



Strategies to promote pedestrian safety from the viewpoints of traffic and transport stakeholders in a developing country: A mixed-method study

Morteza Haghighi^a, Fatemeh Bakhtari^{a,b}, Homayoun Sadeghi-Bazargani^b, Haidar Nadrian^{c,*}

^a Department of Health Education and Promotion, Faculty of Health, Tabriz University of Medical Sciences, Tabriz, Iran

^b Road Traffic Injury Research Center, Tabriz University of Medical Sciences, Tabriz, Iran

^c Social Determinants of Health Research Center, Tabriz University of Medical Sciences, Tabriz, Iran

ARTICLE INFO

Keywords:

Pedestrian safety
Urban traffic
Transport
Mixed-method study
Traffic stakeholders

ABSTRACT

Introduction: Pedestrians are among the most vulnerable groups in traffic accidents. The purpose of this study was to explore the strategies associated with pedestrian safety from the perspective of traffic and transport stakeholders.

Methods: In 2018, this mixed-method study with an explanatory design was conducted in two phases: a quantitative cross-sectional study (the first phase) was conducted among 508 residents in Tabriz, Iran. The valid and reliable Pedestrian Safety Behaviors (PSB) scale was used to collect data through self-report. In the second phase, the quantitative results were presented to twenty-four urban traffic and transport stakeholders during individual interviews (as the qualitative phase) to explore the strategies to promote the safety behaviors of pedestrians. The qualitative data were analyzed applying the conventional content analysis approach.

Findings: In the quantitative phase, the residents acquired more than 62% of the maximum possible score in all constructs. Among all the domains, aggressive behaviors (85.6%), distractive behaviors (77.2%), violation (21.56%), and PSBs (70.5%) were found with the highest scores. Age, gender, and educational level were significant predictors of safety pedestrians' behaviors ($p \leq 0.001$). In the qualitative phase, the strategies to promote pedestrian safety were explored and grouped into four main categories: *building public education policies on traffic safety, developing traffic safety infrastructure, improving the traffic management system, and strengthening urban traffic safety legislation.*

Conclusion: Our findings provided strategies to promote pedestrian safety for urban traffic and transport systems of developing countries with specific complexities, particularly in the management system. The mixed-method approach used in the present study was helpful in identifying the most relevant strategies for promoting safe behaviors of pedestrians in Iran, as a developing country. These strategies may be considered while traffic safety policy-making and/or designing pedestrian safety promotion programs within urban environments. The strategies reported here may pertain not only to the Iranian community but also to other potential sectors in developing countries that have the responsibility of providing pedestrians with a safe roadway environment.

* Corresponding author. Faculty of Health Sciences, Tabriz University of Medical Sciences, Attar-e-Neyshabouri st., Tabriz, Iran.

E-mail addresses: haghighy.m@gmail.com (M. Haghighi), fatemeh.bakhtari@gmail.com (F. Bakhtari), homayoun.sadeghi@gmail.com (H. Sadeghi-Bazargani), haidarnadrian@gmail.com (H. Nadrian).

1. Introduction

In low- and middle-income countries, a large number of annual traffic accident deaths and injuries is due to road crashes among pedestrians. Globally, about 400,000 pedestrians are killed due to road traffic crashes each year (WHO, 2018; Naci et al., 2009). In Iran, every year, more than 4000 pedestrians die in traffic accidents (Hasani et al., 2017). Universal statistics also show a high proportion of pedestrian deaths to total death caused by traffic accidents in developing countries (World Health Organization, 2015; Zegeer and Bushell, 2012). In a majority of developed countries, however, road accidents are declining due to continued investment in infrastructure and safety programs (Levine, 2006; Jadaan et al., 2018). Studies on the risk of pedestrian accidents in developing countries, such as Iran, are in their infancy because road safety interventions have just begun and are in full swing. Besides, in such countries, road safety studies are focused more on improving the safety of drivers than pedestrians (Tulu et al., 2013; Dinh et al., 2020; Shaaban, 2019).

Among all road users, pedestrians are more prone to road accidents because they are so flexible and unpredictable (Papadimitriou et al., 2016; De Lavalette et al., 2009). In literature, several behavioral factors like talking on a cellphone while crossing the street,

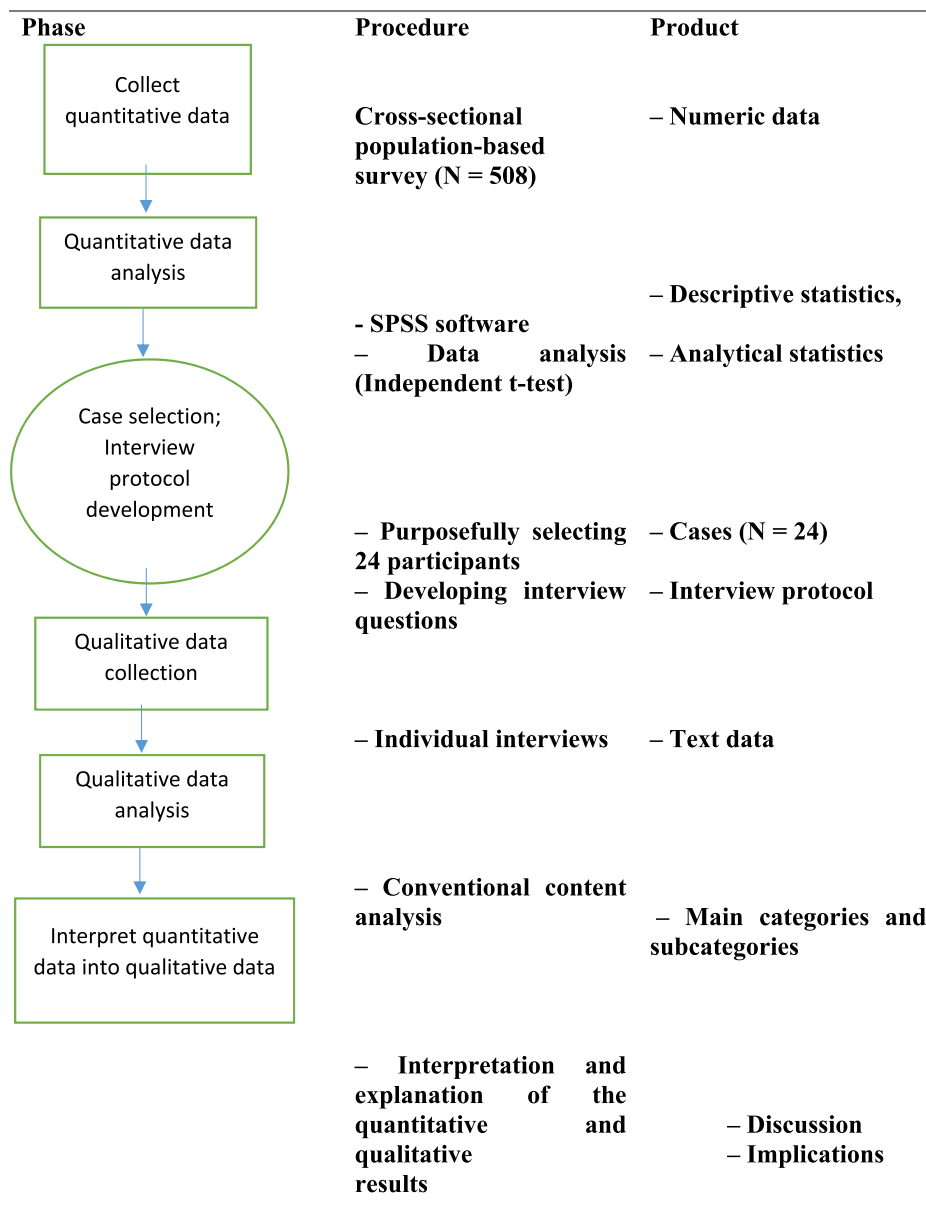


Fig. 1. The diagram of study.

crossing a red light, and crossing at inappropriate places (like non-crossed lines) are suggested as pedestrians' unsafe behaviors (Rosenbloom et al., 2004; Deb et al., 2017; Nasar et al., 2008; Lee et al., 2016). Furthermore, low perceived risk of unsafe behaviors (Granié, 2009; Zhou et al., 2009), consumption of unauthorized drinks, poor visibility on the roads (Miles-Doan, 1996; Mikoski et al., 2019), and distraction (Nasar et al., 2008) are also reported as other behavior-associated factors that endanger pedestrian safety.

As evident in the literature, a wide range of factors are associated with pedestrian safety. In most cases, unsafe situations for pedestrians are associated not only to poor decision-making and risky behaviors exhibited during road crossings but also to the lack of traffic and environmental factors (Zhou et al., 2009; Koh et al., 2014). As an instance, older people experience a sense of insecurity and unsafety to cross the streets because of the lack of pedestrian crossing facilities (Bernhoft and Carstensen, 2008). Based on the literature, some factors like failing to give priority to pedestrians by drivers (Sucha, 2018), ignoring to use facilities due to normalization (Rankavat and Tiwari, 2016), lacking a sense of security in using the facilities especially at night, lack of pedestrian escalators, and the presence of vendors along pedestrian bridges (Rankavat and Tiwari, 2016; Pasha et al., 2015; Räsänen et al., 2007) are also reported as barriers to pedestrian safety.

