

## Original Article

# Pedestrian safety in traffic environment: An E-mail-based intervention to promote crossing behaviors among medical college students

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## ABSTRACT

**Aims:** The aim of this study was to evaluate the effectiveness of E-mail-based intervention on safe crossing behaviors among Isfahan University of Medical Science students, in year 2014 in Iran.

**Materials and Methods:** In over all, 78 boy-students with  $22.33 \pm 1.65$  years were participated in an E-mail-based intervening study. They divided into intervention group ( $n = 38$ ) and control group ( $n = 40$ ) by use of random allocation. The instrument of data collection included questionnaire of theory of planned behavior constructs and traffic behaviors. Questionnaires were filled out by both groups at the baseline and 6 months after the educational intervention. The safe crossing educational intervention was conducted within 1-month through E-mail service for the intervention group. The control group received no education.

**Results:** Results showed no significant differences between groups in mean of attitude toward safe crossing, subjective norms (SNs), perceived behavioral control (PBC), intention and safe crossing behaviors at baseline ( $P > 0.05$ ). MANCOVA test demonstrated that there is a significant difference between groups after the educational intervention with adjusting the effect of age ( $P = 0.001$ ,  $F = 31.144$ , Wilks lambda = 0.313). According to the ANCOVA test, after educational intervention, mean of positive attitude toward safe crossing, PBC, intention and behaviors related to safe crossing were increased in intervention group in comparing control group ( $P < 0.005$ ).

**Conclusion:** E-mail-based intervention can promote safe crossing behaviors among college students. Conducting further studies with focusing on SNs related to safe crossing is suggested.

**Key words:** E-mail-based intervention, pedestrian safety, theory of planned behavior, traffic environment

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## INTRODUCTION

Traffic injuries were known as the tenth leading factors of death in 2002, and it is estimated that it will be an increase to eight leading factor of death in the worldwide in 2030. Ninety percent of death related to traffic accidents is occurred in

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countries with low or moderate income. These countries have 80% of the world population and only 48% of vehicles.<sup>[1]</sup> In Iran, as a developing country, traffic accidents have the highest burden of disease, and it is also known as the second leading cause of death after cardiovascular disease. They are the cause of 14.9% of death, 26.9% of standard expected years of lost life and also 58/100,000 deaths every year. Prevalence of traffic death in men is more than women.<sup>[2]</sup> The most vulnerable people in traffic environments are pedestrian, bicyclists and cyclists, respectively, which they have the highest rate of death and disability. Traffic injuries are mostly happened due to unsafe and careless behaviors of pedestrians and drivers.<sup>[3]</sup> The most prevalent kinds of these unsafe behaviors are not compliance with traffic legislations, unsafe crossing in dangerous situations, running while crossing, cross diagonally, slow walking while crossing, disregarding to traffic signals, crossing at unmarked zones, not looking at the left or right, distracted crossing, using cell phone and media devices and so.<sup>[4-11]</sup> There are several factors that affect pedestrian behaviors while crossing the street. Demographic factors such as age, and gender are associated with the adoption safe or unsafe behaviors. Females wait more than males to red light in signalized intersections. This time is longer in old pedestrians rather than younger people. Male pedestrians are more intended to violate traffic law and perform unsafe behaviors in comparison to females.<sup>[11,12]</sup> Previous studies emphasis on the impact of attitude on pedestrian's safety in traffic environments. Attitude is a factor which can predict human behavior. Attitude has a role in happening of traffic accidents indirectly. This impact is occurred by affecting the perception of danger and unsafe behavior.<sup>[13]</sup> Pedestrians' tendency to conformity with important people in their life and subjective norms (SNs) is another factor which influence pedestrians' behavior in traffic environments.<sup>[14]</sup> According to conducted studies in this field, waiting time for crossing the street is decreased in the presence of other people. In other words, pedestrian tendency to following the mass is increase in dangerous situations.<sup>[12]</sup> Khan (1999) found that pedestrian as a group performed unsafe crossing 1.8 times more than those who cross lonely.<sup>[14]</sup> Perceived behavioral control (PBC) is a predictor of pedestrian intention to safe crossing. This factor is related to people perception of difficulty or simplicity of specific behavior and also understanding of external and internal factors that facilitate or inhibit it.<sup>[15]</sup> Several studies report the effectiveness of educational interventions on PBC.<sup>[16-18]</sup> Furthermore, behavioral intention can determine pedestrians' behaviors in traffic environments.<sup>[15]</sup> Díaz reported that violation of traffic law is associated with behavioral intention which is affected by attitude, SN and perceived PBC.<sup>[19]</sup> Today, the significant challenge is how to combine these variables in a predicting framework of intention and behavior and also design effective intervention in this field.<sup>[20]</sup> Theory of planned behavior (TPB) is a theory of behavior change that could be useful to undertaking in improving pedestrian safe crossing.<sup>[15]</sup> In the other hand, selecting proper communication channel is

