

LATENT TRAITS INFLUENCING PERCEIVED RISK AND RISK-TAKING BEHAVIOR OF PEDESTRIANS IN DHAKA: INSIGHTS FROM A STRUCTURAL EQUATION MODELING STUDY

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ABSTRACT

Dhaka, one of the most densely populated cities of the Global South Asia, has a high volume of pedestrian movement throughout the day. Rapid and unplanned urbanization within the past few decades has resulted in limited infrastructural growth. Pedestrian safety is predominantly influenced by two factors: inadequate infrastructure and non-compliance with traffic regulations. A more recent, emerging concern involves the compounded effects of digital distraction and psychological strain among younger urban populations. A key question is whether young pedestrians' risk-taking stems from ingrained habit or is a compelled response to urban pressure. The analysis suggests that temporally-specific risks, driven by these immediate pressures, surpass those arising from habitual behavior. This study focuses on finding the underlying factors of pedestrian temporal risk-taking behavior by analyzing the survey results collected from 203 pedestrians using a structural equation modelling (SEM) framework. The research particularly emphasizes the young generation and shows that temporal risk-taking behavior is strongly influenced by urban stress arising from Dhaka's overwhelming city environment and by digital distraction. Socio-demographic attributes showed limited influence, underscoring the importance of behavioral drivers in youth crossing decisions. Based on these findings, the study offers youth-centered insights and policy recommendations aimed at reducing temporal risk and improving pedestrian safety in Dhaka.

Keywords: *Pedestrian safety; Temporal risk-taking behavior; Urban stress; Digital distraction; Structural Equation Modeling (SEM)*

1. INTRODUCTION

Pedestrian safety remains a critical yet under-addressed issue in developing countries like Bangladesh, as pedestrians face higher risks than other road users. According to the police report, from 2010 to 2019, nearly half of the traffic deaths were pedestrians ([Bhattacharjee, Mahmud, Raihan, Hazra, & Hasan, 2022](#)). In 2021, the World Health Organization reported 32,000 deaths in traffic crashes in Bangladesh accounting for 1% of total deaths, with pedestrian deaths representing 32% of all road crash fatalities ([Bangladesh Road Safety Profile](#)). These figures indicate that pedestrians are disproportionately affected by traffic risks, yet even in the presence of infrastructure, they continue to adopt unsafe road-crossing behavior. A recent study also highlights that young pedestrians aged 18-30 years are particularly vulnerable as they are the most frequent smartphone users while walking and crossing ([Williamson, Amy & Lennon, Alexia, 2015](#)). Increasing competition in different sectors contributes to time-related risks prompting the question of whether pedestrians take risks habitually or due to time pressure.

Prior research has analyzed how situational and environmental factors along with perceptions of crossing facilities and risk-taking tendencies influence pedestrian behavior and crossing decisions ([Afshari, Ayati, & Barakchi, 2021](#); [Shoabjareh, Mamdoohi, & Nordfjærn, 2021](#)). A study in Spain revealed that risk-taking tendencies in young-adult pedestrians are strongly associated with impulsiveness, particularly in males while females were found to be more conscientious ([Herrero-Fernández, Maca-Guerrero, Silvano-Chaparro, Merino, & Jenchura, 2016](#)). Adolescents are directly influenced by their peers in making pedestrian safety decisions confirming that peers can both promote and discourage risky behavior ([Pfeffer & Hunter, 2013](#)). A study conducted in the suburbs of Sydney demonstrated that talking on a mobile phone while crossing leads to slower walking and reduced attention to traffic, particularly among females suggesting a cognitive distraction that increases pedestrian risk ([Hatfield & Murphy, 2007](#)). While these prior studies have identified situational, environmental and personality-based factors influencing pedestrian risk-taking behavior, they overlook youth-centered behavioral drivers such as competitiveness or time pressure and social media distraction as a predictor of unsafe crossing behavior.

Findings from Bangladesh largely emphasize infrastructural and environmental conditions influencing pedestrian behavior. A study conducted at twelve major locations in Dhaka highlighted that physical features such as guard rails, crosswalk locations, and nighttime lighting were the strongest determinants of crosswalk usage ([Sakib, Paul, Ahmed, Momin, & Barua, 2024](#)). However, research at seven intersections of Dhaka city showed that males and young pedestrians are at a higher risk of crash while crossing compared to females and older adults with behaviors such as oblique crossings, rolling gaps, and mobile phone use contributing most to that risk ([Zafri, Rony, Rahman, & Adri, 2020](#)). Another study held in Dhaka revealed that pedestrians are usually aware of risk and recognize safe practices of crossing, yet frequently engage in unsafe practices creating a gap between their positive attitude and actual behavior ([Bhattacharjee et al., 2022](#)). All existing studies in Bangladesh have primarily focused on infrastructural and environmental determinants of pedestrian behavior creating a gap in showing how digital distractions, hurriedness and the competitive nature of young pedestrians influence decision-making.