Previous studies have also emphasized the identification of pedestrian safety obstacles and challenges before designing any pedestrian safety promotion interventions within societies (Rodríguez et al., 2014; Sandt et al., 2015). Pedestrian risky behaviors is a context-dependent issue affected by a wide range of cultural and attitudinal factors (Nordfjærn and Šim). In many quantitative studies, the reasons for dangerous behaviors of pedestrians during road crossings have not well been established, as the quantitative studies alone on such risky behaviors cannot represent the motives behind the behaviors and so, triangulating the data with qualitative studies may help address the necessities and prerequisites of behavior change (Sullman, 2006; Bryman, 2007). Urban traffic researchers and policymakers can find a better understanding of pedestrian unsafe behaviors and their associated factors through such mixed-method studies (Bryman, 2007). In 2018, we developed a multi-method study to design and implement a Pedestrian Safety Promotion Program (PSPP) aiming to improve pedestrian safety in Tabriz, Iran. In a previously published paper (blinded reference), the challenges associated with pedestrian safety from the perspective of pedestrians were reported. As the diagnosis phase of the program planning, a mixed-method study was applied to identify the risky traffic behaviors of pedestrians and the strategies to promote pedestrian safety from the perspectives of urban traffic and transport stakeholders (the objectives of the study reported in the present manuscript). The findings of this phase were then considered as the basis to develop the PSPP, as a community-based educational intervention, in the second phase. In the present manuscript, we reported the findings on the risky traffic behaviors of pedestrians and the strategies to promote pedestrian safety, as a mixed-method study.

2. Methods

This research was a mixed-method study with an explanatory design (including two phases), the steps of which are shown in Fig. 1. In the first phase, the prevalence rate of risky traffic behaviors of pedestrians was determined through a quantitative data collection method. In the second phase, applying a qualitative study, the experiences of urban traffic and transport stakeholders on pedestrian safety strategies to alleviate the main risky traffic behaviors that identified in phase one were explored. After analyzing the results of statistical tests in the first stage, the interview protocol was prepared for the qualitative phase. Finally, the findings of the quantitative and qualitative phases were merged during the interpretation of the findings (the discussion section).

2.1. Quantitative phase

2.1.1. Design and participants

This cross-sectional study was carried out from July to November 2018 among 508 pedestrians in the municipal district number 2 in Tabriz metropolitan city, northwest of Iran.

2.1.2. Procedure

Cluster sampling was employed to recruit 550 participants. The sample size was calculated to be 250 according to the study of Jalilian et al. (2015). However, considering the effect size of the sampling method and a 10% attrition rate, the final sample size was calculated to be 550. To recruit the samples, the district was divided into four sections, namely, north, south, east, and west. Then, the first researcher referred to the health centers of each section and randomly selected households according to the number of household medical records. From each household, one of the members with 18 years of age and older was invited to participate in the study and to complete the questionnaire through self-report. Forty-two respondents declined to participate in the study, due to reasons like the lack of time and not interested in participating in research studies (response rate = 92.3%). Inclusion criteria were having at least 18 years of age, being consent to participate in the study, and being resident in the studied district for at least 12 months.

2.1.3. Measures

To collect data, the pedestrian safety behaviors (PSB) questionnaire (Heydari ST, 2020), developed and validated by the Traffic Accident Research Center in Tabriz University of Medical Sciences was used. This questionnaire comprises 29 items addressing five domains of pedestrians' traffic safety behaviors in a five-point response format (never, rarely, sometimes, often, and always): positive behaviors of pedestrians 1 (7 items), pedestrians' traffic violations (10 items), positive behaviors of pedestrians 2 (7 items), pedestrians' distraction (4 items) and pedestrians' aggressive behaviors (2 items). Participants' data on their demographic characteristics included age, gender, marital status (single/married), educational level (illiterate/elementary, high school, diploma, Bachelor, Masters and higher), daily walking rate (less than 30 min, 30 min to 1 h, more than an hour) and transportation mode (private car, taxi,

large vehicles [subway, bus, minibus], bicycle, walking, motorcycle).

2.1.4. Analysis

The data were analyzed applying the SPSS version 22 using independent *t*-test, Regression, and ANOVA tests. Kolmogorov-Smirnov test was also used for data normality. Based on the scoring of the PSB, the minimum possible score for none of the subscales was 0. So, the only presentation of the mean and standard deviation did not seem to provide us with a clear understanding of the level of performing behaviors among the participants. The mean percent was, thus, calculated applying the following formula: $((\text{mean score} - \text{minimum score}) \div (\text{maximum score} - \text{minimum score})) \times 100$. To assess the relationships between the total PBQ score and the demographic variables, a series of univariate regressions was applied. Multivariate regressions were performed to examine age, gender, education, marital status, educational level, daily walking rate, and transportation mode as independent variables to determine a set of best predictors for the five domains as the dependent variable.

All results of the quantitative phase were prepared in table and chart formats to be presented to the urban traffic and transport stakeholders during the individual interviews in the qualitative phase with the hope to explore the strategies to promote safety behaviors of pedestrians.

2.2. Qualitative phase

2.2.1. Design, setting, and participants

The qualitative phase was conducted applying a conventional content analysis approach from December 2018 to June 2019. Interviews were carried out either at the health centers or at the work office of stakeholders, according to the agreement between the interviewer and the participants. Twenty-four key stakeholders in the area of urban traffic and transport were selected applying a purposive sampling method with maximum variation in characteristics such as age, gender, specialty, the number of years worked as an urban traffic and transport specialist, and education level. Participants' characteristics are presented in Table 1. Semi-structured individual interviews were conducted to collect data. Inclusion criteria were living and working in Tabriz for at least 2 years and being consent to participate in the study.

2.2.2. Data collection

To explore the challenges and obstacles associated with unsafe behaviors of pedestrians, a summary of the quantitative results in the formats of tables and charts were presented to the participants during individual semi-structured interviews. An interview guide (Table 2) was also prepared before the interviews, based on Krueger and Casey's 2014 standard protocol (Krueger, 2014; Majid et al., 2017). The interviews began with the following main question "How is your opinion about the barriers and challenges related to pedestrian's traffic safety behaviors in Tabriz?" Some probing questions such as "can you explain more" were used to extract more information and to advance the interview. After 21 individual interviews, new codes or categories were rarely identified in transcripts. However, the interviews were continued, and after three further interviews, no new code or category emerged. So, we concluded the theoretical saturation of data and terminated the interviews. The average length of time taken to complete the interviews was 45 min.

2.2.3. Data analysis

A conventional qualitative content analysis approach was applied to analyze data. Initially, the recorded interviews were transcribed verbatim and reviewed two to four times to ensure that the transcripts were correct. The transcripts were coded, and were read and reread several times, and the conceptually similar codes were then grouped into one category. With the progress of the analysis process and reiterated reading of the texts, extracted codes and categories, the similarities and differences between the categories were identified and the themes were distinguished in terms of features and dimensions. The management of data was performed using MAXQDA 11 software.

To increase data validity and transferability, four criteria including credibility, conformability, transferability, and dependability were considered (Speziale et al., 2011). The validity of the current study was provided through careful selection of eligible

Table 1

Characteristics of the traffic and transport stakeholders participated in the study (qualitative phase).

variables		N	%
Gender	Male	17	70.83
	Female	7	29.17
Age	27–36	5	20.82
	37–46	11	45.84
	Older than 47	8	33.35
Educational Level	B.S.	4	16.67
	M.Sc.	8	33.33
	Ph.D.	12	50.0
Job (workplace)	Ministry of Health	8	33.33
	Traffic police	5	20.82
	Ministry of Science	6	25.03
	Urban Traffic Organization	5	20.82

Table 2

The main questions and their associated probing questions asked from the participants (qualitative phase).

What do you suggest about improving the safe behaviors of pedestrians?
What role do you think the authorities can play in protecting pedestrians?
In your opinion, what strategies can be considered for pedestrians to use the passages?
What is your idea about the management system of urban traffic and transport for pedestrian safety in the country? Can you explain more?
What strategies do you suggest for pedestrians to use reflective or light clothing in the dark?
What strategies do you suggest for driver behavior to improve pedestrian safety?
What steps can be taken in the field of legislation to improve the safety of pedestrians?
What strategies do you think social media such as radio and television can use to improve pedestrian safety?

participants, long-term and consistent participation of volunteers during the analysis of information, and the application of experts' opinions at the different stages of the study. The confirmation of the study was obtained by preserving documentation at all stages of the research. Also, two qualitative researchers were provided with the possibility to examine the study process to improve the confirmability of the study. The transferability of findings was evaluated using a complete and detailed description of the situation, participants, and data analysis methods. To increase the reliability of the research, all data were presented to a researcher who had no connection with the research study to determine if he/she had a similar understanding of the data.

