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Influencing Factors on Students' Pedestrian Safety Behavior: A Descriptive Analytical Study

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ABSTRACT

Objectives: This study aimed to identify the factors influencing pedestrians' preventive behaviors regarding road traffic safety among students at Shahid Beheshti University of Medical Sciences (SBMU), using the Health Belief Model (HBM) as a framework.

Methods: In 2022, a total of 337 SBMU students were selected using a multi-stage sampling method. Data were collected using a 45-item questionnaire based on HBM constructs: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and behavior. The questionnaire was distributed electronically via SBMU's social media channels. Data analysis was performed using SPSS software (version 18). $P<0.05$ was considered statistically significant.

Results: The mean age of the participants was 26.68±2.8 years. The most significant influential factor was family (94.3%), followed by social media. Among HBM constructs, perceived susceptibility had the highest mean score. A one-point increase in perceived susceptibility, perceived benefits, and cues to action scores significantly increased the likelihood of adherence to safe pedestrian behavior ($\beta=0.06$, $p=0.04$; $\beta=0.121$, $p<0.001$; $\beta=0.219$, $p=0.003$, respectively). Conversely, an increase in perceived barriers significantly decreased adherence to safe pedestrian behavior ($p<0.001$).

Conclusion: Family and social media play a crucial role in shaping students' perceptions of road traffic safety. Enhancing perceived susceptibility and benefits, as well as providing effective cues to action, can significantly promote preventive behaviors among students.

Keywords: Pedestrian behavior, Road traffic safety, Risk perception, Preventive behaviors.

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Introduction

Road traffic crashes are a significant global public health issue, resulting in significant human losses and severe socioeconomic costs [1]. According to the World Health Organization (WHO), annual road accident deaths have declined slightly to 1.19 million, reflecting the impact of ongoing road safety efforts [2]. Pedestrian safety has emerged as a growing concern worldwide, with traffic accidents in Iran ranking as the second leading cause of death and the primary cause of disability-adjusted life years (DALYs) lost [3]. Previous research indicated that many pedestrians neglect proper safety measures while crossing roads, frequently engaging in distracted behaviors such as using mobile phones or listening to music [4].

To better understand pedestrians' health behaviors and their adherence to traffic rules, this study employed the Health Belief Model (HBM) [5]. Since its introduction in the 1950s by Hochbaum and Roznastak [6], the HBM has been widely used to examine the relationship between personality traits and health outcomes. As one of the earliest theories developed to predict and explain preventive health behaviors [7], the HBM provides a valuable conceptual framework for understanding preventive behaviors related to traffic rules. According to the HBM model, perceived susceptibility and perceived severity influence individuals' perceptions of health risks and their motivation to adopt preventive behaviors [8, 9].

The HBM suggested that individuals were more likely to adopt preventive health behaviors when they (1) perceived themselves as susceptible to a health condition (perceived susceptibility), and (2) believed that the condition could have serious consequences (perceived severity). Additionally, the likelihood of taking action increases when individuals recognize the potential benefits of the behavior and perceive these as outweighing potential barriers [10-12].

Existing research indicated that perceived barriers had the strongest predictive power; however, findings on the influence of other constructs remained inconsistent [13, 14]. The HBM also accounts for internal and external cues, including physiological states and environmental factors (cues to action), as well as the desire to maintain good health (health motivation) [15, 16].

Pedestrians remain particularly vulnerable road users, comprising approximately 23% of annual road traffic fatalities worldwide [2, 17].

Iran, with a population of 82 million, experiences an average of 20.5 fatalities per 100,000 inhabitants, significantly higher than the global average, resulting in estimated economic losses equivalent to 6.5% of its gross domestic product (GDP) [18]. Alarmingly, pedestrians account for nearly 23% of the 1.35 million annual road traffic deaths worldwide [19].

While European data showed pedestrians accounting for about 27% of road casualties, research consistently identifies human factors, such as errors by road users, as key contributors to pedestrian-involved accidents [18].

Despite these risks, few studies have applied the HBM to examine pedestrian safety among young adults in high-risk settings such as Iran. Consequently, this study aimed to investigate factors influencing preventive road safety behaviors among students at Shahid Beheshti University of Medical Sciences (SBMU), using the HBM as a framework.

Materials and Methods

This study employed a descriptive-analytical design. Participants were recruited in 2022 from four Faculties of SBMU, including Health, Medicine, Nursing, and Midwifery. The sample size was calculated using the formula:

$n=(z^2\times s^2)/d^2$

with the following parameters: significance level (α)=0.05, Z-score (Z)=1.96, standard deviation (SD)=16.7 (based on pilot study data), and margin of error (d)=1.7, which yielded an estimated required sample size of 370 participants. An equal number of students was allocated from each Faculty, approximately 124 students per Faculty. Enrollment lists for each academic term were obtained through faculty visits, and participants were selected using a simple random sampling procedure. From the 370 electronic questionnaires distributed, 337 completed responses (91.1% response rate) were obtained for final analysis.

