

**Effects of an educational intervention program based on the PRECEDE–PROCEED model  
for anger management and driving performance of urban taxi drivers: A comparison of  
traditional and online methods**

**Abstract**

This quasi-experimental study implemented and compared the efficacy of an educational intervention based on the PRECEDE–PROCEED model to teach anger management and improve the driving performance of urban taxi drivers delivered using with same instructional materials either face-to-face (traditional) and online. Participants were 76 taxi drivers from two cities in Iran, randomly assigned to face-to-face or online delivery of the intervention. Data was collected using a survey which included demographic questions, Ecological and Educational Assessment Questionnaire (measuring knowledge, reinforcing factors, and enabling factors), Driver Attitude Questionnaire, Driver Behavior Questionnaire, and Driving Anger Scale at baseline, and two-months (follow-up 1) and four-months (follow-up 2) after the intervention. Additionally, participant’s driving performance was assessed using the Wiener Fahrprobe technique. Both intervention modes were effective in improving driving performance in follow-up 1. Knowledge, reinforcing factors and enabling factors were improved in both modes of intervention in follow-up 1, although scores had decayed by follow-up 2. Compared to baseline, face-to-face delivery of the intervention improved drivers' attitudes and self-reported driving behaviors, although there was a small decay at follow-up 2, whereas online delivery improved drivers' attitudes in follow-up 1 only. By follow-up 2, the face-to-face group had reduced driving anger, but no change was observed in the online group. Altogether, retention of the educational intervention was greater in the face-to-face group than the online group. Reasons for this difference can be attributed to increased efficacy of face-to-face teaching that includes an opportunity to question the instructional content and get feedback.

*Keywords:* driving anger, driving behavior, driving performance, taxi drivers, health promotion models

## 1. Introduction

Driver behavior is a very important factor in road safety and a vital variable in the prevention of road crashes (Moslem et al., 2020). Driving behavior refers to behaviors that the driver chooses as a model for their driving and include two categories of positive behaviors and negative or unsafe behaviors (Ulleberg & Rundmo, 2003). Positive behaviors include friendly behaviors toward other drivers and road users (Shen et al., 2018). Unsafe behaviors are often unlawful, as well as endangering themselves, their passengers, and other road users. Examples include not wearing a seat belt, crossing a red light (Mokarami et al., 2019; Parkinson, 2001), or using a cell phone while driving (Hassen et al., 2011). Various individual differences affect drivers' performance, with one of the undesirable being driving anger (McLinton & Dollard, 2010). Anger has several adverse effects on driving and is experienced more frequently while driving than during non-driving situations (Love et al., 2022; Qu et al., 2016; Stephens & Groeger, 2019). According to Spielberger, anger is an emotional state that varies in intensity from mild to intense anger and, like other emotions, it is accompanied by physiological and biological changes (Spielberger, 1988; Spielberger & Reheiser, 2010). Anger stimuli can be either external or internal (Spielberger & Reheiser, 2010). Anger is one of the most important factors in human error (Deffenbacher et al., 2001).

Studies show that human error is involved in the majority of road crashes (e.g. Arvin et al., 2019; Hassen et al., 2011; Young & Salmon, 2012). Pertinent to this study, driving anger is positively associated with traffic violations in general and driving violations in particular, including violent and non-aggressive incidents (Deffenbacher et al., 2002). Drivers with a high level of anger are agitated 2.5 to 3 times more often than other drivers while driving, and when they are aroused, they experience more intense anger (Dahlen & Ragan, 2004). Thus, they are more likely to engage in aggressive behavior such as yelling at another driver and engaging in dangerous behaviors such as speeding and reckless driving. These drivers experience 3.5 to 4 times more aggression and engage in 1.5 to 2 times more risk behaviors. Similarly, angry drivers are also more likely to experience decreased vehicle control, driving violations, and minor (rather than severe) crashes (Dahlen & Ragan, 2004).

Behavioral self-reports by a driver, despite its many benefits such as practicality and ease of implementation, have limitations. They can be influenced by social desirability bias, and individuals are also known to be negligent and inaccurate in their judgments (Batool, 2012; Fernandes et al., 2006). Thus, observer measures of driving performance can complement the shortcomings of self-reports (Batool, 2012). That is, objective measures of driving performance can provide additional information about a driver's behavior (positive and negative) and are recommended to supplement self-reports to provide a more realistic picture of drivers' attitudes and behaviors (Batool, 2012).

Educational intervention methods to change attitudes and behavior can be divided into two categories: traditional methods – such as face-to-face teaching, and supportive pamphlet distribution (Barbaz & Zareiyan, 2012), and e-learning (learning done by studying at home using computers and courses provided on the internet). The latter are online methods that use various media such as audio, videos, films, animations, etc., to meet the specific educational needs of a community, and take into account different learning styles (Lee & Owens, 2004). The widespread access and increasing use of mobile technologies has provided valuable opportunities for their application in the field of education (Beratarrechea et al., 2014). Nevertheless, to achieve effective outcomes, regardless of delivery method, the education provided must be principally based on defined theories and models.

Theories and models can provide a map of the educational process, provide the necessary guidelines for educational assessment and diagnosis, educational planning and design of interventions, and they facilitate evaluation (Mohammadi et al., 2018; Rastgarimehr et al., 2014). One of the most comprehensive planning models is the eight-phase PRECEDE-PROCEED Model developed by Green and Kreuter (2005). The educational and ecological diagnosis phase in this model involves determining predisposing factors (knowledge, beliefs, values, and attitudes), enabling factors (programs, services, availability, and accessibility of resources, or new skills), and reinforcing factors that provide a context for educational interventions to induce behavior change. The PRECEED-PROCEDE model provides a framework to help health planners and policymakers design effective health interventions based on evaluation and analysis of situations. This model has been used in different recent studies related to behavioral change to improve

exposure risks and work-related health problems (Barkhordarzadeh et al., 2022), to drowning prevention (Guevarra et al., 2021), and to promote low back pain behaviors (Pourhaji et al., 2020).

### **1.1. Traditional and online education**

Traditional education and learning systems are based on three main components: learners, educators, and educational content, and all of these components must be physically present in the learning place (Sarrab et al., 2014). There are significant benefits from direct interaction between learners and educators such as immediate discussion and feedback, but also traditional learning has drawbacks from its reliance on a particular venue at a given time, as it is mainly provided face-to-face (Sarrab et al., 2014). The extant literature includes several studies that have examined and confirmed the effectiveness of face-to-face educational methods for driver education (Bates et al., 2020; Cutello et al., 2020; de Craen et al., 2013; Senserrick & Haworth, 2005; Wang et al., 2020). The more recent introduction of e-learning and online education has made education and learning possible for individuals in any field, at any time, and in any place (Kuhn, 2019). For this mode of delivery, there is not the same amount of consideration of efficacy – particularly in terms of interventions to support safe driving. E-learning delivers educational materials electronically, via a computer, to remote learners. This has led to suggestions that it could be a good for on-the-job workforce training (Zhang, et al., 2004). Moreover, advances in online learning have led to predictions that these methods will replace traditional face-to-face methods (Arbaugh & Duray, 2002; Kearns et al., 2004; Kuhn, 2019). With respect to driver education, (Covolo et al., 2017) found a moderate effectiveness of mobile applications in promoting driver health. There are challenges, however, in providing education online. These are related to matching the quality or clarity of instruction compared to traditional classroom learning. There are also questions related to online learning including the comparative cost of participation, the learners' characteristics, the characteristics that govern instructional efficiency, and learners' performance (Kuhn, 2019). Nevertheless, using a mobile phone for learning is attractive to educators because of its low cost, size and very high capabilities, assuming easy wireless connectivity (Sarrab et al., 2014).

## **1.2. Interventions for the reduction of driving anger**

Angry drivers pay less direct attention to apparent dangers and have slow reactions to traffic hazards (Stephens et al., 2013). Behaviorally, angry drivers are more likely to take risks (Lu et al., 2013), are more likely to pass a yellow light (Abdu et al., 2012), and make a sudden change of direction (Jeon et al., 2011). From a cognitive perspective, angry drivers focus only on the central area of the visual field and ignore the peripheral information that is important for hazard detection, thereby reducing risk perception (Mesken et al., 2007).

