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Relationship Between General Health Domains and Pedestrian Safety Behavior: A Cross-Sectional Study

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Abstract

Background: Traffic injuries are one of the top ten leading causes of mortality worldwide that impose a substantial burden on the health and economy of nations. Among all traffic users, pedestrians are the most vulnerable, accounting for a significant share of injuries and fatalities resulting from traffic accidents. Numerous factors contribute to pedestrian traffic accidents, with unsafe pedestrian behavior being one of the most critical factors.

Objectives: Various factors can influence the traffic behavior of pedestrians. Therefore, this study aimed to examine the relationship between demographic characteristics, the general health status of pedestrians, and their traffic behavior.

Methods: In this cross-sectional study, after obtaining ethical approval and participants' consent, data were collected from eligible individuals. The data included participants' demographic information and their responses to the 28-question General Health Questionnaire (GHQ-28) and the Pedestrian Behavior Questionnaire (PBQ). Linear regression analysis was performed to assess the relationships between demographic variables, general health domains, and the total score obtained from the PBQ.

Results: Among the 1 421 participants in the study, 720 (50.7%) were female and 1 310 (92.2%) were under the age of 60. In terms of marital status, 979 individuals were married (69.5%), and 368 (26.2%) were single. The overall score of the general health of the participants was high in 623 individuals (43.8%), moderate in 666 individuals (46.9%), low in 122 individuals (8.6%), and very low in 10 individuals (0.7%). The mean (standard deviation) score of pedestrian behavior was also 57.89 (±11.9). There was a significant relationship between female gender, age of 15-29 years, being single, and domains of general health (somatic symptoms, anxiety assessment, social dysfunction assessment, and depression assessment) with the overall score of pedestrian behavior. Additionally, a significant relationship was found between the overall score of the participants' general health and the overall score of their pedestrian behavior.

Conclusions: There is a significant relationship between demographic characteristics and various domains of the general health of pedestrians and their behavior. Paying attention to this issue in policymaking and conducting further studies to identify other factors affecting pedestrian traffic behavior to prevent traffic injuries seems necessary.

Keywords: Health Status, Mental Health, Pedestrians, Traffic Accidents

1. Background

Traffic injuries are one of the top ten leading causes of mortality worldwide, and these injuries are the main cause of death among young people aged 15 to 29 (1). Such accidents result in 20 to 50 million non-fatal injuries, with many individuals experiencing disabilities as a result of these accidents (2). According to the World Health Organization (WHO) report, 1.25 million people lost their lives in traffic accidents worldwide in 2013 (1). Traffic accidents have a significant impact in terms of pain and suffering for the affected individuals - the victims, their families, and friends - and carry a substantial economic burden. It is estimated that traffic

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injuries will cost the global economy $1.8 trillion US dollars from 2015 to 2030, which is equivalent to an annual tax of 0.12% on the world's Gross Domestic Product (GDP). Although low- and middle-income countries bear the highest health burden, their share of the economic burden of road injuries is only 46.4%, indicating their lower share in the global economy compared to high-income countries (2).

Motorcycle riders, cyclists, and pedestrians are the most vulnerable road users, especially in developing countries, due to a lack of protective equipment (3, 4). Studies have shown that approximately 45% of fatal traffic accidents in low- and middle-income countries are related to pedestrians (5), while only 18% of these injuries are attributed to pedestrians in developed countries (3). According to a report by WHO in 2009, 33% of traffic-related mortality in Iran is attributed to pedestrians (6), which is consistent with the findings of other local studies conducted on this subject (7). Unfortunately, in Iran, although the years of life lost index among male pedestrians has decreased from 2.5 in 2009 to 1.5 in 2013, during the same period, this index has increased from 0.9 to 2.1 among female pedestrians. Thus, most fetal traffic accidents among pedestrians occur in urban areas, among illiterate and married women, and during the day (8). Although fetal traffic injuries have decreased in the country in recent years (9), understanding the health and economic burden of these injuries and their distribution among different regions of the country is essential for policymakers (2).

