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## Assessment of Road Safety for Pedestrians in Rajshahi City, Bangladesh

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### Abstract

Every day, a significant number of pedestrian deaths occur in road accidents in Bangladesh, and the country must address this tragedy. According to a survey by the World Health Organization (WHO), collisions between automobiles and pedestrians account for approximately half of all road deaths, with an average daily fatality rate of 18 people in Bangladesh. It is of the utmost importance to try to save lives since human lives are priceless assets. This study examines the existing road conditions, safety measures, road accidents related to pedestrians, and safety measures in the city of Rajshahi in Bangladesh. Using the methodology of the International Road Assessment Programme (iRAP), the roads from Katakhal Bazaar to Talaimari Chattar, Talaimari Chattar to Zero Point, Zero Point to Rail Gate, and Talaimari Chattar to Rail Gate have been analyzed and established a star rating for pedestrian safety and a road protection safety score. The star rating and safety score reflect the overall safety of pedestrians. Our findings indicate that the current state of the roadways is not up to the mark. To reduce the vulnerability of pedestrians on roads, it is crucial to implement practical and stringent safety measures.

**Keywords:** *Pedestrian safety; Transportation Engineering; Star rating; Safety score; iRAP*

### 1. Introduction

Road safety is a critical issue in Bangladesh, over the past several years, Bangladesh has seen an alarming increase in the number of traffic accidents. From 2020 to 2021, the number of accidents and fatalities grew steadily. In comparison to January through December of 2020, which had 5,431 fatalities and 7,379 injuries on the roads, at least 6,284 people passed away, and 7,468 others were wounded, according to the Bangladesh Road Safety Foundation's (RSF) annual report. (Seema, 2022). 1,627 pedestrians were killed in traffic incidents in 2022, according to the Road Safety Foundation, an organization dedicated to the prevention of accidents on the road. Injuries occurred to 48.74% of them when they were moving on the streets and to 51.25% of them while they were crossing the roadway (Hoque et al., 2016). Vehicles were traveling at irresponsible speeds in 59.78% of collisions (Tajmim, 2023). The lack of pathways, pedestrian crossings, and overpasses, among other deficiencies in the infrastructure for pedestrians, puts pedestrians at serious risk. The issue is further aggravated by inadequate signage and bad road design. Accidents involving pedestrians are often caused by careless driving habits, including speeding, failing to yield to pedestrians at crosswalks, and breaking traffic laws. Because law enforcement is so weak, these actions frequently go unpunished. The risk of accidents can be increased if pedestrians are not adequately informed on traffic safety precautions and best practices, such as how to utilize pedestrian facilities and how to read traffic signals.

Since Rajshahi is one of Bangladesh's major cities, the city's pedestrian safety is also in jeopardy. Many of all traffic deaths in the city are pedestrian-related. The poor pedestrian infrastructure has turned into a major risk issue. Major issues were a lack of adequate pathways, designated pedestrian crossings, enough lighting, and huge capacity loss of carriage way both at mid-block and intersection (Islam et al., 2019). In Rajshahi City, hazardous driving behaviors including speeding and failing to yield to pedestrians are significant causes of pedestrian accidents. The number of traffic-related deaths and accidents is rising daily. This has an impact on everyone who uses the roads, but it also puts a strain on the national economy. As a result, the International Road Assessment Programme (iRAP) has created a technique for assigning a road a star rating on a scale of 1 to 5, together with a knowledge of the flaws and causes of traffic accidents, and a financial analysis of each preventative action in

terms of the Safety Road Implementation Plan (Radhakrishnan and Athiappan, 2021). Road Assessment Programmes (RAP) are now active in more than 100 countries (iRAP, 2021). The iRAP has developed an online software called ViDA which can measure road safety by analyzing various factors, such as accident data, road conditions, traffic patterns, and infrastructure design. It has demonstrated success in decreasing costs because of its data-driven evaluations, star marking system, and focused improvement planning. The objectives of this study are 1. To determine the road's present condition. 2. To determine road safety and vulnerability. 3. To determine pedestrian safety.

## 2. Methodology

To evaluate the current degree of safety offered to road users by conducting a site inspection, traffic observation, and the implementation of a star rating system. Finally, the most hazardous road stretch has been discussed. The steps of the study are graphically presented in Figure 1.