The study protocol was approved by the Medical Ethics and Law Research Center (IR.SBMU.RETECH.REC.1401.680).

The research utilized a 45-item questionnaire adapted from Heshmati *et al.,* in Iran [20]. The questionnaire was validated based on the HBM constructs.

It aimed to measure six key dimensions: perceived susceptibility (5 items, such as "I am at risk of traffic accidents"), perceived severity (8 items, such as "I could die due to a traffic accident"), perceived benefits (6 items, including "I feel secure when I cross over a footbridge"), perceived barriers (7 items including "It takes a long time to cross the pedestrian bridge"), cues to action (7 items with Yes/No responses, such as "What is the most effective media for promoting safety principles and traffic rules?"), and behavior (12 dichotomous items with Yes/No/Occasionally responses, e.g., "I cross the street at the crosswalk"). Additionally, 5 sociodemographic items collected information on age, sex, level of education, marital status, and having a driver's license. All HBM constructs were measured on a five-point Likert scale ranging from "completely agree" (4) to "completely disagree" (0), yielding total score ranges of 0-20 for perceived susceptibility, 0-32 for perceived severity, 0-24 for perceived benefits, 0-28

for perceived barriers, 0-7 for cues to action, and 0-24 for the behavior construct.

The reliability of the HBM scale was previously tested in the same population in a study by Heshmati *et al.,* reporting Cronbach's alpha coefficients of 0.79 [20]. In this study, the Cronbach's alpha coefficients were calculated at 0.72 (perceived sensitivity=0.79, perceived severity=0.70, perceived benefits=0.80, perceived barriers=0.71, cues to action=0.66, and behavior=0.71).

The inclusion criteria required that students must have completed at least one semester of their academic program, and the exclusion criteria were unwillingness to participate in the study.

The questionnaires were prepared electronically using the Google Docs platform, and the link was shared with the students through SBMU's social media and communication platforms. The survey began with an informed consent form, ensuring participants acknowledged their voluntary agreement before proceeding. Students who agreed to participate in the study first completed the informed consent form before proceeding to the questionnaire. The study was conducted across various faculties of SBMU, whose student population represents diverse geographic regions of the country, thereby enhancing the demographic diversity of the sample. All participants were explicitly instructed to provide truthful responses to all survey questions.

The data were analyzed using SPSS software (version 18). The normality of the data was tested using the Kolmogorov-Smirnov test. Both descriptive statistics, including frequencies, means, and standard deviations, and analytical statistics were used to determine the relationship between study variables. Linear regression analysis was conducted to identify predictors of HBM constructs and behavioral outcomes. A significance level of less than 0.05 was considered for all analyses.

Results

The mean age of the participants was 26.68±2.8 years, ranging from 17 to 40 years. Of these, 152 (45.1%) were men, and 283 (83.9%) were single (Table 1).

Perceived susceptibility demonstrated the highest mean score (mean±SD) among all HBM constructs (Table 2).

Among different age groups, perceived susceptibility showed the highest mean score in the 26-30 age group compared to others, while other constructs had their highest means among those aged 31 and older.

Doctoral students demonstrated higher scores for perceived severity and perceived benefits, whereas MSc students scored higher on perceived susceptibility and perceived barriers. BS students showed the highest overall scores.

Single students had the highest perceived barrier scores, whereas married students scored highest on perceived susceptibility. Students with driver's licenses showed higher perceived severity scores, while those without licenses reported higher perceived susceptibility and perceived barriers (Table 3).

The primary cues to action were family (94.3%), followed by social media (90.8%), and police (90.5%).

Regarding pedestrian behavior, a one-point increase in perceived susceptibility, perceived benefits, and cues to action scores significantly increases the probability of traffic behavior beliefs by 0.06 (p=0.04), 0.121 (p<0.001), and 0.219 (p=0.003), respectively. A one-point increase in perceived benefits, cues to action, and perceived susceptibility increases the odds of safe behavior by 12.1%, 21.9%, and 65%, respectively.

Table 1. Distribution of demographic variables

Variable	Characteristics	N	%
Sex	Female	185	54.9
	Male	152	45.1
Level of education	BS	107	31.8
	MSc	93	27.6
	MD	91	27
	PhD	46	13.6
Marital status	Single	283	83.9
	Married	54	16.1
Having a driver's license	Yes	156	46.3
	No	181	53.7

Table 2. Descriptive statistics of Health Belief Model constructs.