Various intervention studies have addressed driving anger management using different approaches. Deffenbacher et al. (2002) provided eight weekly small group sessions to support development of relaxation coping skills and cognitive restructuring of specific driving situations which, when compared to no-treatment controls after 4 weeks, reduced some, but not all of their self-report measures of driving anger. They concluded that the methodology should be improved in future studies, as well as a need to include long-term follow up evaluations to ascertain maintenance effect. A similar cognitive-behavioral approach was used in the intervention study of Galovski et al. (2003). In this case-control study participants included US drivers who had been arrested for driving violations associated with aggression. They received four weekly “treatments” which included relaxation exercises, as well as educational material and cognitive restructuring. The psychophysiological measures taken were significantly reduced immediately following the treatment, however there was no further follow-up. In summary, the intervention in both of these studies reduced trait anger, driving anger indicators, and the hostile and aggressive forms of expressing driving anger. They also increased adaptive/constructive methods of expressing driving anger, and the cognitive-relaxation intervention also reduced the frequency of high-risk behaviors. In another study, Feng et al. (2018) examined the effectiveness of a cognitive intervention and a forgiveness intervention to reduce anger and aggressive expression in two separate samples of 18 male bus drivers in China, compared to a control sample (also n=18), all with a record of traffic crashes or violations. Post-treatment both interventions were found to increase anger control ability and improved negative emotions. This study also included a two-month follow up evaluation. Maintenance of the lower

levels of anger and fewer negative cognitions was seen in the cognitive intervention group. A limitation of this study was the reliance on self-report measures and lack of any objective measure.

Other relevant research includes that of S. Li et al. (2020) who examined the impact of a speech-based intervention with positive comments and showed that positive and negative feedback interventions can reduce perceived anger and workload and improve driving performance, and Shokohiyekta et al. (2015) who examined the effectiveness of psychosocial skills educational on driver's aggression and anger. Their results showed that the educational package was effective in reducing aggression, but it did not have a significant effect on reducing anger. Finally, a review of the effectiveness of interventions in reducing anger and aggression in angry drivers showed that the outcome literature on anger reduction is small, but there is empirical support for cognitive, sedative, and behavioral interventions and a combination of them (Deffenbacher, 2016). The authors highlighted the need for examining new interventions with correct theoretical rationale and empirical support in anger management. Accordingly, the present study employed the PRECEDE–PROCEED model to fill the gap in the literature on anger management and driving performance.

### **1.3. Intervention studies on driving safety performance**

Safety performance refers to the set of actions and behaviors that individuals perform to maintain and improve the safety and health of themselves and others (Hon et al., 2014; Rajabi et al., 2020). Risky driving behaviors include willful violations, unintentional errors, advertent errors, deliberate mistakes, unintentional violations, and unintentional mistakes (Alavi et al., 2016). There are few intervention studies performed to improve driving safety behaviors, and many of these focus on the older driver. These include the research of Kosuge et al. (2021), who studied Japanese older drivers and reported the effectiveness of an educational intervention on the accuracy of self-awareness of driving performance and general driving performance.

Several studies have tried to identify the factors that influence safe driving behavior in taxi drivers in cross-sectional analyses (Hassen et al., 2011; Tahmasby et al., 2015). To date, the findings have not been

explored using a theoretical framework to develop interventions despite suggestions that theory based approaches can improve attitude and behavioral control in other professional drivers (Ashoogh et al., 2013). Nævestad et al. (2018) conducted review of 20 studies that have performed interventions to improve safety culture in various modes of transport using professional drivers. They found that compared to air, rail and maritime sectors, safety management interventions for professional road drivers were limited (n = 8) and had a focus on heavy goods vehicles and buses. The interventions ranged from group discussions to comprehensive company campaigns to improve road safety management to reduce driving accidents. Ultimately the authors concluded that informative group discussions with drivers were more viable for smaller companies, both because cost-effective and because it encourages ownership of driving safety problems. Critically, the content and the process of the interventions influenced the degree of success, although all those reviewed were effective on some level.

Most recently, drawing upon evidence that distracted driving is a significant problem in young people, Berlin et al. (2021) examined the effect of a five-weekly 20-minute educational intervention on distracted driving knowledge, attitudes, and behaviors among college students aged 18-33 years. Their results confirmed the effect of classroom-based health education on improving distracted driving attitudes and behavior among the participants when assessed two-weeks after the intervention.

#### **1.4. Summary**

The literature provides confirmation that interventions to improving anger management and driving safety are feasible. There is a need to improve methods, including extending follow-up periods. Our review indicated that no study has addressed both variables of safe driving behavior and driver anger using the robust PRECEDE-PROCEED model to measure safe driving behaviors in the form of self-reported and observed behaviors. The eight-phase PRECEDE-PROCEED model provides a useful framework for designing, implementing and evaluating educational interventions. It has been shown to work well in a variety of health promotion programs, and is readily adaptable, making it suitable for use in our study.

In addition, no study to date has compared the effectiveness of traditional and online educational intervention methods for reducing anger and improving driving performance. Given the high rate of driving crashes in the world, especially in Iran, and the high rate of violence committed by drivers, especially urban taxi drivers, conducting educational interventions for taxi drivers is essential. In this regard, the present study was conducted based on the comprehensive, participatory, and step-by-step phases of the PRECEDE–PROCEED model to compare the effect of two types of traditional and online educational interventions on anger management and driving performance of urban taxi drivers. It was anticipated that the educational intervention would successfully reduce driver anger and improve driving performance. The impact and sustainability of the two types of delivery (tradition and online) was explored at two follow-up points to provide evidence whether the mode of delivery of the intervention was relevant to the efficacy of the intervention.

## **2. Method**

### **2.1. Research design and participants**

This quasi-experimental study was conducted in 2021. Participants were 76 taxi drivers, all male, from two cities in Iran (Dezful and Andimeshk). These two cities are located in the southwest of Iran, at a distance of 3 km from each other. They were chosen because they have many cultural and socio-economic similarities, as well as a similar hot and dry climate. Inclusion criteria were: working as a registered taxi driver with an official driving license for at least one year; willingness to participate in the study; and having no severe mental illness. 640 taxi drivers met the inclusion criteria. The sample size was estimated as 34 persons per group using the following formula by taking the 95% test power, 95% confidence interval, and 10% dropout rate.

$$n = \frac{N \cdot Z_{\frac{1-\alpha}{2}}^2 S^2}{d^2(N-1) + (N \cdot Z_{\frac{1-\alpha}{2}}^2 S^2)}$$

Where  $N$  is the number of members of the population,  $S$  is the standard deviation, and  $d$  is the error level.

To select the participants, the number of members in the target population was divided by the required number of participants, and the distance between every two choices was specified. Then, using the random number table, the first participant was selected from the list of taxi drivers in each city. Other participants were selected by systematic random sampling until an adequate number of participants were included in the research sample for each city. After participant selection, participants of one city were allocated to the traditional (face-to-face) group, and the other to the online group, for delivery of the educational intervention. Whilst we could have further split the sample to have half participants in each city receiving each intervention mode, this approach minimized the possibility of the taxi drivers comparing the way they received their educational materials, and thus contamination. There was no reason to consider a significant difference in the conditions of the two cities as ultimately in the same area.

*Insert Figure 1 about here*

In the next step, the objectives of the study were explained to the participants. To comply with health protocols, a web-based questionnaire was developed and the access link distributed to all participants using an online group. The data were measured at three time points; before the intervention (baseline), two months after the intervention (follow-up 1), and four months after the intervention (follow-up 2) in both groups (see Figure 1). All participants gave written informed consent. Questionnaires were filled out and submitted anonymously.

## **2.2. Procedure**

This study used a procedure based on the eight-phase PRECEDE-PROCEED model (see Figure 2) to develop an educational intervention, to implement it using two modes of delivery, and to evaluate the efficacy of the intervention according to the two modes of delivery.

*Insert Figure 2 about here*

In the first phase, a social assessment was performed by reviewing the literature, searching databases, holding face-to-face interviews with 18 taxi drivers and also observing their driving behaviors. This provided information supporting the identification of the most important factors affecting the performance of urban taxi drivers in the two cities.

In the second phase, epidemiological assessment, the factors affecting driving behavior that were identified in the social assessment phase were separated into two categories of behavioral factors and non-behavioral (environmental) factors by a panel of experts. These factors were also ranked based on the criteria of importance and priority variability.

In the third phase, educational and ecological diagnosis, factors affecting driving behavior were identified and classified into three categories: predisposing factors, enabling factors, and reinforcing factors.

Predisposing factors included variables that precede behavior change and motivate behavior (such as knowledge, beliefs, attitudes, values, and perceptions). Enabling factors were considered as preconditions for behavioral or environmental change that would allow an environmental motivation or policy to be realized (such as access to resources, availability, rules, regulations, and skills). Reinforcing factors were defined as a set of influences and circumstances that lead to behavior tracking and which provide ongoing reward for maintaining a behavior (such as family, peers, teachers, employers, health personnel, community leaders, and decision-makers). In this study, based on the problems identified in the previous phases, the predisposing factors included knowledge and attitude, enabling factors, and reinforcing factors.

