Proceedings of the 5th International Conference on Civil Engineering for Sustainable Development (ICCESD 2020), 7~9 February 2020, KUET, Khulna, Bangladesh (ISBN-978-984-34-8764-3)

URBAN ROAD SAFETY SITUATION IN BANGLADESH: A SYNOPSIS

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ABSTRACT

Rapid urbanization and migration of rural population to urban areas have challenged the existing urban transportation system of Bangladesh. This ever-growing demand posed a tremendous pressure on the cities road network to cater the need which eventually allowed heterogeneous unfit vehicles, over-loaded and over-crowded buses, minibuses and human haulers. Thus, the urban transport system has become imbalanced and unsustainable with increasing road safety hazards. This study presents a synopsis of the nature and extent of the urban road safety scenario in Bangladesh. Microcomputer Accident Analysis Package five (MAAP5) software of Accident Research Institute (ARI) at Bangladesh University of Engineering and Technology (BUET) was used to analyze the police reported crash data. The analyses revealed that urban road fatalities increased from 20% of total road fatalities to 37% of the total road fatalities during 2005-2015. The major collision type for fatalities was hit pedestrian (57%). The analyses also demonstrated that the fatalities were comparatively higher (63%) during daytime (6 am to 6 pm) than night. Mid-blocks of the road network contributed to the major percentage (65%) of the urban fatalities. The study also compares the safety situation of the major metropolitan areas of Bangladesh. The comparative analyses elicited that almost half of the urban road fatalities occurred in the Dhaka metropolitan area. Dhaka, the capital, contributed up to 55% of urban hit pedestrian fatalities, 48% of urban fatalities due to right angle and 45% of urban fatalities due to rear end collisions. The findings from this study will help authorities to assess the urban road safety scenario, and thus assist decision-making processes for improving the safety situation of Bangladesh.

Keywords: *Road safety, Urban, Metropolitan city, MAAP5.*

1. BACKGROUND

Every year more than 1.35 million lives are lost, and 20 to 50 million people suffer non-fatal injuries which incurre disabilities due to road traffic crashes. 90% of these fatalities occur on the roads of low and middle-income countries which have 60% of the world's registered vehicles (World Health Organisation [WHO], 2015). Road traffic crashes have emerged as a serious socio-economic issue and are affecting the communities enormously in the developing countries like Bangladesh. Although the official statistics (police reported crash data) reveal 2,500 crashes and 3,000 deaths eache year in Bangladesh, the actual scenario is quite contrasting (ARI, 2015); the actual numbers could well be at least four times higher than the reported figures (Hoque, Hossain, Rahman & Islam**,** 2014). WHO (2015) estimates the annual road traffic fatalities in Bangladesh could be around 20,000.

The road crash problem is disproportionately greater in urban areas compared to rural areas (Lundebye, 1995). Rapid urbanization, migration of rural people and economic development have played a pivotal role behind such disproportionity, particularly in developing countries (WHO, 2013). In Bangladesh, around 36% of total population is urban dwellers (Worldometers, 2018). However, there was only 9% property living in urban areas of Bangladesh in 1994 (Hayes et al., 2015). Employment opportunities in the urban areas is the primary reason for people migrating from rural areas in the country. This migration have immensely enhanced transportation demand that outstripped roadway capacity. To meet up this demand, a wide range of vehicles sharing the same road networks are providing urban public transportation facilities. But, the preference for a particular mode is often influenced by cost of the service rather than its quality. Therefore, low-income commuters often prefer unfit and overcrowded bus, minibus and human haulers due to cheaper fare (Gallagher, 2016). These unfit and substandard vehicles often create both on-road and off-road troubles, such as, congestions, higher emissions, adverse health effects and higher traffic crashes. Thus, road safety and sustainability has become a major concern for the urban dwellers.