3. Results

3.1. Quantitative phase

The mean age of participants was 36.55 ± 10.44 . About 58% of the participants were female and 80% were married. Most participants had 7-12 grades of education (36.6%). Less than half of the participants (42.9%) reported less than 30 min of daily walking, and more than half (57.1%) announced the use of a private car to move around the city. There was also a significant difference in the mean score of pedestrian safe behaviors by gender ($p < 0.001$). The difference favored by women (Table 3).

The frequency (%) of participants' answers to all items of the scale is presented in Table 4. About half (49.4%) of the pedestrians did not wear bright or reflective clothing when walking at night, and 31.2% reported passing the cross even if there is a "No Cross" signpost. Also, several unsafe behaviors, such as "walking in the path of vehicles" (40.3%), "using handsfree and cellphone while crossing the street" (15.7%), and "not using pedestrian bridges even in the case of availability" (17.3%) were common (Table 4).

Table 5 shows descriptive statistics for PSBs and all the domains. The Cronbach α for all the constructs in the study was 0.7 and more, showing an acceptable to excellent internal consistency for the constructs. For all domains of the PSBs, the level of scores was more than 62%. In other words, the residents acquired more than 62% of the maximum possible score in all constructs. Among all the domains, aggressive behaviors (85.6%), distractive behaviors (77.2%), violation (21.56%), and PSBs (70.5%) were found with the highest scores (Table 5).

Multivariate regression showed age, gender, marital status, and educational level as significant predictors of safety pedestrians' behaviors and some of its domains (Table 6). As an instance, gender was a significant predictor for the behaviors and all the domains, except for adherence to traffic rules and positive behaviors. Also, educational status predicted the behaviors and all the domains.

3.2. Qualitative phase

According to the experts' perspective and using content analysis of data from the interviews, 340 codes and 27 subcategories were extracted and classified into four main categories including *building public education policies on traffic safety*, *developing traffic safety infrastructure*, *improving the traffic management system*, and *strengthening urban traffic safety legislation* (Table 7).

3.2.1. Building public education policies on traffic safety

1 Involvement of a pedestrian safety course in the national driving licensing curriculum

As participants believed, training the driving license applicants on pedestrian's rights was an option to improve pedestrian safety (Table 7, Narrations. Participant [P] 17).

2 Training students about pedestrian safety at schools

Participants pointed out to the need for training students about traffic rules and pedestrian safety at schools (Table 7, Narrations. P7).

3 Enhancing the capacity of mass media in acculturation of safe traffic behaviors

Participants believed that mass media (e.g., television and radio) in the country lacks in developing the culture of traffic and pedestrian safety within the society (Table 7, Narrations. P6, P22).

Table 3

Mean score differences in the pedestrian safe behaviors by demographic characteristics (N = 508).

		N	Positive behaviors1		Violation		Positive behaviors2		distraction		aggression		Total Safety Behaviors	
			M (SD)	p	M (SD)	p	M (SD)	p	M (SD)	p	M (SD)	p	M (SD)	p
Gender	Male	211	24.09 (4.64)	0.173	37.61 (7.89)	0.001	21.82 (4.53)	0.260	15.54 (3.53)	0.001	8.25(2.38)	0.001	107.30 (16.73)	0.001
	Female	297	24.68 (4.91)		40.23 (6.47)		22.25 (4.13)		16.94 (3.24)		9.28(1.55)		113.39 (13.86)	
Age	18–27	98	23.77 (4.51)	0.320	36.98 (7.90)	0.003	20.62 (4.27)	0.001	15.36 (3.28)	0.003	8.56(2.04)	0.019	105.28 (15.46)	0.001
	28–35	57	24.32 (4.42)		39.88 (6.59)		21.97 (4.34)		16.38 (3.26)		8.89(1.89)		111.44 (14.58)	
	36–43	51	24.92 (4.99)		40.21 (5.99)		23.30 (4.14)		17.01 (2.99)		9.24(1.45)		114.68 (13.05)	
	≤44	59	24.55 (5.26)		36.62 (8.34)		21.88 (4.10)		16.35 (4.09)		8.57(2.57)		110.01 (17.72)	
Marital status	Single	92	23.13 (5.20)	0.008	36.77 (8.35)	0.001	20.54 (4.86)	0.001	15.75 (3.63)	0.07	8.46 (2.33)	0.03	104.65 (16.46)	0.001
	Married	416	24.72 (4.67)		39.67 (6.83)		22.41 (4.10)		16.49 (3.38)		8.94 (1.91)		112.23 (14.82)	
Educational level	Diploma and lower than diploma	246	23.55 (4.99)	0.001	37.67 (7.64)	0.001	21.63 (4.53)	0.027	16.13 (3.84)	0.158	8.57 (2.32)	0.002	107.57 (16.15)	0.001
	Above the diploma	262	25.26 (4.47)		40.52 (6.48)		22.48 (4.04)		16.56 (2.99)		9.12 (1.6)		113.95 (13.99)	
Walking rate per day	30 min a day	219	25.01 (4.66)	0.036	39.88 (7.32)	0.019	22.75 (4.20)	0.004	16.43 (3.45)	0.160	8.86(2.18)	0.138	112.92 (16.62)	0.002
	Between 30 min to an hour	210	24.19 (4.96)		39.10 (6.47)		21.74 (4.46)		16.53 (3.39)		9(1.73)		110.54 (14.34)	
	Above an hour a day	79	23.51 (4.60)		37.23 (8.36)		21.08 (3.90)		15.68 (3.47)		8.47 (2)		105.98 (16.48)	
Mode of Transportation	Personal car	302	24.83 (4.91)	0.072	39.92 (6.87)	0.012	22.39 (4.34)	0.21	16.36 (3.27)	0.50	8.94(1.89)	0.66	112.43 (14.80)	0.196
	Taxi	79	24.13 (4.41)		38.14 (7.49)		21.57 (4.14)		16.03 (3.72)		8.76(2.20)		108.62 (15.76)	
	Public Transportation	64	23.83 (4.97)		38.59 (7.82)		22.05 (4.33)		16.70 (3.91)		8.66(2.35)		109.83 (17.33)	
	Bicycle or motorcycle	15	21.67 (4.63)		34.40 (5.71)		20.53 (4.03)		15.33 (3.26)		8.33(1.75)		100.2(14.68)	
	Walking	48	24.13 (4.30)		38.13 (7.63)		21.40(4.3)		16.75 (3.31)		8.92(1.92)		109.31 (14.53)	

• Independent t-test; M: Mean; SD: Standard deviation.

Table 4

Frequency (percent) and mean (standard deviation) score of pedestrian safety behaviors of the participants (N = 508).

The items of Pedestrian behaviors Questionnaire (PBQ)			Never F (p) ^a	Rarely F (p)	Sometimes F (p)	Often F (p)	Always F (p)	M(SD)
Positive behaviors 1	1	On a two-way street without crosswalk, I cross through the first part and wait in the middle of the street until it is secure to cross the second part.	52 (10.2)	57 (11.2)	64 (12.6)	145 (28.5)	190 (37.4)	3.72 (1.3)
	2	When the truck or bus stops, I cross the street from behind for my own safety.	90 (17.7)	60 (11.8)	86 (16.9)	122 (24)	150 (29.5)	3.36 (1.4)
	3	When walking on the streets at nights, I use bright-colored or reflective clothes.	137 (27)	114 (22.4)	116 (22.8)	96 (18.9)	45 (8.9)	2.6 (1.3)
	4	When crossing an intersection, I cross only after estimating the time of vehicle arrival.	44 (8.7)	53 (10.4)	92 (18.1)	162 (31.9)	157 (30.9)	3.66 (1.2)
	5	When I am in a hurry, I cross a street hastily.	105 (20.7)	21 (4.1)	50 (9.8)	88 (17.3)	244 (48)	3.68 (1.5)
	6	I cross a street when the pedestrian light is green and all vehicles are stopped.	33 (6.5)	34 (6.7)	52 (10.2)	135 (26.6)	254 (50)	4.07 (1.2)
	7	When crossing a street with traffic jam, I go back quickly if I get stuck in a dangerous situation.	84 (16.5)	67 (13.2)	88 (17.3)	135 (26.6)	134 (26.4)	3.33 (1.4)
Violation	1	When another pedestrian crosses a pedestrian red-light unintentionally, I follow him/her regardless of the circumstance.	312 (61.4)	98 (19.3)	49 (9.6)	32 (6.3)	17 (3.3)	4.29 (1.0)
	2	When there is a dangerous situation while crossing a street, I follow other pedestrians who cross the street unsafely.	346 (68.1)	88 (17.3)	30 (5.9)	30 (5.9)	14 (2.8)	4.42 (1.0)
	3	If there is no suitable pavement on a street, I try to walk in the path of the vehicles.	93 (18.3)	98 (19.3)	112 (22)	118 (23.2)	87 (17.1)	2.98 (1.3)
	4	I pass a cross even if there is a "No Cross" signpost.	154 (30.3)	77 (15.2)	123 (24.2)	86 (16.9)	68 (14.3)	3.32 (1.4)
	5	For my convenience, I do not use pedestrian bridges, even if there is one available.	264 (52)	90 (17.7)	66 (13)	50 (9.8)	38 (7.5)	3.97 (1.3)
	6	To save time, I cross a street or intersection indirectly and in a diagonal form.	224 (44.1)	112 (22)	90 (17.7)	46 (9.1)	36 (7.1)	3.87 (1.2)
	7	To save time, I cross a street hastily.	223 (43.9)	48 (9.4)	76 (15)	138 (27.2)	23 (4.5)	3.96 (1.7)
	8	Due to the non-observance of the rules by some traffic officers, I do not obey the pedestrians' traffic rules.	316 (62.2)	72 (14.2)	53 (10.4)	32 (6.3)	35 (6.9)	4.19 (1.2)
	9	As the most of pedestrians do not use pedestrian bridges, I do not use them either.	272 (53.5)	94 (18.5)	67 (13.2)	54 (10.6)	21 (1.4)	4.07 (1.2)
	10	When I cross a street with traffic jam, I move spirally between vehicles.	245 (48.2)	123 (24.2)	86 (16.9)	38 (7.5)	16 (3.1)	4.07 (1.1)
Positive behaviors 2	1	On a pavement, I walk on the right side so as to not bothering other pedestrians.	32 (6.3)	60 (11.8)	84 (16.5)	160 (31.5)	172 (33.9)	3.75 (1.2)
	2	When walking as a pedestrian on a street, I obey the pedestrians' traffic laws.	16 (3.1)	21 (1.2)	69 (13.6)	167 (32.9)	235 (46.3)	4.15 (1.0)