In the fourth phase, political and managerial recognition, consultation meetings, and group discussions were held with the officials of the taxi management organization to allocate privileges to those taxi drivers without any reported violations or fines. Meetings were also held with the officials of the traffic department of both cities to hold periodic courses and to assign points and incentives to safe and non-infringing drivers. The taxi management organizations of both cities were also recommended to launch a text message system to encourage passengers to rate their drivers and to incentivize drivers to behave safely by providing rewards for high-rating drivers.

In the fifth phase, the developmental information from the previous four phases was collated into the educational intervention program for anger management and safe driving performance, and then implemented. That is, the pre-test data were analyzed and provided the required information regarding identifying weaknesses in the predisposing, enabling and reinforcing factors. This, together with the social assessment provided a focus for educational intervention. Then, instructional materials were prepared by reviewing various databases, including books, journals, and online resources. The required materials were simplified according to the participants' literacy level.

Participants engaged with the educational intervention in one of two ways. Half of the sample (n=38) were the traditional groups and received face-to-face teaching, using supported by an educational booklet, and the other half were the online group (n=38) were presented with the same teaching materials using a mobile app.

The traditional intervention was delivered in subgroups of two or three participants due to social distancing conditions associated the COVID-19 pandemic. Each of the seven weekly sessions was designed to provide about one hour of face-to-face teaching, but they often lasted up to 1.5 hours to accommodate participant's questions and answers. For the online intervention group the educational materials were presented in the app for one week, then renewed each week until the seven sessions had been given, to mirror the approach of the delivery of materials to the traditional intervention group.

Table 1 describes the content of the educational sessions.

*Insert Table 1 about here*

In the sixth phase, a process evaluation was performed including filling out the questionnaires (described in the next section), the absence/presence at the educational sessions, sending text messages to the participants to study educational materials, and analyzing preliminary results. Accordingly, a process evaluation was performed to ensure that the intervention program was implemented according to the protocol. The intervention program was evaluated through a panel discussion and some changes were made to improve the program.

In the seventh phase, an impact evaluation was carried out to assess the immediate effects of the intervention program two months after the intervention by comparing the scores of the studied variables obtained before the intervention with those taken two months later (i.e. follow-up 1).

In the eighth phase, an outcome evaluation was carried out to assess the medium-term effects of the intervention program on the study variables four months after the intervention. The evaluation was performed by comparing the scores of the studied variables obtained before the intervention and four months after the intervention (i.e. follow-up 2).

### **2.3. Instruments**

#### ***2.3.1 Demographic Information Questionnaire***

A researcher-made questionnaire was used to assess the participants' demographic characteristics including age, sex, marital status, education, number of years of driving, smoking, drug use, and eyesight.

#### ***2.3.2. Ecological and Educational Assessment Questionnaire***

This researcher-made questionnaire was developed following the educational and ecological evaluation phase of the PRECEDE–PROCEED model. It consisted of three scales: (1) Knowledge (ten items) included items about drivers' knowledge of the traffic rules, traffic signs, the rights of drivers and pedestrians, and the anger skills in driving; (2) Enabling Factors (ten items) included items about drivers' access to organizational resources and traffic guidance experts, counselors and health care staff for anger control and financial ability to perform periodical examinations and personal check-ups; (3) Reinforcing Factors (eight items) included items about incentives from the organization, colleagues, family and relatives about safe driving, internal incentives such as the feeling of pride from the praise of passengers for safe driving and the pleasant feeling of being able to control anger. The Knowledge scale items had a multiple-choice format each with four-options of which only one was correct. Each correct answer was scored 1 and wrong answers were scored 0. Thus, the maximum score was 10 and the minimum score was 0. The Enabling Factors items were scored on a 5-point Likert frequency scale (always/often/sometimes/rarely/never), with a score range of 10 to 50. Reinforcing Factors items were

scored on a 5-point Likert frequency scale. The minimum and maximum scores were 8 and 40, respectively.

The psychometric properties of this questionnaire were confirmed in this study. The face validity of the items was checked and confirmed. A panel of experts consisting of 10 health promotion, safety, and ergonomic professors and five traffic experts reviewed the questionnaires. The content validity index (CVI) and content validity ratio (CVR) scores for the educational diagnosis questionnaire were .87 and .88, respectively. The questionnaire had good internal consistency and its Cronbach's alpha coefficient was .79.

### ***2.3.3. Driving Attitude Questionnaire (DAQ)***

This questionnaire was developed by (Batool, 2012). It contains 58 items each scored on a 5-point Likert agreement scale, with a score range of 58 to 290, where a high score indicates a better attitude to responsible driving. The questionnaire measures speed, compliance with fastening one's seat belt, lane changes, crossing a red light, one-way driving, driving very close to other cars, driving after drinking alcohol, driving after consuming drugs, overtaking behavior, distracted driving, driving with the right vehicle, compliance with driving regulations and rules, aggressive driving, driving self-assessment, other basic driving rules, driving environment, and social norms. The DAQ translated into Persian based on the cross-cultural adaptation guidelines for instrument translation proposed by Beaton et al. (2000). The CVI and CVR scores for the questionnaire were .81 and .76, respectively. The DAQ had good internal consistency and its Cronbach's alpha coefficient was .75.

### ***2.3.4. Driving Behavior Questionnaire (DBQ)***

The DBQ was designed by Lawton et al. (1997), and revised by (Batool, 2012). This questionnaire evaluates self-reported driving behavior, focusing on aggressive violations and highway code violations. A higher score in the questionnaire indicated a better driving behavior. The DBQ contains 29 items scored on a 6-point scale (0 = never, 1 = rarely, 2 = occasionally, 3 = often, 4 = most often, and 5 = almost always). The DBQ translated into Persian based on the cross-cultural adaptation guidelines for instrument

translation proposed by Beaton et al. (2000). CVI and CVR scores were .80 and .79, respectively. The questionnaire had good internal consistency and its Cronbach's alpha coefficient was .71.

### **2.3.5. Wiener Fahrprobe (WF)**

The WF technique – also known as the Vienna driving test – is an in-vehicle observation method developed by Risser (1985) to study the actual performance of drivers in different driving conditions. In this study, two observers arranged for a taxi ride as if normal passengers. The WF tool was accessed using a mobile phone, and the online activity by the ‘passengers’ could have been any texting activity typical of taxi passengers. This method reduced the potential for a socially desirable driving performance contrary to the participant’s normal driving behavior. One passenger used a coding tool to measure ‘standardized observations’, and the other made notes of any ‘unpredictable events’ during the journey: errors, interactions, and traffic conflicts. Standardized observations refer to normal behaviors while driving, which can be established as appropriate or not. These include driving speed, overtaking and changing lanes, lane choice and behavior at traffic lights. Errors are events that indicate a violation of the law and/or a risk. The process of interactions/communication means intentional neglect of the rules. Traffic conflicts are situations in which at least two road users are on the collision route and can only be prevented by an unavoidable action taken by at least one of them (Batool, 2012). Lower WF scores represent a better driving performance. The WF translated into Persian based on the cross-cultural adaptation guidelines for instrument translation proposed by Beaton et al. (2000). Inter-rater reliability index based on the opinions of two raters was used to assess WF reliability. Both raters analyzed a situation based on the WF items. The intra-class correlation coefficient (ICC) between raters was .76, indicating a satisfactory consistency (Ebadi et al., 2017). The CVI and CVR scores for the WF were .85 and .82, respectively.

### **2.3.6. Driving Anger Scale, Short Form (DAS)**

The Driving Anger Scale is a 14-item tool used to assess driving anger (Kazemeini et al., 2013). Respondents were asked to imagine the incidents described and grade the anger level that each situation would induce. The DAS uses a 5-point scale (not at all, a little, some, much, and very much). The DAS

short form yields a single score of driving anger. A lower score in the scale indicated a better driving anger management. The DAS translated into Persian based on the cross-cultural adaptation guidelines for instrument translation proposed by Beaton et al. (2000). The CVI and CVR scores for the scale were .91 and .89, respectively. The scale had good internal consistency and its Cronbach's alpha coefficient was .88.