Traffic injuries often have various causes. Many factors, including demographic characteristics, individuals' driving skills, roads, environment, and vehicle conditions, and the traffic behavior of drivers and pedestrians, contribute to the occurrence of injuries (10). In general, unsafe behavior in traffic refers to actions that lead to accidents. Unsafe pedestrian behavior, in traffic studies, refers to behaviors that violate road traffic safety laws and regulations (11). According to studies, unsafe behavior of individuals, particularly pedestrians, is the primary factor in road accidents (11, 12).

Cognitive psychologists believe that the human information processing system and the performance of various behaviors are governed by three stages: Perception, judgment, and response (13). Various factors influence these three stages, with one of the most important factors being human general health. Human general health is influenced by various factors such as physical health, mental health (including anxiety levels and the ability to control anxiety, depression, and sleep disorders), and appropriate social functioning. Impairment in any of these factors can harm general health and human behavior, putting their performance at risk (14). Therefore, a low level of general health among pedestrians can affect their traffic behavior and the occurrence of traffic accidents. Thus, the relationship between demographic characteristics, the general health of pedestrians, and their traffic behaviors is an important topic that, if considered, can be effective in modifying urban and rural infrastructures, reducing the vulnerability of pedestrians, and improving the safety of cities (10).

Numerous studies have been conducted on pedestrians and traffic accidents, each focusing on specific dimensions of the subject. However, there has been limited research on the association between demographic characteristics, general health, and pedestrian traffic behavior, particularly in Iran.

2. Objectives

Considering the importance of this issue, the objective of this study is to examine the demographic characteristics, general health, and traffic behaviors of pedestrians and evaluate the relationship between them.

3. Methods

This cross-sectional study was conducted as part of the Persian Traffic Cohort (PTC) on the general population of the city of Tabriz. The required data were collected between 2020 and 2021 through the interviews to conduct the traffic cohort.

The target population of the study included the residents of the city of Tabriz, and the reference population included the residents of the two municipal districts of Tabriz. The list of households and the household members of the two municipal districts of Tabriz was initially taken from the health center database of Tabriz. To categorize the neighborhoods of Tabriz by the socioeconomic status (SES) level, an expert panel (provincial health center experts and traffic research center experts) was conducted. In total, the neighborhoods of Tabriz were divided into three strata, including low, medium, and high levels of SES. Next, 20 neighborhoods were randomly selected from all strata as clusters. The number of clusters in each stratum was determined based on the proportion of neighbors in each stratum to the total neighbors. Then, within each cluster, 20 households were randomly selected. In the end, all persons in each household entered the study. Each health center was defined as a category, and the households investigated in each category were selected

randomly in accordance with the existing population. Finally, 1 421 individuals participated in the study.

The inclusion criteria included living in District 2 of Tabriz for at least six months, volunteering to participate in the study, and being at least 14 years of age. The exclusion criteria included individuals under the age of 14, unwillingness to participate in the study, residing in other areas of the city during data collection, and incomplete questionnaire information.

In the next stage, after the study was approved by the Ethics Committee of Tabriz University of Medical Sciences, the Pedestrian Behavior Questionnaire (PBQ) and the General Health Questionnaire (GHQ) were distributed, and each participant in the study completed them.

The PBQ is a standardized tool to assess the traffic safety behavior of pedestrians. It is considered reliable and valid (15). The questionnaire consists of two parts. The first part includes questions related to demographic and background variables such as age, gender, education level, marital status, amount of daily walking, and the usual mode of transportation. The second part includes 29 questions related to five different subscales of pedestrians' traffic safety behaviors. The first subscale includes 6 questions regarding traffic rules compliance, the second subscale includes 10 questions regarding pedestrian rules violations, the third subscale includes 7 questions regarding pedestrian positive behaviors, the fourth subscale includes 4 questions regarding pedestrian distracting behaviors, and finally, the fifth subscale includes 2 questions regarding pedestrian aggressive behaviors and violence. This questionnaire is scored from 1 to 5 on a Likert scale (never = 1 and always = 5). The total score of the questionnaire is calculated by summing the scores of all questions. A higher score on the questionnaire indicates riskier pedestrian behavior.

