Understanding the Shared Risk: A Questionnaire Survey of Pedestrian and Driver Safety Concerns at Street Crossings in Motorcycle-dependent cites

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Abstract: Pedestrian safety at crossings in motorcycle-dependent cites, especially in theHanoi capital of Vietnam presents significant challenges. The study, based on a sample of 213 respondents, underscores the complex interplay between behavioral, infrastructural, and emotional factors influencing pedestrian safety at midblock crossings. While both groups acknowledged the fundamental importance of pedestrian safety and the necessity of coordinated efforts, significant discrepancies emerged regarding the causes of unsafe crossings. Pedestrians predominantly attributed risks to driver behaviors and infrastructural deficiencies, expressing fear and frustration, while drivers emphasized pedestrian non-compliance and voiced concerns about pedestrian behavior. This divergence reveals a critical perceptual gap, highlighting the need for a nuanced approach to safety interventions. To develop effective strategies, future research should employ mixed methods, including observational studies, to explore driver behaviors and evaluate the impact of targeted interventions such as enhanced enforcement and community-based programs.

Keywords: pedestrian safety, questionaire survey, mixed traffic condition, mixed-methods approach, midblock crossing.

1. INTRODUCTION

In major cities in Vietnam, such as Hanoi, which like many rapidly developing cities, grapple with the complexities of a vibrant and dynamic urban landscape. This "mixed traffic" environment, characterized by a diverse array of vehicles including motorcycles, bicycles, trucks, cars, and pedestrians, presents unique challenges to road safety (Figure 1). Among these challenges, pedestrian safety at midblock crossings emerges as a critical concern (Apardian *et al.*, 2017; Chaudhari *et al.*, 2020; Chen *et al.*, 2019). At these unguarded crossings, often lacking even basic infrastructure and visibility, pedestrians are highly vulnerable as they attempt to navigate the complex stream of vehicles, with jaywalking being a common occurrence.

The dominance of motorcycles in Hanoi significantly influences the dynamics of pedestrian-vehicle interactions. Motorcycles, with their agility, speed, and often less conspicuous presence, can be particularly challenging for pedestrians to perceive and anticipate. Their ability to weave through traffic, accelerate quickly, and utilize narrow gaps between vehicles creates a dynamic and unpredictable traffic environment. This unpredictability, coupled with the high volume of motorcycle traffic, significantly increases the risk of pedestrian-motorcycle collisions at midblock crossings.

Furthermore, the distinctive characteristics of Hanoi's urban fabric exacerbate these challenges. Narrow streets, dense traffic, and often inadequate infrastructure, such as limited sidewalks and poorly maintained roadways, pavement marking, road sign as well as traffic signal system create a challenging environment for pedestrians. Limited visibility, obstructed sight distance due to parked vehicles and roadside activities – like shops, stalls, and billboards

as well as unmainternance trees encroaching upon sidewalks and pedestrian crossings – further constrict pedestrian space and increase the risk of accidents. The lack of dedicated pedestrian infrastructure at many midblock crossings contributes significantly to the heightened risk for pedestrians (Figure 2 and Figure 3). Meanwhile, observations revealed persistent instances of unsafe pedestrian behavior, including crossing at undesignated locations without road markings or crossing facilities, and a reluctance to utilize desinated crossing facilities when available (Figure 4).

This study aims to investigate pedestrian safety at midblock crossings in Hanoi by employing a mixed-methods approach, with a primary focus on a comprehensive questionnaire survey. A key feature of this study is the inclusion of perspectives from both pedestrians and drivers, particularly motorcycle riders. This dual-perspective approach offers an particular advantage: it allows for the cross-checking of information and the identification of potential discrepancies in perceptions and reported behaviors. By understanding the shared and divergent perspectives of these two key road user groups, this study aims to gain a more comprehensive and nuanced understanding of the factors contributing to pedestrian safety at midblock crossings in Hanoi's mixed traffic environment.