Prior studies largely emphasize physical infrastructure, traffic conditions and broad personality traits like impulsiveness, conscientiousness without adequately addressing the youth-centered behavioral drivers such as competitiveness, hurriedness and time pressure that shape crossing decisions particularly in urban settings. Moreover, existing literature has insufficiently quantified the role of digital social media distraction as a predictor of unsafe crossing behavior. This study, therefore, aims to fill these gaps by incorporating youth-specific behavioral drivers and the measurement of digital distraction, providing new insights and policy recommendations to ensure pedestrian safety.

The remainder of the paper is divided into five sections. The next section presents the data collection and survey design followed by analyzing the data using the Structural Equation Model. A detailed

discussion on the findings is then provided, highlighting the underlying factors influencing pedestrian risk behavior. Finally, the paper concludes by summarizing the key findings and policy recommendations based on these findings.

2. DATA COLLECTION

The data for this study were collected via an online survey conducted from November 5 to November 10. The primary objective of the survey was to explore the latent traits affecting the perceived risk of pedestrians. The survey focused on young generation (aged 27 or younger) as this age group is most likely to engage with urban walking environments. Initially, 211 responses were collected; however, after screening the data, only 203 valid responses were retained. Responses that were completed in under 5 minutes were excluded due to concerns regarding accuracy and potential discrepancies.

The survey focused on four key latent factors: urban stress and cognitive load, digital distraction, perceived infrastructure fairness, and temporal risk behavior. The data collection instrument used a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree) to assess respondents' attitudes and perceptions concerning these factors. The analysis aimed to understand how these traits influence pedestrian risk perceptions within urban environments.

The respondents were asked to rate various statements regarding these latent traits. Each of the latent constructs was measured through specific items, with their average ratings being used to assess the overall influence of each factor. **Table 1** below provides the mean scores for the different latent traits as perceived by the participants:

Table 1. Overview of respondents' perceptions about the pedestrian safety

Parameter	Statements	Mean
Urban Stress and Cognitive Load (US)	US1. I often feel anxious or overwhelmed when walking in crowded urban areas.	3.88
	US2. Noise and traffic congestion make it difficult for me to stay focused while walking.	3.90
	US3. I feel mentally exhausted after walking through busy city streets.	4.07
	US4. I find it hard to assess traffic risks when I'm stressed or in a hurry.	3.90
Digital Distraction (DD)	DD1. I regularly use my phone while walking on streets or crossings.	1.91
	DD2. I often check messages or social media while walking, even near traffic.	1.92
	DD3. I wear headphones or earbuds while walking near roads.	1.84
	DD4. Using my phone while walking has distracted me from oncoming vehicles before.	2.32
	DD5. I feel uneasy if I can't check my phone while walking.	1.80
Temporal Risk Behavior (TR)	TR1. I feel less cautious walking at night than during the day.	2.42
	TR2. My walking habits change depending on how rushed I am.	3.92
	TR3. I take more risks when I am running late.	3.55
	TR4. I pay less attention to traffic when I'm walking familiar routes.	3.42

3. METHODOLOGY

3.1 Data Analysis

The study employs Structural Equation Modeling (SEM) to evaluate the fit of a hypothesized conceptual framework. The primary objectives of SEM are twofold: first, to test theoretical models that describe relationships among variables; and second, to explain the variance in observed indicators through underlying latent constructs ([Hox & Bechger, 1998](#)).

SEM can be broadly categorized into two approaches: Covariance-Based SEM (CB-SEM) and Partial Least Squares SEM (PLS-SEM). The latter offers distinct advantages in terms of predictive accuracy and model estimation particularly when theoretical foundations are less established or when the data violates normality assumptions ([Hair Jr. & Matthews, 2017](#)). Therefore, this study adopts the PLS-SEM approach.

Prior to conducting the SEM analysis, a Confirmatory Factor Analysis (CFA) was performed to evaluate whether the data adequately fit the hypothesized measurement model. CFA allows researchers to examine the degree to which the observed data corresponds to the theoretical measurement structure specified a priori, based on established theory and prior empirical evidence ([Hair et al., 2017](#)). **Table 1** summarizes the latent factors included in the SEM analysis.