The GHQ is reliable and valid (16), with 28 questions and 4 subscales, including somatic symptoms, anxious/insomnia symptoms, social dysfunction, and depression. Each subscale contains 7 questions. The total score of each individual is obtained from the sum of the scores of four subscales. The overall score level of the GHQ is as follows: 1) High (score 0 - 21): Favorable health status; 2) Medium (score 22 - 42): Medium health status; 3) Low (score 43 - 63): Low health status, and 4- Very low (score 64 - 84): Very low or severe health status.

Data were analyzed using STATA statistical software version 16. The normality of the data was assessed using the Kolmogorov-Smirnov test. Frequency (percentage) was used to describe qualitative data. Mean (standard deviation) was also used to describe normal quantitative data. Linear regression analysis was used to assess the relationships between demographic variables and general health factors with the total score obtained from the PBQ. Finally, variables with a P-value less than 0.05 were tested using multivariate regression. The significance level was considered 0.05 in all tests.

Ethical permission to conduct the present research was obtained from the Regional Research Ethics Committee of Tabriz University of Medical Sciences (IR.TBZMED.REC.1401.741).

4. Results

The study involved 1421 participants, with 720 (50.7%) being female. The majority of individuals, 1 310 (92.2%), were under the age of 60. In terms of marital status, 368 (26.2%) were single, 979 (69.5%) were married, 45 (3.2%) were widowed, and 16 (1.1%) were divorced. Looking at education, 66 (4.8%) individuals were illiterate, 180 (12.9%) had completed elementary education, 659 (47.3%) had a diploma, 93 (6.7%) had an associate degree, 276 (19.8%) had a bachelor's degree, 95 (6.8%) had a postgraduate degree, and 24 (1.7%) held a Ph.D. or higher degree.

In this study, the scores of GHQ and PBQ are as follows (Table 1).

Table 1. The Scores of the General Health Questionnaire and Pedestrian Traffic Behavior

Questionnaire	Variables	Categories	Frequency (%)
General health	Somatic symptoms	High	1178 (82.9)
		Medium	202 (14.2)
		Low	41 (2.9)
	Anxiety	High	1172 (82.5)
		Medium	213 (15.0)
		Low	36 (2.5)
	Social dysfunction	High	398 (28.0)
		Medium	859 (60.5)
		Low	164 (11.5)
	Depression	High	1324 (93.1)
		Medium	72 (5.1)
		Low	25 (1.8)
	Overall score	High	623 (43.8)
		Medium	666 (46.9)
		Low	122 (8.6)
		Very Low	10 (0.7)
Pedestrian traffic behavior	Positive behavior 1 [a]		17.85 (5.3)
	Violation [a]		6.40 (3.0)
	Positive behavior 2 [a]		18.02 (4.5)
	Distraction [a]		13.15 (4.8)
	Aggression [a]		2.47 (1.1)
	Overall [a]		57.89 (11.9)

[a] Mean (standard deviation).

The relationship between the overall score of pedestrians' behavior and GHQ domains and demographic characteristics of the participants in the study based on the simple linear regression model is as follows (Table 2).