2. LITERATURE REVIEW

2.1 Global Context of Urban Road Safety

The life in urban areas is facing tremendous threat due to continuous increase of urban population. In 2014 the urban populations were accounted up to 54% of the total global population (Economic and Social Commission for Asia and the Pacific [ESCAP], 2014). In Asia, ESCAP (2014) estimated 1.6 billion people (40 % of total population) lives in urban areas in 2011 which is predicted to be 2.7 billion in 2030. This continuous growth of urban residents has resulted in rapid increases of transport activities and private vehicle ownership. Study of Europian Transport Society Council [ETSC] (2017) revealed that cities and towns are home to 72% of the population of the European Union (EU). Their statistics also show that 9500 people were killed on urban roads in the EU in 2017, accounting for 38% of all road deaths. Additionally, 70% of those killed on urban roads are vulnerable road users: 39% are pedestrians, 12% cyclists and 19% powered-two-wheeler riders. Besides, car occupants account for 25% of all roads deaths on urban roads in EU. The study also highlighted that on average 26 people are killed on urban roads per million urban inhabitants in EU, 5 people in Norway, 9 in Sweden, 11 in the UK, 13 in the Netherlands and 14 in Ireland and Spain. The same study demonstrated that countries with a good overall road safety record tend to have lower mortality on urban roads too. In the USA, over the past decade, road fatalities have increased in urban areas and decreased in rural areas. Study of Safe Road USA (2017) underscored that there has been a general downward trend in the proportion of road deaths in rural areas, with the proportion declining from 61% in 2000 to 47% in 2017 while in urban areas the deaths proportions have increased from 36% in 2000 to 53% in 2017. According to the study pedestrian fatalities have surged by 46% in urban areas since 2008. In Australia, Bureau of Infrastructure, Transport and Regional Economics [BITRE] (2017) showed that urban areas accounted for 86% of the population and 49% of all fatal crashes. They also published that the proportion of urban fatal crashes was 48% in 2010 which increase to 49% in 2015.

2.2 Context of Urban Road Safety of Bangladesh

As urban population is increasing in Bangladesh, the pressure on transport networks and facilities is also increasing simultaneously. However, the existing networks and facilities are often failed to meet up this pressure. While the standard road space for an urban city is 25% of its area, there is only 9% of area is occupied by road space in Dhaka city (Mahmud & Hoque, 2008). This limited road space cannot provide enough space for increasing traffic. Therefore, occupied walkways, congestions, outdated public transportations and substandard in-vehicle conditions are the daily life occurrence of city dwellers. Several studies quantified the safety and adverse health effects of these occurrences. Hoque, Mahmud & Qazi (2008) demonstrated that around, 25% of the total fatalities occurred in urban areas of Bangladesh during 1998-2006. The study also showed that urban crashes are concentrated in metropolitan areas. Of the total urban accidents of Bangladesh, 82% are metropolitan related accidents which contributed to nearly 75% of urban fatalities during 1998-2006. More alarmingly, pedestrians were the worst sufferers of these road fatalities in the metropolitan areas with an average of 65%. Further analysis revealed that most of the pedestrians' fatalities occurred while crossing the road (41%) and was closely followed by walking on the road (39%) from 1998 to 2006. Another study suggested that large proportions of road crashes in cities are concentrated on the main street network (Hoque, Rabbi, Mahmud**,** Siddiqui & Anowar, 2007). They suggested to install exposure control, injury control and behavior control measures to address these concentrated crashes. Apart from road fatalities, emission of hazardous pollutants into the air and additional noise is common from unfit vehicles in urban areas. It was estimated that around 1000 tons of pollutants are pumped into the environment every day in Dhaka, of which 70% comes from vehicles (Mahmud, Rahman & Rabbi, 2007). Adequate studies and research are needed in this arena for further understanding the facts and taking necessary measures.

3. RESEARCH GAPS AND OBJECTIVES OF THE STUDY

Urban crash characteristics might have changed in recent years in Bangladesh. The safety situations considering recent data are yet to be analyzed. Pedestrian locations during crashes have been scarcely considered in available studies. Considering the recent transportation growth in Dhaka city, its contributions to urban safety need to be assessed. To develop effective road safety strategies, introduce modern and smart technologies, and prioritize these strategies, up-to-date urban road safety research is of utmost importance. Therefore, this study intends to provide a synopsis of the prevailing urban road safety scenario considering the latest data in Bangladesh. The findings of the study will help to provide an insight into the recent safety situation and guide the stakeholders to take appropriate urban road safety improvement strategies for the country.

