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Perceptions of Safety in the Urban Built Environment and Its Impact on Active Transport Behavior

Masuma Parvin Joyti[1]
Mohammad Lutfur Rahman[1*]
Rowshan Jahan[2]

Abstract

This study investigated the relationship between urban built environment safety and its influence on active transport behavior. Although the safety of the urban built environment, including traffic and personal safety, is a key factor in encouraging active transport, few studies have comprehensively examined the combined effects of traffic and personal safety within the built environment on active transport in developing countries, like Bangladesh. To bridge this gap, the study conducted an empirical analysis based on data collected from 375 participants, of which 250 valid responses were analyzed. A structured 20 to 25-minute questionnaire was utilized to gather data on participants' sociodemographic characteristics, travel mode choices, and perceptions of urban safety. The multivariate analysis revealed that urban built environment traffic safety, such as high traffic volume ($p<0.01$), elevated traffic speeds ($p<0.01$), and dangerous intersections ($p=0.033$) were negatively associated with active transport. Personal safety concerns, such as inadequate street lighting ($p=0.035$) and the presence of crime ($p=0.049$), were also negatively correlated with active transport. However, the impact of crime along transport routes was not statistically significant when age and gender were controlled. These findings underscore the urgent need for urban planners and policymakers to address safety issues within the urban built environment, particularly concerning traffic and personal safety, to create environments that support active transport in urban areas of developing countries. Future research should consider objective measures of the urban built environments to investigate the relationship between using active transport in a large sample among different age groups over time.

Keywords: Built environment, active transport, traffic safety, personal safety, multivariate model

1. Introduction

The urban built environment exerts a profound influence on public health, particularly through its impact on active transport modalities such as walking, cycling, and other non-motorized travel modes (Timperio et al., 2018). Active transport is crucial for enhancing physical fitness, mitigating chronic diseases, and fostering mental health and overall well-being (Faulkner et al., 2009). However, the perception of safety within the urban built environment is a pivotal factor determining whether individuals engage in active transport (Caetano et al., 2021). Environments perceived as secure and conducive can significantly motivate individuals to participate in active transport, thereby improving public health outcomes (Mandic et al., 2020).

[1] Department of Urban and Regional Planning, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh

[2] Researcher, Participatory Management Initiative for Development (PMID), 1/11 Iqbal Road, Block-A, Mohammadpur, Dhaka-1207, Bangladesh, Email: lrahman@juniv.edu

Perceived urban built environment safety encompasses two primary dimensions: traffic safety and personal safety (Rahman, Moore, et al., 2020). Traffic safety includes factors such as traffic volume, velocity, intersection density, availability of traffic signals and crossings, and the quality of pedestrian and cycling infrastructure. Personal safety involves elements like the presence of unfamiliar individuals, neighborhood crime rates, and the adequacy of street lighting along commuting routes (Rahman, Moore, et al., 2020). When these safety features are perceived as adequate, individuals are more inclined to feel secure and motivated to walk or cycle, leading to increased physical activity and reduced reliance on motorized transportation (Rahman et al., 2023). Safety within the urban built environment can be assessed both subjectively and objectively (Adams et al., 2009). Perceived safety is often evaluated through self-reported data from interviews or questionnaires (Carlson et al., 2014; Deforche et al., 2010), while objective measures can be obtained using Geographic Information Systems (GIS) (Campos-Sánchez et al., 2020; Pocock et al., 2019; Rahman et al., 2023). However, perceptions of safety are influenced by factors beyond observable features or GIS data, necessitating a nuanced understanding of how perceived safety impacts active transport behaviors (Larkin et al., 2021).