Table 2. Results of Simple Liner Regression Between Overall Score of Pedestrians' Behavior and Demographic Characteristic/ General Health Questionnaire Domains

Variables and Category	OR	CI (95%)		P-Value [a]
		Lower	Upper	
Sex (Male)				
Female	0.19	0.063	0.63	0.006
Age (30 - 65)				
15 - 29	25	12	26	0.001
60+	0.21	0.019	2.34	0.2
Marital status (Married)				
Single	32.3	7.7	36.7	0.001
Widow	0.08	0.006	1.26	0.07
Divorced	0.19	0.04	8.8	0.2
Education status (Illiterate)				
Elementary	0.05	0.001	2.13	0.13
Diploma	0.34	0.01	10.40	0.54
Associate degree	0.01	0.001	0.92	0.02
Bachelor's degree	0.27	0.07	9.37	0.47
Postgraduate	0.05	0.008	3.28	0.16
Ph.D. and above	0.83	0.001	6.2	0.95
Walking time per day (< 30 min)				
30 - 60 min	2.08	0.47	9.1	0.3
60 - 120 min	15.12	1.42	21.07	0.02
> 120 min	20.41	0.41	32.07	0.1
Somatic symptoms assessment (Low)				
High level of health	0. 3	0.06	0.66	0.01
Medium level of health	0.01	0.001	1.31	0.06
Anxiety assessment (Low)				
High level of health	0.001	0.0003	0.85	0.003
Medium level of health	0.012	0.001	0.92	0.04
Social dysfunction assessment (Low)				
High level of health	0.07	0.002	0.89	0.001
Medium level of health	0.024	0.003	0.38	0.001
Depression assessment (Low)				
High level of health	0.03	0.002	0.6	0.003
Medium level of health	0.08	0.02	12	0.4
Overall score of general health (Very low level of health)				
High level of health	0.03	0.006	0.6	0.001
Medium level of health	0.28	0.03	0.09	0.001
Low level of health	0.2	0.12	7	0.1

[a] P-value by a linear regression model.

Finally, the relationship between variables after entering the score of pedestrians' behavior and the overall score of general health and demographic characteristics of participants in the multiple linear regression model is as follows (Table 3).

Table 3. Results of Multiple Liner Regression Between Overall Score of Pedestrians' Behavior and Demographic Characteristic/General Health Questionnaire Domains

Variables and Category	OR	CI (95%)		P-Value [a]
		Lower	Upper	
Sex (Male)				
Female	0.13	0.039	0.46	0.001
Age (30 - 65)				
15 - 29	14	7.4	21.5	0.001
60+	0.1	0.007	1.51	0.09
Marital status (Married)				
Single	1.63	0.23	11	0.6
Widow	0.22	0.01	4.3	0.3
Divorced	0.01	0.006	5.54	0.15
Education status (Illiterate)				
Elementary	0.03	0.007	1.21	0.06
Diploma	0.032	0.008	1.16	0.06
Associate degree	0.001	0.0002	0.07	0.001
Bachelor's degree	0.019	0.004	0.81	0.03
Postgraduate	0.006	0.005	0.42	0.01
Ph.D. and above	0.05	0.003	5	0.3
Walking time per day (< 30 min)				
30 - 60 min	1.86	0.45	7.7	0.39
60 - 120 min	7.26	0.69	21.3	0.09
> 120 min	9.83	0.16	16.4	0.26
Overall score of general health (Very low level of health)				
High level of health	0.42	0.12	0.86	0.001
Medium level of health	0.68	0.09	0.88	0.01
Low level of health	0.81	0.21	0.96	0.04

[a] P-value by linear regression model/OR adjusted for all variables.

5. Discussion

In this cross-sectional study, a significant relationship was found between various variables of demographic characteristics, the general health of the participants, and the overall score of pedestrian traffic behavior. For example, among the demographic characteristics, there was an inverse relationship between the female gender and risky pedestrian behavior, and a direct relationship between being young (15 - 29 years old) and single and risky pedestrian behavior.

This was consistent with many studies, including the study by Cullen et al., Visby et al., and Kovacevic et al.'s study showed that younger men were more exposed to

traffic accidents and resulting injuries compared to younger women and older individuals, with young men being 1.25 times more likely to be involved in any type of traffic incident (17-19). Visby and Lundholt study also demonstrated a significant relationship between unsafe behavior and traffic accidents and young age, male gender, low education level, and low socio-economic status (18). This could be attributed to factors such as speeding among men, disregard for traffic laws, aggressive driving behavior, and fatigue from long-duration driving (18, 20). Kovacevic et al.'s study also indicated a significant relationship between unsafe driving and pedestrian behaviors and low education level, being single, drug or alcohol consumption, and hospitalization after a traffic accident (19).