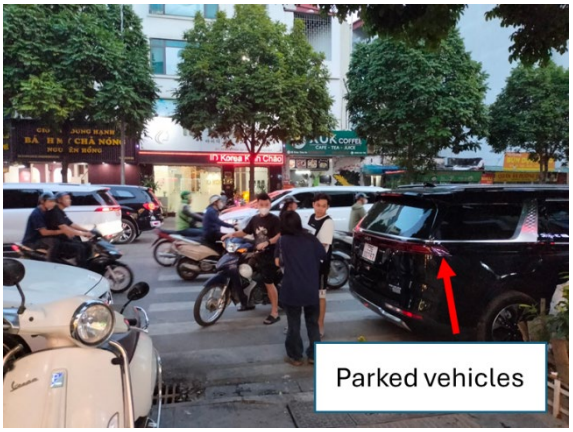
The findings of this study will contribute to a deeper understanding of the challenges and opportunities for enhancing pedestrian safety not only in Hanoi, but other places with similar contexts. By identifying key areas of concern and understanding the perspectives of all road users, this research will inform the development of evidence-based interventions to improve safety for pedestrians and all other road users at midblock crossings. These interventions may include infrastructure improvements, such as the installation of raised crosswalks, improved signage, and the creation of dedicated pedestrian zones. Additionally, the findings of this study can inform targeted public awareness campaigns to educate both pedestrians and drivers on safe crossing behaviors and the importance of shared responsibility for road safety.

a) Variou types of approaching vehicles

b) High volume of approaching traffic

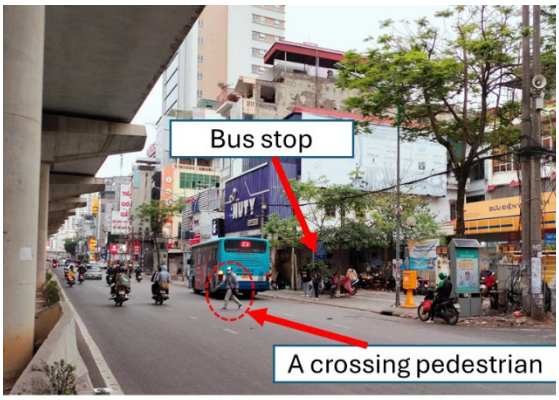
Figure 1. The complexity of approaching traffic flow a pedestrian crosswalk

a) Obstructed signs by tree and roadside activities



b) illegal parked vehicles

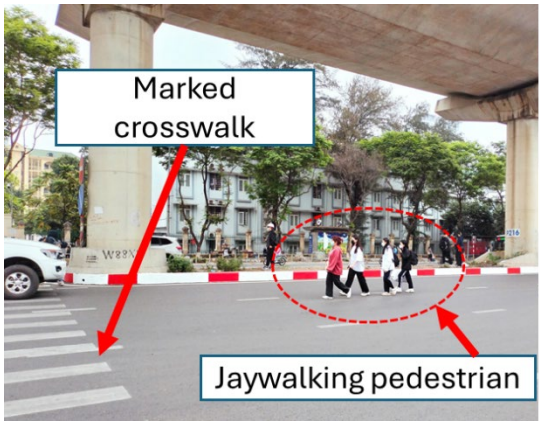
Figure 2. Lack of areweness of pedestrian crossing



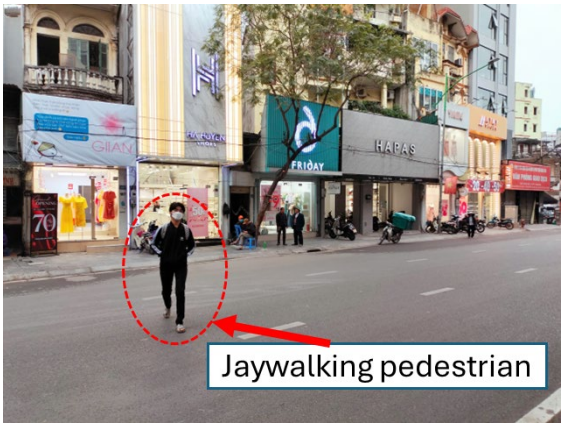
a) No designated crosswalk for pedestrian crosssing at bus stop

b) Low quality of zebra marking for pedestrian crossing

Figure 3. Inadequate and poor maintenance of crossing infrastructure



a) Pedestrians do not use marked crosswalk to cross the street.