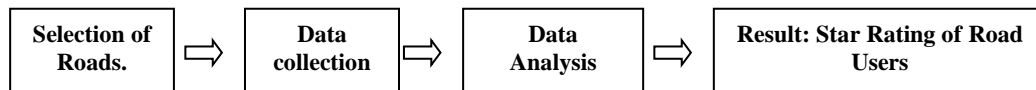


Figure 1. Flow chart of the study

### 2.1 Selection of Roads

iRAP helps to identify high-risk roads that have a significant impact on road safety. Rajshahi is one of the major cities of Bangladesh. In this study, 3 different roads of Rajshahi were selected having a significant number of pedestrians. The roads are presented in Table 1. and the geographical location is in Figure 2.

Table 1. Details of Selected Roads

No	Road Section	Road Type	Length
1	Katakhali Bazar to Talaimari.Mor, Figure 2 (a)	Highway	5.1 km
2	Talaimari Mor to Zero Point, Figure 2 (b)	Urban Road	3.0 km
3	Zero Point to Rail Station, Figure 2 (c)	Urban Road	1.6 km



Figure 2. (a) Geographical location of Road no. 1 (b) Geographical location of Road no. 2 (c) Geographical location of Road no. 3

### 2.2 Data Collection Process

As an additional precaution to the road safety assessment, the iRAP approach is being utilized on road infrastructure projects, and India and other nations adopt it widely (Sunil and Sharma, 2021).

Data used for pedestrian star ratings were obtained directly from the field through site inspections and field observational studies. A thorough site investigation and traffic observation research were conducted in addition to the iRAP analysis to identify accident sites. iRap needs various types of data for analysis, the data that is needed by iRAP is collected and grouped into 7 sections. That is described in Figure 3.

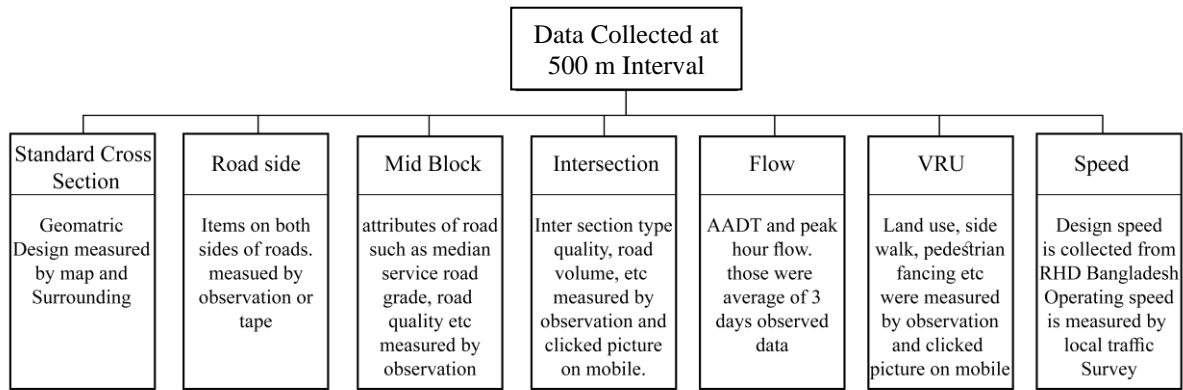


Figure 3. Types of Data required and their Collection Process

The data on road structure that will be needed for iRAP is illustrated and given below in Figure 4.

