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Exploring Street-Crossing Behavior of the Pedestrians: A Study on Urban and Rural Settings of a Developing Country, Bangladesh

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Abstract

Pedestrian safety remains a significant concern in developing countries like Bangladesh, where vulnerable road users frequently encounter hazardous street-crossing environments. This study investigates pedestrian crossing behavior in both urban and rural settings of Chattogram, Bangladesh, using a questionnaire-based survey of 864 individuals. The survey assessed demographic characteristics, awareness levels, use of crossing facilities, and satisfaction across diverse groups. Statistical analyses, including Chi-square tests and ANOVA, were employed to examine relationships between crossing behavior and variables such as profession, gender, age, and location. Findings reveal substantial behavioral differences between urban and rural pedestrians, with urban respondents more likely to use designated crossing facilities and exhibit cautious behavior. A significant association was found between profession and crossing preference, as well as between gender and crossing awareness. Rural pedestrians expressed higher satisfaction with crossing experiences, while satisfaction varied across age groups. These insights highlight the influence of socio-demographic factors on pedestrian behavior and the need for context-sensitive urban planning. The study's findings can inform policy decisions aimed at enhancing pedestrian infrastructure, raising public awareness and ultimately improving road safety for all users.

Keywords: *Pedestrians; Behavior; Safety.*

1 Introduction

Pedestrian-related traffic accidents have become a serious global concern, particularly in emerging nations where rapid urbanization and mixed land use increase road safety challenges (Hamed, 2000; Jain et al., 2014). Walking is an integral part of every trip, regardless of the main mode of transport, and is especially dominant in developing cities with high population density and low motorization rates (Bhattacharjee et al., 2023). As the most vulnerable road users, pedestrians account for a significant share of global traffic casualties. Road crashes claim more than 1.2 million lives annually worldwide, and a considerable proportion of these involve pedestrians (Pasha et al., 2015). In Bangladesh, pedestrian fatalities represent nearly half of all road deaths. Between 1999 and 2008, over 13,000 pedestrians lost their lives, making up 53% of crash-related fatalities (Pasha et al., 2015). More recent police statistics also indicate that "hit pedestrian" crashes remain the most common crash type, accounting for 44 to 48% of all fatalities, with an even higher share in urban areas (Bhattacharjee et al., 2023). Despite the availability of facilities such as foot overbridges and underpasses, many pedestrians avoid using them due to inconvenient placement, poor design, or social and time-related barriers. Consequently, unsafe behaviors such as jaywalking are widespread (Pasha et al., 2015). This study investigates pedestrian crossing behavior, focusing on the use of road crossing facilities in both urban and rural contexts of Chattogram, Bangladesh. The specific objectives of the study are: (i) to examine the relationship between pedestrians' socio-demographic characteristics (age, gender, profession, etc.) and their street-crossing behavior; (ii) to compare pedestrian crossing behavior and satisfaction levels between urban and rural settings; and (iii) to identify the key factors influencing the use of designated crossing facilities and pedestrians' overall satisfaction with crossing experiences. By achieving these objectives, the study aims to provide valuable insights for policymakers and urban planners to improve safety measures, encourage proper facility use, and reduce pedestrian casualties.

2 Methodology

2.1 Questionnaire Development

The questionnaire was developed based on an extensive review of literature on pedestrian behavior and road safety. A pilot test was conducted to ensure clarity, avoid misinterpretation, and evaluate reliability. Expert feedback was also incorporated before finalization. Two forms of the questionnaire were used: (i) hard copies filled out through face-to-face interviews with 432 pedestrians, and (ii) smartphone-based surveys using Kobo software to observe another 432 respondents while crossing. Thus, the study covered a total of 864 participants. The questionnaire included demographic and socioeconomic details (age, gender, occupation, income, education), along with questions on satisfaction with existing facilities, perception of risk, crossing attitude, and frequency of use.

