure 13. Only 1% respondents said that it doesn't create trouble for pedestrians. Speed hump, a traffic calming device used to slow down the speed of motorized vehicle is available in the roads of Dhaka city. In reply asking of how much effective it is in case of providing safety to the pedestrians, majority (67%) of the respondents said that it is effective. In the meantime, 9% of the respondents said it doesn't ensure safety to pedestrians therefore it is ineffective. Also, 24% of the respondents said it works well sometimes as shown in figure 14.

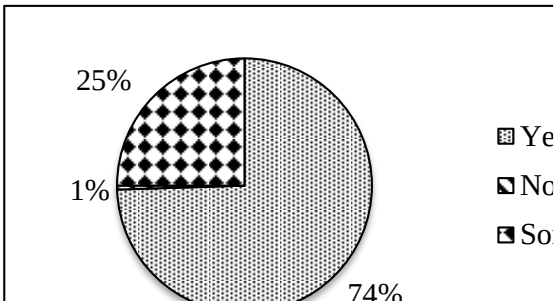

Figure 13: Cutting and filling process on road hampering pedestrian facilities

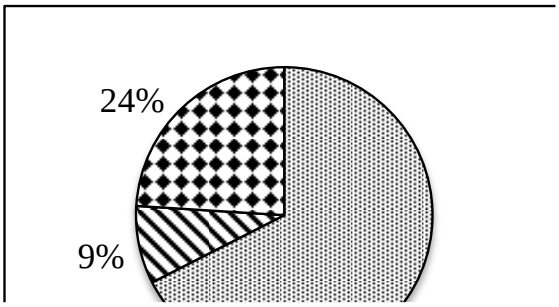

Figure 14: Effectiveness of speed hump on road for pedestrians' safety

Based on respondent's perception the level of existing pedestrian facilities has been shown in figure 15. Majority of the respondents (65%) rated existing pedestrian facilities as "Poor" while 16% of the respondents rated it as "Very Poor". 14% of the respondents rated the facilities as "Satisfactory" and only 5% respondents said the facilities are "Good". None rated the level of pedestrian facilities as "Very Good". Figure 16 shows the willingness of the respondents to use pedestrian facilities if the facilities are improved. Majority (98%) of the respondents agreed that they will use the facilities but 2% of the respondents said that they won't use the facilities yet the facilities are improved.

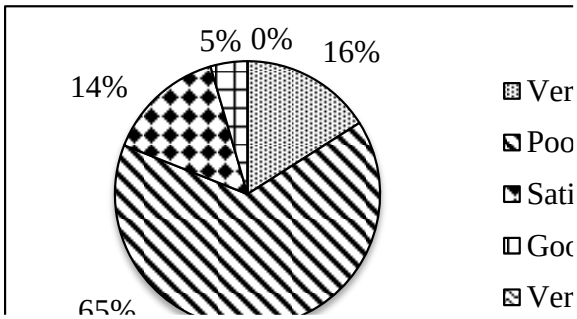

Figure 15: Level of existing pedestrian facilities

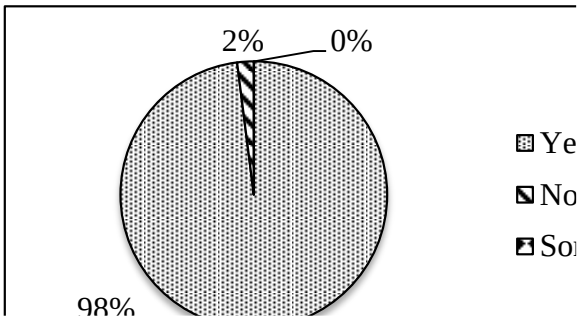

Figure 16: Willingness to use pedestrian facilities if improved

To ensure pedestrians' safety respondents were asked to provide their opinion at where they want improvements. Figure 17 shows that majority (31%) of the respondents want improvement of traffic rules where 25% of the respondents' first demand is proper footpath. Also, 19% respondents said that properly controlling traffic will improve pedestrian facilities and ensure pedestrian safety.