very necessary to deliver successful intervention. An effective and inexpensive communication channel is internet and its related instruments and services.<sup>[21-24]</sup> Internet-based interventions can be available asynchronously for the learners and provide strong sources of consultation and support to behavior change.<sup>[25]</sup> E-mail service is an internet-based channel and can play important role in delivering effective intervention.<sup>[18]</sup> Available documents on E-mail-based interventions demonstrated the advantage of application of this service in behavior change interventions.<sup>[18,26,27]</sup> Parrott *et al.* was reported the effectiveness of sending message through E-mail in changing individual attitude and intention.<sup>[18]</sup> In the other study, Plotnikoff *et al.* showed the positive effect of receiving weekly E-mail in changing human behavior.<sup>[28]</sup> Therefore, the aim of this study was to evaluate the effectiveness of E-mail-based intervention on safe crossing behaviors among Isfahan University of Medical Science students, in year 2014 in Iran.

## MATERIALS AND METHODS

A total of 103 medical college students registered to participate in the study. Seventy-eight students had inclusion criteria and complete consent form. Inclusion criteria were access to internet at least 1-h/day, having E-mail account, checking E-mail every 2 days routinely and not suffering from any physical disability. After registration, participants were divided into intervention group ( $n = 38$ ) and control group ( $n = 40$ ) by use of randomized allocation. Baseline data were collected by use of TPB constructs and safe crossing behaviors questionnaire. Educational intervention was conducted to the intervention group. This group received an E-mail every 2 days within 1-month. The messages provide information on change attitude toward safe crossing; improve persuasive SNs, PBC and intention to safe crossing by sending pictures, videos, texts. The participants were asked to reply to messages and send their opinion about specific topics. Table 1 shows how to apply the TPB constructs in promoting the safe crossing. Control group received no educational intervention during the study. Both groups participants refilled out study questionnaire after 6 months follow-up. Follow-up data were collected during 1-week and when the students were in their classes. Crossing behaviors were measured by use of Granié *et al.* questionnaire.<sup>[29]</sup> This questionnaire is consisting of 32 items. The reliability and validity of this questionnaire measured to cultural adaptation by calculation of the content validity ratio (CVR), content validity index (CVI) by use of Lawshe table.<sup>[30]</sup> After the calculation of CVR and CVI, 9 items were deleted, and 23 items were remained which Cronbach alpha 0.87 was calculated by conduct a pilot study on 182 medical college students' measuring. Items were scored by five-point Likert scale (always to never). We developed a questionnaire, including 15 items to measuring of TPB constructs related to safe crossing. Reliability and validity of the questionnaire were calculated by conduct a pilot study on 182 students

( $\alpha = 0.70$ ). This questionnaire was designed to evaluate attitude toward safe crossing (6 items), SN (4 items), PBC (2 items) and behavioral intention (3 items). All items scored using five-point Likert scale. Attitude, SN and were scored from strongly agree to strongly disagree. PBC items were scored very easy to very difficult. Behavioral intention items were scored from very likely to very unlikely. Minimum and maximum score for attitude was 5-30 while it was 4-20 for SN, 2-10 for PBC and 3-15 for behavioral intention. In all of the TPB Constructs, high score was considered good. This is a randomized group and pretest-posttest design study. Baseline and follow-up data were analyzed by independents sample *t*-test, MANCOVA, and ANCOVA. Covariance analysis was used to find a significant difference between groups after 6 months follow-up. Independent sample *t*-test was conduct to detect the differences between groups at

baseline. In all calculations  $P < 0.05$  was considered as significant.