The present study showed a significant relationship between high levels of health in different domains of the GHQ and the traffic behavior of pedestrians. In this study, there was a correlation between high levels of somatic health and safe behavior of pedestrians. In this regard, Doi et al., Ng et al., and Lenardt et al. found consistent results with ours. Doi et al. showed a relationship between a decline in the somatic and mental health of individuals and the occurrence of traffic accidents, especially among pedestrians. Physical weakness and cognitive impairment can increase the likelihood of traffic accidents. Also, in this study, there was a relationship between shrinking, exhaustion, slowness, low physical activity, and traffic accidents (21-23). The study by Ng et al. indicated a correlation between proper somatic performance and a reduction in the occurrence of traffic accidents in such a way that the presence of somatic symptoms and physical impairments due to delayed reactions could lead to decreased safety and increased accidents (22). The study by Lenardt et al. also showed a relationship between physical frailty, decline in physical health, and limitations in the mobility of drivers and pedestrians (23).

In this study, a significant correlation was found between anxiety level (high level of health) and safety pedestrian behavior. This finding is consistent with the results of studies by Kummeneje and Rundmo, Herrero-Fernandez et al., Pourabdian and Azmoon, and Dula et al. Kummeneje and Rundmo investigated the relationship between pedestrians' anxiety, worry, and their behavior. The study showed that anxiety and worry were associated with walking at night and its duration and could increase the likelihood of unsafe behavior by affecting the cognitive skills and risk perception of pedestrians (24-27). Herrero-Fernandez et al. also showed that the emotional state of pedestrians can negatively affect their ability to perceive risk and lead to traffic accidents. Emotional disturbances, such as happiness, sadness, and anxiety, can increase the risk of traffic accidents (25). On the other hand, Pourabdian and Azmoon found a significant relationship between anxiety and driving errors, ordinary and aggressive violations. Trait anxiety can increase the likelihood of traffic accidents by affecting the memory and risk perception of drivers and pedestrians (26). Dula et al. also showed a significant correlation between anxiety and unsafe behavior among traffic users. High levels of anxiety in this study negatively affected the cognitive performance of drivers and pedestrians and increased the likelihood of traffic injuries (27).

The findings of this study regarding the relationship between social functioning and pedestrian safety behavior are consistent with the studies by Abdoli et al. and Aduen et al. study showed that low level of mental health, such as the presence of symptoms of depression, anxiety, insomnia, and social dysfunction, is associated with unsafe traffic behavior. Each of these variables can be considered an independent predictor of unsafe behavior among drivers and pedestrians (28, 29). Therefore, timely psychological screening and the development of educational programs to promote safe behavior among traffic users are strongly felt to prevent traffic accidents more than ever before. On the other hand, Aduen et al.'s study also supported the above-mentioned points. They considered psychiatric disorders such as Attention-deficit Hyperactivity Disorder (ADHD) and depression as important causes of unsafe behavior among pedestrians and drivers. The presence of psychiatric disorders can harm individuals' social functioning on the one hand and increase the likelihood of traffic accidents by limiting timely and appropriate performance among traffic users on the other hand. Therefore, timely evaluation of traffic users, especially drivers, and appropriate interventions in this regard are highly important (29).