Perceived urban built environment features may influence safety, such as traffic and personal safety. For example, previous studies in New Zealand have shown that individuals felt unsafe using active transport because of their safety concerns in neighborhood environments (Rahman, Pocock, et al., 2020; Sophia et al., 2012). A systematic review reported that high traffic volume and speed were negative, whereas crossing was positively associated with using active transport. A significant positive association was found between the presence of crossing, traffic signals, and active transport in the United States and Canada (Esteban-Cornejo et al., 2016; Lee et al., 2022; Rothman et al., 2021). Another systematic review reported that too many intersections along the routes negatively influenced active transport (Yuan et al., 2023). Individuals felt unsafe using active transport in neighborhood environments due to the presence of dangerous crossings along the routes in New Zealand (Rahman, Pocock, et al., 2020). A European study reported that individuals living in neighborhoods with more streetlights were more likely to use active transport (Yang et al., 2017). Previous American studies found that crime in neighborhood environments negatively correlated with using active transport (Esteban-Cornejo et al., 2016; Lee et al., 2022). However, no association was found between crime and active transport in Brazil (Dias et al., 2019). In Bangladesh, very few studies have been conducted to investigate the impact of the built environment on active transport (Jamal et al., 2020; Uddin et al., 2018); however, these studies only reported crime and traffic volume as barriers to using active transport. A comprehensive investigation combining urban built environment traffic and personal safety and their impact on active transport is warranted. Bangladesh also lacks infrastructure facilities to support active transport, and safety is a significant concern for active transport users (Jamal & Mohiuddin, 2020). When individuals perceive their neighborhood environments as safe, they may be more likely to use active transport. Conversely, environments perceived as unsafe may discourage active transport, leading to lower physical activity levels and adverse health outcomes.

In addition, perceived built environment features varied across different geographical settings (Rahman, Pocock, et al., 2020). In Bangladesh, the features of urban built environments are also different from those of other countries (Jamal & Mohiuddin, 2020). Therefore, further research should explore the differential effects of safety perceptions across various neighborhood-built environments in different contexts. Addressing these knowledge gaps may enhance the understanding of creating safer, more active urban environments that promote public health. Thus, this study aimed to explore the relationship between perceived urban built environment safety features and their influence on active transport behavior in Bangladesh. By addressing these gaps, the research provides valuable insights into designing safer and more supportive urban environments that promote active transport and enhance public health.

2. Materials and Methods

2.1 Research Approach and Study Area

This study employed quantitative methodology to investigate the association between perceived urban built environment safety and active transport usage. A quantitative approach was selected to statistically evaluate whether significant relationships exist between urban safety perceptions and active transport behaviors. The research was conducted in Dhaka, Bangladesh's capital, which has a lack of infrastructure support for active transport (Sarker et al., 2020). In Dhaka, public transport accounts for approximately 70.22% of travel, individual motorized transport 12.89%, and active transport 16.88% (ESCAP, 2018). Recent data indicate a 3.92% increase in active transport over the past six years. Active transport is predominantly utilized by young professionals and students for daily commuting in Dhaka (Sarker et al., 2020).

2.2 Participants and Sampling Technique

Participants with an age range of 18 to 35 participated in this study. The purpose of the study was explained to the participants before collecting data, and their verbal consent was obtained. The participation was entirely voluntary, and the participants had the right to withdraw from the survey at any time. The sample size was calculated with a 95% confidence interval and a 5% standard error due to a large population. The required sample size was 375. The purpose sampling technique was used. All participants were approached; however, finally, 250 valid responses (response rate: 66.67%) were considered for further analysis.

2.3 Data Collection

A structured questionnaire of 20-to-25 minutes was developed to conduct a survey to gather data on sociodemographic characteristics, travel mode choices, and perceived urban built environment safety factors. All the data were collected using both offline and online platforms. For online data collection, a web-based survey was administered by distributing a questionnaire hyperlink on social media, particularly Facebook. The online survey was created using Google Forms, ensuring anonymity for participants. In addition to the online approach, offline data were collected using a face-to-face survey.

Sociodemographic data included age, gender, income, and vehicle ownership. Participants' preferred means of transportation to their daily commuting were asked to report their mode of travel, including motorized transport (car, bus, motorbike, rideshare, and CNG-compressed natural gas) and active transport (walking and bicycle).