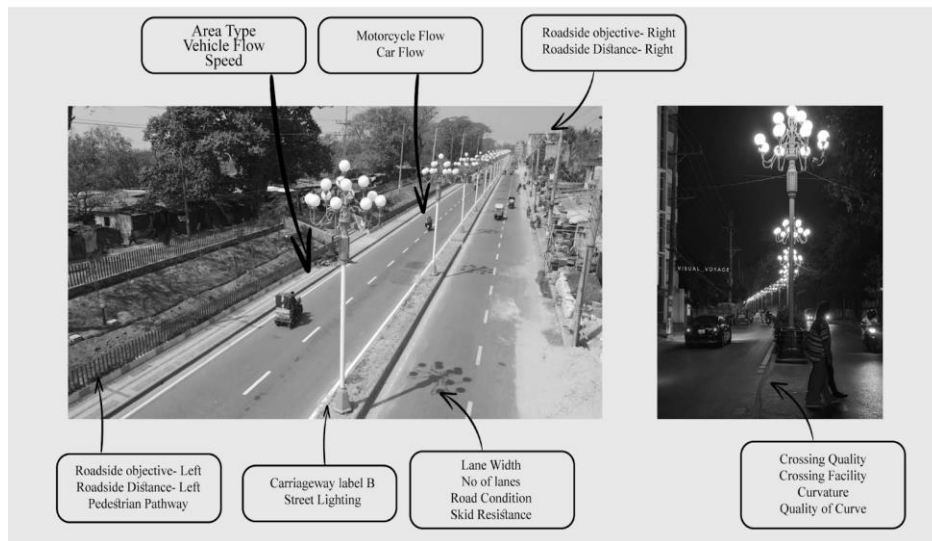


Figure 4. Road Structure

### 2.3 Analysis and Star Rating of Roads

After the completion of the field observations, the data was utilized to generate Star Ratings for each category of road user. The iRAP Demonstrator was used for this. The measurements for this study were done manually and the road segments were taken almost identically and of length of 500 meters. To determine a star rating, road infrastructure characteristics that are known to influence collision severity and likelihood are examined. The program provides a star rating to the route based on specific input data. The iRAP star rating system uses a range of 1 to 5 stars to indicate the safety level as shown in Table 2.

Table 2. The safety level of roads according to Star Rating (iRAP., 2021)

Star Ratings	1 Star	2 Star	3 Star	4 Star	5 Star
Significance	The least amount of safety	Less safety mismeasures than required	A fair level of safety	Good enough	Excellent and have a high degree of safety

iRAP gives a rating according to the road structure. Roads having wide and well-designated lanes, walkways or footpaths, sufficient crossing facilities, crossroads with correct signage, traffic signals, turning lanes, and enough street lighting are considered good roads. And the roadways frequently don't include essential safety elements like sidewalks, crosswalks, or pedestrian bridges. In this type of road there are narrow lanes, inadequate road markings & signs, a poorly designed intersection, and Insufficient Street lighting are considered the least safe roads and are also rated low.

### 3 Result and Discussion

#### 3.1 Road no 1: Katakhalı Bazar to Talaimari Mor

Katakhalı to Talaimari Mor is the only highway selected for the study. The road is 5.1 km long with the movement of a vast number of vehicles like buses, cars, bikes, cycles, and mainly a vast number of pedestrians which is one of the most vulnerable sections on the road. The road is divided into 11 sections. Every section is a road of 500m in length. The overall star rating of this road is presented in Table 3.

Table 3. Overall Star Rating of Road no 1

Star Rating	Vehicle owners		Motorcyclist		Pedestrians		Bicyclist	
	Percentage	Distance (km)	Percentage	Distance (km)	Percentage	Distance (km)	Percentage	Distance (km)
5 Star	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 Star	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 Star	18.18	1.00	9.09	0.50	9.09	0.50	0.00	0.00
2 Star	45.45	2.10	36.36	2.00	0.00	0.00	18.18	1.00
1 Star	36.36	2.00	54.54	2.60	90.90	4.60	81.81	4.10

The road is the most dangerous one for the pedestrian. Just one section shows 3 stars that is the first section in Figure 5. Which is at Katakhalı bazar because of having facility of pedestrian fencing, sidewalks on both sides, school zone warning & street light. In the other 10-section star rating of the pedestrians is just one star because of don't have the facility like the first section. In the same way, some sections 4th & 6th 500m section is quite good for vehicles having 3 stars. The road is also dangerous for bicyclists 81.81% of the road is dangerous for them & only two sections 4<sup>th</sup> & 6<sup>th</sup> sections have 2 stars for them. It is also dangerous for bikes 54.54% of the road got 1 star. 3rd, 7th, 9th & 10th sections are some of the most dangerous sections of the road no 1 (Table 4.), because they are bazaar & university areas with poor under-construction road sections, also having high vehicle flow and poor road facilities (VRU, Mid-block). In the 3rd section, there is a huge construction work being done in the bazaar area like Binodpur, and the other 3 section is the university area of RUET & University of Rajshahi. This area can cause a fatal accident.