#### **2.4. Data analysis**

The collected data were analyzed using descriptive statistics (mean, standard deviation, and frequency). In the three evaluation phases, first histograms and Kolmogorov-Smirnov tests were used to check the normality of the data distribution and data skewness. The dependent variables were all normally distributed. Thus, ANOVA, independent samples *t*-tests, chi-square, paired samples *t*-tests, and one-way repeated measures ANOVA were used to compare the changes in the evaluated data in the three different periods. In the one-way repeated measures ANOVA, the sphericity of the covariance matrix was checked based on the Mauchly test, and if this assumption was not met, the Greenhouse Geisser test result was used to correct for the violation. Partial eta squared values were used to evaluate the effectiveness of the intervention. All analytical procedures were performed using SPSS software (version 24) (SPSS Inc., Chicago, IL, USA). A *p*-value  $\leq .05$  represented statistical significance.

### **3. Results**

The mean age of the participants in the traditional educational group and the online educational group was 35.8 (*SD* = 6.4) years and 34.0 (*SD* = 7.1) years, respectively, and there was no statistically significant intergroup difference ( $t = 1.16, p = .249$ ). Mean driving years were 9.5 (*SD* = 4.5) and 10.8 (*SD* = 6.9), respectively, and again there was no statistically significant difference between the two groups ( $t = -0.925; p = .249$ ). The other demographic data of the participants are shown in Table 2.

*Insert Tables 2 and 3 about here*

Mean scores for all the research variables at baseline, follow-up 1, and follow-up 2 for the participants in both groups are presented in Table 3. There was a significant difference between the two intervention groups in terms of knowledge score at baseline ( $p = .017$ ), however, not at follow-up 1 ( $p = .916$ ) or follow-up 2 ( $p = .698$ ). The rate of change in the mean knowledge score at follow-up 1 and follow-up 2 compared to the baseline in the traditional educational group increased by 4.13 and 4.05 points, respectively, showing a statistically significant increase at both time points ( $p < .001$ ). Regarding the online educational group, the rate of change in the mean knowledge score at follow-up 1 and follow-up 2 increased by 3.39 ( $p < .001$ ) and 3.27 ( $p < .001$ ), respectively, compared to baseline. This was also a significant increase in knowledge. The results of a repeated measures ANOVA confirmed a significant difference in the mean scores of knowledge at baseline, follow-up 1, and follow-up 2 in both intervention groups ( $p < .001$ ).

The scores of enabling factors at baseline showed a significant difference between the two intervention groups ( $p < .01$ ). However, the advantage for the online group in this respect was no longer observed by follow-up 1 ( $p = .430$ ) or follow-up 2 ( $p = .161$ ). The mean difference in enabling factors scores in the traditional intervention group increased by 7.84 and 5.21 for follow-up 1 and follow-up 2, respectively, compared to baseline, and these differences were both statistically significant ( $p < .001$ ). Compared to the baseline, the mean difference in the scores of the enabling factors in the online intervention group also increased by 4.14 in follow-up 1 ( $p < .001$ ) and by 2.11 in follow-up 2 ( $p < .001$ ), also showing statistically significant increases. The repeated measures ANOVA showed that there was a significant difference in both intervention groups in the mean scores of enabling factors at baseline, follow up 1, and follow up 2 ( $p < .001$ ).

Analysis of the scores of reinforcement factors showed a significant difference between the two intervention groups in the baseline ( $p = .002$ ), and also at follow-up 1 ( $p < .001$ ), and follow-up 2 ( $p < .001$ ). Compared to baseline, the mean scores of reinforcement factors in the traditional intervention group increased by 6.39 and 4.21 in follow-up 1 ( $p < .001$ ) and follow-up 2 ( $p < .001$ ), respectively. Similarly, compared to baseline, the mean scores of reinforcement factors in the online intervention group increased

by 7.37 and 3.34 in follow-up 1 ( $p < .001$ ) and follow-up 2 ( $p < .001$ ), respectively. A repeated measures ANOVA showed significant differences in both intervention groups in the mean scores of reinforcement factors at baseline, follow-up 1, and follow-up 2 ( $p < .001$ ).

A comparison of the attitude scores showed a significantly higher score indicating better driving attitude in the online intervention group than the traditional intervention group at baseline ( $p < .01$ ). However, there was no significant intergroup difference at follow-up 1 ( $p = .430$ ) or follow-up 2 ( $p = .161$ ). The mean driving attitude score in the traditional intervention group was significantly increased by 30.0 and 11.95 in follow-up 1 ( $p < .001$ ) and follow-up 2 ( $p < .001$ ), respectively, compared to baseline. However, although the mean scores of the driving attitudes in the online intervention group were significantly increased by 22.71 in follow-up 1 ( $p < .001$ ), this improvement was not maintained in follow-up 2 assessment ( $p < .082$ ). The mean driving attitude score was then only increased by 1.13 compared to baseline, which was not significant different. The repeated measures ANOVA showed significant differences in both intervention groups in the mean scores of driving attitudes in the baseline, follow-up 1, and follow-up 2 ( $p < .018$ ).

A comparison of the mean scores for self-reported driving behavior in the two groups is shown in Figure 3. There was no significant difference between the two intervention groups at baseline ( $p = .228$ ), however, there were significant differences at follow-up 1 ( $p < .001$ ) and follow-up 2 ( $p < .001$ ). The mean scores of self-reported driving behavior in the traditional intervention group increased by 39.84 ( $p < .001$ ) in follow-up 1 and by 28.31 ( $p < .001$ ) in follow-up 2 compared to the baseline scores. The mean scores of the self-reported driving behavior in the online intervention group were significantly increased by 21.94 in follow-up 1 ( $p < .001$ ), but this improvement was not sustained and scores were reduced by 2.85 compared to baseline in follow-up 2. The repeated measures ANOVA showed significant differences in both intervention groups in the mean scores of the self-reported driving behavior in the baseline, follow-up 1, and follow-up 2 ( $p < .001$ ).

*Insert Figures 3 and 4 about here*

A comparison of the mean scores of driving anger in the two groups is shown in Figure 4. There was no difference between the two intervention groups in the baseline ( $p = .228$ ) or at follow-up 1 ( $p = .477$ ). However, there was a significant difference between the two intervention groups in follow-up 2 ( $p < .001$ ). Compared to the baseline, the mean scores of driving anger in the traditional intervention group decreased by 13.73 in follow-up 1 ( $p < .001$ ) and 12.65 in follow-up 2 ( $p < .001$ ). The mean scores of driving anger in the online intervention group decreased by 14.65 in follow-up 1, showing a significant difference compared to the baseline ( $p < .001$ ), however, the improvement was not sustained. Although the mean was decreased by 3.6 in follow-up 2 compared to the baseline, this difference was not significant ( $p = .083$ ). The repeated measures ANOVA showed significant differences in both intervention groups in the mean scores of driving anger in the baseline, follow-up 1, and follow-up 2 ( $p < .001$ ).

*Insert Figure 5 about here*

A comparison of the mean scores of driving performance in the two groups is shown in Figure 5. There was no significant difference in terms of mean score of driving performance between the two intervention groups at baseline ( $p = .228$ ) or follow-up 1 ( $p = .477$ ). Driving performance significantly improved in the traditional intervention group, as shown by a decrease in the mean score by 5.00 in the follow-up 1 compared to baseline ( $p < .001$ ). Similarly, the mean score of driving performance in the online intervention group decreased by 5.36 in follow-up 1 compared to baseline scores ( $p < .001$ ).

#### **4. Discussion**

This study investigated the effectiveness of educational interventions developed based on the PRECEDE–PROCEED model on anger management and driving performance of urban taxi drivers when delivered using traditional face-to-face teaching and using an online app. Safe driving behaviors were assessed in the form of self-reported and observed behaviors to compare the effectiveness of traditional and online educational intervention methods in reducing anger and improving taxi drivers' driving performance. The results indicated that the intervention improved knowledge, enabling factors, and reinforcing factors in

both traditional and online groups that was sustained, accepting a small decay at follow-up 2 in the scores of these variables. In addition, the traditional intervention improved drivers' attitudes and self-reported driving behaviors. However, the teaching may not have been sustained so well, as scores had decayed in follow-up 2 but nevertheless remained significantly improved compared to baseline. In contrast, in the online intervention group, the improvement in drivers' attitudes and self-reported driving behavior seen in follow-up 1 was not seen the follow-up 2. Indeed, at the outcome evaluation there was no difference to baseline level for these two variables for those who received the intervention online. Similar changes were observed in driving anger, and traditional educational interventions reduced driving anger behavior and this was sustained, but the reduction observed for the participants in the online educational group at follow-up 1 had disappeared by follow-up 2. We also found both traditional and online education interventions were effective in improving driving performance in follow-up 1. Unfortunately, COVID-19 restrictions prevented driving performance being observed using the Wiener Fahrprobe in follow-up 2.