(continued on next page)

Table 4 (continued)

The items of Pedestrian behaviors Questionnaire (PBQ)			Never F (p) ^a	Rarely F (p)	Sometimes F (p)	Often F (p)	Always F (p)	M(SD)
distraction	3	In the twilight, I walk on a street and cross it carefully.	24 (4.7)	33 (6.5)	64 (12.6)	168 (33.1)	219 (43.1)	4.03 (1.1)
	4	Crossing the intersection, I observe the priorities.	18(3.5)	25 (4.9)	72 (14.2)	141 (27.8)	252 (49.6)	4.15 (1.0)
	5	While crossing a street, I let the vehicles pass, even if it is my right to cross.	53 (10.4)	68 (13.4)	148 (29.1)	141 (27.8)	98 (19.3)	3.32 (1.2)
	6	Crossing a street, I try to set an eye contact with the driver.	132 (26)	111 (21.9)	119 (23.4)	85 (16.7)	61 (12)	2.67 (1.3)
	1	When crossing a street, I use cell phone because I do not think to be distracted.	260 (51.2)	132 (26)	63 (12.4)	34 (6.7)	19 (3.7)	4.14 (1.1)
	2	When crossing a street, I use handsfree.	330 (65)	73 (14.4)	45 (8.9)	42 (8.3)	18 (3.5)	4.29 (1.1)
	3	When crossing a street, I use cell phone only if I have an emergency need.	138 (27.2)	195 (38.4)	119 (23.4)	37 (7.3)	18 (3.5)	3.78 (1.0)
	4	When crossing a street, I talk with my cell phone and/or listen to music with headphone.	295 (58.1)	61 (15.9)	52 (10.2)	50 (9.8)	30 (5.9)	4.1 (1.2)
aggression	1	If I get angry with a driver's behavior, I hit his/her car with hands or feet.	371 (73.2)	68 (13.4)	28 (5.5)	16 (3.1)	24 (4.7)	4.46 (1.0)
	2	If I get angry with other road users (driver, pedestrian, cyclist), I insult them.	360 (70.9)	76 (15)	25 (4.9)	22 (4.3)	25 (4.9)	4.37 (1.1)

^a F = Frequency; p = Percent; M = Mean; SD = Standard deviation.

Table 5

Mean, mean percent, number of items, possible range and internal consistency of the pedestrian safety behaviors (PSB) scale and all its domains in the present study.

PSBs constructs	Mean (SD ^a)	Mean Percent	Number of items	Possible range	Cronbach α
Positive behavior 1	24.44 $\pm$ 4.80	62.28	7	7–35	0.68
Violation	39.14 $\pm$ 7.20	72.85	10	10–50	0.79
Positive behavior 2	22.07 $\pm$ 4.30	66.95	6	6–30	0.73
Distraction	16.36 $\pm$ 3.43	77.25	4	4–20	0.71
Aggression	8.85 $\pm$ 2	85.62	2	2–10	0.82
Pedestrian safety behaviors (PSBs)	110.86 $\pm$ 15.40	70.56	29	29–145	0.74

^a SD = Standard deviation.

4 Using virtual social networks to promote pedestrian safety

Most of the participants emphasized the role of virtual social networks in promoting safe pedestrian behaviors and pedestrian safety, as well (Table 7, Narrations, P20).

5 Raising the traffic knowledge and awareness of people within the community

Raising traffic knowledge and awareness was one of the strategies that many participants mentioned in different ways (Table 7, Narrations, P3, P24).

6 Increasing perceived threat of vehicle-pedestrian collisions among drivers

Most participants mentioned the need to increase the perceived susceptibility and severity of drivers to better understand the danger, as a strategy to improve pedestrian safety (Table 7, Narrations, P14). They also emphasized training drivers about distraction (using mobile phones, texting, etc. while driving) and its effects on safe driving (Table 7, Narrations, P5).

3.2.2. Developing traffic safety infrastructure

1 Improving safe crossings for pedestrians

Most of participants reported the measures like the use of appropriate facilities for pedestrians (such as using mechanized pedestrian bridges, elevators next to pedestrian bridges), as practical actions to decrease the possibility of performing unsafe behaviors among pedestrians and thus to promote pedestrian safety (Table 7, Narrations, P2, P21, P9).

2 Using intelligent traffic signal systems

One of the areas that the participants mentioned frequently was the use of intelligent traffic signs and equipment at all intersections, which may play a significant role in adopting safety and pedestrian safety behaviors (Table 7, Narrations, P3, P18).

3 Making safe crossings accessible

As participants reported, in the case of easy access to safe crossings, a high number of pedestrians will discontinue unsafe crossing behaviors (Table 7, Narrations, P9, P6, P2).

4 Improving the beauty of passages and pedestrian crossings

One of the strategies that the participants mentioned was associated to the aesthetic component of the streets, passages, and equipment (Table 7, Narrations, P21).

5 Ongoing maintenance of pedestrian facilities

Another strategy to improve pedestrians' safety mentioned by the participants was ongoing maintenance and operational aspects of pedestrian facilities and eliminating the shortcomings by relevant bodies (Table 7, Narrations, P13).

3.2.3. Improving traffic management system

1 Capacity building among traffic and transport staff

Participants pointed out to building capacity in pedestrian safety among traffic and transportation system staff (Table 7, Narrations,

Table 6

Predictors of pedestrian safety behaviors and all its domains by demographic characteristics.

	N (%)	Positive behaviors1		Violation		Positive behavior2		distraction		Aggression		Total Pedestrian Behaviors	
		β	p-value	β	p-value	β	p-value	β	p-value	β	p-value	β	p-value
Age (ref = ≤ 44)													
18–27	98 (19.3)	−1.15	0.12	−3.10	0.004	−1.60	0.017	−2.0	0.001	−0.41	0.18	−8.27	0.001
28–35	152 (29.9)	−1.27	0.03	−0.78	0.37	−0.64	0.23	−0.67	0.12	−0.17	0.47	−3.54	0.054
36–43	145 (28.5)	−0.67	0.27	−0.47	0.59	0.61	0.26	−0.12	0.78	−0.18	0.45	−0.47	0.79
Gender (ref = Female)													
Male	211 (41.5)	−0.21	0.63	−2.26	0.001	−0.007	0.987	−1.37	0.001	−1.04	0.001	−4.90	0.001
Marriage status (ref = Married)													
Single	92 (18.1)	−1.09	0.08	−0.52	0.56	−0.84	0.13	0.46	0.29	0.007	0.979	−4.90	0.001
Educational level (ref = Bachelor and higher)													
Illiterate/elementary	65 (12.8)	−3.59	0.001	−6.72	0.001	−2.50	0.001	−2.09	0.01	−1.40	0.001	−16.31	0.001
Secondary	181 (35.6)	−1.15	0.018	−2.19	0.002	−.26	0.54	0.04	0.89	−0.32	0.10	−3.88	0.008
Diploma	61 (12)	−0.42	0.54	−3.98	0.001	−.65	0.28	−0.52	0.28	−0.55	0.05	−6.13	0.003
Walking (minutes per day) (ref = ≥ 60)													
30 $\geq$	219 (43.1)	0.85	0.20	0.83	0.38	1.18	0.048	0.31	0.51	−0.08	0.75	3.10	0.12
31–60	210 (41.3)	0.34	0.59	0.96	0.30	0.37	0.51	0.59	0.19	0.28	0.28	2.55	0.18
Transportation mode (ref = Walking/bicycling)													
Private car	302 (59.4)	−0.40	0.54	−0.26	0.81	−0.29	0.65	−1.19	0.027	−0.28	0.352	−2.44	0.28
Public transportation	143 (28.1)	−0.73	0.34	−1.05	0.34	−0.36	0.60	−1.15	0.03	−0.52	0.09	−3.83	0.10
Motorcycle	10 (2)	−2.24	0.17	−3.39	0.15	−1.06	0.46	−2.29	0.04	−0.12	0.84	−9.13	0.06

Table 7

The main categories, their associated subcategories and examples of narrations for the qualitative phase.