2.2 Data Collection

The survey was conducted in both urban (Bohoddarhat Junction, GEC Moor, 2 No. Gate, Muradpur) and rural (Modunaghat, Noapara, Goshchi, Shantir Haat) locations of Chattogram. Participants were randomly selected and informed about the study objectives before responding. Interviews were conducted in both formal and informal settings to encourage authentic responses. Observations were made simultaneously to record real-life crossing patterns, including whether pedestrians stopped, checked traffic, used facilities, or jaywalked. This dual approach (interview + observation) ensured greater accuracy in understanding pedestrian behavior.

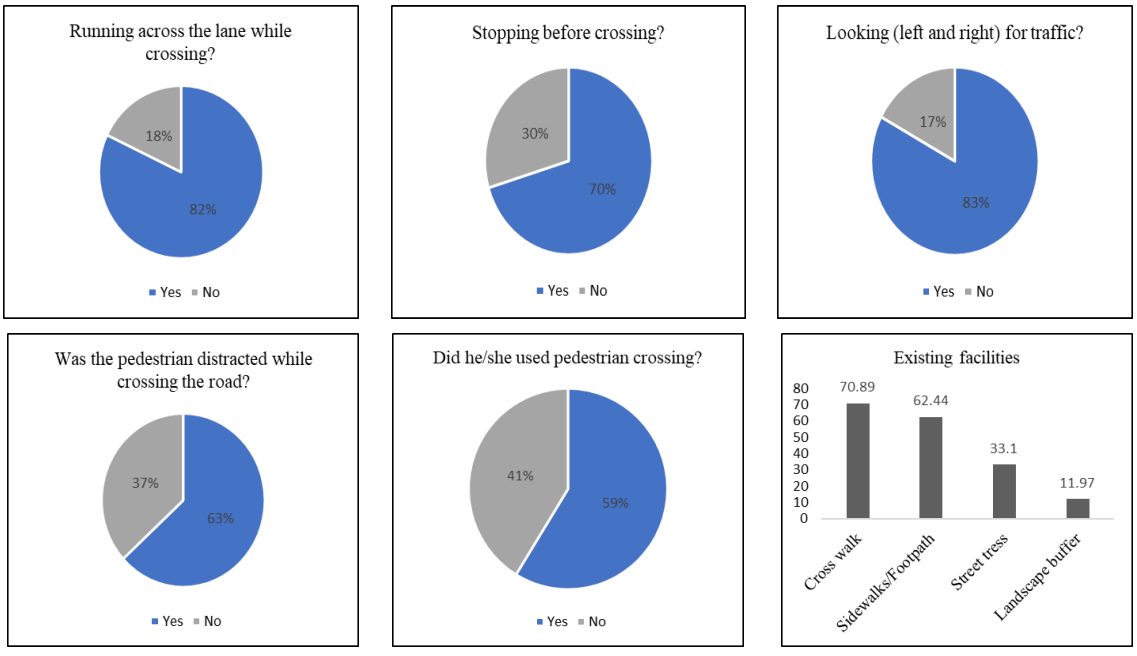
2.3 Data Analysis

Collected data were analyzed using statistical techniques. The Chi-squared test was employed to examine relationships between categorical variables, such as profession and crossing preferences, or gender and awareness. In addition, Analysis of Variance (ANOVA) was applied to assess differences in satisfaction across age groups and between urban and rural areas. These methods allowed the identification of significant behavioral variations across demographic groups and contexts. The results provided insights into how pedestrians' characteristics influence their use of crossing facilities and overall safety behavior.

3 Data Analysis & Interpretation

3.1 Questionnaire Survey Interpretation

The survey revealed that about 30% of pedestrians cross without stopping, often hastily and ignoring traffic. While 83% check both sides before crossing, 17% fail to do so. Women were generally more cautious than men. Around 18% preferred running across lanes, and 37% were distracted, mainly due to smartphone use. Notably, 41% avoided designated crosswalks, citing reasons such as empty roads, poor visibility, or vehicles blocking the crossings, despite the availability of facilities.