Knowledge of appropriate driving behavior was an important variable to assess in the present study of an educational intervention. The results showed that after the intervention, drivers' knowledge in the traditional intervention group was increased compared to baseline, in line with the findings of other studies using traditional educational interventions (Berlin et al., 2021; Hill et al., 2020; Jones et al., 2012; Lanning et al., 2018). The mean knowledge score was also improved for the participants in the online intervention group. This was expected following the literature. For instance, a study by Jones et al. (2012) showed that self-study using films significantly improved drivers' knowledge. Similarly, three other online studies have reported findings in line with those of the present study (Q. Li et al., 2020; Li et al., 2014; Whatnall et al., 2019). Nevertheless, the intergroup comparisons indicated that increase in knowledge was superior in participants in the traditional intervention, compared to the online group, which supports the assertion of Sekhavat et al. (2021) that driving education with a trainer present was more effective than online instruction. As the two modes of delivery provided the same education the difference can be attributed to factors such as the motivating presence of the instructor at the educational site that one has tried to attend; the effect of body language and non-verbal communication only provided in traditional education;

information and emotions that are important for the subject can be transferred more effectively face-to-face, and the participants could ask and answer questions. Moreover, in this study, the educational sessions were held with the presence of a very small number of study participants due to the COVID-19 outbreak and the application of social restrictions. It is likely that the small number of participants was a part of the advantage of face-to-face educational intervention because the participants were more active in the course, more focused on the content and materials, and had more opportunities to ask and answer questions. Thus, it can be argued that these small groups with three main characteristics (namely active participation, purposeful activity, and effective face-to-face communication) were able to effectively learn the intended concepts and share information (Dent & Ramani, 2017). On the other hand, we suggest that learners' communication and discussion with peers and their teachers could contribute to improving group dynamism, which would help to improve group learning.

The results of the present study showed that the mean score of enabling factors increased significantly in both intervention groups in follow-up 1 compared to baseline. Solhi et al. (2020) suggested that educational intervention improves enabling factors in lifestyle among college students. These findings indicated that the provision of educational content in both traditional and online learning modules had a positive effect, confirming the effectiveness of the interventions. Enabling factors such as access to educational resources and skills are a prerequisite for changing attitudes and behaviors. Improving these factors as a component of the intervention contributed to enhancing the drivers' attitudes and behaviors. The data also showed that in both intervention groups, there was decay in mean scores of enabling factors at follow-up 2 although the observed decrease was still significantly better than the baseline position. This decay may indicate a relatively low retention effect of the educational intervention in the long run and the need for regular revision, as well as providing facilities and resources for people to access them. Providing suitable environmental factors such as safe roads and the presence of comfortable vehicles with effective heating and cooling systems and proper organizational policies to provide more people with the necessary resources, such as the constant availability of traffic experts to answer questions related to driving behavior

and performance or having a source for behavioral and expert counseling to control anger, can be examples of enabling factors available to drivers.

In this study, the mean score of reinforcement factors in the traditional intervention group in both follow-up evaluations was increased compared to baseline. This is in line with previous research which has indicated that face-to-face educational interventions can improve the reinforcing factors ((Deng & Hu, 2013; Solhi et al., 2016). A new finding is that similar changes were observed in the online educational intervention group. The findings of the present study indicate that providing educational content through either traditional or online methods can be effective in improving reinforcing factors to support driving anger management. Furthermore, the overall effectiveness of the three forms of intervention in the ecological and educational evaluation phase of the PRECEDE–PROCEED model were confirmed.

In this study, the traditional educational groups comprised a very small number of the participants due to the COVID-19 pandemic. This supported a high level of participatory interactions between the people in the groups and facilitated the exchange of information among the group members which in turn, played a reinforcing role in group discussions to induce behavioral change. Nevertheless, the online intervention was interesting for the drivers and the use of videos and online learning acted as an effective incentive for the participants to use information. In addition, constant access to the instructions enabled the participants to use the instructions and materials any time they wished. It should be noted that discussions about educational intervention at the taxi drivers' gathering station were also important in reinforcing the learning outcomes in both groups.

The results of this study also showed that the mean score of driving attitude in the traditional intervention group in the two follow-up evaluations was higher than the corresponding values of driving attitude at the baseline. Previous studies (Berlin et al., 2021; Casutt et al., 2014; Deng & Hu, 2013; Solhi et al., 2016) have similarly shown that face-to-face educational intervention improves driver's attitudes. Driving attitude scores in the online intervention group also increased significantly in follow-up 1 compared to baseline, however, unlike the traditional educational group, no difference was found in driving attitude was seen at follow-up 2. That is, the educational interventions in both groups enhanced driver's attitude in follow-up 1

compared to baseline, however, the retention effect of the educational program on driving attitudes was small, and a significant improvement compared to baseline only seen in follow-up 2 in the traditional educational group. The decay in the driving attitude score can be attributed to the nature of this variable, the duration of the intervention, the learning environment, and learners. Attitude is a prerequisite for behavior change and because it is rooted in beliefs and values, it will be much more difficult to change and maintain it, and maintaining change requires strong reinforcing factors in the long run. Thus, the participatory nature of educational sessions in the traditional intervention group, the instructor's presence, close face-to-face communication, question and answer discussions, and informal discussions in the taxi drivers' gathering stations is likely to have contributed to improving the retention effects of instructions provided in the traditional intervention group. In the online education group, a lack of close and face-to-face human interactions and exchange of emotions, together with no opportunity to challenge the discussions could be reasons for the substantial decay in participants' scores in follow-up 2.

Regarding self-reported driving behavior, for the traditional group this was significantly better in follow-up 1 than baseline. However, there was a decay in the mean score at follow-up 2, although still a significant improvement compared to baseline, indicating retention of the intervention, and that face-to-face educational intervention improves people's behaviors. These results are consistent with the observations made in others study (Berlin et al., 2021; Taubman–Ben-Ari et al., 2017). On the other hand, while self-report driving behavior in the online group increased significantly in the follow-up 1 evaluation compared to baseline, there was no change in follow-up 2 scores compared to the pre-intervention scores. This indicates that the effect of online educational intervention in follow-up 1 was not retained in the long run. These results were in line with the findings of some similar study where self-guided driving interventions do not have longevity (Jones et al., 2012; Khandelwal & Upadhyay, 2021; Siero et al., 1989). The same declining trend was also observed for driving attitudes. Accordingly, it can be argued that lack of close and face-to-face human interactions and lack of exchange of emotions, and the failure to take part in discussions about the materials were the main reasons for the sharp decrease in the participants' scores in follow-up 2 compared to the baseline in the online intervention group. Besides, the outcome of these

effects on attitudes as prerequisites for behavioral change reduced the mean scores of self-reported driving behaviors in the online educational group.

The present study found that driving anger scores in the traditional intervention group in follow-up 1 were significantly lower than before the intervention. A comparison of mean driving anger score in follow-up 2 with follow-up 1 indicated a slight decay and thus high retention of the educational intervention. Similarly, Haustein et al. (2021) showed that a traditional educational intervention can reduce road anger in drivers. Other studies also confirm the results of the present study (Feng et al., 2018; Kazemeini et al., 2013; S. Li et al., 2020). Regarding the online intervention group, although the mean score of driving anger in follow-up 1 was lower than at baseline, four months after the educational intervention, there was no reduction in driving anger and the obtained scores were close to the baseline scores. As stated earlier, the lack of face-to-face communication, and emotions expressed in the teacher's tone and behavior, a lack of non-verbal communication and body language, a lack of immediate feedback from other learners, and a lack of opportunity to challenge the instructional content in online educational served to reduce the retention effects of online educational compared to traditional face-to-face learning (Dent & Ramani, 2017; Gunn et al., 2007).