Categories	Subcategories	Examples of Narrations
Building public education policies on traffic safety	Involvement of a pedestrian safety course in the national driving licensing curriculum	"Well, a person who gets a driving license of course drives based on the received trainings and does not pay much attention to pedestrians rights". (P17 ^a)
	Training students about pedestrian safety at schools	"There is a training gap in this field at schools. We do not have any educational course or book in this regard. Pedestrian safety should be embedded in the educational programs of the schools". (P7)
	Enhancing the capacity of mass media in acculturation of traffic behaviors	"When an actor is talking on a cell phone while driving, crossing a street while talking either on a cell phone or with a friend, you know, people especially teenagers and young adults perceive such unsafe behaviors as the true way of crossing." (P6) "We have to work on colors, or we have to use reflectors like other countries, and we have to give the necessary training to make the pedestrian better visible at nights." (P22)
	Using virtual social networks to promote pedestrian safety	"In fact, virtual network is a boundless sea. Social networks or discussions between two people or members of the group should be practical ... So, people who lead the group or the people who manage these channels should bring these issues to the group as leaders, also, today all children are present in virtual space" (P20)
Developing traffic safety infrastructure	Raising the traffic knowledge and awareness of people within the community	"It is better to train them about the pedestrian's safety at the social environment, and training is not just about teaching them how to walk and cross the street, rather, we must remind them how vulnerable they are, and we must institutionalize this attitude. (P3) "We have to give the necessary trainings [on wearing visible clothes] to make the pedestrian better visible at nights." (P24) "Understandings of drivers from the danger and the sensitivity of pedestrians should be increased. The driver should be aware of the difference between 60 km/h and 80 km/h in a collision with a pedestrian. He should know that where to be careful when the pedestrian's crosses or entering an alley ... He should know that how fast he should drive." (P14) "Now, it is common using the mobile phone while driving, which can cause an crash. So, in any format the necessary training must be given, such as campaigning or broadcasting." (P5)
	Increasing perceived threat of vehicle-pedestrian collisions among drivers	"Bridges must be mechanized. In many cases, people prefer to accept the risk and cross the street instead of climbing a large number of stairs." (P2) "The necessary standards must be met on the sidewalks for pedestrians who are disabled or elderly." (P21) "Many of our streets don't even have sidewalks, and you know that all the streets must have sidewalks." (P9)
	Improving safe crossings for pedestrians	"Now, most of the intersections should be equipped by smart equipment, for example, to set the time required to cross the pedestrians and the cars, a speed camera is needed that In addition to smoothing traffic, it also affect the safety of the pedestrians. In the event that in Tabriz, unfortunately, there are only 1–2 intersections like this"(P3) "We have to work on colors, or we have to use reflectors like other countries." (P18) "We need to provide pedestrians with the fastest and easiest ways to cross the streets." (P9) "If I want to use the pedestrian overpasses, I have to go 40–50 m further down the street, go up about 100 steps, and then come down; so, I definitely do not use the overpass and cross the street, therefore, the easiest and fastest route should be available to pedestrians ".(P6)
	Using intelligent traffic signal systems	"When a sidewalk is built, an important issue is the maintenance of accessibility to the facility, which should be smooth and without gaps".(P2) "Look, a sidewalk or a pedestrian bridge should have a special beauty which increases the chance of being used. In this regard, I think a majority of the streets within the city lacks in this regard". (P21)
Improving traffic management system	Making safe crossings accessible	"There is the sidewalk, it is in a proper place and it is built in a principled way, but its escalator does not work or its entrance is closed, which means that the cost has been made, but it is not used for any reason" (P13)
	Improving the beauty of passages and pedestrian crossings	"One of the key points on the authorities is a creation of understanding that the safety of the people is a priority and, I have to see this priority in every policy and planning and plan for it. Such attitude has not yet been created among a majority of staff." (P19) "The world is evolving and managers should not think that they know everything. This training should be constantly provided to managers at different levels"(P15)
	Ongoing maintenance of pedestrian facilities	"The traffic managers shouldn't think that they know what there is in the field. Managers at different levels of management have to get familiar with the latest evidence and be able to get familiar with new solutions, and use them." (P2) "Decision-making based on scientific evidence is necessary to promote pedestrian safety. But, a majority of our stakeholders do not pay attention to it ". (P8)
	Evidence-based policymaking and planning	"When they want to build even a pedestrian bridge, they have to do a need assessment and an impact assessment to determine which is the busiest area of the

(continued on next page)

Table 7 (continued)

Categories	Subcategories	Examples of Narrations
Strengthening urban traffic safety legislation	Creating a systemic approach with unite leadership	street that people cross and what may be the impacts of this measure". (P12) "It should be determined which groups are more at risk and which groups are in fact more likely to be affected." (P18) "In fact, there should be a systemic approach to traffic safety and pedestrian safety. The systemic approach should be implemented; organizations should not act independently. The measures should not be taken separately and unprofessionally. Using the trial-and-error method to solve the problems is too costly". (p 11) "one way to reduce traffic crashes is to create a leading organization. A leading organization headed by urban transport experts and policy makers could manage many aspects of the issue".(P8)
	Inter-sectoral collaborations and coordination	"Things need to be more cohesive; all relevant organizations active in the field of traffic should be involved. For example, the Ministry of Culture and Islamic Guidance has a good potential and should help in this area. (P4)
	Involvement of non-governmental organizations	"It is important to use the capacities of the [private] sector, for example, handing over some parts of projects, like safety utility construction and facilities related to pedestrians to a private sector. It will definitely be useful. "(P10) "So a strategy can be the participation of ... non-governmental sector to improve the safety of sidewalks, crossings and traffic culture in general." (P2) "In relation to diabetes prevention and medication and other similar diseases, there are NGOs, but in the case of traffic, I have not seen such organizations that are active in promoting urban traffic safety, that NGOs can have a great impact in the field of traffic." (P5)
	Promoting communication channels between people and officials	"Well ... this [traffic safety promotion] will not happen unless the public demands of society are promoted. The people must be demanding and work must be done in this regard." (P14) "Using new campaigns on virtual networks helps a lot in realizing citizenship rights and so that people know their rights and demand for them." (P1) "We should develop the channels for receiving reports from the people and then tracking them and again feedback to the citizens, this will be accompanied by a mutual trust between the system and on the residents". (P11) "People do not know where to go to complain about pedestrian safety and if they do, will they be effective?" (P15)
	Governing a health-oriented perspective in the traffic management system	"In the developed countries, traffic issues and pedestrian safety are considered from the aspect of health promotion, but this is a recent subject in our country and such a health-oriented perspective must be created in the officials." (P14)
	Proper design of vehicle manufacturing	"Another measure that can be taken into account to protect pedestrians is related to vehicles. Cars manufactured in the country are poorly designed". (P4)
	High supervision over law enforcement	"But the main point is that there may be regulations or laws, but the quality and supervision of implementation is weak. For example, you must have monitoring whether the principles of safety have been observed? This should be one of the priorities of the authorities" (P20) "An issue is the poor monitoring of the law enforcement. We have not been so successful in supervising over the implementation of law in traffic safety." (P7)
	Improving the legislative system for pedestrian traffic behaviors	"We have fines for traffic violations of car drivers, but unfortunately we have no fine for pedestrians". (P16) "For example, is there a law to fine a driver who intimidates a pedestrian with high speed and pushes him back across the street? There should be a law to fine this driver, I think". (P1) "The laws allow the police to fine offending pedestrians, but they don't. I mean, this law is not applicable and the most of fines are focused on drivers." (P12)

^a P stands for Participant.

P19, P15).

2 Evidence-based policymaking and planning

An issue emphasized by most participants was to improve pedestrian safety through evidence-based policymaking and planning (Table 7, Narrations, P2, P8).

3 Needs/impact assessment of traffic and transport measures

Most of the participants reported the necessity to perform needs and/or impact assessments before conducting any traffic and transport measures (Table 7, Narrations, P12, P18).

4 Creating a systemic approach to unite leadership

Participants believed that the Iranian traffic and transport system lacks an exclusive management system to lead the organization. They emphasized the establishing of a leading traffic system in the country as one of the important solutions to promote pedestrian safety (Table 7, Narrations, P11, P8).