Source: Field Survey, 2023

Figure 3.1: Survey data interpretation based on observation

3.2 Analysis between the area of survey (urban/rural) and various pedestrian road crossing factors

Null Hypothesis (H0): There is no significant association between the different factors.
Alternative Hypothesis (H1): There is a significant association between the factors.
Significance Level = 0.05

Table 3.1 Chi Square Table

Calculation of Chi Square				
Observed Values (O)	**Expected Values (E)**	**(O-E)**	**(O-E) ^2**	**(O-E) ^2/E**
153	160.8747628	-7.875	62.01188929	0.3854669
188	189.4867173	-1.487	2.210328234	0.0116648
50	40.4886148	9.5114	90.46644841	2.2343676
96	84.21631879	11.784	138.855143	1.6487914
82	93.93358634	-11.93	142.4104829	1.5160763
145	137.1252372	7.8748	62.01188929	0.4522281
163	161.5132827	1.4867	2.210328234	0.0136851
25	34.5113852	-9.511	90.46644841	2.6213508
60	71.78368121	-11.78	138.855143	1.9343553
92	80.06641366	11.934	142.4104829	1.7786544
			Total	12.596641

Chi Square Value (Calculated) = 12.596641
Degree of Freedom = (Columns - 1) (Rows - 1)
= 4
Chi Square Value (Tabular) = 9.49
Chi Square Value (Calculated) > Chi Square Value (Tabular)
So, Null hypothesis is rejected, and alternate hypothesis is accepted.
There is a significant association between these factors.
The analysis shows a strong link between survey area (urban/rural) and pedestrian crossing behavior. In urban areas, controlled intersections and crosswalks encourage safer practices like stopping and looking for traffic. In contrast, rural pedestrians, facing lighter traffic and simpler environments, are more likely to run across lanes or be distracted. These differences highlight the need for context-specific safety measures.

3.3 Analysis of Street-Crossing Satisfaction Across Area (Urban area)

In this analysis the objective was to investigate whether there are significant differences in street-crossing satisfaction levels between pedestrians in urban and rural areas.
Null Hypothesis (H0): There are no significant differences in street-crossing satisfaction levels between pedestrians in urban and rural areas
Alternative Hypothesis (H1): There are significant differences in street-crossing satisfaction levels between pedestrians in urban and rural areas

Table 3.2 Descriptive Statistics

Area Type	N	Mean	Std. Deviation	Std. Error	95% CI Lower Bound	95% CI Upper Bound	Min	Max
Urban	207	5.58	1.754	0.122	5.34	5.82	0	10
Rural	200	6.79	1.436	0.102	6.59	6.99	3	10
Total	407	6.17	1.714	0.085	6.01	6.34	0	10

Rural pedestrians express higher satisfaction (mean=6.79) than their urban counterparts (mean=5.58), with non-overlapping 95% confidence intervals indicating potential significance. To quantify this, an ANOVA test was conducted to assess the statistical significance of the observed differences.

Table 3.3 ANOVA Results

Source	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	147.792	1	147.792	57.315	0.000
Within Groups	1044.323	405	2.579		
Total	1192.114	406			

The F-ratio (57.315) and p-value (<0.05) confirm significant differences in satisfaction between urban and rural pedestrians. Rural pedestrians reported higher satisfaction, suggesting that local conditions contribute to more positive crossing experiences, while urban factors reduce satisfaction.

3.4 Relationship Between Profession and Preference

This study used a Chi-squared (χ^2) test to examine the relationship between individuals' professions and their street-crossing preferences. The test, commonly applied to categorical data, determines whether observed differences across groups are statistically significant, revealing associations that may not be evident from simple observation.

Null Hypothesis (Ho): There is no relationship between Profession and Preference.

Alternative Hypothesis (H1): There is a relationship between Profession and Preference.