Regarding actual driving performance, in the traditional intervention group this was significantly improved in follow-up 1 compared to baseline, and the results were consistent with the self-report driving performance data. However, due to the COVID-19 pandemic conditions and time and operational constraints, evaluation was not performed in follow-up 2. Evaluating and comparing self-reported and observed driving behaviors can provide a more realistic picture of drivers' attitudes and behaviors (Batool, 2012). This robust methodology was used in the present study. Consistent with these results, Feng et al. (2018) showed that traditional educational improves drivers' performance, and a similar conclusion have also been as drawn in other studies (Casutt et al., 2014; Kosuge et al., 2021; Lavallière et al., 2012). The results of the present study also suggested that the mean score of driving performance in the online intervention group in follow-up 1 increased significantly compared to baseline. Sekhavat et al. (2021) showed that driving behavior education with the presence of an online teacher can improve the learning

outcomes and performance of learners. Niu et al. (2017) also reported similar results. Driving performance can be considered a reliable outcome reflecting the data on previous variables. Improving self-report behavior can sometimes be attributed to social desirability bias, but performance is assessed by impartial evaluation and is independent of self-report behavior bias. Performance is the actual behavior of individuals, which, in a chain process, first enhances the knowledge of individuals and then has the potential to improve their attitude and behavior. Changes in people's behavior can be seen in their observed performance. The results of this study indicated that although there is need for more comprehensive studies to cover the shortcomings of this study, the educational intervention improved the performance of the target groups, and there is much scope for practitioners to support professional drivers such as urban taxi drivers in anger management and safe driving.

#### **4.1. Limitations**

This study has some limitations. First, COVID-19 pandemic conditions and time and operational constraints, meant that driving performance was only investigated in follow-up 1. A second limitation was that all participants were male. To generalize to all nations, a future study should include female taxi drivers to ensure there is no sex difference. In Iran, along with several other countries, professional driving is seen as a masculine job and in line with social and cultural mores, women do not enter this profession and thus were not included in our recruitment. Similarly, this study was conducted only in two southern cities of Iran, so generalizing the results of the study to diverse cultural environments should be done with caution. We acknowledge the use of self-report tools may be associated with some bias. To mitigate for this participants were provided with full account of the study in advance. We also note that evaluation of long-term results in the PRECEDE–PROCEED model is based on indicators of health status and quality of life such as mortality rate, disease rate, and disability rate in the target population. However, due to the relatively short duration of this study, such long-term effects of the educational intervention could not be investigated. On the other hand, even in the limited follow-up times used in this study, the changes in enabling factors were not positive or stable enough, which indicates the need to design longer interventions, as well as the availability of facilities and resources for access in future studies. During this

study, and the current situation, obtaining strong incentives from organizations to persuade and encourage people and provide available resources was difficult and we also acknowledge that this is a limitation.

## **5. Conclusion**

The present study investigated the effectiveness of traditional and online educational interventions on anger management and driving performance of urban taxi drivers based on the PRECEDE–PROCEED model. The results indicated that both traditional and online education interventions were effective in improving knowledge, enabling factors, reinforcing factors, and driving performance. In the traditional intervention group, relative stability was observed in driving anger and self-reported driving behavior, and relatively less in attitude. In the online educational group these variables were not stable. In general, the retention effects of instructions were greater in the traditional educational group than the online educational group. The reason for this difference can be attributed to factors such as lack of face-to-face communication, lack of emotions expressed in the teacher's tone and behavior, lack of non-verbal communication and body language, lack of immediate feedback from learners, and lack of opportunity to challenge the instructional content, affecting the retention of online group educational. Improving knowledge is a prerequisite for changing attitudes, and consequently changing behavior and performance. Furthermore, changing attitudes is a long and difficult process as attitudes are rooted in people's beliefs and values. For this reason, the stability of educational and improving the stability of attitude can bring better behavior and performance in people and these results are likely to be more stable in the long run. Following the findings of the present study, it is suggested future studies be performed at a time other than during the COVID-19 pandemic and participatory education be used in traditional educational sessions. Besides, in online education, software and interactive capabilities of online media should be used and efforts should be made to provide a space for the exchange of emotions and interactive communication to improve the effect of educational programs. Accordingly, future studies can be performed in longer timeframes to explore the retention effects of educational intervention programs.

## References

- Abdu, R., Shinar, D., & Meiran, N. (2012). Situational (state) anger and driving. *Transportation Research Part F: Traffic Psychology and Behaviour*, 15(5), 575-580.  
<https://doi.org/10.1016/j.trf.2012.05.007>
- Alavi, S. S., Mohammadi, M., Soori, H., Kalhori, S. M., Sepasi, N., Khodakarami, R., Farshchi, M., Hasibi, N., Rostami, S., Razi, H., & Babareisi, M. (2016). Iranian Version of Manchester Driving Behavior Questionnaire (MDBQ): Psychometric Properties. *Iranian Journal of Psychiatry*, 11(1), 37-42. PMID:27252767; PMCID: PMC4888139.
- Arbaugh, J. B., & Duray, R. (2002). Technological and Structural Characteristics, Student Learning and Satisfaction with Web-Based Courses. *Management Learning*, 33(3), 331-347.  
<https://doi.org/10.1177/1350507602333003>
- Arvin, R., Kamrani, M., Khattak, A.J. (2019). The role of pre-crash driving instability in contributing to crash intensity using naturalistic driving data. *Accident Analysis & Prevention*, 132, 105226.  
<https://doi.org/10.1016/j.aap.2019.07.002>
- Ashoogh, M., Aghamolaei, T., Ghanbarnejad, A., Tajvar, A. (2013). Utilizing the theory of planned behavior to Prediction the safety driving behaviors in truck drivers in Bandar Abbas 1392. *Iranian Journal of Health Behavior and Health Promotion*, 1(3), 5-14.  
URL: <http://journal.ihepsa.ir/article-1-56-en.html>
- Barbaz, A., & Zareiyan, A. (2012). Comparison of three instructional methods for drug calculation skill in nursing critical care courses: lecturing, problem solving, and computer-assisted self-learning. *Iranian Journal of Medical Education*, 12(6), 420-429. URL: <http://ijme.mui.ac.ir/article-1-1798-en.html>
- Barkhordarzadeh, S., Choobineh, A., Razeghi, M., Cousins, R., & Mokarami, H. (2022). Effects of an ergonomic intervention program based on the PRECEDE–PROCEED model for reducing work-related health problems and exposure risks among emergency medical dispatchers. *International*

*Archives of Occupational and Environmental Health*, 95, 11389–11399.

<https://doi.org/10.1007/s000420-033-01846-8>

Bates, L., Evenhuis, A., & Lennon, A. (2020). Effectiveness of a pre-licensing driver education program on five psycho-social factors over twelve months. *Accident Analysis & Prevention*, 148, 105806.

<https://doi.org/10.1016/j.aap.2020.105806>

Batool, Z. (2012). *Attitudes towards road safety and aberrant behaviour of drivers in Pakistan*. (Doctoral dissertation, University of Leeds).

Beaton, D. E., Bombardier, C., Guillemin, F., & Ferraz, M. B. (2000). Guidelines for the process of cross-cultural adaptation of self-report measures. *Spine*, 25(24), 3186-3191.

Beratarrechea, A., Lee, A. G., Willner, J. M., Jahangir, E., Ciapponi, A., & Rubinstein, A. (2014). The impact of mobile health interventions on chronic disease outcomes in developing countries: a systematic review. *Telemedicine and e-Health*, 20(1), 75-82.

<https://doi.org/10.1089/tmj.2012.0328>

Berlin, H., Coughenour, C., Pharr, J., Bungum, T. J., Manlove, H., & Shan, G. (2021). The impact of an educational intervention on distracted driving knowledge, attitudes, and behaviors among college students. *Journal of Community Health*, 46(6), 1236-1243. [https://doi.org/10.1007/s10900-021-](https://doi.org/10.1007/s10900-021-01014-y)

[01014-y](https://doi.org/10.1007/s10900-021-01014-y)

Casutt, G., Theill, N., Martin, M., Keller, M., & Jäncke, L. (2014). The drive-wise project: driving simulator training increases real driving performance in healthy older drivers. *Frontiers in Aging Neuroscience*, 6, 85. <https://doi.org/10.3389/fnagi.2014.00085>

Covolo, L., Ceretti, E., Moneda, M., Castaldi, S., & Gelatti, U. (2017). Does evidence support the use of mobile phone apps as a driver for promoting healthy lifestyles from a public health perspective? A systematic review of Randomized Control Trials. *Patient Education and Counseling*, 100(12),

