Listening to Pedestrian; What are the Influential Factors on Bridge use?

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Abstract

Background: Pedestrian bridges are safe tools for street crossing. Bridges structural characteristics, locating and also pedestrian perception and attitudes may affect their bridge use behavior. The aim of this study was to identify the factors influencing use/non-use of pedestrian bridges in Tabriz, Iran.

Methods: Using cross-sectional approach, we have conducted a study in Tabriz, 2019. Through a pilot study data and Cochrane formula, the sample size was estimated to be 360. Sampling was done using simple random sampling method. Pedestrians around two types of the bridges with/whiteout escalator were included in the study. Sample allocation was done equally among bridges. A valid questionnaire (CVI= 0.78, α=0.75) was used for data collection. Data was analyzed using SPSS 21.

Results: Totally 358 people were participated with an average age of 29±11.6 years. More than 72% of the participants had driving license and about a quarter of them had a crash history. Nearly 10% declared that they use pedestrian bridge sometimes or never. About 43% believed that bridge using is necessary only in crowded streets. Locating issues including bridge distance from zebra lines and pedestrian destination, lack of escalator, bridge darkness at nighttime and pedestrian perception of bridge safety were the main barriers to use bridges. Having a driving license and education level were significantly associated with pedestrian bridge use behavior (p<0.05).

Conclusions: Designing pedestrian bridges using artistic principles will create more sense of safety and positive perception which will facilitate bridges utility. Future developments in pedestrian safety initiatives should consider effective countermeasures which influence pedestrian safe behavior such as bridge use.

Background:

Road Traffic injuries (RTIs), as a public health challenge, are the cause of 1.35 million death, annually, worldwide [1]. The recent decade (2011-2020) was declared as "decade of action for road safety" by World Health Organization (WHO) to bring global efforts to improve traffic safety, especially for vulnerable road users including pedestrian, cyclists and motor riders [2]. More than 50% of deaths are related to vulnerable road users, worldwide. Pedestrian accounts for 14% in South-East Asia to 40% in Africa of RTIs deaths [1, 3]. RTIs in Iran is one of the priority challenges treating people life which accounts about 17000 deaths, annually. About 25% of these are pedestrian [4-6].

Unsafe road crossing was introduced as the main cause of pedestrian accidents [7-9]. Regarding, pedestrian safety infrastructures such as marked crossings, bridges and etc. were built, especially in urban areas to facilitate adherence to traffic regulations [10, 11]. Pedestrian bridges are one of the facilities in urban areas separating vehicle and pedestrian route which is the recommended by Haddon countermeasure [12].

Evidences showed that pedestrian willingness to use bridges is influenced by various human and environmental variables. Bridge location, distance from pedestrian destination, convenience of use and
time saving were reported as influential factors by pedestrian to use overpasses [13-16]. Bridges structural characteristics such as color, lightening, scenic and safety vision were reported as factors dis/encouraging its usage [10, 17, 18]. Rasanen et al (2007) in a study in Turkey, reported that individuals who have frequent visit of business centers, are less likely to use bridges. Moreover, they indicated bridge use behavior as a habit [17]. In a qualitative study in Iran, pedestrians risk perception, adherence to social behaviors and existence of physical barriers in street was introduced the influential factors to use bridge [18]. As bridges construction is a costly intervention, special attention should be paid on influential factors on its utilization and effectiveness, such as road and bridge characteristics and human factors. Regarding, this study was aimed to investigate the influential factors on pedestrian bridge usage in Tabriz, Iran.

Methods:

Design and setting

This was a cross-sectional study conducted in Tabriz, in 2019. Tabriz, as the capital city of East-Azerbaijan province, is the 6th populated city in Iran with a population of more than 1550000. It is the biggest city in Northwest of Iran.

Study tool

An adapted questionnaire was used for data collection. Questionnaire items were extracted from literature and then its validity was investigated by experts (n = 15). Validity of each item was rated based on 3 criteria including relevance, necessity and clarity by experts (Table 1). Experts' comments on each items content also were considered.

| Item | Necessity          | Relevance               | Clarity                   |
|------|--------------------|-------------------------|---------------------------|
| 1( not useful) | 1( not relevant)   | 1(not clear)            |
| 2(not necessary) | 2(item need some revision) | 2(item need some revision) |
| 3(useful but not essential) | 3(relevant but need minor revision) | 3(clear but need minor revision) |
| 4(necessary) | 4( completely relevant) | 4(very clear)          |

Questionnaire included items about pedestrian perceptions and affecting factors to use bridges including bridge structure, characteristics and location and personal perceptions (Additional file 1). Content Validity Index was calculated to be 0.78 and the questionnaire validity approved .To investigate the reliability of the questionnaire, a pilot study (n = 30) was run and cronbach alpha coefficient was calculated to be 0.75.
Sampling and Data collection

There are nearly 90 pedestrian bridges in Tabriz city. Most of them are without escalator. We have selected 5 bridges with escalator and 5 without escalator. Bridges are in places where there were shopping centers or Bazzar, schools, health center or hospital and etc. which people have to pass the road. Based on pilot study data and using G-power software through Cochrane formula () \( d = 0.364, \alpha = 0.05 \), sample size was estimated to be 360. Sample allocation was done equally \( n = 36 \) for each bridge site.