b) Pedestrian crossing at un-designated crosswalk

Figure 4. Jaywalking is common among pedestrians crossing the street in Hanoi

2. LITERATURE REVIEW

Numerous studies have investigated the factors contributing to pedestrian accidents. These studies can be viewed from several perspectives, such as the driver's perspective, the pedestrian's perspective, and the perspective of urban planners.

Studies consistently demonstrate that pedestrian behavior plays a crucial role in accident risk, particularly at midblock crossings where pedestrians are less protected compared to at signalized intersections. Additionally, insufficient pedestrian awareness frequently leads to hazardous actions, including jaywalking. Jaywalking, defined as crossing the street outside of designated crosswalks or against traffic signals, is a significant contributor to pedestrian injuries and fatalities (Jason and Liotta, 1982; Zhang *et. al.*, 2023; Anik *et. al.*, 2021). Zegeer and Bushell (2012) also indicate that pedestrians are at highest risk in urban areas partly due to the high volume of pedestrians and vehicles in urban areas.

Driver behavior significantly influences pedestrian safety when running through midblock crossing areas. Studies show that drivers who fail to yield the right of way are a risk factor for traffic accidents for pedestrians (Fitzpatrick *et al.*, 2006; Van Houten and Malenfant, 2004; Preusser *et al.*, 2002). Other behavior of drivers, including speeding, distracted driving, and aggressive driving, also plays a crucial role in pedestrian collisions. These behaviors significantly increase the risk of collisions and the severity of injuries (Tefft, 2013; Klauer *et al.*, 2006; AAA Foundation for Traffic Safety, 2016).

Dąbrowska and Sicińska (2021) also examined pedestrian and car driver attitudes at crosswalks in Poland, based on questionaire survey method. The study reveals discrepancies between declared behaviors and actual actions, with 78% of pedestrians and 72% of drivers supporting stricter laws to enhance pedestrian safety. Key findings include risky behaviors by both groups, with drivers often failing to yield to pedestrians. This research also indicate that, a significant majority of car drivers (76%) identified risky pedestrian behavior as the primary issue at crosswalks. This perception was reinforced by pedestrian self-reports, with 90% acknowledging the necessity for extreme caution when crossing.

Furthermore, the design and layout of crossings significantly influence pedestrian safety. Well-designed infrastructure, such as raised crosswalks, clearly marked pedestrian crossings, and adequate lighting, can enhance pedestrian visibility and reduce the risk of accidents (Elvik *et al.*, 2000; Zegeer *et al.*, 2005). Zegger *et al.* (2005) also indicated that pedestrian facility enhancements such as traffic signals, traffic-calming, pedestrian warranted or other substantial crossing improvement before adding marked crosswalks can improve crossing safety for pedestrians.

In an another perspective, Bhuiyan *et al.* (2004) assesses pedestrian crossing facilities' impact on Bangladeshi traffic focusing on travel time costs and benefit-cost ratios (BCR). Findings show grade-separated facilities are better in low-pedestrian areas, while pedestrian signals are best in crowded zones. The findings reveal that grade-separated facilities yield superior BCR in areas with limited pedestrian traffic, while pedestrian signals boast the highest BCR in densely pedestrianized zones. The study highlights the importance of considering both vehicle and pedestrian travel time costs when planning crossing facilities. It also offers insights for urban planners and policymakers seeking to optimize traffic flow and enhance pedestrian safety.