## RESULTS

A total of 78 medical college students were participated in the study and filled out questionnaires at the baseline and after 6 months follow-up. Samples of questionnaire variables based on the TPB constructs including results of Cronbach's alpha are shown in Table 2. The mean age of the participants in intervention and control groups was  $22.82 \pm 2.18$  and  $21.89 \pm 1.13$ , respectively. 87.2% ( $n = 68$ ) of them reported the life-time accident history as pedestrian and 12.8% ( $n = 10$ ) reported no history. No significant differences were found between group in accident history ( $P = 0.931$ ). According to the results, at baseline, the mean score of

**Table 1: Theory, strategies and educational activities related to pedestrian safety**

Potential mediator of behavior change (theory construct)	Theory-based strategies for mediators of behavior change	Practical educational activities, learning experiences, content, or messages
Attitude toward safe crossing	Reflection on affect/feeling Information about outcome expectations Persuasive communications about positive outcomes Information on response efficacy or effectiveness of taking action Increase salience of issues or concerns about problems Convey threat or use fear communications	Attitude statements and discussion, emotion-based messaging Clear image of the threat (e.g., film clips on risk of distracted walking or unsafe crossing Provide scientific evidence, national and international statistics on pedestrian injury in the traffic environment
SN	Awareness of social norms or social expectations	View text, pictures, and video; discuss impact of others
PBC	Decrease perception of barriers or negative outcomes	Discussion on barriers and ways to overcome them Brainstorming
Behavioral intention	Decisional balance: Analysis of pros and cons of actions Values clarification: Resolving resistance and ambivalences anticipated regret	Worksheets or discussion to the analysis of pros and cons of actions, choices Values clarification worksheet for individual activities

SN: Subjective norm, PBC: Perceived behavioral control

**Table 2: Summary and samples of questionnaire variables based on the TPB construct including results of Cronbach's alpha**

TPB constructs	Description	Number of items	Cronbach's alpha	Sample item
Attitude	Beliefs about the likely outcomes of the behavior and the evaluations of these outcomes	11	0.70	"I believed that talking on a cell phone while crossing distracted me" (score 1 strongly disagree to 5 strongly agree)
SN	Beliefs about the normative expectations of others and motivation to comply with these expectations	7	0.63	"My friends believes that the use of the pedestrian bridge is a waste of time and energy" (score 1 strongly disagree to 5 strongly agree)
PBC	Beliefs about one's ability to perform (or not to perform) the behavior	6	0.85	"I am confident that I never use my phone while crossing the street" (score 1 strongly disagree to 5 strongly agree)
Behavioral intention	Reflects the motivation to perform the behavior and the likelihood they will perform it in the future	6	0.72	"How likely is it that you would cross the road next month;" "I would expect to cross the road when the light is green" (score 1 very unlikely to 5 very likely)
Safe crossing behavior	Crossing the street in a safe manner	23	0.87	"I cross the street even though the pedestrian light is red" (score 1 never to 5 always)

SN: Subjective norm, PBC: Perceived behavioral control, TPB: Theory of planned behavior

persuasive SNs related to safe crossing, PBC, behavioral intention and safe crossing behaviors were relatively low in both study groups. However the mean score of attitude toward safe crossing was high. In other words, participants in two groups reported they crossed in unsafe manner and likelihood of adopting safe behavior while crossing is low. Comparing of TPB constructs at baseline showed that there are no significant differences between groups ( $P > 0.005$ ). More details were provided in Table 3. Multivariate analysis of covariance after adjusting the effect of age revealed a significant difference between groups in TPB constructs after 6 months follow-up ( $P = 0.001$ ,  $F = 31.144$ , Wilks lambda = 0.313). According to the univariate test in comparing mean differences of TPB constructs between groups after 6 months, an significant increase in mean of positive attitude toward safe crossing, PBC, behavioral intention was found ( $P < 0.05$ ). However, a significant difference was not found in persuasive SNs for safe crossing ( $P > 0.005$ ). Findings in safe crossing behaviors after 6 months demonstrate a significant increase in adopting safe crossing behaviors in the intervention group in comparing a control group ( $P < 0.005$ ) [Table 4].

## DISCUSSION

The study examined the effectiveness of E-mail-based persuasive messaging on safe crossing and TPB constructs among medical college students. It is hypothesized that design and implementation of E-mail-based intervention with applying TPB constructs can improve safe crossing among students. Results provide encouragement for future