5. Inter-sectoral collaborations and coordination

Having a better level of collaboration and coordination among the organizations associated with urban traffic and transport was another strategy suggested by the participants (Table 7, Narrations, P4).

6 Involvement of non-governmental organizations

A majority of participants emphasized the involvement of the private sector in the planning and implementation of traffic and transport projects (Table 7, Narrations, P10, P2, P5).

7 Promoting communication channels between people and officials

Participants reported a lack of demand for high-level traffic and transport services among community members as a challenging reason for the poor communication channels. So, they believed in promoting the demanding level among residents (Table 7, Narrations, P14, P1, P11, and P15).

8 Governing a health-oriented perspective in the traffic management system

Lack of a health-oriented perspective in the urban traffic management system was reported as an issue that hinders the governance of safety culture and pedestrian safety in the management system (Table 7, Narrations, P14).

3.2.4. Strengthening urban traffic safety legislation

1 Proper design of vehicle manufacturing

A majority of participants pointed out to the need for stricter laws in designing and manufacturing domestic vehicles, which is in direct association with pedestrian safety while accidents (Table 7, Narrations, P4).

2 High supervision over law enforcement

As participants believed there are several traffic issues associated with pedestrian safety within the community which is resulted from poor supervision over traffic law enforcement (Table 7, Narrations, P20, and P7).

3 Improving the legislative system for pedestrian traffic behaviors

As most participants believed, setting legal rules and limitations for the behavior of pedestrians and drivers was a way to improve pedestrian safety (Table 7, Narrations, P16, P1, P12).

4. Discussion

To our knowledge, this was the first study that used a mixed-method approach to identify the possible strategies for promoting pedestrian safety in a developing country, like Iran. According to the findings in the quantitative phase, pedestrian safety behaviors were at a moderate to good level among the residents. However, a high percentage of pedestrians did not wear bright or reflective clothing when walking at night, did follow unsafe crossing behaviors of others in the case of dangerous situations, use mobile phones while crossing the street, and did not use pedestrian bridges even if one was available. Age, gender, and educational status were associated with pedestrian safety behavior and almost all its domains. In the qualitative phase, *building public education policies on traffic safety, developing traffic safety infrastructure, improving the traffic management system, and strengthening urban traffic safety legislation* were recognized as the main strategies to promote pedestrian safety from the viewpoints of traffic and transport stakeholders.

Not similar to those reported by Granié et al. (2013), in the present study, the mean scores for pedestrian safety behaviors (PSBs) and all the domains were somewhat high. Analyzing the mean score of PSBs showed that more than three-fourth of residents perform the safety behaviors. Similar to the findings of previous studies (Granié et al., 2013; Deb et al., 2017), in the present study, the most and the least commonly reported pedestrian safety behaviors were positive and aggressive behaviors, respectively. Such high level of performing safe behaviors in the present study may be associated to the community that selected as the setting to conduct the study. The municipal district number 2 in Tabriz city is one of the five districts of the city which was randomly selected as the setting for a community-based pedestrian safety intervention (The main study from which the results of this manuscript were derived). This district includes the residents with moderate to high levels of socioeconomic status, which may justify the high level of pedestrian safety behaviors in the present study.

In the present study, “violent and aggressive behaviors” was associated to the respondents’ education level in a way that residents with a better education level reported lower levels of violation and aggressive behaviors. Therefore, having a higher level of education may lead to fewer violations and aggressive behaviors among pedestrians. Similar to our findings, [Antić et al. \(2016\)](#), found associations between age and the rate of safety behaviors. In their study, age had positive and negative associations with positive and violation behaviors, respectively.

Providing urban traffic and transport stakeholders with the quantitative results during individual interviews enabled us to identify a wide range of pedestrian safety promotion strategies.

The stakeholders as the participants of the qualitative phase reported several strategies ranged from those associated with improvements in the infrastructure, public and community education to legislation and the management system. These findings confirm the claim noted by et al., () based on which pedestrian safety seems to be a multi-factorial issue affected by a wide range of factors.

Building public education policies on traffic safety emerged as the main strategy to promote pedestrian safety behaviors. Previous studies have shown that public education alone may not reduce deaths or injuries resulting from an accident ([Duperrex et al., 2002](#)). Our participants believed that besides public education and awareness-raising, there is a great need for mass media support, virtual social networks, supportive legislation, and law enforcement, as recommended in previous research ([Elvik, 2004](#)). Besides emphasizing some common factors in developing countries, participants stressed some factors that are not frequently reported from the developing countries in the literature. Examples of such novel strategies were increasing the demanding level of residents through promoting communication channels between people and officials, governing a health-oriented perspective in the traffic management system, and involvement of non-governmental organizations ([Han et al., 2010](#)). In many cases, pedestrians are unaware of their traffic-associated high-risk behaviors, road hazards, and the consequences of their behaviors ([Lam, 2001](#); [Tulu et al., 2013](#)). Thus, promoting pedestrians’ awareness of road hazards is also an important factor in adopting safe behaviors ([Poudel-Tandukar et al., 2007](#)). In Iran, like a majority of developing countries, although limited training on traffic principles such as Police Aid Program (PAP) is conducted at schools ([Ainy et al., 2010](#)), there is almost no credible and formal training program on traffic safety at schools and universities. Of course, to enable pedestrians in performing pedestrian safe behaviors, planning educational programs is not enough, and instead, multifaceted interventions including public health campaigns, community mobilization, as well as advocacy and social marketing efforts are necessary. So, policymakers and traffic stakeholders should improve pedestrian safety in the community by developing multifaceted traffic safety promotion programs.

As participants noted, increasing the perceived threat of vehicle-pedestrian collisions among drivers was a priority to improve pedestrian safety. As reported in previous studies ([Sucha, 2018](#); [World Health Organization, 2015](#); [Şimşekoğlu et al., 2013](#); [Choudhary and Velaga, 2017](#)), drivers’ poor perceived risk, traffic rules violations, and distracting behaviors were challenges associated to pedestrian safety reported by residents in the quantitative phase of the present study. According to a previous study, risky behaviors in drivers are factors that can lead to pedestrian overruns ([Jiménez-Mejías et al., 2016](#)). Findings from another study similarly showed that most pedestrians did not feel safe while crossing the road due to disregarding pedestrians’ right-of-way by drivers ([Sucha, 2018](#)). In a current study in Ghana, many drivers reported to not pay attention to pedestrian crossings and approach them very quickly ([Obeng-Atuah et al., 2017](#)). As a combination of perceived susceptibility and perceived severity, perceived threat is considered as a predictor of health-related behaviors ([Glanz et al., 2008](#)), including traffic safety behaviors ([Ngueutsa and Kouabenan, 2017](#)). Considering the basics of the Health Belief Model ([Glanz and Bishop, 2010](#)), the drivers who believe they are at a situation with low risk of performing a behavior, which results in a vehicle-pedestrian collision (e.g. distracting behaviors), are more likely to perform the risky behavior. So, increasing the perceived threat of vehicle-pedestrian collisions among drivers through educational interventions may be considered as a good strategy for helping drivers to be highly attentive and reactive to potential pedestrian road hazards.

Another main strategy to improve pedestrian safety, as participants reported, was to develop traffic safety infrastructure. For instance, participants pointed out to the construction of safe pedestrian lanes, particularly for older adults and disabled persons, the use of intelligent traffic signal systems, and mechanized pedestrian bridges to improve pedestrian safety. In a community with poor pedestrian-associated environmental infrastructure, it is not unusual for pedestrians to violate traffic rules. As a participant noted, “If I want to use pedestrian overpasses, I have to walk 50–100 m further down the street, go up the stairs about 50 steps, and then come down; so, I definitely do not use the overpass and cross the street!”. So, the consequence is that more than one-third of road traffic injuries happen while walking on the roads ([Dandona et al., 2006](#)). Similar to our findings, non-mechanized pedestrian bridges with a high number of steps influenced the rate of bridge used by pedestrians ([Räsänen et al., 2007](#)). As our participants stated, pedestrians are indifferent to the bridges located in inappropriate places or have difficult accessibility, so they prefer to cross the street, as noted in a previous study ([MacKenzie et al., 2008](#)). According to literature, pedestrians give higher priority to convenience and time-saving compared to safety ([Rankavat and Tiwari, 2016](#); [Hussein and Sayed, 2015](#)), which should be considered by the policymakers and stakeholders while planning to promote urban traffic and transport infrastructure. It should be considered that the continuity of sidewalks and their appropriate slope may have a positive relationship with fewer accidents occurrence ([Osama and Sayed, 2017](#)). Factors like uneven surfaces, crowded intersections and stairs, and slippery surfaces, as the environmental issues commonly reported by participants in our study, play important roles in the rate of pedestrian falls ([Schepers et al., 2017](#)). According to the findings of present study, the mismatch of facilities with older pedestrians and disabled individuals was another barrier to pedestrian safety. Addressing the needs of older adults while redesigning urban spaces is so important that the WHO urged the need for constructing the cities, in terms of the distribution of public services and facilities, based on the needs of the older population ([World Health Organization, 2007](#)).