Significance Level has been taken 0.05

Table 3.4 Chi Square Table

Observed Value	Expected Value	O-E	(O-E) ^2	(O-E) ^2/E
34.0	30.3	3.7	13.5	0.44
6.0	6.4	-0.4	0.1	0.02
16.0	16.8	-0.8	0.6	0.03
5.0	4.8	0.2	0.0	0.01
1.0	2.0	-1.0	1.0	0.50
3.0	2.0	1.0	1.0	0.51
18.0	20.8	-2.8	7.6	0.36
10.0	10.2	-0.2	0.1	0.01
0.0	2.2	-2.2	4.6	2.15
4.0	5.7	-1.7	2.7	0.48
3.0	1.6	1.4	1.9	1.19
2.0	0.7	1.3	1.8	2.62
0.0	0.7	-0.7	0.5	0.67
9.0	7.0	2.0	4.0	0.57
26.0	29.6	-3.6	12.9	0.44
8.0	6.2	1.8	3.1	0.50
18.0	16.4	1.6	2.7	0.17
3.0	4.7	-1.7	2.8	0.60
1.0	1.9	-0.9	0.9	0.46
2.0	1.9	0.1	0.0	0.00
23.0	20.3	2.8	7.6	0.37
6.0	5.8	0.2	0.0	0.00
2.0	1.2	0.8	0.6	0.48
4.0	3.2	0.8	0.6	0.18
1.0	0.9	0.1	0.0	0.01
1.0	0.4	0.6	0.4	0.98
0.0	0.4	-0.4	0.1	0.38
2.0	4.0	-2.0	4.0	1.00
Total				**15.15**

Now, Degree of freedom = (row-1) (column-1)

= (7-1) (4-1)

= 18

From the below chart we get the value 28.87

But we get the value of Chi-square is 15.15

And 15.15 < 28.87

So, Null Hypothesis (H0) was rejected and Alternate Hypothesis (Ha) accepted.

Result: There is a relationship between Profession and Preference.

Upon conducting the Chi-squared test, a significant relationship emerged between individuals' professions and their preferences in street crossing behavior. This indicates that the type of profession one holds influences the likelihood of adopting specific crossing habits. The findings provide valuable insights into the interplay between professional contexts and pedestrian behavior, offering a nuanced understanding that can contribute to urban planning and safety considerations.

3.5 Frequency of Using Pedestrian Crossing Among Different Profession in Urban Area

This analysis is based on 216 data entries, including students, doctors, engineers, day laborers, service holders, teachers, and others. Significance level is considered 0.05.
Null Hypothesis (H0): There is no significant difference in the mean frequencies of using pedestrian crossing among different professions.
Alternative Hypothesis (H1): There is a significant difference in the mean frequencies of using pedestrian crossing among different professions.

Table 3.5 ANOVA Results

Frequency (Per Week)				
	Sum of Squares	df	Mean Square	F
Between Groups	3405.708	6	567.618	2.333
Within Groups	50843.250	209	243.269	
Total	**54248.958**	**215**		

Here, F value is 2.33 which is greater than value of chart which is shown above (2.09). So, null hypothesis rejected, and alternative hypothesis accepted. That means, there is a significant difference in the mean frequencies of using pedestrian crossing among different professions. The conclusion drawn is that there exists a significant difference in the mean frequencies of using pedestrian crossings among various professions in the urban area, based on the ANOVA results.

3.6 Street-Crossing Satisfaction Across Age Groups

Analysis of Variance (ANOVA) is a statistical test used to determine if there are any statistically significant differences between the means of three or more independent groups. It assesses whether the variation within group means is consistent with the variation between group means. In this context, ANOVA is applied to evaluate if there are significant differences in street-crossing satisfaction levels across various age groups in the developing country of Chattogram, Bangladesh. The p-value from the ANOVA test is used to determine whether to reject or fail to reject the null hypothesis regarding overall group mean equality. So, the objective would be to investigate if there are significant differences in street-crossing satisfaction levels among various age groups.
Null Hypothesis (H0): There are no significant differences in street-crossing satisfaction levels among different age groups.
Alternative Hypothesis (H1): There are significant differences in street-crossing satisfaction levels among different age groups.