HBM Construction	mean	SD
Perceived Susceptibility	19.5	3.19
Perceived Severity	17.49	7.71
Perceived Benefits	11.22	4.68
Perceived Barriers	20.24	5.21
Behavior	19.44	4.14

Table 3. Descriptive statistics of Health Belief Model constructs stratified by demographic characteristics.

Variable	Perceived Susceptibility	Perceived Severity	Perceived Benefits	Perceived Barriers	Behavior
Age					
Under 20 ages	19.38±3.06	17.25±6.89	11.27±66	19.93±62	18.85±11
20-25	19.41±3.42	17.36±7.69	11.05±4.19	20.14±4.80	19.96±4.21
26-30	20.33±0.81	14.00±5.32	8.33±2.06	20.00±4.28	16.00±2.75
Older than 31	20.83±3.19	24.50±12.84	16.00±11.02	24.16±8.58	20.83±7.54
Marital Status					
Single	19.47±3.17	17.69±7.83	11.18±4.62	20.36±5.00	19.54±4.40
Married	19.62±3.43	16.95±7.14	11.66±5.01	19.79±6.29	19.04±2.77
Level of education					
BS	18.66±4.21	18.11±9.51	11.55±6.14	20.00±5.70	18.16±4.13
MSc	19.68±3.00	17.41±7.46	11.11±4.32	20.31±5.19	19.76±4.08
MD/ PhD	16.50±3.53	21.00±4.24	17.50±9.19	19.50±6.36	13.00±1.41
Having a driver's license					
No	18.88±3.61	17.56±8.31	11.47±5.07	18.91±5.36	19.28±4.68
Yes	20.31±2.50	17.13±6.83	11.01±4.26	21.67±4.80	19.72±3.58

Table 4. Predictor factors of behaviors, according to the linear regression

Variable	HBM construction	B (Unstandardized Coefficient)	Beta (Standardized Coefficient)	Confidence Interval		t	*p* value
				Lower	Upper		
Beliefs about traffic behavior	Perceived susceptibility	0.06	0.104	-0.054	0.368	2.37	0.042
	Perceived severity	0.026	0.062	0.025	0.223	1.117	0.265
	Perceived benefits	0.121	0.226	0.035	0.345	4.04	<0.001
	Perceived barriers	-0.12	-0.227	-0.376	-0.104	4.391	<0.001
	Cue to action	0.219	3.004	-0.169	0.488	3.004	0.003

HBM: Health Belief Model Constructs, P<0.05 was considered statistically significant.

Conversely, a one-point increase in perceived barriers reduced the likelihood of beliefs about traffic behavior by a factor of 0.12, with a significant decrease (p<0.001) (Table 4).

In other words, the results indicated that perceived susceptibility, perceived benefits, cues to action, and perceived barriers all significantly influenced preventive traffic-related behaviors. Whether these subscales increased or decreased, they significantly affected the probability of engaging in such preventive behaviors.

Discussion

The primary objective of this study was to identify the factors influencing preventive behaviors regarding road traffic rules among SBMU students. It was found that the rising annual rate of traffic injuries particularly affects young people.

The findings of this study demonstrated that family, media, and police, ranked by significance, were the most influential factors promoting preventive behaviors. These results were consistent with a previous study conducted in Iran, which also revealed the significance of police, family, and friends as key resources for acquiring information about traffic rules [21]. Moreover, Heshmati *et al.,* emphasized the importance of media as a primary source of information [20].

These findings underscored the critical importance of families, media, and police in fostering preventive behaviors related to road traffic rules. Existing evidence confirmed that seeking guidance and heeding warnings from influential sources were positively correlated with reduced risky traffic behaviors [22].

Families play a pivotal role in shaping the students' road safety behaviors and attitudes. Parents serve as positive role models by demonstrating proper adherence to traffic rules and educating children about their importance. This familial reinforcement helps cultivate responsibility and accountability regarding road safety. Meanwhile, social media provide valuable channels for disseminating traffic safety awareness, sharing educational content, and promoting safe practices among students. Overall, the combination of family influence and social media can work together to positively impact students' preventive behaviors related to road traffic rules. This dual approach of promoting safety culture and responsibility both at home and online contributes significantly to creating safer road environments for students.

Traffic behaviors frequently cluster within families, showing strong correlations between fathers and their children, as well as among siblings. This pattern reveals the family's central role in either encouraging risky behaviors or fostering protective ones. Given Iran's strong familial and collectivist culture, traffic safety interventions for children should focus on the family unit rather than individuals alone.

Family-based prevention programs might prove more effective than individual approaches in reducing children's risky traffic behaviors [23].

Furthermore, the results indicated that doctoral students had the highest mean score for perceived severity. Similarly, in 2017, Bener *et al.,* found that education level significantly influenced compliance with traffic regulations [24].