Generally, through the literature reviews, it is found that pedestrian accidents stem from a complex interplay of factors, encompassing pedestrian behavior, driver actions, and infrastructural design. Studies consistently highlight the significant role of pedestrian behavior, particularly risky actions like jaywalking and decreased awareness at midblock crossings, in elevating accident risk. However, driver behavior, including failure to yield, speeding,

distracted driving, and aggressive driving, is equally critical in jeopardizing pedestrian safety. The importance of well-designed infrastructure, incorporating features like raised crosswalks, clear markings, and adequate lighting, is crucial for mitigating these risks. Overall, enhancing pedestrian safety requires a holistic approach that addresses both pedestrian and driver behaviors. This necessitates integrating stricter enforcement, improved infrastructure, and targeted educational campaigns to foster a culture of mutual responsibility and awareness among all road users.

3. METHODOLOGY

This study employs a mixed-methods approach to investigate pedestrian safety at midblock crossings in Hanoi, Vietnam. The methodology is designed to capture the complexities of pedestrian-vehicle interactions in a mixed traffic environment, with a particular focus on the perspectives of both pedestrians and motorcycle riders. The subsequent sections provide a detailed description of the data collection process, results, and analysis.

3.1 Data Collection

The primary data collection method is a structured questionnaire survey targeting two key road user groups: pedestrians and drivers. The survey is designed to capture their perceptions, behaviors, and experiences related to midblock crossings in Hanoi. The questionnaire is divided into several sections. For the pedestrian, that includes:

Demographics and walking habits:

- Age, Gender, Occupation

Road Crossing Safety and Behavior of pedestrians

- Do you often have to walk across the street? (*Rarely, Occasionally, Once a week, Several times a week, Daily*)
- How safe do you feel when walking across the street? (*Very dangerous, Dangerous, Neutral, Safe, Very safe*)
- Why do you feel unsafe when walking across the street? (*Vehicles do not yield, High traffic volume, Vehicles driving at high speed, Drivers not paying attention, Lack of designated pedestrian crossings, Other…*)
- Have you ever crossed the street in an undesignated place for pedestrians (A location where people cross the street outside of designated crosswalks, without markings, signs, or other infrastructure such as pedestrian overpass or underpass)? (*Never, Rarely, Occasionally, Frequently, Very frequently*)
- How safe do you feel when crossing the street in an undesignated place for pedestrians? (*Very dangerous, Dangerous, Neutral, Safe, Very safe*)

Attitudes towards Overpasses/Underpasses

- If there is an pedestrian overpass or underpass nearby, do you use it to cross the street? (*Do not use, Unlikely, Neutral, Likely, Definitely*)
- Why don't you want to use an overpass or underpass for pedestrians? (*Inconvenient (too far or not available), Poor design, not user-friendly, Poor sanitation, Lack of lighting or shelter, Unsafe, Other reasons…*)

Opinions and suggestions for Improvement

- Suggestions to improve safety and service quality for pedestrians when crossing the road. (*Increase awareness of pedestrian crossings, Increase the*

construction of pedestrian overpasses and underpasses, Educate and raise awareness among drivers to yield to pedestrians, Increase penalties for drivers who do not yield and cause accidents, other…)

For the drivers, that includes:

Demographics and driving habits

Age, Gender, Occupation, Main mode of transportation used as a driver, Frequency of vehicle use.

Pedestrian crossing awareness and behavior of drivers

- Do you identify pedestrian crossings (the crossing point with pavement markings, pedestrian crossing signs) when driving? (*Never, Rarely, Occasionally, Frequently, Very frequently*)
- In your opinion, is the system of markings and signs for pedestrian crossings in Hanoi sufficient and clear? (*Strongly disagree, Disagree, Neutral, Agree, Strongly agree*)
- Do you reduce speed when driving through a pedestrian crossing? (*Never, Rarely, Occasionally, Frequently, Very frequently*)
- When you see pedestrians crossing the street at the designated place, do you yield to them? (*Never, Rarely, Occasionally, Frequently, Very frequently*)
- When driving, do you see pedestrians crossing the street in undesignated places? (*Never, Rarely, Occasionally, Frequently, Very frequently*)
- Which area do you think is the most dangerous when pedestrians cross the street in undesignated places? (*At intersections, inter – intersections segments, low traffic volume street, busy street, obstructed visibility due to trees, bridge pillars, other…*)