Figure 5. Star Rating of 1st 500 m of Road no 1

Table 4. Dangerous Sections of Road no 1 for different road users

Road Name	Road Section	Distance from the Start point (Km)	Star Rating			
			Motor Vehicle	Bike	Pedestrian	Bicycle
Katakhali to Talaimari Mor	Dewan Para Mor - Subway Filling Station	1-1.5	1	1	1	1
	Binodpur Bazar	3-3.5	1	1	1	1
	RU main-Kazla more	4-4.5	1	1	1	1
	RU main gate - Kazla Mor	4.5-5	1	1	1	1

### 3.2 Road no 2: Talaimari Mor to Zero Point

Talaimari Mor is a vital intersection at the entrance of Rajshahi city. It possesses a poor intersection quality. The Table 5. Depicts that the road is dangerous for pedestrian mostly. 66.66% of the road got 1 star, and the four section that contains the intersection of 4 legs (unsignalized) have no protected turn lane. Crossings for pedestrians are in poor condition, having no marking for crossing, and no traffic police to implement traffic rules in intersections. The sections of 1<sup>st</sup> 500m and last 600m sections are the most dangerous sections as they are the most crowded place on the whole road (Talaimari Mor & Zero Point) having huge AADT, flow rate, poor intersections, and poor crossing quality. Other sections of the road are quite good for vehicles & bikes. The condition of the dangerous section is shown in Table 6.

Table 5: Overall Star Rating of Road no 2

Star Rating	Vehicle owners		Motorcyclist		Pedestrians		Bicyclist	
	Percentage	Distance (km)	Percentage	Distance (km)	Percentage	Distance (km)	Percentage	Distance (km)
5 Star	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 Star	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 Star	66.66	2.00	66.66	2.00	0.00	0.00	50.00	1.50
2 Star	33.33	1.10	16.67	0.50	33.33	1.00	50.00	1.60
1 Star	0.00	0.00	16.67	0.60	66.66	2.10	50.00	1.50

Table 6: Dangerous Sections for the Pedestrian on Road no 2

Road Name	Road Section	Distance from the Start point (Km)	Star Rating			
			Motor Vehicle	Bike	Pedestrian	Bicycle
Talaimari to Zero Point	Talaimari Mor - Nupur Ladies Hostel	0-0.5	2	2	1	2
	Nupur Ladies Hostel Hadir Mor	0.5-1	3	3	1	3
	Utshab Cinema Hall Mor - Alupotti- Kumarpara Mor	2-2.5	3	3	1	2
	Kumarpara Mor - Zero point	2.5-3	2	1	1	2

### 3.3 Road no 3: Zero Point to Rail Station

The road is quite dangerous for pedestrians because of the poor crossing quality, and poor intersection quality. The road is between the market and commercial area with a huge crowd & AADT but there is no traffic signal, crossing marks for pedestrians so it is dangerous. It is also dangerous for vehicles, bikes, and bicycles as there is a higher AADT, poor Intersections, a huge number of pedestrians on the roads (Table 7.).

Table 7. Overall star rating of Road no 3

Star Rating	Vehicle owners		Motorcyclist		Pedestrians		Bicyclist	
	Percentage	Distance (km)	Percentage	Distance (km)	Percentage	Distance (km)	Percentage	Distance (km)
5 Star	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 Star	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 Star	25.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00
2 Star	75.00	1.10	100.00	1.60	0.00	0.00	75.00	1.50
1 Star	0.00	0.00	0.00	0.00	100.00	1.60	25.00	0.10

#### 4. Conclusion

This study provided insight into the state of highway safety's correlation with the quality of the infrastructure along the sides of the roadways and provided fresh opportunities for analysis. This study results in Star ratings of certain roads & makes it easy to understand how the condition of the stated road sections. It is depicted that the pedestrians on stated roads are at high risk, iRAP results show that 90.90% pedestrian of Katakhal to Talaimari, 66.66% of the road from Talaimari to zero point & 100% of the road from zero point to station the least rating, 1 star. So, it can be said that pedestrians are the most vulnerable users of roads. 81.81% & 25% of bicyclists on the roads of Katakhal to Talaimari & Zero Point - Station are given 1 star, so bicyclists can be considered the second vulnerable users of the road. Especially on the road, Katakhal to Talaimari Mor 54.54% of motorcyclists are given 1 star for this section on that road motorcyclists are the second most vulnerable users of the road. The road from Talaimari to Zero-point 4 sections is considered to be the most dangerous section. They are Talaimari Mor to Nupur Ladies Hostel, Nupur Ladies Hostel to Hadir Mor, Uthab Cinema Hall Mor to Alupotti Kumarpara Mor, Kunarpara Mor to Zero Point. Here pedestrians are the most vulnerable users of the road. About 100% of the pedestrians got the least star. The absence of traffic signals, poor intersection quality, overspeed, and poor crossing quality made the sections dangerous.

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