4. DATA COLLECTION AND METHODOLOGY

In Bangladesh, police is the primary source of road crash data. They collect information of each crash after site investigation and fill up the First Information Report (FIR). Later, the information from FIR is transferred into Accident Report Form (ARF) which is the prescribed form of road crash data. The data is sent to Accident Research Institute (ARI) of Bangladesh University of Engineering and Technology (BUET). After necessary corrections and editing with Road User Movement (RUM) code the data is stored in Microcomputer Accident Analysis Package 5 *(MAAP5)* software. This study collected latest available data from *MAAP5* of ARI, BUET from 2005 to 2015. The software was also used to analyze the collected data.

5. ANALYSIS AND DATA INTERPRETATION

Detailed analysis of road crash and fatality data was done in terms of frequency and pattern by time, day of the week, month, junction type, collision type, age, pedestrian action, road sections, metropolitan area and contributing factor to fatalities. The results of the analysis are discussed in the following sections.

5.1 Trend of Urban Crashes and Fatalities in Bangladesh

Analysis of road fatality data showed that the proportion of urban road fatalities gradually decreased from 1998 to 2005 (Figure 1). But, afterward, it increased steeply. From the year 2007 to till now the ratio has not decreased below 30%. The probable cause of this high percentage of fatalities in urban areas in recent times may be due to rapid urbanization, outdated transport facilities, lack of road safety knowledge of the road users and uncontrolled flow of people from rural areas to urban areas.

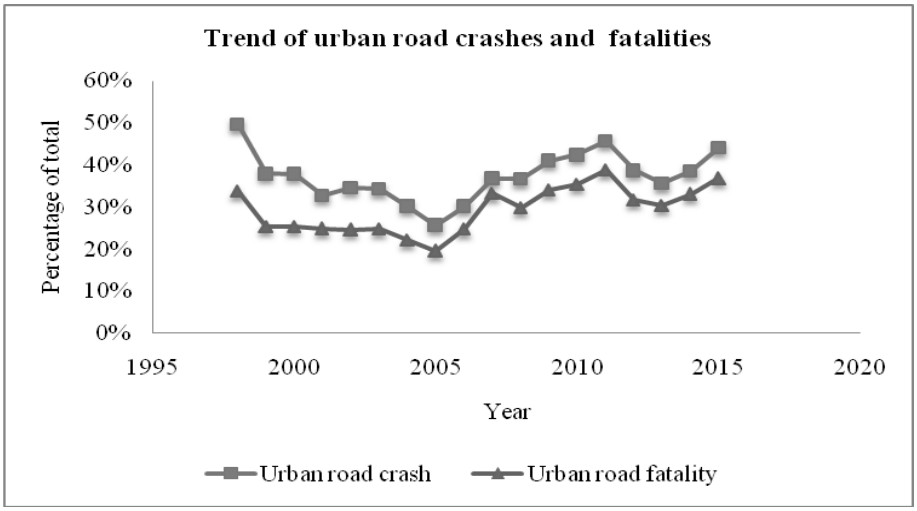

Figure 1: Trend of urban road crashes and fatalities in Bangladesh

5.2 Urban Fatalities by Time of the Day

The time distribution of the road fatalities in the urban areas of Bangladesh shows that the highest percentage of fatalities occurred during the interval of 10 am to 12 pm (12%), Figure 2. Though the percentage of fatalities was comparatively high during the day (60%), a significant percentage of fatalities at night (40%) time implies that human error plays a significant role in traffic crashes in urban areas. It is evident from several studied that drivers' ability to avoid collisions is hindered under low lighting (Owens & Sivak, 1993; Elvik, 1995; Rice, Peek-Asa & Kraus, 2003). Other studies highlighted that pedestrians are three to seven times more vulnerable in the dark than in the daylight (Owens & Sivak, 1993; Elvik, 1995; Rice, Peek-Asa & Kraus, 2003). Moreover, it was seen that the installation of overhead lighting reduces the number of night-time crashes (Elvik, 1995).