Attitudes and opinions

- In your opinion, is crossing the street in undesignated places very dangerous for pedestrians and traffic? (*Strongly disagree, Disagree, Neutral, Agree, Strongly agree*)
- What solutions do you think are needed to improve safety for pedestrians? (*Increase awareness of pedestrian crossings with painted lines, Increase the construction of pedestrian bridges and underpasses, Educate and raise awareness among pedestrians, Increase penalties for pedestrians violating traffic laws, other…*)

Survey locations are chosen in a major corridor in Hanoi such as Hotungmau – Xuan Thuy – Cau Giay street that are locations with high traffic volume as well as pedestrian crossing volume. Additionally, this is a large street with a system of overpass bridges for metro trains in the street median (with many pillars that limit driver visibility). The field survey work is shown in Figure 5. A total of 213 respondents are targeted, with an approximately equal representation of pedestrians and drivers. The survey time frame was in November 2013.

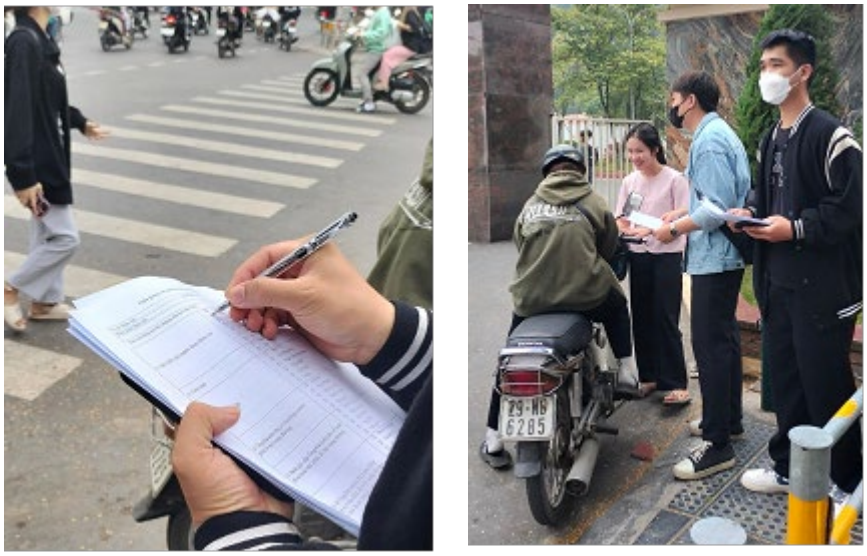


Figure 5. On site questionaire survey work

Prior to the survey date, comprehensive training will be provided to all surveyors. On the survey date, surveyors will convene at a designated meeting point 30 minutes before the start time. Surveyors will then proceed to their assigned locations and approach road users that include pedestrians and drivers to request their participation in the survey. If a road user agrees, the surveyor will guide them through the questionnaire, ensuring accurate completion. After reviewing the responses, the surveyor will thank the participant and proceed to survey other road user in the area.

3.2. Result and analysis

The major methodology is to analyzes pedestrian and driver perspectives, including their thoughts and feelings, on safety at midblock crossings using a mixed-methods approach. Quantitative data from surveys of 105 pedestrians and 108 drivers was analyzed to identify trends, correlations, and significant differences in responses. Key metrics included perceived safety, frequency of risky behaviors, and attitudes towards various safety measures. Qualitative data, gathered through open-ended survey questions, was analyzed thematically to identify recurring themes and insights regarding the thoughts and feelings between the two surveyed groups. This dual perspective allows for comparison and validation of information, highlighting areas of agreement and discrepancy between pedestrian and driver experiences. For instance, differing perceptions regarding yielding behavior at crossings, including the underlying thoughts and feelings associated with these perceptions, can be investigated to understand the causes of safety concerns. The combined findings offer a comprehensive understanding of the factors, including the interplay of thoughts and feelings between pedestrians and drivers, influencing pedestrian safety at these crossings.