research in the realm of E-mail-based persuasive messaging in behavior change. Our hypothesis of effectiveness of the intervention based on E-mail was confirmed by findings the significant differences between two groups after 6 months follow. Before the intervention, at baseline, a significant difference was not found in two groups in attitude toward safe crossing. However, after intervention (6 months follow-up) attitude toward safe crossing increased significantly in the intervention group in comparison with the control group. This finding is consisted with results of other conducted study in the field of pedestrian safety.<sup>[17]</sup> There are several studies that reported change in attitude after implementing interventional programs.<sup>[18,31-33]</sup> Parker *et al.* reported the improvement in attitude toward speed limit restriction among drivers.<sup>[31]</sup> In present study, the hypothesis of improvement in SNs after E-mail-based intervention was not proved. Designed intervention could not significantly altered one's feelings of whether those in their social network would support safe crossing behaviors. Further, SN would likely be an extremely difficult construct to positively change with any type of mediated intervention approach. Although the mean of SNs was increased in the intervention group in comparison with the control group, However, this improvement was not significant. However, this improvement highlighted this point that people need to be persuade and support from important persons in their social interactions for taking safe crossing behaviors. Our findings are consist with the results of Parrott *et al.* study which was conducted to evaluation of the impact of E-mail-based intervention on persuasive SNs related to physical activity among students.<sup>[18]</sup> Zhou *et al.* were reported the influence of others presence on people crossing behaviors. According to mentioned study, the tendency to following others can affect crossing behaviors in high-risk situations.<sup>[15]</sup> More studies are needed to investigation the effect of SNs on pedestrian's safe crossing behaviors. Our findings revealed that PBC was improved significantly in the intervention group after 6 months follow-up in comparison with the control group. These results showed the effectiveness of E-mail-based intervention in decreasing the barriers to safe crossing. Increasing of people perception of simplicity of performing safe crossing behaviors in different situations can develop this believe that they have more control over behaviors. Our findings are compatible with results of previous studies in the investigation of the impact of E-mail-based interventions on improving PBC among

**Table 3: Baseline characteristics and theory of planned behavior measures for pedestrian safety intervention in a college student population**

Characteristics	Control group		Intervention group		P
	Mean	SD	Mean	SD	
Age	22.82	2.18	21.89	1.13	0.071
Attitude toward safe crossing	24.52	1.55	24.50	1.87	0.949
SN	12.15	1.80	12.13	2.04	0.966
PBC	4.8	1.66	4.42	1.53	0.3
Behavioral intention	10.55	1.48	10.81	2.06	0.514
Safe crossing behavior	81.85	8.39	77.18	16.87	0.123

SN: Subjective norm, PBC: Perceived behavioral control, SD: Standard deviation

**Table 4: Mean changes in TPB measures for pedestrian safety intervention in a college student population**

TPB constructs <sup>a</sup>	Control group			Intervention group			F	P
	Mean	SD	SE	Mean	SD	SE		
Attitude toward safe crossing	1.90	2.57	0.406	3.26	2.25	0.365	4.285	0.042
SN	2.30	2.63	0.416	3.34	3.09	0.502	1.307	0.256
PBC	2.05	1.75	0.277	7.52	2.47	0.402	116.468	0.001
Behavioral intention	0.20	1.50	0.238	2.28	2.52	0.409	18.254	0.001
Safe crossing	-1.80	8.92	1.41	18.86	18.12	94.2	40.993	0.001

<sup>a</sup>A multivariate analysis of covariance with age as covariates, SD: Standard deviation, SE: Standard error, SN: Subjective norm, PBC: Perceived behavioral control, TPB: Theory of planned behavior



several population.<sup>[16-18]</sup> Intervention group participants reported significantly high score of safe crossing behaviors after 6 months follow-up in comparison with the control group. After 6 months follow-up, Intervention group participants were reported compliance with traffic laws, cross in signalized intersections, no crossing in dangerous situations, looking for traffic follow and red traffic signal significantly more than the control group. Furthermore, distracted walking and crossing in the intervention group was significantly decreased in comparison with the control group. Several studies reported the efficacy of E-mail-based intervention in changing the behaviors.<sup>[18,26,34]</sup> Bendtsen *et al.* showed the impact of sending persuasive messages on behavioral change, saving time and resources among a wide population of college students.<sup>[34]</sup> According to Parrott *et al.* study findings, prepare and sending messages based on TPB constructs have high effect on individual behavior change.<sup>[18]</sup> Our findings are congruence with mentioned study.

## CONCLUSION

E-mail-based interventions have shown high effectiveness to improve cognitive factors related to safe crossing among medical college students. SNs were not significantly change, and more studies are needed to investigate and recognition of appropriate interventional strategies to change it among road users specifically pedestrians. Given the lack of available literature on the topic of E-mail-based safe crossing interventions, this investigation was conducted with the expectation that many follow-up studies would be performed in the future. These data provide valuable information concerning the use of E-mail as an affordable, high-impact intervention tool for promoting safe crossing behaviors among pedestrians.

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