Table 3.6 Descriptive Statistics

Age Range	**N**	**Mean**	**Std. Deviation**	**Std. Error**	**95% CI (Lower)**	**95% CI (Upper)**	**Min**	**Max**
10-20	95	6.19	1.504	0.154	5.88	6.50	3	10
20-30	122	6.02	1.882	0.170	5.68	6.35	0	10
30-40	110	6.49	1.505	0.143	6.20	6.77	3	10
40-50	57	5.99	1.867	0.247	5.50	6.49	0	9
50-60	16	6.31	1.991	0.498	5.25	7.37	2	10
>60	7	5.00	2.000	0.756	3.15	6.85	3	8
Total	407	6.17	1.714	0.085	6.01	6.34	0	10

This table summarizes the basic statistics for satisfaction levels in different age groups, including the mean (average), standard deviation (spread of values), standard error (variability of the sample mean), and the 95% confidence interval for the mean. The minimum and maximum values indicate the range of satisfaction scores within each age group.

Homogeneity of Variances: The Levene's test assesses whether the variances (spread or dispersion of satisfaction scores) are roughly equal across all age groups. A non-significant result ($p > 0.05$) suggests that the assumption of equal variances is met, allowing for more robust interpretation of the ANOVA results. We checked if satisfaction levels had similar variability across age groups. The test result ($p = 0.253$) indicates that the variability is reasonably consistent among age groups.

Table 3.7 Levene's Test Results

Satisfaction level (0-10)			
Levene Statistic	df1	df2	Sig.
1.323	5	401	.253

Table 3.8 ANOVA Results

Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	25.645	5	5.129	1.763	0.119
Within Groups	1166.469	401	2.909		
Total	**1192.114**	**406**			

The main question was whether there are significant differences in satisfaction levels across age groups. The ANOVA results show that, overall, there isn't a strong statistical difference ($p = 0.119$). In other words, on average, people across different age groups report similar levels of satisfaction with street-crossing experiences.

Table 3.9 Multiple Comparisons (LSD)

Age Range (I)	Age Range (J)	Mean Difference (I-J)	Std. Error	Sig.	95% CI (Lower)	95% CI (Upper)
20-30	30-40	-0.470*	0.224	0.037	-0.91	-0.03
>60	30-40	1.486*	0.665	0.026	0.18	2.79

We dug deeper to see if there were specific age group pairs with significant differences. Notable findings include:

- The satisfaction levels between the 20-30 and 30-40 age groups are significantly different ($p = 0.037$).
- People over 60 differ significantly in satisfaction levels compared to those aged 30-40 ($p = 0.026$) and 50-60 ($p = 0.090$).

The ANOVA results ($p = 0.119$) do not provide sufficient evidence to reject the null hypothesis, indicating no significant overall differences in street-crossing satisfaction levels among age groups. However, specific pairwise comparisons suggest distinctions between the age groups 20-30 and 30-40, as well as those over 60 and 30-40. This implies that while overall satisfaction trends are similar, certain age groups exhibit variations in their street-crossing experiences.

4 Conclusion

This study explored the diverse patterns of pedestrian crossing behavior across both urban and rural settings of Chattogram, Bangladesh, and successfully met its intended objectives. The findings demonstrate that socio-demographic factors such as profession, gender, and age play a significant role in shaping pedestrians' crossing choices and safety awareness. Clear behavioral contrasts were observed between urban and rural areas, with urban pedestrians tending to be more cautious and reliant on designated facilities, while rural pedestrians expressed greater satisfaction with their overall crossing experience. The results also revealed that factors like profession and area type strongly influence the frequency of using crossing facilities and the level of satisfaction, emphasizing the importance of context in understanding pedestrian behavior. The study provides valuable insights for urban planners and policymakers aiming to develop safer and more inclusive road environments. Strengthening pedestrian infrastructure, improving facility accessibility, and promoting awareness through education and enforcement are essential to encourage safer crossing practices and reduce pedestrian-related risks in Bangladesh.

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