Perceived urban built environment safety, including traffic and personal safety, was assessed based on the statements adapted from previous research (Deforche et al., 2010; Hume et al., 2009; Mandic et al., 2017; Rahman, Pocock, et al., 2020; Salmon et al., 2007; Timperio et al., 2006; Verhoeven et al., 2017; Verhoeven et al., 2016). There were five statements to measure traffic safety, such as there was too much traffic along the routes, the traffic speed was high along the routes, there were enough signals to cross busy streets along the routes, There were many dangerous intersections along the routes, and there were enough crosswalks to cross busy streets. There were two statements to measure personal safety, such as streetlights were available along the routes, and the presence of crime (e.g., hijacking, robbery, theft, and incidents of abusing females) along the routes. Participants' perceptions of the urban built environment safety were assessed using a four-point Likert scale ranging from "Strongly agree =1" to "Strongly disagree=4", where participants indicated their agreement or disagreement with each statement.

2.4 Data Analysis

Sociodemographic characteristics, travel mode choice, and perceived urban built environment safety features were analyzed using descriptive statistics. Descriptive statistics included percentages, mean, and standard deviations (SD). The data collected on perceptions of the urban built environment using a four-point Likert scale was subsequently transformed into a two-point Likert scale ranging from "Agree (1)" to "Disagree (2)". A binary logistic regression model was used to determine the correlates of perceived urban built environment safety features for active transport users. The dependent variable was travel mode choice, organized into two categories (1=if participants used active transport; 0=otherwise). The independent variables were participants' sociodemographic characteristics, perceived traffic, and personal safety features. A bivariate analysis was conducted to identify the individual relationship between perceived urban built environment traffic and personal safety features and active transport. The variables significant in the bivariate model were further considered in the multivariate model. Participants' age and gender were considered control variables in the multivariate model to identify whether they influenced perceived urban built environment traffic and personal safety. The SPSS (version 27) software was used for data analysis, and a p-value <0.05 was considered significant.

3. Results

Among 250 participants' sociodemographic characteristics, the average age was 22.26, with a standard deviation 1.77 (Table 1). Gender male was 52%, and female was 48%. Over two-thirds of the participants had no driving license, bicycle, motorbike, or car ownership (Table 1). Among transport mode users, approximately two-thirds of the participants used motorized transport, and 20.8% of the participants used active transport (Table 2). One-third of the participants used the bus for daily commuting, and only 7.2% used CNG (Table 2). Among active transport participants, 19.2% walked, and only 1.6% cycled (Table 2).

Table 1. Sociodemographic characteristics of the study participants.

	Survey participants (n = 250)
Age (mean ± SD)	22.26 ± 1.77
Gender [n (%)]	
Male	130 (52%)
Female	120 (48%)
Bicycle ownership [n (%)]	
Yes	35 (14)
No	215 (86)
Motorbike ownership [n (%)]	
Yes	38 (15.2)
No	212 (84.8)
Car ownership [n (%)]	
Yes	31 (12.4)
No	19 (87.6)
Driving license [n (%)]	
Yes	49 (19.6)
No	201 (80.4)

SD= Standard deviation

Table 2. Participants' Travel Mode Choice.

Travel mode	**Survey participants** [n (%)]
Motorized/non-motorized transport	
Car	31 (12.4)
Bus	83 (33.2)
Motorbike	39 (15.6)
Rideshare	16 (6.4)
CNG	18 (7.2)
Rickshaw	11 (4.4)
Active transport	
Bicycle	4 (1.6)
Walk	48 (19.2)

Participants' perceptions of the urban built environment related to traffic safety varied between motorized and active transport users. Compared to motorized transport users, more than 90% of the active transport users stated that there was too much traffic on the routes (Table 3). 17.30% of active transport users reported high traffic speed along the routes. Approximately 85% of the active transport users agreed that there were many dangerous intersections, two-thirds found a lack of traffic signals, and three-fourths reported a lack of crosswalks along the routes (Table 3).