The results of the present study regarding the relationship between pedestrians' safe behavior and high health status in relation to depression were consistent with the studies of Tsoutsi et al., Hill et al., and Chen et al. The study by Tsoutsi et al. showed that depression can affect the traffic behavior of individuals directly or indirectly by creating anxiety and sleep disturbances. This can increase the likelihood of unsafe behaviors such as disregarding regulations, speeding, and aggressive driving (30-32). Hill et al. also showed that depression is associated with unsafe behaviors in traffic users with an Odds Ratio (OR) of 1.78 - 3.99. Depression can increase the risk of traffic accidents in

drivers and pedestrians up to twice (31). Chen et al. also indicated that any psychiatric symptoms can be accompanied by a high risk of unsafe traffic behavior and traffic-related injuries. Among psychiatric disorders, obsessive-compulsive disorder (OCD), interpersonal sensitivity, hostility, and depression were more associated with unsafe traffic behavior. In this study, depression, with a prevalence of 5.62%, was the fifth most common psychiatric disorder associated with unsafe traffic behavior in traffic users. These findings highlight the need for screening and appropriate psychiatric interventions to prevent traffic-related injuries (32).

Finally, there was a significant relationship between the high and moderate general health status of participants and the score of pedestrian behavior. As mentioned, traffic accidents are influenced by various factors, including vehicles, environmental and road conditions, driving skills, and the general health status of traffic users. Scientific studies show a correlation between the general health status of traffic users (including the presence of chronic diseases and somatic symptoms, alcohol consumption, use of different medications, and low mental health status) and unsafe behaviors of individuals, which can ultimately have an impact on traffic accidents. Finally, as the general health status of drivers and pedestrians improves, their self-perception of risk also improves, leading to a significant reduction in traffic injuries (28, 33-35).

Although the implementation of various inter-organizational plans has reduced road fatalities in the country, the pedestrian mortality rate in Iran is still high and needs to be addressed with a sector-specific approach that is suitable for the national conditions.

Considering the factors contributing to fatal pedestrian accidents, creating a comprehensive national approach to enact relevant laws and ensure their strict enforcement, developing various educational programs to enhance public awareness of pedestrian safety behaviors (36), redesigning vehicles and roads to protect the environment and pedestrians (37), periodic psychological screening of traffic users, especially drivers and appropriate interventions (32), training healthcare providers (physicians, nurses, health caregivers, environmental and occupational health experts) on safe traffic behaviors, and developing educational programs on traffic safety behaviors in schools can be crucial in reducing traffic-related injuries.

5.1. Study Limitation

Although the findings of this study offer valuable insights for healthcare professionals and policymakers regarding the influence of demographic characteristics and different aspects of general health on pedestrian traffic behavior, there are certain limitations to be acknowledged. First, the study utilized a cross-sectional design over a two-year duration, focusing exclusively on the population of citizens aged 15 years or above residing in District 2 of Tabriz municipality. Consequently, this study did not encompass children, individuals below the age of 14, or rural populations. Furthermore, the long-term effects of various dimensions of general health on pedestrian traffic behavior were not evaluated. Therefore, while the study provides valuable information, it is essential to conduct further research to generalize the findings to the entire country.

5.2. Conclusions

Traffic injuries are one of the top ten leading causes of mortality worldwide, with a significant portion occurring in developing countries. Pedestrians, as vulnerable traffic users, are more exposed to traffic accidents and resulting injuries. Many factors, such as gender, education level, age, and marital status, influence pedestrian traffic behaviors, but one of the most important factors is the general health of pedestrians. Many aspects of general health (somatic, mental, and social functioning) are associated with safe pedestrian behavior and the reduction of traffic accidents, which can be addressed in health policies. Conducting further studies to understand various dimensions that affect pedestrian traffic behaviors, identifying vulnerable points in urban and rural areas, developing appropriate solutions, and creating a safe environment for their movement are deemed necessary. Implementing such measures necessitates a comprehensive and appropriate intersectoral strategy.

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Footnotes

Authors' Contribution: Conceptualization: Mahdi Zarei and Mostafa Farahbakhsh. Data curation: Elham Davtalab Esmaeili and Mahdi Zarei. Investigation: Mahdi Zarei, Elham Davtalab Esmaeili, and Sepehr Shakeri Bavil

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Data Availability: Data supporting the findings and conclusions are available upon request from the corresponding author.

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