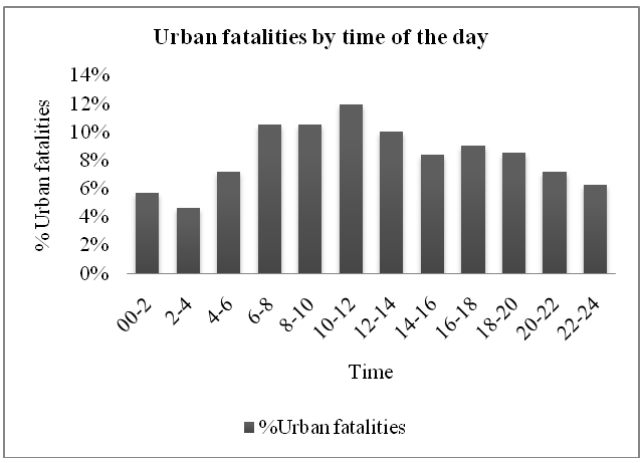

Figure 2: Urban fatalities by time of the day

5.3 Urban Fatalities by Days of the Week

Figure 3 shows the distribution of urban fatalities by day of the week. The data revealed that the fatality constituted a lower percentage during government holidays in Bangladesh i.e. Friday (14%) and Saturday (13%). During the other days of the week, the percentage was higher except for Monday. This might be the result of unholy competitions among drivers and higher traffic flow at working days in urban areas. Most of the fatalities occurred on Sunday (15%) as seen from Figure 3.

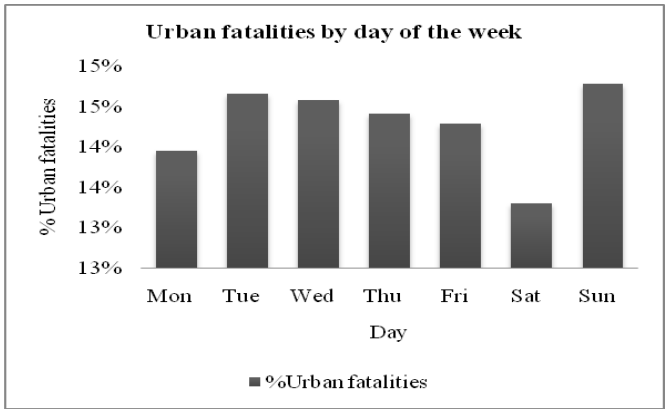

Figure 3: Urban fatalities by day of the week

5.4 Monthly Variation of the Urban Fatalities

The month-wise distribution of fatalities in the urban areas of Bangladesh showed that urban fatalities were higher during the month of January (10%) and April (10%). Besides, February, March, May and June also showed higher percentages (9% in each month). The month from October to December showed lower percentages (7% in each month) (Figure 4). These higher fatalities, particularly between January to May may have been due to the increased travel for major government vacations, picnics and other recreational activities.

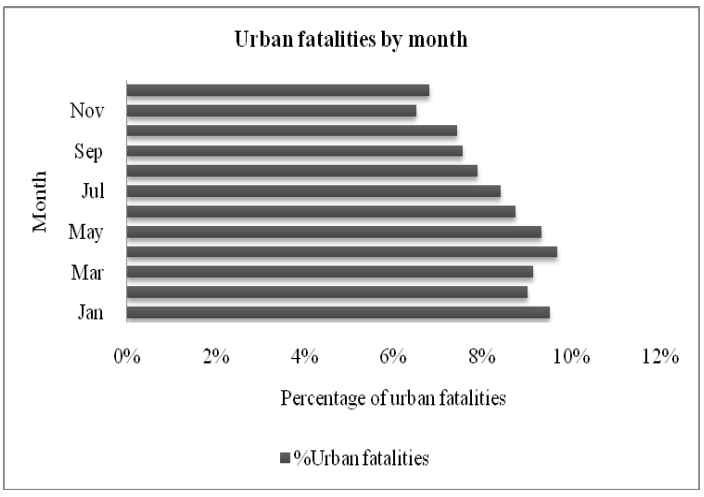

Figure 4: Urban fatalities by month of the year

5.5 Urban Fatalities by Junction Type

The distribution of fatalities according to junction type in urban areas showed that the major fatalities occurred in the not-junction areas (61%), shown in Table 1. It is a matter of great concern in the context of Bangladesh. Because it is claimed that most of the crashes in Bangladesh occur due to over speed and careless driving. Besides, tee junctions (11%) and cross junctions (9%) also shared a significant percentage of fatalities. Fewer fatalities were involved in the crashes at the staggered junctions (2%) and roundabouts (2%), shown in Table 1.