Participants' perceptions of the urban built environment related to personal safety also varied between motorized and active transport users. Compared to motorized transport users, more than 50% of the active transport users agreed that there were no traffic lights along their daily commuting routes (Table 3). In addition, three-fourths of the active transport users agreed that crimes (e.g., hijacking, robbery, theft, and incidents of abusing females) frequently occurred along routes for their daily trips (Table 3).

Table 3. Perceived urban built environment safety for motorized vs. active transport users.

Perceived built environment safety features	Transport modes (n = 250)			
	Motorized [n (%)]		Active transport [n (%)]	
	Agree	Disagree	Agree	Disagree
Traffic safety				
There was too much traffic along the routes	130 (65.6)	68 (34.4)	49 (94.2)	35 (5.8)
Traffic speed was high along the routes	170 (85.8)	28 (14.2)	9 (17.3)	43 (82.7)
There were enough signals to cross busy streets along the routes	80 (40.4)	118 (59.6)	20 (38.5)	32 (61.5)
There were many dangerous intersections along the routes	186 (93.9)	12 (6.1)	44 (84.6)	8 (15.4)
There were enough crosswalks to cross busy streets	36 (18.2)	162 (81.8)	12 (23.1)	40 (76.9)
Personal safety				
Streetlights are available along the routes	78 (39.4)	120 (60.6)	29 (55.8)	23 (44.2)
The presence of crimes (e.g., hijacking, robbery, theft, and incidents of abusing females) along the routes	171 (86.4)	27 (13.6)	39 (75)	13 (25)

The bivariate binary logistic regression analysis illustrated that among the urban built environment, traffic volume (p=0.000), traffic speed (p=0.000), intersections (p=0.033), availability of street lights (p=0.035), the presence of crime (p=0.049), and access to public transit (p=0.047) along the routes were statistically significant (Table 4). The negative coefficient of traffic volume and speed indicated that younger adults were less likely to use active transport due to a high traffic volume and speed along the routes for their daily commuting. Too many intersections along the routes were also negatively associated with using active transport among younger adults. The availability of streetlights was a positive correlate, whereas the presence of crime on the daily commuting routes negatively correlated with using active transport.

In the multivariate analysis without controlling age and gender, younger adults were less likely to use active transport due to a high traffic volume, high traffic speed, too many intersections, and the presence of crime along the routes. Younger adults were more likely to use active transport due to the availability of streetlights on the routes. While controlling age and gender, the presence of crime was not statistically significant (Table 5).

Table 4. Bivariate correlates of the perceived urban built environment safety for active transport users.

Perceived built environment safety features	Co-efficient	Standard error	95% CI		p-value
			Lower bound	Upper bound	
Traffic safety					
There was too much traffic along the routes	-2.14	.61	2.56	28.42	**.000**
Traffic speed was high along the routes	-3.36	.41	.01	.07	**.000**
There were enough signals to cross busy streets along the routes	-.08	.32	.49	1.72	.799
There were many dangerous intersections along the routes	-1.03	.48	.13	.92	**.033**
There were enough crosswalks to cross busy streets	.03	.37	.64	2.82	.426
Personal safety					
Streetlights are available along the routes	0.66	.31	1.04	3.59	**.035**
The presence of crimes (e.g., hijacking, robbery, theft, and incidents of abusing females) along the routes	-.74	.38	.22	1.00	**.049**

Table 5. Multivariate correlates of the perceived urban built environment safety for active transport users without controlling age and gender.