Several factors might explain doctoral students' elevated risk perception: their specialized knowledge about potential hazards, the heightened stress of advanced academic work, and greater road experience among licensed drivers. License holders typically develop sharper hazard awareness through driving experience, which may amplify their perception of risk severity.

This outcome could be attributed to doctoral students' greater maturity and specialized knowledge compared to other students. Decision-making likely makes this demographic more inclined to consistently follow traffic regulations.

The analysis revealed that the participating students who had a driver's license exhibited a higher mean score for perceived benefits, whereas those without a driver's license had the highest mean score for perceived obstacles. Individuals with driver's licenses were more inclined to engage in protective behaviors due to their involvement in driving-related concerns. Furthermore, pedestrian safety behaviors might vary according to individual temperament and personality differences [25].

Furthermore, it should be noted that young men demonstrated more negative attitudes toward traffic regulations than women. This pattern corresponds with their higher involvement in alcohol- and speed-related collisions [26]. Similarly, other studies reported sex differences in traffic rule compliance, attributing them to factors such as risk assessment, impulse control, and social norms [27]. However, research suggested that the extent of these differences is context-dependent, with some populations showing negligible gender gaps [28]. Given Iran's high traffic fatality rates, future studies should explore how societal influences may shape gender-specific risk perceptions and rule adherence.

The findings of the present study indicated that perceived severity showed a stronger correlation with behavior than other constructs. This finding was in agreement with the results of previous studies, which similarly found significant correlations between most HBM constructs, excluding perceived severity and protective behavioral intentions [20, 21]. However, contrasting results emerged from Lajunen *et al.,* [29], who reported that perceived barriers and cues to action were the strongest predictors of the HBM components. They suggested that pedestrian safety programs should prioritize barrier reduction over benefit promotion, particularly regarding helmet use.

Our results suggested that interventions should primarily target perceived barrier reduction. The findings of our study indicated that perceived sensitivity, perceived benefits, perceived barriers, and cues to action had a significant relationship with students' behavior. However, no significant statistical relationship was found between perceived severity and behavior. In contrast, Soltani *et al.,* conducted a study on helmet use behavior and found a significant relationship between all the constructs of the HBM and the intention of drivers in wearing safety helmets [30]. Besides, they suggested that the HBM could serve as a viable framework for helmet-use educational programs.

Agha Moulay's findings similarly demonstrated a significant relationship between perceived barriers and cues to action regarding helmet use [31]. Ozkan *et al.,* identified relationships between both perceived barriers and perceived severity with safe driving behaviors, suggesting that individuals with a higher perceived severity showed lower engagement in dangerous driving behaviors [32]. Additionally, *Ross et al.,* found a significant relationship between all HBM constructs and driver's performance [33].

Goniewicz, *et al.,* declared that the educational training focused on road traffic safety could significantly reduce the risk of road accidents, including promotional campaigns and skill training for pedestrians. By addressing key risk factors such as excessive speed, alcohol use, failure to wear seatbelts or helmets, and poor visibility, education can lead to safer behaviors, increased awareness, and ultimately fewer accident rates and injuries [34].

In conclusion, this study highlighted the significance of psychological factors, including risk perception, parental behavior, and attitudes toward traffic safety, on road safety behaviors. These findings emphasized the critical role of parental influence in shaping adult driving behaviors. Furthermore, the results demonstrated that promoting health literacy among students can be achieved through various means, such as providing information via social media and establishing health campaigns and networks.

This study contributed novel insights by specifically examining HBM constructs as predictors of traffic behaviors. The analysis revealed how these constructs operate within the context of traffic behavior, offering valuable insights into the cognitive processes and beliefs underlying individuals' traffic-related decisions and actions.

Additionally, the study highlighted the importance of considering these factors in designing targeted interventions and strategies to promote safer and more responsible traffic conduct.

Prevention programs should incorporate these psychological factors while addressing specific concerns that promote cautious behaviors. Key priorities include: (1) raising awareness of traffic rule benefits, (2) mitigating compliance barriers, and (3) implementing proper training initiatives. Such multifaceted approaches can significantly improve regulatory compliance among students and enhance

overall road safety. Future studies should investigate the longitudinal effects of family-based interventions on pedestrian safety outcomes.

Declaration

Ethics approval and consent to participate: The Medical Ethics and Law Research Center of Shahid Beheshti University of Medical Sciences (SBMU) confirmed that this study was conducted in compliance with institutional ethical standards. The research protocol received formal approval from both the University's Research Council and the Human Subjects Review Board (IR.SBMU.RETECH.REC.1401.680). All participants provided written informed consent prior to enrollment. This study adheres strictly to the ethical principles outlined in the Declaration of Helsinki (2013 revision) (http://ethics.iit.edu/ecodes/node/3931) and involved no animal subjects.

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