The pedestrian survey group consisted of 105 participants (Table 1), with a slightly higher proportion of males (54.3%) than females (45.7%). The largest age group represented was 18-24 years old, comprising 50.5% of the respondents. The remaining participants were older than 24, but the specific age ranges are not provided here. In terms of occupation, students made up the largest segment at 31.4%, followed by office workers at 23.8%, and retired individuals at 17.1%. Other occupations were represented, but the percentages are not specified. As the survey was conducted near several universities along the survey corridor, the high proportion of young

people, students, and office stafts is not surprising.

Table 1. Demographic information of pedestrian group

Characteristic	Result	%
Total respondents	105	
Gender		
Male	57	54.3
Female	48	45.7
Age		
18-24	53	50.5
25-34	8	7.6
35-44	10	9.6
45-54	11	10.5
55-64	12	11.4
65+	11	10.5
Occupation		
Student	33	31.4
Freelancer	10	9.5
Office staft	25	23.8
Worker	13	12.4
Retired	18	17.1
Other	6	5.7

Table 2. Demographic Information of the vehicle driver group

Characteristic	Result	%
Total respondents	108	
Gender		
Male	69	63.9
Female	39	36.1
Age		
18-24	41	38.0
25-34	11	10.2
35-44	17	15.7
45-54	13	12.0
55-64	19	17.6
65+	7	6.5
Occupation		
Student	23	21.4
Freelancer	21	19.6
Service driver (Taxi, Grab, truck, bus, other services)	10	9.3
Office staft	25	23.4
Worker	11	10.3
Retired	17	15.9
Type of vehicle used		
Bicycle	10	9.3
Motorcycle	73	68.2
Car	13	12.1
Truck/Bus/Coach	9	8.4
Other motorized vehicles	2	1.9

The majority of pedestrians surveyed answered that they cross the street every day, accounting for 61.9%. The majority of pedestrians surveyed assessed that crossing the street is dangerous, with very dangerous levels accounting for 28.6% and dangerous levels accounting for 33.3%. Regarding the reasons for felling unsafe when crossing the street, pedestrians mainly said that it was due to heavy traffic (67.6%), high-speed vehicles (59%), while the remaining reasons were that vehicles do not yield the right of way (38%), drivers fail to see pedestrian (41%), and a lack of pedestrian crossing facilities (35.2%). Questions about pedestrian behavior showed that 5.7% of pedestrians very often cross the street at undesignated locations (jaywalk), 16.2% often, and 61% are normal. Some pedestrians who answered normally also added an explaination that it was sometimes yes and sometimes no, depending on the convenience of crossing the street. 20% of the pedestrians asked also answered that they would definitely use the overpass or underpass to cross the street and 34.3% answered definitely. Some of the reasons pedestrians do not use overpasses or underpasses to cross the street were because they are inconvenient or too far away (43.8%), have unreasonable design (41%), lack of shelter or lighting (33.3%), do not ensure environmental hygiene (29.5%) and are unsafe (29.5%). Finally, to improve pedestrian safety, pedestrians suggested solutions such as increasing the construction of overpasses and underpasses for pedestrians to cross the road (68.6%), increasing the level of penalties for drivers who do not give way and cause accidents to pedestrians (65.7%), educating and raising awareness for drivers who give way to pedestrians (64.8%) and increasing awareness of crosswalks (29.5%).