Table 1: Urban fatalities by junction type

Junction type	Urban fatalities
Not junction	61.2%
Cross	9.3%
Tee	10.6%
Staggered	1.7%
Roundabout	1.6%
Railway crossing	0.4%
Other	15.2%

5.6 Urban Fatalities by Collision Type

Data analysis depicted that, the major collision type for fatalities was hit pedestrian (55%) (as shown in Figure 5). This implies that they are the most vulnerable road users of the area. This high percentage also represent poor facility for pedestrians in the urban roads of Bangladesh. Moreover, pedestrians also do not know the proper rules while using the roads. Besides, head on (15%) and rear end (14%) types of collision also shared a significant percentage of fatalities in the urban roads. These head on collisions occur mostly at local urban roads and few in primary roads due to wrong side driving. The other collision types responsible for fatalities were side swipe (4%), vehicle overturn (4%), hit parked vehicle (2%), right angle (1%), hit object off road (1%), hit object on road (1%), and others (3%) (Figure 5).

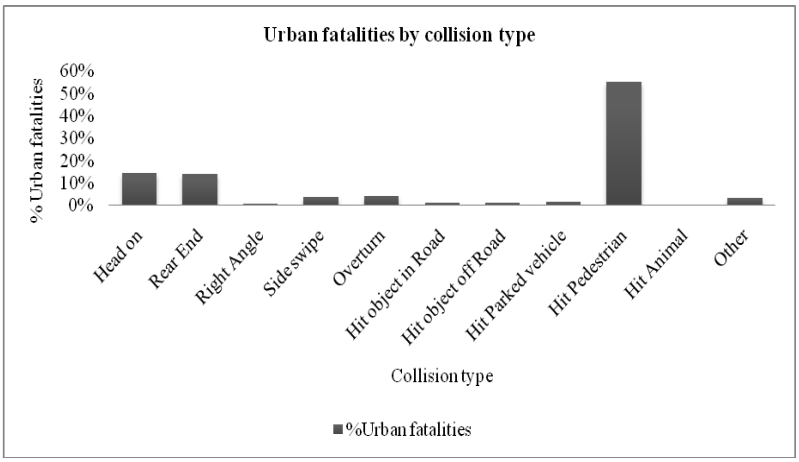

Figure 5: Urban fatalities by collision type

5.7 Urban Fatalities by Sex and Age Group

The percentage of fatalities in urban areas based on age group is shown in Figure 6. It is observed that the young and working group (age 21-40) of the society was mostly killed due to crashes in the urban area (49%). This is a critical issue as it affects the national GDP more severely. The most vulnerable age group was 26-30 years (15%). Again, from the analysis it was seen that 83% of victims of urban fatalities were male.

5.8 Urban Pedestrian Fatalities by Pedestrian Actions

Table 2 shows the comparison of pedestrian fatalities based on the pedestrian actions in the urban and rural areas of Bangladesh. It is observed that most of the fatalities of pedestrian occurred while crossing the road (53%) in urban areas, whereas in rural areas the percentage was 25%. The major causes behind this high percentage of fatalities of pedestrians in urban areas may be due to the absence of proper road crossing facilities and poor knowledge of pedestrians on road safety issues. Moreover, the density of traffic as well as traffic congestion is higher in urban areas is higher than in rural areas.