Strengthening urban traffic safety legislation and improving pedestrian-related laws were reported as another effective strategy to promote pedestrian safety. This issue is also mentioned in Jung’s study as a strategy to improve pedestrian safety ([Jung et al., 2016](#)). The illegal crossings on the roads in some developing countries have been well studied, and in many cases have been emphasized as a

reason for the high rate of pedestrian accidents (Cherry et al., 2012; Damsere-Derry et al., 2010). A study in Chile found that pedestrians have a positive attitude toward illegal crossings (Diaz, 2002). Of course, in some cases, due to the lack of facilities, the illegal crossing is the only way to cross the road. It seems that in addition to promote a safety culture and educational interventions, the adoption of appropriate laws and regulations for pedestrians as well as high supervision over law enforcement can be good options to improve the safe behaviors of pedestrians. Proper design in Iranian-manufactured cars in terms of pedestrian safety was another issue mentioned by stakeholders. Compliance with vehicle safety standards has a significant impact on pedestrian safety (Tulu et al., 2013) and has to be considered as the rules to be obeyed by car manufactures in developing countries. Because the proper design of vehicles plays an important role in maintaining the safety of pedestrians and injure them less in accidents (Crandall et al., 2002).

Moving further, improvement in the traffic management system was an important theme that emerged from the data. A majority of participants pointed out to capacity building among traffic and transport staff, as well as creating a systemic approach to urban traffic, as there is no unite management system to mediate between different sectors associated with urban traffic and transport. For example, *"Things need to be more cohesive; all relevant organizations should be actively involved in traffic and transport issues"*. In countries with successful experience in reducing the number of traffic accidents, there is usually an organization with sufficient authority and stewardship for managing urban traffic and transport systems, and other organizations are responsible for a high level of collaboration and cooperation with (Schepers et al., 2017; Al Turki, 2014). According to the WHO reports, traffic accident prevention and traffic safety promotion may not be achieved without cooperation among different organizations (Dalvi, 2004) which are also emphasized in previous Iranian studies (Khorasani-Zavareh et al., 2009; Khankeh et al., 2007).

5. Conclusion

Our findings provided strategies to promote pedestrian safety as recommendations for urban traffic and transport systems of developing countries with specific complexities, particularly in the management system. The mixed-method approach used in the present study was helpful in identifying the most relevant strategies for promoting safe behaviors of pedestrians in Iran, as a developing country. The quantitative findings on the unsafe behaviors of pedestrians provided a basis for exploring the best-fit strategies to promote pedestrian safety from the perspective of key informants. Using evidence (in our case the findings of the quantitative phase) in identifying the best strategies (the qualitative phase) while pedestrian safety policy-making and program planning is recommended. The strategies not only shed light on future actions by the policymakers but also address research needs and technology use in the urban traffic environment. The strategies reported here may also pertain to other potential sectors in developing countries that have the responsibility of providing pedestrians with a safe roadway environment. Traffic safety researchers, traffic policymakers, municipalities, and government officials, particularly in developing countries, may consider this various range of pedestrian safety strategies while traffic safety policy-making and/or designing pedestrian safety promotion programs within urban environments.

Author statement

In this study, Haghighi and Nadrian were responsible for the study design. sadeghi did the analyses. Bakhtari and Sadeghi, were responsible for data interpretation. Haghighi helped in the study design and data gathering, Haghighi and Nadrian helped in the drafts of the manuscript. All authors have read and approved the final manuscript.

Financial disclosure

The Authors received fund from Tabriz University of Medical Sciences. Fund Code: 5/d/707/086.

Declaration of competing interest

The authors have no conflicts of interest to report.

Acknowledgment

The authors wish to acknowledge the education and research help of the Tabriz University of medical science. The authors also thank all those who have cooperated in this research for their kind participation.

References

- Ainy, E., Soori, H., Montazeri, A., Omidvari, S., Jahangiree, A.C., Shiran, G., 2010. The role of pupils liaisons on traffic penalties and road traffic injuries in Iran. *Inj. Prev.* 16, A17–A17.
- Al Turki, Y.A., 2014. How can Saudi Arabia use the Decade of Action for Road Safety to catalyse road traffic injury prevention policy and interventions? *Int. J. Inj. Contr. Saf. Promot.* 21, 397–402.
- Antić, B., Pešić, D., Milutinović, N., Maslač, M., 2016. Pedestrian behaviours: validation of the Serbian version of the pedestrian behaviour scale. *Transport. Res. F Traffic Psychol. Behav.* 41, 170–178.
- Bernhoft, I.M., Carstensen, G., 2008. Preferences and behaviour of pedestrians and cyclists by age and gender. *Transport. Res. F Traffic Psychol. Behav.* 11, 83–95.
- Bryman, A., 2007. Barriers to integrating quantitative and qualitative research. *J. Mix. Methods Res.* 1, 8–22.
- Cherry, C., Donlon, B., Yan, X., Moore, S.E., Xiong, J., 2012. Illegal mid-block pedestrian crossings in China: gap acceptance, conflict and crossing path analysis. *Int. J. Inj. Contr. Saf. Promot.* 19, 320–330.

- Choudhary, P., Velaga, N.R., 2017. Modelling driver distraction effects due to mobile phone use on reaction time. *Transport. Res. C Emerg. Technol.* 77, 351–365.
- Crandall, J.R., Bhalla, K.S., Madeley, N., 2002. Designing road vehicles for pedestrian protection. *BMJ* 324, 1145–1148.
- Dalvi, Q., 2004. World report on road traffic injury prevention by world health organization and world bank (WHO, Geneva, April). *Transport Rev.* 24, 365–376.
- Damsere-Derry, J., Ebel, B.E., Mock, C.N., Afukaar, F., Donkor, P., 2010. Pedestrians' injury patterns in Ghana. *Accid. Anal. Prev.* 42, 1080–1088.
- Dandona, R., Kumar, G.A., Raj, T., Dandona, L., 2006. Patterns of road traffic injuries in a vulnerable population in Hyderabad, India. *Inj. Prev.* 12, 183–188.
- De Lavelette, B.C., Tijus, C., Poitrenaud, S., Leproux, C., Bergeron, J., Thouez, J.-P., 2009. Pedestrian crossing decision-making: a situational and behavioral approach. *Saf. Sci.* 47, 1248–1253.
- Deb, S., Strawderman, L., Carruth, D.W., Dubien, J., Smith, B., Garrison, T.M., 2017. Development and validation of a questionnaire to assess pedestrian receptivity toward fully autonomous vehicles. *Transport. Res. C Emerg. Technol.* 84, 178–195.
- Diaz, E.M., 2002. Theory of planned behavior and pedestrians' intentions to violate traffic regulations. *Transport. Res. F Traffic Psychol. Behav.* 5, 169–175.
- Dinh, D., Vũ, N., McIlroy, R., Plant, K., Stanton, N., 2020. Effect of attitudes towards traffic safety and risk perceptions on pedestrian behaviours in Vietnam. *IATSS Res.* 44, 238–247.
- Duperrex, O., Bunn, F., Roberts, I., 2002. Safety education of pedestrians for injury prevention: a systematic review of randomised controlled trials. *BMJ* 324 (7346), 1129.
- Elvik, R., Vaa, T., Høy, A., Sørensen, M., 2009. *The Handbook of Road Safety Measures*. Emerald Group Publishing.
- Glanz, K., Bishop, D.B., 2010. The role of behavioral science theory in development and implementation of public health interventions. *Annu. Rev. Publ. Health* 31, 399–418.
- Glanz, K., Rimer, B.K., Viswanath, K., 2008. *Health Behavior and Health Education: Theory, Research, and Practice*. John Wiley & Sons.
- Granié, M.-A., 2009. Effects of gender, sex-stereotype conformity, age and internalization on risk-taking among adolescent pedestrians. *Saf. Sci.* 47, 1277–1283.
- Granié, M.-A., Pannetier, M., Gueho, L., 2013. Developing a self-reporting method to measure pedestrian behaviors at all ages. *Accid. Anal. Prev.* 50, 830–839.