2231-2243. <https://doi.org/10.1016/j.pec.2017.07.032>

- Cutello, C. A., Gummerum, M., Hanoch, Y., & Hellier, E. (2020). Evaluating an intervention to reduce risky driving behaviors: Taking the fear out of virtual reality. *Risk Analysis*, *41*(9), 1662-1673.  
<https://doi.org/10.1111/risa.13643>
- Dahlen, E. R., & Ragan, K. M. (2004). Validation of the propensity for angry driving scale. *Journal of safety research*, *35*(5), 557-563. <https://doi.org/10.1016/j.jsr.2004.09.002>
- de Craen, S., Vlakveld, W. P. (2013). Young drivers who obtained their licence after an intensive driving course report more incidents than drivers with a traditional driver education. *Accident Analysis & Prevention*, *58*, 64-69. <https://doi.org/10.1016/j.aap.2013.03.037>
- Deffenbacher, J. L. (2016). A review of interventions for the reduction of driving anger. *Transportation Research Part F: Traffic Psychology and Behaviour*, *42*, 411-421.  
<https://doi.org/10.1016/j.trf.2015.10.024>
- Deffenbacher, J. L., Filetti, L. B., Lynch, R. S., Dahlen, E. R., Oetting, E. R. (2002). Cognitive-behavioral treatment of high anger drivers. *Behavior Research and Therapy*, *40*(8), 895-910.  
[https://doi.org/10.1016/s0005-7967\(01\)00067-5](https://doi.org/10.1016/s0005-7967(01)00067-5)
- Deffenbacher, J. L., Lynch, R. S., Oetting, E. R., & Swaim, R. C. (2002). The Driving Anger Expression Inventory: A measure of how people express their anger on the road. *Behaviour research and therapy*, *40*(6), 717-737. [https://doi.org/10.1016/s0005-7967\(01\)00063-8](https://doi.org/10.1016/s0005-7967(01)00063-8)
- Deffenbacher, J. L., Lynch, R. S., Oetting, E. R., & Yingling, D. A. (2001). Driving anger: Correlates and a test of state-trait theory. *Personality and Individual Differences*, *31*(8), 1321-1331.  
[https://doi.org/s0191-8869\(00\)00226-9](https://doi.org/s0191-8869(00)00226-9)
- Deng, W., & Hu, J. (2013). The effects of a pilot intervention for community-dwelling adults with rheumatoid arthritis in Wuhan, China. *Frontiers in Public Health*, *1*, 43.  
<https://doi.org/10.3389/fpubh.2013.00043>
- Dent, J. & Ramani, S. (2017). Learning with patients: inpatient and outpatient. In, J. Dent, R. M. Harden, & D. Hunt, (Eds.) A practical guide for medical teachers, 5<sup>th</sup> Edition. Elsevier Health Sciences. IBSN 9780702068911

Ebadi, A., Taghizadeh, Z., Montazeri, A., Shahvari, Z., Tavousi, M., & Bagherzadeh, R. (2017).

Translation, development and psychometric properties of health related measures-Part 2: construct validity, reliability and responsiveness. *Payesh*, 16(4), 445-455.

URL: <http://payeshjournal.ir/article-1-93-en.html>

Feng, Z., Zhan, J., Ma, C., Lei, Y., Liu, J., Zhang, W., Wang, K. (2018). Is cognitive intervention or

forgiveness intervention more effective for the reduction of driving anger in Chinese bus drivers?

*Transportation Research Part F: Traffic Psychology and Behaviour*, 55, 101-113.

<https://doi.org/10.1016/j.trf.2018.02.039>

Fernandes, R., Hatfield, J., & Job, R. J. F. (2006). Examination of different predictors of different risky

driving behaviours in young NSW drivers. *Final Report for the Motor Accidents Authority of NSW (2006, July)*. Available at:

<http://www.irmrc.unsw.edu.au/documents/predictors%20of%20risky%20driving%20report.pdf>

Galovski, T. E., Blanchard, E. B., Malta, L. S., Freidenberg, B. M. (2003). The psychophysiology of

aggressive drivers: Comparison to non-aggressive drivers and pre-to post-treatment change

following a cognitive-behavioural treatment. *Behaviour Research and Therapy*, 41(9), 1055-1067.

[https://doi.org/10.1016/s005-7967\(02\)00242-5](https://doi.org/10.1016/s005-7967(02)00242-5)

Green, L. W. & Kreuter, M. W. (2005). Health program planning: An educational and ecological approach.

McGraw-Hill Education. ISBN 9780072556834

Guevarra, J. P., Peden, A. E., & Franklin, R. C. (2021). Application of the PRECEDE–PROCEED model

in the development of evidence-informed interventions for drowning prevention: a mixed-methods

study protocol. *BMJ open*, 11(7), e050688. <https://doi.org/10.1136/bmjopen-2021-050688>

Gunn, V., & House, S. (2007). Approaches to small group learning and teaching. *learning and Teaching*

*Centre University of Glasgow*.

Hassen, A., Godesso, A., Abebe, L., & Girma, E. (2011). Risky driving behaviors for road traffic accident

among drivers in Mekele city, Northern Ethiopia. *BMC Research Notes*, 4(1), 535.

<https://doi.org.10.1186/1756-0500-4-535>

- Haustein, S., Holgaard, R., Åbele, L., Andersen, S. K., Møller, M. J. (2021). A cognitive-behavioural intervention to reduce driving anger: Evaluation based on a mixed-method approach. *Accident Analysis & Prevention*, *156*, 106144. <https://doi.org/10.1016/j.aap.2021.106144>
- Hill, L., Rybar, J., Jahns, J., Lozano, T., & Baird, S. (2020). 'Just Drive': An Employee-Based Intervention to Reduce Distracted Driving. *Journal of Community Health*, *45*(2), 370-376. <https://doi.org/10.1007/s10900-019-00752-4>
- Hon, C. K., Chan, A. P., & Yam, M. C. (2014). Relationships between safety climate and safety performance of building repair, maintenance, minor alteration, and addition (RMAA) works. *Safety Science*, *65*, 10-19. <https://doi.org/10.1016/j.ssci.2013.12.012>
- Hosseini, S. A., Kavosi, A., Sanagoo, A., Jouybari, L., & Mohammadi, G. (2017). The effect of anger management training on student's adaptability, Golestan University of Medical Sciences. *Pajouhan Scientific Journal*, *16*(1), 10-18. <https://doi.org/10.18869/acadpub.psj.16.1.10>
- Jeon, M., Yim, J.-B., & Walker, B. N. (2011). An angry driver is not the same as a fearful driver: Effects of specific negative emotions on risk perception, driving performance, and workload. *Proceedings of the 3rd International Conference on Automotive User Interfaces and Interactive Vehicular Applications*. <https://doi.org/10.1145/2381416.2381438>
- Jones, V., Gielen, A., Bailey, M., Rebok, G., Agness, C., Soderstrom, C., Abendschoen-Milani, J., Liebno, A., Gaines, J., Parrish, J. (2012). The effect of a low and high resource intervention on older drivers' knowledge, behaviors and risky driving. *Accident Analysis & Prevention*, *49*, 486-492. <https://doi.org/10.1016/j.aap.2012.03.021>
- Kazemeini, T., Ghanbari-e-Hashem-Abadi, B., & Safarzadeh, A. (2013). Mindfulness based cognitive group therapy vs cognitive behavioral group therapy as a treatment for driving anger and aggression in Iranian taxi drivers. *Psychology*, *4*(08), 638-644. <https://doi.org/10.4236/psych.2013.48091>

- Kearns, L. E., Shoaf, J. R., & Summey, M. B. (2004). Performance and satisfaction of second-degree BSN students in web-based and traditional course delivery environments. *Journal of Nursing Education*, 43(6), 280-284. <https://doi.org/10.3928/01484834-20040601-07>
- Khandelwal, K., & Upadhyay, A. K. (2021). Virtual reality interventions in developing and managing human resources. *Human Resource Development International*, 24(2), 219-233. <https://doi.org/10.1080/13678868.2019.1569920>
- Kosuge, R., Okamura, K., Nakano, Y., Fujita, G. (2021). Effect of educational intervention addressing inaccurate self-assessment of driving performance in older Japanese adults. *Accident Analysis & Prevention*, 163, 106460. <https://doi.org/10.1016/j.aap.2021.106460>
- Kuhn, P. R. (2019). *A Case Study on the Differences in Scores of Undergraduate Students in Traditional, Online, and Hybrid Classes*. University of Arkansas. ProQuest Dissertations Publishing. 27670037.
- Lanning, B. A., Melton, K., Abel, N. (2018). The impact of a supplemental drivers' education program on teenage risk perception and driving behaviors. *Transportation Research Part F: Traffic Psychology and Behaviour*, 58, 442-451. <https://doi.org/10.1016/j.trf.2018.06.019>
- Lavallière, M., Simoneau, M., Tremblay, M., Laurendeau, D., & Teasdale, N. (2012). Active training and driving-specific feedback improve older drivers' visual search prior to lane changes. *BMC Geriatrics*, 12(1), 5. <https://doi.org/10.1186/1471-2318-12-5>
- Lee, W. W., & Owens, D. L. (2004). *Multimedia-based instructional design: computer-based training, web-based training, distance broadcast training, performance-based solutions*. John Wiley & Sons. ISBN 9780787970697
- Li, Q., Tay, R. (2014). Improving drivers' knowledge of road rules using digital games. *Accident Analysis & Prevention*, 65, 8-10. <https://doi.org/10.1016/j.aap.2013.12.003>
- Li, S., Zhang, T., Zhang, W., Liu, N., & Lyu, G. (2020). Effects of speech-based intervention with positive comments on reduction of driver's anger state and perceived workload, and improvement of

driving performance. *Applied Ergonomics*, 86, 103098.