For drivers, the results of 108 surveys were obtained (Table 2) with 63.9% of drivers being male while 36.1% were female. Of these, 68.2 are motorbike users and 9.3 are bicycle users, the rest are car, truck and bus users. The age group surveyed was mainly from 18-24 years old (38%). The occupations of the drivers interviewed were mainly students (21.4%), self-employed (19.6%), office workers (23.4%), and other subjects including service drivers (9.3%). Regarding the behavior of drivers, the interview results showed that drivers very often (26.9%) and often (38%) reduced speed when driving through pedestrian crossings, while 20.4% of respondents said they very often yield the way to pedestrians and 47.2% said they often yield the way to pedestrians.

In addition, drivers reported frequently observing pedestrians crossing the street at undesignated locations, with 15.7% saying they 'often' see this, and 42.6% reporting seeing it 'frequently. Moreover, drivers said that the most dangerous areas for pedestrians to cross the street are the areas that are out of sight due to trees and bridge pillars of metro system (25.9%), while busy street and inter-intersection segment both account for 20.4%. The rest are low traffic streets and at intersections, each option only accounts for 16.7%. Furthermore, 40.7% of drivers strongly agreed and 36.1% agreed that pedestrians crossing the street in the undesignaged place is very dangerous for pedestrians and vehicles. Similar to the results of interviews with pedestrians, the majority of drivers said that it is necessary to increase the construction of overpasses for pedestrians (55.6%) and 42.6% said that it is necessary to increase awareness of pedestrian crossings. To prevent pedestrians from crossing the street in the wrong place, drivers believe that it is necessary to educate and raise awareness among pedestrians (50.9%) and increase the level of punishment for pedestrians who violate traffic laws (47.2%).

4. DISCUSSION AND CONCLUSION

This study revealed a complex interplay of factors affecting pedestrian safety at midblock crossings in Hanoi, characterized by both shared concerns and notable discrepancies between pedestrian and driver perspectives.

Regarding shared concerns and the need for coordination, both pedestrians and drivers

recognized the paramount importance of pedestrian safety and the necessity of crossing at designated locations. They also acknowledged the need for close coordination among all stakeholders to ensure safe crossing practices. This shared understanding forms a crucial foundation for developing effective interventions.

Concerning the divergent perspectives and underlying issues, significant differences emerged in how each group perceived the causes of unsafe crossings. Pedestrians often attributed the problem to driver behavior, emphasizing the need for stricter adherence to traffic laws and yielding to pedestrians. Conversely, drivers frequently pointed to pedestrian behavior, highlighting instances of jaywalking and improper crossing. This divergence underscores a potential disconnect between reported driver actions and actual pedestrian experiences, likely fueled by differing perceptions of responsibility and risk. Furthermore, pedestrians emphasized the need for enhanced traffic infrastructure, including more traffic lights, road markings, and signs. Drivers, while acknowledging infrastructure improvements, also stressed the importance of pedestrian education and awareness campaigns. These contrasting priorities highlight the need for a balanced approach that addresses both infrastructure deficiencies and behavioral factors.

In considering the role of emotional dimensions, the qualitative data highlighted the emotional dimensions of the safety issue. Pedestrians expressed frustration and fear when crossing, while drivers, despite reporting compliance, voiced concerns about pedestrian behavior. These emotional responses must be considered when designing interventions. Educational campaigns, for instance, could foster empathy and mutual understanding, emphasizing the vulnerability of pedestrians and the shared responsibility for road safety.

While providing valuable insights, the study's findings are limited by the relatively small sample size of 213 respondents, which may not fully represent Hanoi's diverse population. Nevertheless, the results underscore the need for a multi-faceted approach to improve pedestrian safety.

Future research should delve deeper into the specific factors influencing driver behavior, including traffic volume, road design, and driver attitudes. Observational studies could complement survey data, providing a more objective assessment of behavior. Additionally, investigations into the effectiveness of targeted interventions, such as targeted enforcement of speed limits in midblock crossing areas and enforcement of yielding to pedestrians and community-based programs, are warranted. By integrating quantitative and qualitative data, and by acknowledging the interplay of perceptions and emotions, a more holistic and effective approach to enhancing pedestrian safety can be developed.

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