3.2 Internal Consistency Reliability

Reliability refers to the internal consistency or stability of the measurement model. Cronbach's alpha and composite reliability are both employed to assess internal consistency; however, composite reliability is often preferred in SEM as it accounts for individual indicator loadings ([Hair et al., 2017](#)). Reliability coefficients between 0.60 and 0.70 may be considered acceptable for exploratory research, whereas values above 0.70 are recommended for confirmatory studies ([Nunnally & Bernstein, 1994](#)). **Table 2** illustrates the reliability coefficients obtained for each construct. After evaluating reliability, the subsequent step involves assessing validity, which encompasses both convergent and discriminant validity of the constructs.

3.3 Convergent and Discriminant Validity

A factor loading represents the correlation between an observed variable and its underlying latent factor, indicating how much of the variance in the observed variable is explained by the factor ([Brown & Moore, 2012](#)). Standardized factor loadings of 0.50 or higher are typically considered acceptable, indicating that the latent factor explains at least 25% of the variance in the indicator variable ([Kline, 2016](#)). In addition, Average Variance Extracted (AVE) measures the amount of variance captured by a construct in relation to the variance due to measurement error ([Hair et al., 2017](#)). Convergent validity is established when the Average Variance Extracted (AVE) is 0.50 or higher ([Fornell & Larcker, 1981](#)). However, if AVE is below 0.50, convergent validity is still acceptable if the composite reliability exceeds 0.6 ([Muley et al., 2024](#)). **Table 2** additionally presents the AVE values and factor loadings for the variables.

Table 2. Evaluation of Measurement of model

Construct	Observed Variable	Factor Loading	Cronbach's Alpha	Composite Reliability	AVE
Urban Stress and Cognitive Load (US)	US1	0.702	0.772	0.777	0.469
	US2	0.741			
	US3	0.743			
	US4	0.532			
Digital Distraction (DD)	DD1	0.901	0.789	0.804	0.471
	DD2	0.851			
	DD3	0.599			
	DD4	-			
	DD5	0.551			
Temporal Risk Behavior (TR)	TR1	-	0.369	0.717	0.462
	TR2	0.584			
	TR3	0.769			
	TR4	0.673			

Discriminant validity assesses the extent to which a construct is truly distinct from other constructs ([Brown & Moore, 2012](#)). It is established when the square root of the AVE of each construct is greater than its highest correlation with any other construct ([Fornell & Larcker, 1981](#)). **Table 3** demonstrates that each variable is empirically distinct, confirming discriminant validity.

Table 3. Discriminant validity of constructs

Construct	US	DD	TR
US	0.685		
DD	0.087	0.687	
TR	0.441	0.344	0.679

3.4 Significant of Path Coefficient

Path coefficients in structural equation models are standardized partial regression coefficients that represent the strength and direction of the relationships between variables in the model ([Lohelin, 2004](#)). Therefore, bootstrapping is utilized to obtain reliable standard errors and confidence intervals for path coefficients, regardless of data distribution ([Hair et al., 2017](#)). In this study, the bootstrapping technique was employed with 5,000 resamples to estimate the stability and significance of the model parameters. **Table 4** demonstrates that the variables exhibit no significant cross-loading issues.

Table 4. Cross loading of observed variables

Construct	Observed Variable	US	DD	TR
Urban Stress and Cognitive Load (US)	US1	0.783	0.086	0.311
	US2	0.825	0.097	0.304
	US3	0.832	0.041	0.415
	US4	0.595	0.008	0.327
Digital Distraction (DD)	DD1	0.074	0.959	0.317
	DD2	0.089	0.896	0.336
	DD3	0.094	0.630	0.226
	DD5	0.003	0.581	0.204
	TR2	0.380	0.304	0.645
Temporal Risk Behavior (TR)	TR3	0.400	0.304	0.850
	TR4	0.233	0.251	0.744

4. RESULTS

4.1 Analysis of Structural Model

Upon conducting 5,000 bootstraps, the final SEM model is presented in **Figure 2** and **Table 5**. The results indicate that the relationship between urban stress and cognitive load with temporal risk-taking is statistically significant at the 0.01 level, with a t-statistic of 2.878, which exceeds the threshold value of 1.96, thereby confirming Hypothesis H1. Furthermore, the relationship between digital distraction and temporal risk-taking is also statistically significant at the 0.01 level, with a t-statistic of 3.101, again surpassing the critical value of 1.96.