Blinded Reference

- Haghighi, M., Nadrian, H., Sadeghi-Bazargani, H., Bhalla, H.D.R., Bakhtari Aghdam, F., 2020. Challenges related to pedestrian safety: a qualitative study identifying Iranian residents' perspectives. *Int. J. Inj. Contr. Saf. Promot.* 27 (3), 327–335.
- Han, J., Singh, M., Zhao, D., 2010. Road safety literacy for speakers of English as a foreign language: educating novice drivers for the public's health. *Lit. Numeracy Stud.* 18, 52–66.
- Hasani, J., Ahanchi, N., Rajabi, A., Ghadizadeh, M., Hashemi Nazari, S., 2017. An epidemiologic study of deceased pedestrians in road traffic accidents in Iran during 2012–2013. *Arch. Trauma Res.* 6, 63–68.
- Heydari, S.T., Sadeghi-Bazargani, H., Haghighi, M., Rezaei Shah Kalaei, F., 2020. Developing and validating a measurement tool to self-report pedestrian safety-related behavior: the Pedestrian Behavior Questionnaire (PBQ). *Bull. Emerg. Trauma* 8 (4), 229.
- Hussein, M., Sayed, T., 2015. Microscopic pedestrian interaction behavior analysis using gait parameters. *Transport. Res. Rec.* 2519, 28–38.
- Jadaan, K., Al-Braizat, E., Al-Rafayah, S., Gammoh, H., Abukahlil, Y., 2018. Traffic safety in developed and developing countries: a comparative analysis. *J. Traffic Logis. Eng.* 6.
- Jalilian, M., Mostafavi, F., Mahaki, B., Delpisheh, A., Rad, G.S., 2015. An application of a theory of planned behaviour to determine the association between behavioural intentions and safe road-crossing in college students: perspective from Isfahan, Iran. *JPMA: JPMA (J. Pak. Med. Assoc.)* 65, 742–746.
- Jiménez-Mejías, E., Martínez-Ruiz, V., Amezcua-Prieto, C., Olmedo-Requena, R., De Dios Luna-Del-Castillo, J., Lardelli-Claret, P., 2016. Pedestrian-and driver-related factors associated with the risk of causing collisions involving pedestrians in Spain. *Accid. Anal. Prev.* 92, 211–218.
- Jung, S., Qin, X., Oh, C., 2016. Improving strategic policies for pedestrian safety enhancement using classification tree modeling. *Transport. Res. Pol. Pract.* 85, 53–64.
- Khankeh, H.R., Mohammadi, R., Ahmadi, F., 2007. Health care services at time of natural disasters: a qualitative study. *Iran J. Nurs.* 20, 85–96.
- Khorasani-Zavareh, D., Mohammadi, R., Khankeh, H.R., Laflamme, L., Bikhmoradi, A., Haglund, B.J., 2009. The requirements and challenges in preventing of road traffic injury in Iran. A qualitative study. *BMC Publ. Health* 9, 486.
- Koh, P., Wong, Y., Chandrasekar, P., 2014. Safety evaluation of pedestrian behaviour and violations at signalised pedestrian crossings. *Saf. Sci.* 70, 143–152.
- Krueger, R.A., 2014. *Focus Groups: A Practical Guide for Applied Research*. Sage publications.
- Lam, L.T., 2001. Factors associated with parental safe road behaviour as a pedestrian with young children in metropolitan New South Wales, Australia. *Accid. Anal. Prev.* 33, 203–210.
- Lee, E.J., Ko, B.C., Nam, J.-Y., 2016. Recognizing pedestrian's unsafe behaviors in far-infrared imagery at night. *Infrared Phys. Technol.* 76, 261–270.
- Levine, N., 2006. Houston, Texas, metropolitan traffic safety planning program. *Transport. Res. Rec.* 1969, 92–100.
- Mackenzie, S., Seedat, M., Swart, L., Mabunda, M., 2008. Pedestrian Injury in South Africa: Focusing Intervention Efforts on Priority Pedestrian Groups and Hazardous Places. *Crime, Violence and Injury Prevention in South Africa: Data to Action*. Medical Research Council-University of South Africa, Pretoria.
- Majid, M.A.A., Othman, M., Mohamad, S.F., Lim, S.A.H., Yusof, A., 2017. Piloting for interviews in qualitative research: operationalization and lessons learnt. *Int. J. Acad. Res. Bus. Soc. Sci.* 7, 1073–1080.
- Mikoski, P., Zlupko, G., Owens, D.A., 2019. Drivers' assessments of the risks of distraction, poor visibility at night, and safety-related behaviors of themselves and other drivers. *Transport. Res. F Traffic Psychol. Behav.* 62, 416–434.
- Miles-Doan, R., 1996. Alcohol use among pedestrians and the odds of surviving an injury: evidence from Florida law enforcement data. *Accid. Anal. Prev.* 28, 23–31.
- Naci, H., Chisholm, D., Baker, T.D., 2009. Distribution of road traffic deaths by road user group: a global comparison. *Inj. Prev.* 15, 55–59.
- Nasar, J., Hecht, P., Wener, R., 2008. Mobile telephones, distracted attention, and pedestrian safety. *Accid. Anal. Prev.* 40, 69–75.
- Nordfjærn, T., Şimşekoğlu, Ö., 2013. The role of cultural factors and attitudes for pedestrian behaviour in an urban Turkish sample. *Transport. Res. F Traffic Psychol. Behav.* 21, 181–193.
- Obeng-Atuah, D., Poku-Boansi, M., Cobbinah, P.B., 2017. Pedestrian crossing in urban Ghana: safety implications. *J. Transport & Health* 5, 55–69.
- Osama, A., Sayed, T., 2017. Evaluating the impact of connectivity, continuity, and topography of sidewalk network on pedestrian safety. *Accid. Anal. Prev.* 107, 117–125.
- Papadimitriou, E., Lassarre, S., Yannis, G., 2016. Introducing human factors in pedestrian crossing behaviour models. *Transport. Res. F Traffic Psychol. Behav.* 36, 69–82.
- Pasha, M.M., Rifaat, S.M., Hasnat, A., Rahman, I., 2015. Pedestrian's Behaviour on Road Crossing Facilities, vol. 73. *Jurnal Teknologi*.
- Poudel-Tandukar, K., Nakahara, S., Ichikawa, M., Poudel, K.C., Jimba, M., 2007. Risk perception, road behavior, and pedestrian injury among adolescent students in Kathmandu, Nepal. *Inj. Prev.* 13, 258–263.
- Rankavat, S., Tiwari, G., 2016. Pedestrians perceptions for utilization of pedestrian facilities—Delhi, India. *Transport. Res. F Traffic Psychol. Behav.* 42, 495–499.
- Räsänen, M., Lajunen, T., Alticafarbay, F., Aydin, C., 2007. Pedestrian self-reports of factors influencing the use of pedestrian bridges. *Accid. Anal. Prev.* 39, 969–973.
- Rodríguez, J.M., Medina, M.H., Campuzano, J.C., Bangdiwala, S.I., Villaveces, A., 2014. Methodological proposal for implementing an intervention to prevent pedestrian injuries, a multidisciplinary approach: the case of Cuernavaca, Morelos, Mexico. *Inj. Prev.* 20 e1–e1.
- Rosenbloom, T., Nemrodov, D., Barkan, H., 2004. For heaven's sake follow the rules: pedestrians' behavior in an ultra-orthodox and a non-orthodox city. *Transport. Res. F Traffic Psychol. Behav.* 7, 395–404.
- Sandt, L., Marshall, S.W., Ennett, S.T., 2015. Community-based pedestrian and bicycle safety program: developmental framework and process evaluation. *Transport. Res. Rec.* 2519, 51–60.
- Schepers, P., Den Brinker, B., Methorst, R., Helbich, M., 2017. Pedestrian falls: a review of the literature and future research directions. *J. Saf. Res.* 62, 227–234.
- Shaan, K., 2019. Assessing sidewalk and corridor walkability in developing countries. *Sustainability* 11, 3865.
- Şimşekoğlu, Ö., Nordfjærn, T., Zavareh, M.F., Hezaveh, A.M., Mamdoohi, A.R., Rundmo, T., 2013. Risk perceptions, fatalism and driver behaviors in Turkey and Iran. *Saf. Sci.* 59, 187–192.

- Speziale, H.S., Streubert, H.J., Carpenter, D.R., 2011. Qualitative Research in Nursing: Advancing the Humanistic Imperative. Lippincott Williams & Wilkins.
- Sucha, M., 2018. Pedestrians' habits while crossing the road at a former zebra crossing. *Social Psychol. Soc.* 9, 33–46.
- Sullman, M.J., 2006. Anger amongst New Zealand drivers. *Transport. Res. F Traffic Psychol. Behav.* 9, 173–184.
- Tulu, G.S., Washington, S., King, M.J., Haque, M., 2013. Why Are Pedestrian Crashes So Different in Developing Countries? A Review of Relevant Factors in Relation to Their Impact in Ethiopia.
- World Health Organization, 2007. Global Age-Friendly Cities: A Guide. World Health Organization, .
- World Health Organization, 2015. Global Status Report on Road Safety 2015. World Health Organization, .
- World Health Organization, 2018. Global Status Report on Road Safety 2018. World Health Organization.
- Zegeer, C.V., Bushell, M., 2012. Pedestrian crash trends and potential countermeasures from around the world. *Accid. Anal. Prev.* 44, 3–11.
- Zhou, R., Horrey, W.J., Yu, R., 2009. The effect of conformity tendency on pedestrians' road-crossing intentions in China: an application of the theory of planned behavior. *Accid. Anal. Prev.* 41, 491–497.