Pedestrian were invited to participate in the study in bridge sites by questioners. First study goals were describe for individuals who accepted to participate, then they filled the questionnaire. The study was approved by ethical committee on Tabriz University of Medical Sciences.

Data analysis

Descriptive analysis including frequency, mean and standard deviation were used to describe the data. Kolmogorov-Smirnov test was used for data normality investigation. Chi-square test was used for investigating the relation between variables. Data analysis was done using SPSS 21.

Results:

Totally 358 people were participated with an average age of \( 29\pm11.61 \) years. About 36% were female and 37% have BSc level of education. About a quarter (25%) of participants have a crash history. More than 56% of participants declared that they did not have personal car while 26.8% of them said that they did not have driving licensure. Moreover, majority of participants (74.4%) did not have motorcycle driving history. Participants' demographics are presented in Table 2.

Most of the participants (35.5%) declared sport as they cause of walking followed by going to work (23.3%) and shopping or doing affairs (19.9%). Nearly 10% of participants expressed that they use pedestrian bridge sometimes or never. In contrast, 44.5% said that they always use pedestrian bridges to cross the road. Only 4.2% of participants declared that they have mobility problem.

Interestingly, about 29% of participants said that use of pedestrian bridges, did not provide their safety. Moreover, 43% of participants believed that using bridge is necessary only in streets with high speed driving. Using bridges to cross the streets creates safety sense in 85% of the participants while 12.7% of participants said that they feel safe when they cross the street without bridge and zebra line. About 18% of participants declared that using pedestrian bridges leads to waste time. Figure 1 shows the barriers of bridges use by Tabriz pedestrians.
Table 2
Participants demographics

| Variables                                           | Number (%)     |
|-----------------------------------------------------|----------------|
| sex                                                 |                |
| Male                                                | 225 (63.6)     |
| Female                                              | 129 (36.4)     |
| Marital status                                      |                |
| Single                                              | 223 (64.5)     |
| Married                                             | 123 (35.5)     |
| Education                                           |                |
| Illiterate                                          | 8 (2.2)        |
| Under-Diploma                                       | 44 (12.3)      |
| Diploma                                             | 105 (29.3)     |
| Bachelor                                            | 133 (37.2)     |
| Master and higher                                   | 60 (16.8)      |
| Job                                                 |                |
| Self-employed                                       | 138 (39.7)     |
| Worker                                              | 12 (3.5)       |
| Office employee                                     | 60 (17.3)      |
| workless                                            | 84 (24.2)      |
| Other                                               | 53 (15.3)      |
| Economical level (comparing to community average level) |            |
| Very high                                           | 13 (3.7)       |
| Higher                                              | 54 (15.3)      |
| Equal                                               | 229 (64.9)     |
| lower                                               | 43 (12.2)      |
| Very low                                            | 14 (3.9)       |

Based on chi-square test having a driving license was significantly associated (p<0.03) with use of pedestrian bridges as individual with license were more likely to use bridge. Moreover, education level were also significantly associated (p<0.002) with individuals bridge use. Accident history, gender, cause of walking, having personal car and mobility problem were not associated with bridge use behavior.

**Discussion:**

The results revealed a variation in pedestrian preferences and perceptions leading to use/ not using bridges. Locating issues including bridge distance from zebra lines and pedestrian destination, lack of escalator, bridge darkness at nighttime and pedestrian perception of bridge safety were the main barriers...
to use bridges. Having driving license and education level were significantly associated with bridge use behavior.