Perceived built environment safety features	Co-efficient	Standard error	Odd ratio	95% CI		p-value
				Lower bound	Upper bound	
Traffic safety						
There was too much traffic along the routes	-2.19	.72	11.72	2.16	37.21	**.000**
Traffic speed was high along the routes	-3.26	.45	.04	.01	.09	**.000**

Perceived built environment safety features	Co-efficient	Standard error	Odd ratio	95% CI		p-value
				Lower bound	Upper bound	
There were many dangerous intersections along the routes	-.62	.69	.53	.13	2.11	**.037**
Personal safety						
Streetlights are available along the routes	.70	.43	2.08	.86	4.72	**.039**
The presence of crimes (e.g., hijacking, robbery, theft, and incidents of abusing females) along the routes	-.03	.55	1.03	.35	3.07	**.048**

Table 6. Multivariate correlates of the perceived urban built environment safety for active transport users with controlling age and gender.

Perceived built environment safety features	Co-efficient	Standard error	Odd ratio	95% CI		p-value
				Lower bound	Upper bound	
Sociodemographic characteristics						
Age	-.10	1.26	.89	.07	10.62	.933
Gender	-.39	.48	.67	.25	1.74	.416
Traffic safety						
There was too much traffic along the routes	-2.46	.76	8.97	2.62	52.33	**.000**
Traffic speed was high along the routes	-3.21	.48	.03	.01	.10	**.000**
There were many dangerous intersections along the routes	-.71	.72	.48	.11	2.00	**.031**
Personal safety						
Streetlights are available along the routes	.73	.46	2.01	.84	5.17	**.046**
The presence of crimes (e.g., hijacking, robbery, theft, and incidents of abusing females) along the routes	.23	.59	1.26	.39	4.00	.694

4. Discussion

This study provides significant insights into how urban built environment safety perceptions impact individuals' active transport behaviors. The present study findings highlight that traffic safety, including high traffic volume, excessive traffic speed, hazardous intersections, and personal safety, such as inadequate street lighting and high crime rates, were key factors influencing the likelihood of engaging in active transport among individuals.

Previous studies found that high traffic volume and speed were negatively associated with active transport due to perceived or real safety concerns (Guo et al., 2007; Kolidakis et al., 2024). Prior studies conducted in the United States and Bangladesh reported that compared to using motorized transport, high traffic volume on the usual travel routes increased the likelihood of individuals choosing active transport, such as walking or cycling, due to the time efficiency or convenience (Hossen & Zaman, 2022; Rodríguez & Joo, 2004). In an urban area with high traffic volume on the usual travel routes, an individual was more likely to prefer active transport in a developing country, particularly walking for their short-distance travel (Hossen & Zaman, 2022). Traffic speed may also play a crucial role in understanding how people choose to get around and affect their decisions on walking or cycling as alternative modes of transportation. A study conducted in China found that low traffic speeds made it easier for people to choose active transport, such as walking and cycling (Han et al., 2022). High traffic volume and speed may discourage people from walking and cycling for their daily commuting purposes because of creating risk and discomfort (Teuber & Sudeck, 2021). Creating controlled traffic volume and speed environments may encourage younger adults to choose walking and cycling as transport options.

The present study reported that individuals felt unsafe using active transport at many dangerous intersections along the routes. A systematic review of intersectionality and urban mobility found that individuals were less likely to use active transport for dangerous intersections along the routes (Yuan et al., 2023). However, high intersection density ensured more connected roadways and encouraged active transport in the United States (Marshall & Garrick, 2010). Another study conducted in a similar context found that high intersection density, where motorized traffic predominates, would discourage individuals from using active transport (Schneider, 2013). In New Zealand, too many dangerous intersections along the routes were also negatively associated with active transport (Rahman et al., 2022). Individuals' perceptions of safety related to dangerous intersections along the routes varied within a reasonable distance whether they used active transport (Mandic et al., 2022). The present study suggests that initiatives taken to manage intersections along the routes may reduce individuals' safety concerns about using active transport over private vehicles.