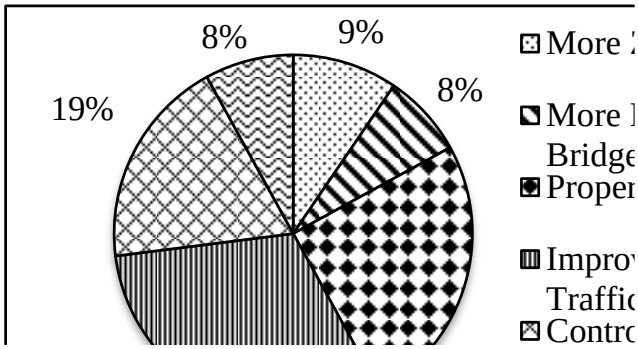

Figure 17: Required improvements or facilities to ensure pedestrian safety

4. RESULTS

This study evaluates pedestrians' safety considering available pedestrian facilities in Dhaka city. By occupation, majority (42%) of the respondents are student and office worker (22%). It indicates more

than half of the total pedestrian number consists of students and office workers together. Considering road safety 78% of the respondents have said that the roads in Dhaka are unsafe where only 3% respondents found the roads to be safe. 39% of the respondents said that lack of pedestrian facilities is making the roads unsafe for pedestrians. Mainly inadequate and inefficient foot over bridge, zebra crossing and footpath is resulting in poor pedestrian facilities. Respondents' are unlikely to use the existing poor pedestrian facilities as 67% of the respondents don't use zebra crossing; 44% respondents don't use foot over bridge and 47% respondents don't use footpath. Major reasons behind not using footpaths are presence of hawkers on footpath; insufficient space and discontinuous footpath which influence people to avoid using footpaths. Non-appearance of zebra crossing due to faded colour, not maintaining the rules of zebra crossing by vehicles and inadequate numbers of zebra crossing are the major problems associated with the use of zebra crossing which are driving people to avoid using it regularly. People tend to avoid using foot over bridge due tiredness of climbing foot over bridge, outnumbered foot over bridges compared to demand and lack of time. Also, pedestrian facilities are greatly hampered by some unexpected and illegal incidents such as road side parking, motor bike riding on footpath and so on. 97% respondents agreed that illegal road side parking hampers pedestrian facilities. Also, almost all (99%) of the respondents agreed that motor bike riding on footpath greatly disturbs pedestrians' normal movement. Not only these illegal and unexpected incidents are hampering pedestrian facilities but also some activities done by the city officials are disturbing normal movement of pedestrians. Cutting and filling process on road is a common scenario in Dhaka city which is greatly disturbing the pedestrian facilities as 74% of the respondents have said that it is creating trouble for pedestrians. Also, 78% of the respondents have said that unplanned water drainage system is causing problem for pedestrians. Considering pedestrians safety, many speed humps have been installed throughout the roads in Dhaka city. 67% of the respondents agreed that speed humps are effective in ensuring pedestrian safety where 9% of the respondents have said that speed humps are ineffective in this case. Considering all the existing facilities for pedestrians, majority (65%) of the respondents have rated the level of existing pedestrian facilities as "Poor" while 16% of the respondents have rated it as "Very Poor". Due to poor facilities provided to pedestrians, people are unwilling to use the existing facilities. But 98% of the respondents have agreed that they are willing to use these facilities if they are improved. For ensuring pedestrian safety majority (31%) of the respondents have said that they want the traffic rules to be improved first. Also, 25% of the respondents demanded proper footpath while 19% of the respondents demanded controlled traffic system to ensure pedestrian safety.

5. CONCLUSIONS

Poor pedestrian facilities are the main reasons behind not using the facilities by pedestrians. Therefore, it is important to improve the existing facilities to ensure pedestrians safety. Proper footpath should be designed and constructed to improve pedestrian facilities. Also, it should be assured that the footpaths are hawker free so people get enough space to use it comfortably. At the same time traffic rules should be improved and strictly enforced which will certainly improve the traffic condition on road and will facilitate the movement of pedestrians. Road side parking and motor bike riding on footpath should be strictly handled as it hampers pedestrian facilities. City officials should pay attention to improve pedestrian facilities by properly planning an effective and long-lasting drainage system. Not only in drainage system but also at every possible aspect the city officials should come up with proper planning to reduce harassing the pedestrians as continuous unplanned cutting and filling process on road disturbs pedestrian facilities. Also, awareness should be raised among pedestrians to use pedestrian facilities and abide by the traffic law.

Findings from this study may help the city officials on understanding the existing pedestrian facilities and decide the improvement sectors. Improving pedestrian facilities will not only ensure pedestrian safety but also will encourage people to use pedestrian facilities regularly. For further study, including more variables, increasing the number of samples and adding more survey locations may help to achieve better and precise result which will help the city officials in taking future decisions.

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