Pedestrian bridge locating is a vital factor in its utility. The results showed that bridge distance from zebra line <50m and pedestrian destination>50m was acted as bridge use barriers. Wu et al study (2014) results revealed detour distance negatively influence bridge use behavior[19]. Moreover, bridges distance from legal or illegal crossing routs was introduced as factors affecting bridge use/not use [10, 20]. This becomes more prominent when individuals are in hurry and they think that using bridge will waste their time [21, 22]. Individuals in hurry are more likely to not use bridge to cross street [16]. In Oviedo-Trespalacios et al. (2017) study, 47% of participants who did not used bridge, believed that with using bridge, they waste considerable amount of time [20]. In our study, about 18% of participants declared using bridge lead to waste time. Time-saving were also reported as a bridge use barrier in previous studies [13, 15, 23]. Bridges with escalator/ elevator are more likely to be used by pedestrian. Rasanen et al (2007) in a study of five bridges in Ankara, Turkey, reported the highest usage rate (63%) was related to bridges with escalator [17]. Installing escalator was introduced as a solution to increase pedestrian bridge use rate in literature [16, 17, 20, 23]. Selecting proper interventions to change bridge use behavior should consider cost-effectiveness indicators and also socio-cultural characteristics. Moreover, development and extension of online services such as online stores etc. in form of an intelligent city, could decrease travel demand and eventually improve pedestrian safety.

Bridge safety and pedestrian perception about its safety is another factor affecting bridge utility. Safe feeling while using bridge was introduced as one of pedestrian behavior predictors [17] which is similar to our results. Counterintuitively, results of a study in Colombia showed that pedestrian perception of safety arising from bridge use was not related with their bridge usage rate[20]. Fear of bridge height was revealed to significantly affect pedestrian behavior in past studies [16, 17, 24]. In our study, only 12.8% of participants declared fear of height as a barrier of bridge use. Construction of a pedestrian bridge is an engineering intervention improving objective dimension of safety. To promote bridge utility, subjective safety also should be considered to create safe feeling in pedestrian. Impressive design, proper lightening and using bright colors in bridges induce safety for users.

Having a pervious accident experience was not associated with pedestrian bridge use behavior. This result was consistent with previous studies reported that involvement in accident dose not impact bridge use rate by pedestrian [10, 22]. Conversely, a study in Colombia concluded that in urban roads with high speed limit, pedestrian who have past experience of injury, were more likely to use bridge to cross [20]. Some literature declared that pedestrian bridge use behavior is habitual than a cognitive process [17, 20]. It was discussed that previous behavior could predict pedestrian future behavior as a habit [25]. This type of behavior puts pedestrian in greater risk of injury. Interventions on increasing pedestrian awareness of their behavior negative consequences and creating negative public sphere of not using bridges will affect their attitude toward the behavior, subjective norms and their perceived behavioral control (PBC) which based on Theory of Planned Behavior (TPB) are latent predictors of pedestrian behavior intention [26, 27].
Effect of past behavior and experiences on pedestrian behavior is an issue of traffic psychology which needs to be more explored in future studies.

Injury prevention education is one of the common and effective interventions to improve pedestrian safety. However, education should be compatible with pedestrian behavior intention predictors. Considering socio-cultural and environmental characteristics of community, in line with using various educational methods such as group-work, simulator or virtual reality and peer-education will lead to more positive outcomes. Moreover, considering effective construction countermeasures, land usage and locating, weather condition and traffic volume will increase the likelihood of bridge use by pedestrian. However, designing a safe pedestrian network, especially in city crowded areas, would decrease risk of injury for pedestrian.

**Conclusions:**

This study examined pedestrian perception towards pedestrian bridge use barriers. Locating issues including distance from zebra lines and pedestrian destination, lack of escalator and pedestrian perception of bridge safety were the main barriers to use bridges. Future developments in pedestrian safety should consider effective countermeasures which influence pedestrian safe behavior such as bridge use.

**Limitations:**

This was a self-report study and this kind of data potentially are criticized for under/over estimation. All of the participants were over 15 years old. As a group of pedestrian, child and teenagers under 15, might be a study group for future studies.

**Abbreviations:**

RTIs, Road Traffic Injuries; WHO, World Health Organization.

**Declarations:**

**Ethics approval and consent to participate:**

This study was approved by ethical committee of Tabriz University of Medical Sciences, Tabriz, Iran (Ethic code: IR.TBZMED.REC.1396.1090). Verbal consent were obtained from participate which was approved by ethical committee.

**Consent for publication:**

Not applicable
Availability of data and materials:

The datasets generated and/or analyzed during the current study are not publicly available due ethical committee limitations but are available from the corresponding author on reasonable request.

Competing interests:

The authors declare that they have no competing interests.

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Authors' contributions:

MS, AD, MD and ME developed the study concept and design. EH, ME, TH, TN, HM participated in study tool design, data collection. MS, AJ contributed in data analyses. MS, TH, EH and MD participated in results interpretation. MS, AJ drafted the manuscript. All the authors approved the final version of the manuscript.

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**Figures**

![Figure 1](image-url)
Pedestrian Bridges using barriers in Tabriz

Supplementary Files

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