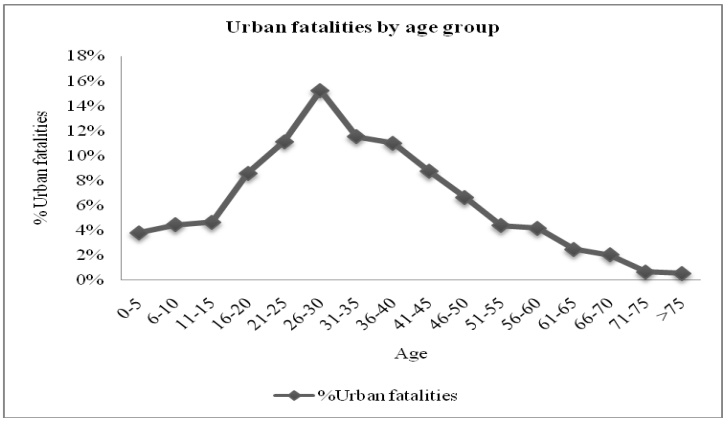

Figure 6: Urban fatalities by age group

Walking through the edge of the road contributed up to 28% and 48% of urban and rural fatalities of pedestrians respectively. In this case, the percentage of rural fatalities was higher than urban fatalities. Because in rural roads are narrower and has a very limited facility for walking for the pedestrians. In many segments of the road, it is also absent due to the presence of small plants, bushes and stagnant water due to poor drainage facility. Moreover, the presence of permanent wall, shops etc. Just on the edge of the road also compels pedestrians of rural areas to walk on the edge of the road. Walking on the road contributed to 6% and 9% of urban and rural fatalities of pedestrians respectively. Besides, working/playing on the road contributed to 1% and 2% of urban and rural fatalities of pedestrians respectively.

Table 2: Urban urban and rural fatalities by pedestrian actions

Pedestrian actions	Urban fatalities	Rural fatalities
None	12%	16%
Crossing	53%	25%
Walking on the road	6%	9%
Walking through edge of the road	28%	48%
Working/playing on the road	1%	2%

5.9 Urban Pedestrian Fatalities by Road Sections

It is observed that most of the fatalities of pedestrians occurred at the center of the road (48%) in urban areas, whereas in rural areas the percentage was 20%, as shown in Table 3. This result demonstrates that significant percentage of pedestrians cross the roads at any section other than using designated pedestrian crossing The percentage of fatalities of pedestrians in the walkways was the same (2%) in both urban and rural roads. It emphasizes that pedestrians are still unsafe while using walkways.

Table 3: Urban and rural fatalities by road sections

Road sections	Urban fatalities	Rural fatalities
Pedestrian crossings	16%	26%
Within 50m of pedestrian crossings	2%	3%
Divider	0%	0%
Centre of the road	48%	20%
Walkway	2%	2%
Roadside	30%	48%
Bus stop	1%	1%

Higher pedestrian fatalities at side of road (31% in urban and 48% in rural roads) underscore that the lacks of adequate sidewalk or occupied sidewalks force pedestrians to walk along side of the road. Besides, the pedestrian fatalities in pedestrian crossing (16% in urban and 26% in rural roads) imply that pedestrians are not getting priority in the roads. The data also showed few pedestrians died within 50m of pedestrian crossing (2% in urban and 3% in rural roads).

5.10 Urban Fatalities by Metro Cities

The DMP shared nearly half (48%) of total fatalities that occurred in the urban areas of Bangladesh (Table 4). The fact shows the vulnerable situation of road safety in the Dhaka metropolitan area. Besides, each of Chittagong Metropolitan (CMP) and Rajshahi Metropolitan (RMP) shared 10% fatalities of urban areas. Moreover, Sylhet Metropolitan (SMP), Khulna Metropolitan (KMP) and Barishal Metropolitan (BMP) shared 5%, 3% and 1% of total urban fatalities respectively.

Table 4: Urban fatalities by major metro cities

Metro cities	% Of urban crashes	% Of urban fatalities
DMP	52%	48%
CMP	10%	10%
RMP	3%	10%
SMP	3%	5%
KMP	3%	3%
BMP	1%	1%

5.11 DMP Fatalities by Urban Fatalities by Collision Types

Fatality data of DMP shows that the percentage of hit pedestrian fatalities was about 63% of urban hit pedestrian fatalities. The rest of 37% fatality due to hit pedestrian crashes was shared by all other major metro cities except DMP. This shows the vulnerable conditions of pedestrians in DMP. Moreover, fatalities due to the right angle, hit parked vehicles and rear end crashes shared 56%, 54% and 50% respectively (Table 5).