Table 5. Evaluation of Structural Model

Hypothesis	Path from Hypothesis	Path coefficient	T statistics	p-value	Significance Level	Interpretation
H1	US → TR	0.478	2.878	0.004	0.01	Supported
H2	DD → TR	0.341	3.101	0.002	0.01	Supported

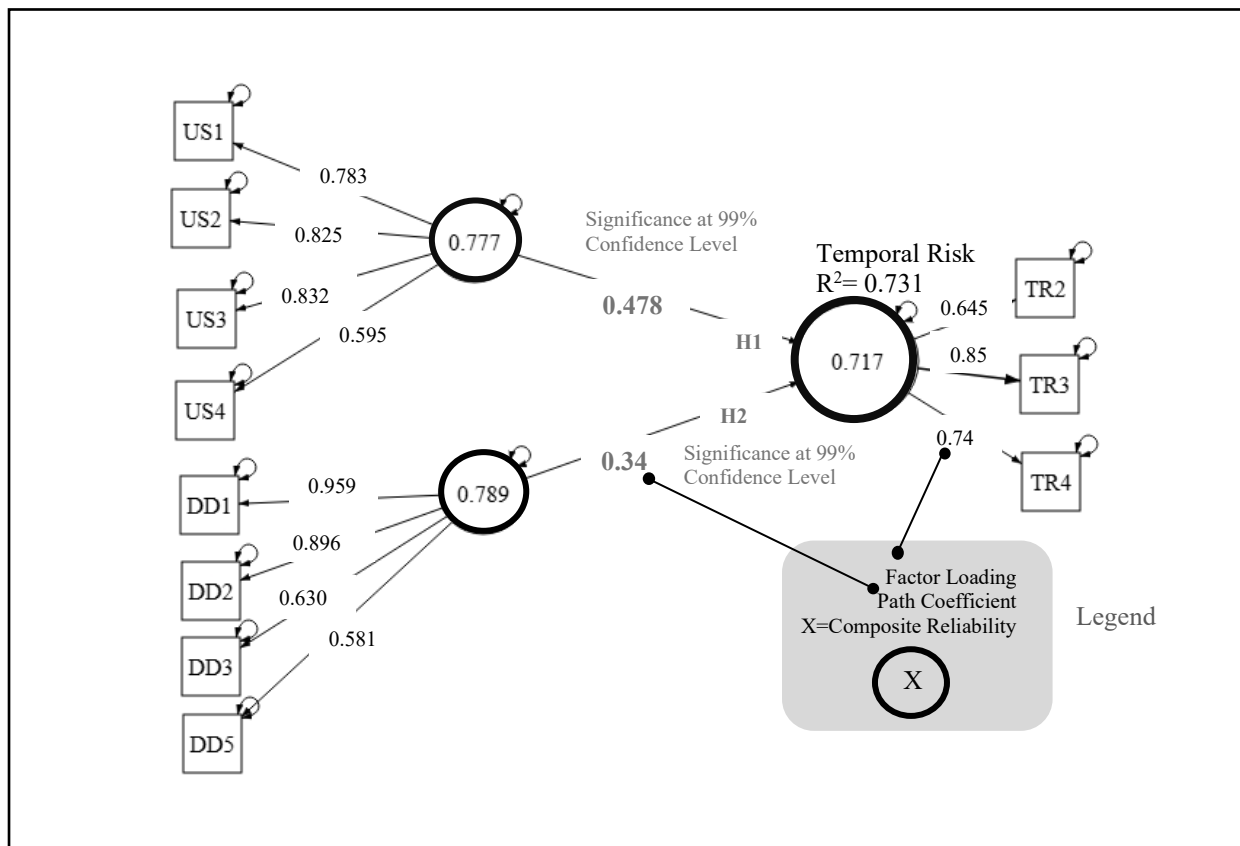


Figure 1. SEM Measurement Model

4.2 Direct effects on Urban Stress, Digital Distraction, and Socio-demographic factors on Temporal Risk

The structural model examining direct effects on TR revealed that two behavioral constructs, Urban Stress and Cognitive Load ($\beta = 0.478$, $p = 0.011$) and Digital Distraction ($\beta = 0.383$, $p = 0.003$)

significantly predict time-bounded pedestrian risk taking behavior. In contrast, none of the socio-demographic variables, including gender, income, transportation expenditure, education level, primary transport mode, or private vehicle ownership, exhibited a significant direct effect on temporal risk. **Table 6** reports the direct influences of both constructs and socio-demographic factors on TR.