The present study found a significant positive association between the perceived urban built environment-related personal safety, such as the availability of street lights and active transport. This finding is consistent with the previous study that found a positive association between the availability of street lights and using active transport such as walking and cycling in Germany (van Bommel & van Bommel, 2015). Another study conducted in China found that due to well-lit streets, adults were more likely to use active transport (Yin et al., 2022). The availability of street lighting along the routes to promote walking and cycling, particularly in densely urban areas, is substantial (Ma & Zeng, 2016). Good street lighting along the routes may reduce accidents and enhance the sense of security among younger adults, thus promoting active transport.

Another personal safety, including the presence of crime along the daily commuting routes, was negatively associated with active transport among younger adults. One previous study reported that adults who experienced crime along the routes of their daily commuting purposes were less likely to use walking and/or cycling in the United Kingdom (Heinen, 2023). In the United States, high crime levels negatively influenced discretionary travel decisions among adults, as increased perceptions of insecurity lead to a decrease in walking (Singleton & Wang, 2014). In the United States, adults living in high-crime neighborhoods were less inclined to walk or cycle and preferred public transit options (Appleyard & Ferrell, 2017; Ferrell et al., 2015). Reducing crime levels along the routes may encourage younger adults to walk and cycle instead of public transit.

4.1 Study Implications

In developing countries, where traffic congestion and car dependency have increased, local authorities and policymakers need policies to encourage people to use active transport instead of private vehicles and reduce traffic congestion. The present study suggests that reducing traffic volume and speed along the routes may promote active transport among adults, particularly walking and cycling in major cities of developing countries. The challenges for integrating active transport into transport policies in Bangladesh may not be well addressed. The present transport policies in Bangladesh are primarily focused on infrastructure development, which is favorable to motorized transport instead of promoting active transport. However, encouraging active transport may significantly reduce traffic congestion in large cities in many developing countries. Even in a newly developed residential area, where active transport is easier to integrate into the mainstream transport system development may not be emphasized by transport planners and policymakers in Bangladesh. The present study highlights that the lack of street lights and the presence of crime along the routes discourage younger adults from walking or cycling for daily commuting. Therefore, the present study suggests that providing adequate street lighting along the routes and identifying the crime hotspot areas may increase the rate of use of active transport among younger adults. Policymakers may integrate the policies related to mapping the crime hotspot areas while planning for active transport in the major cities in developing countries, particularly in Dhaka, Bangladesh. Since accessibility to public transit encourages younger adults to use active transport, transport planners and policymakers should take necessary initiatives or interventions (e.g., constructions of footpaths or cycle paths, provision of adequate street lightings, and identification of crime hotspots areas along the routes) to reduce the barriers to using active transport from home to transit stations.

4.2 Study Strengths and Limitations

The study's major strength was to explore the influential factors associated with perceived urban built environment safety in a developing country context, where active transportation would be promoted to reduce traffic congestion and health-related costs. However, the study has limitations, including a relatively small sample size, which may limit the generalizability of the findings. Additionally, the focus on perceived safety without considering objective metrics of the urban environment is a notable limitation. Future research should address these limitations by incorporating objective assessments and employing longitudinal and experimental designs to determine causal effects between safety perceptions and active transport behaviors. Exploring how these factors influence different age groups and demographic contexts would further refine strategies for promoting active transport.

5. Conclusions

Perceived urban built environment safety, including traffic and personal safety, significantly influences the travel behavior of active transport users. Traffic safety, such as high traffic volume and speed, discouraged individuals from using active transport. A significant positive association was observed between personal safety (e.g., availability of street lights) and active transport. Another personal safety, such as the presence of crime along the routes was a negative correlate of perceived urban built environments to use active transport. In addition, adults were more likely to use active transport due to the accessibility to public transit. Transport planners and policymakers should address perceived urban built environment issues, particularly traffic and personal safety, to design interventions to promote active transport among younger adults in major cities of developing countries.

Declaration of interest statement

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Data availability statement

The data are not publicly available because they contain information that could compromise the privacy of research participants.

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