Table 5: DMP fatalities by collision type

Collision type	%DMP crashes by urban	%DMP fatalities by urban
Head on	22%	17%
Rear end	50%	40%
Right angle	56%	18%
Side swipe	47%	43%
Overturn	36%	31%
Hit object in Road	38%	12%
Hit object off Road	49%	60%
Hit Parked vehicle	54%	43%
Hit pedestrian	63%	64%
Other	32%	23%
Total	52%	48%

5.12 Principle Contributing Factor to Urban Fatalities

Analysis of police reported crash data indicated that 90% of total urban crashes occurred due to overspeeding and careless driving of the driver (Table 6).

Table 6: Urban fatalities by contributing factor

Contributing factors	Fatalities
Over speeding and careless driving	90%
Pedestrian actions	5%
Adverse road conditions or environment	2%

Contributing factors	Fatalities
Vehicle defects	1%
Overtaking, overturning and others	2%

Only 5% and 2 % of crashes occurred due to pedestrian actions and adverse road conditions respectively.

6. DISCUSSION ON KEY FINDINGS

This study reveals that the urban fatalities have shared 32% of total fatalities in Bangladesh during 2005-2015 whereas it was only 25% of the total fatalities during 1998-2006 (Hoque, Mahmud & Qazi, 2008). It emphasizes that road safety problems in urban areas should be taken as an emerging issue and thus need to be addressed urgently. The reduction of urban hit pedestrian fatalities from 59% to 55% during this period indicates few interventions have been taken to address the pedestrian safety in these areas. More inventions could further reduce this type of fatality. Our study also demonstrates that during 1998-2006, the pedestrian fatalities while crossing the road were 41% which has been increased to 53% during 2005-2015. Again, it is found that only 16% of pedestrian fatalities occur at designated crossings while 48% of pedestrian fatalities occur at the center of the road other than designated crossings. It warrants adequate crossing facilities in the urban areas. Additionally, random and erratic pedestrian movements could be also a reason behind this high percentage. In this case, awareness and road safety knowledge among pedestrians should be disseminated effectively. Again, recent increasing of the fatalities due to head on collisions from 11% to 15% draws new attention to the road safety practitioners. Prohibition of wrong side driving and strict law enforcement is essential in these circumstances. Furthermore, the meeting points of feeder roads and primary roads in urban areas should be focused more to reduce this type of fatality. Channelization, traffic islands and necessary traffic control devices along with adequate street lighting could be taken as standard treatments for these points. This study also shows that the share of DMP crashes in total urban crashes has been decreased from 60% to 52% while there have not been found any significant changes in other major metropolitan cities. However, the share of the fatalities of other metropolitan cities has been increased significantly. The road environmental and engineering improvements by incorporating new approaches and methods are needed to be addressed to solve this emerging problem in these areas.

7. CONCLUSIONS

The major aspects considered in this paper are the traffic safety issues of Bangladesh's urban areas. The upward trend of urban road fatalities elicited from the study has emerged as a priority issue. Furthermore, higher pedestrian fatalities highlighted in this study demonstrate the urgency of safe pedestrian facilities in urban areas. The study found higher fatality rates at mid-blocks of the road network which substantiated the prevalent higher speed and careless user behavior in the causation of urban fatalities. These factors should be addressed while designing and setting safety measures. The study also compared the safety situation of the major metropolitan cities of Bangladesh. The comparative analysis revealed that the road fatalities in Dhaka metropolitan area should be taken as an emergency problem. The integrated and comprehensive approach of stakeholders is essential to solve this problem. Furthermore, policy for effective public transportation management, safe vehicles, safe pedestrian management and adequate research should be adopted for safe and sustainable urban transport for Bangladesh.

ACKNOWLEDGMENTS

The work presented in this paper is a part of a research work carried out at the Accident Research Institute (ARI), BUET. The opinion and views expressed in this paper are those of the authors.

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