Table 6. Direct effects on TR

Predictor	Path coefficient	T-statistics	p-value	Significance
US → TR	0.478	2.536	0.011	Significant
DD → TR	0.383	2.963	0.003	Significant
Gender → TR	0.128	0.588	0.557	Not Significant
Income → TR	0.102	0.744	0.457	Not Significant
Transportation Expenditure → TR	-0.175	-1.081	0.280	Not Significant
Primary Mode → TR	0.077	1.344	0.179	Not Significant
Education → TR	0.189	0.514	0.608	Not Significant
Private Vehicle Ownership → TR	-0.149	-0.515	0.606	Not Significant

5. DISCUSSION

5.1 Key Structural Relationships from the SEM Model

This study examined the underlying behavioral factors that influence temporal risk-taking among young pedestrians in Dhaka. The SEM results demonstrate two clear and distinct pathways. First, urban stress and cognitive load emerged as a strong predictor of time-sensitive risk behavior. It indicated the fact that crowded environments, noise, and mental fatigue significantly impair young pedestrians' ability to judge traffic situations. Similar to findings reported in other SEM-based behavioral studies ([Muley et al., 2024](#)), the significant structural path highlights the critical role of psychological strain in shaping pedestrian decision-making. Second, digital distraction most notably the influence of smartphones and habitual online engagement also showed a significant positive association with temporal risk. Together, these findings imply how urban stress coupled with cognitive load and digital destruction of the younger populace jointly shape unsafe crossing decisions in dense city environments.

5.2 Direct Effects and Influence of Latent Factors

The direct-effects model further reinforces the dominance of psychological and behavioral traits over socio-demographic attributes in explaining temporal risk. Both latent constructs—urban stress and cognitive load, and digital distraction were found to be significant contributors to time-pressured risk-taking. On the other hand, there was no discernible impact from any of the socio-demographic factors, such as gender, income, education, method of transportation, or private vehicle ownership. These findings align with studies that emphasize the importance of behavioural drivers in pedestrian risk models ([Muley et al., 2024](#)). Additionally, these findings suggest that situational mental states and distraction patterns have a stronger impact on risk-taking than demographic differences for most young pedestrians.

5.3 Policy and Planning Implications

The findings offer several practical implications for urban safety planning. Measures for reducing environmental noise as well as crowd-induced stress such as reduced horn usage, improved sidewalk conditions etc. can help mitigate states of cognitive overload. In addition, distraction related hazards such as the use of mobile phone while crossing can be prevented by stronger law enforcement through

fines or camera-based monitoring. Collectively, these strategies can make pedestrian environments safer in rapidly urbanizing cities like Dhaka.

5.4 Limitations and Future Scope

This study despite providing important insights into youth-centered pedestrian behavior also offers scopes for future work. The modest dataset is limited to young respondents from a single metropolitan area in spite of being adequate for this study. Future studies could adopt larger and more diverse samples from multiple cities. Incorporating observational or mixed-method approaches and also including traffic flow, environmental noise levels, variance between weekends and weekdays as well as smartphone usage logs could provide better behavioural insights. This may also deepen understanding of how psychological and environmental pressures interact. These additions would undoubtedly strengthen the standardization of the findings and provide more insight into more effective pedestrian safety policies.

6. CONCLUSION

This study investigated the latent traits influencing temporal risk-taking behavior among young pedestrians in Dhaka focusing specifically on respondents aged 27 or younger falling under the demographic cohort of Generation Z. The SEM results revealed that temporal risk-taking is strongly shaped by two key behavioral constructs: urban stress and cognitive load, reflecting the excessive mental pressure created by Dhaka's dense, noisy and fast-paced urban environment; and digital distraction, driven by the young population's rapid loss of focus due to habitual smartphone dependence which is further compounded by external urban stressors such as noise pollution, overcrowding and a perceived lack of regulatory enforcement. These factors significantly reduce situational awareness and increase the likelihood of risky crossing decisions when pedestrians navigate the city under time-related pressure.

The findings also indicate that traditional socio-demographic variables do not significantly influence temporal risk-taking within this youth cohort, underscoring the dominance of psychological and behavioral traits over demographic attributes. These insights highlight the need for policy measures that mitigate environmental stressors and address distraction-related vulnerabilities, particularly smartphone use at crossings. Improving pedestrian infrastructure, reducing sensory load, and developing youth-focused awareness strategies may help reduce temporally driven unsafe behaviors. Although limited to young respondents from a single metropolitan context, the study provides a foundation for future mixed-method and multi-city research aimed at enhancing pedestrian safety in rapidly urbanizing regions.

DECLARATION OF USE OF AI

The authors declare that AI-assisted tools were used solely for language editing to improve clarity and academic presentation. These tools were not used for data analysis, interpretation, or decision-making, and all scientific content remains the responsibility of the authors.

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