<https://doi.org/10.1016/j.apergo.2020.103098>

Love, S., Kannis-Dymand, L., Davey, J., & Freeman, J. (2022). Metacognition, rumination and road rage: An examination of driver anger progression and expression in Australia. *Transportation research part F: traffic psychology and behaviour*, 84, 21-32.

<https://doi.org/https://doi.org/10.1016/j.trf.2021.11.015>

Lu, J., Xie, X., & Zhang, R. (2013). Focusing on appraisals: How and why anger and fear influence driving risk perception. *Journal of Safety Research*, 45, 65-73. <https://doi.org/10.1016/j.jsr.2013.01.009>

McLinton, S. S., & Dollard, M. F. (2010). Work stress and driving anger in Japan. *Accident Analysis & Prevention*, 42(1), 174-181. <https://doi.org/10.1016/j.aap.2009.07.016>

Mesken, J., Hagenzieker, M. P., Rothengatter, T., & de Waard, D. (2007). Frequency, determinants, and consequences of different drivers' emotions: An on-the-road study using self-reports,(observed) behaviour, and physiology. *Transportation research part F: Traffic Psychology and Behaviour*, 10(6), 458-475. <https://doi.org/10.1016/j.trf.2007.05.001>

Mohammadi, F., & Hosseini, M., Matbouei, M., & Sefidkar, R. (2018). The effect of educational inter components of PRECEDE model in hypertension patients. *Medical Science*, 22(92), 390-396. EISSN 2321-7367

Mokarami, H., Alizadeh, S. S., Pordanjani, T. R., Varmazyar, S. (2019). The relationship between organizational safety culture and unsafe behaviors, and accidents among public transport bus drivers using structural equation modeling. *Transportation research part F: Traffic Psychology and Behaviour*, 65, 46-55. <https://doi.org/10.1016/j.trf.2019.07.008>

Moslem, S., Gul, M., Farooq, D., Celik, E., Ghorbanzadeh, O., & Blaschke, T. (2020). An integrated approach of best-worst method (BWM) and triangular fuzzy sets for evaluating driver behavior factors related to road safety. *Mathematics*, 8(3), 414. <https://doi.org/10.3390/math8030414>

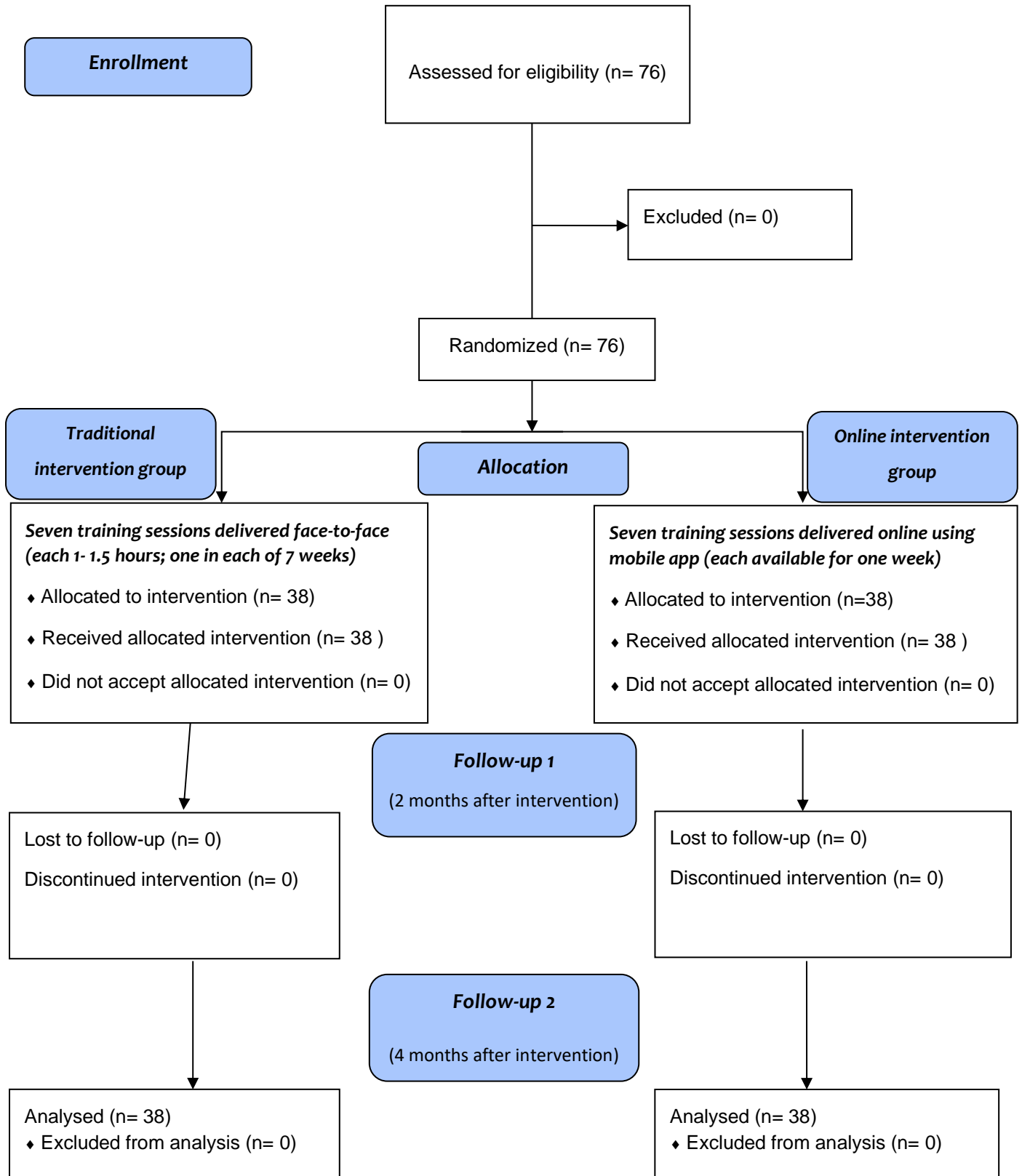
- Nævestad, T-O. Hesjevoli, I. E., & Phillips, R. O. (2018). How can we improve safety culture in transport organizations? A review of interventions, effects and influencing factors. *Transportation Research Part F: Traffic Psychology and Behaviour*, 54, 28-46. <https://doi.org/10.1016/j.trf.2018.01.002>
- Parkinson, B. (2001). Anger on and off the road. *British Journal of Psychology*, 92(3), 507-526. <https://doi.org/10.1348/000712601162310>
- Pourhaji, F., Delshad, M. H., Tavafian, S. S., Niknami, S., & Pourhaji, F. (2020). Effects of educational program based on Precede-Proceed model in promoting low back pain behaviors (EPPLBP) in health care workers Shahid Beheshti University of medical sciences: randomized trial. *Heliyon*, 6(10), e05236. <https://doi.org/10.1016/j.heliyon.2020.e05236>
- Qu, W., Dai, M., Zhao, W., Zhang, K., & Ge, Y. (2016). Expressing Anger Is More Dangerous than Feeling Angry when Driving. *PloS one*, 11(6), e0156948. <https://doi.org/10.1371/journal.pone.0156948>
- Rajabi, F., Mokarami, H., Cousins, R., Jahangiri, M. (2020). Structural equation modeling of safety performance based on personality traits, job and organizational-related factors. *International Journal of Occupational Safety and Ergonomics*, 28(1), 644-658. <https://doi.org/10.1080/10803548.2020.1814566>
- Rajabi, F., Mokarami, H., Cousins, R., Jahangiri, M. J. I. j. o. o. s., & ergonomics. (2020). Structural equation modeling of safety performance based on personality traits, job and organizational-related factors. 1-15.
- Rastgarimehr, B., Afkari, M. E., Solhi, M., Taghdisi, M. H., Mansourian, M., Shafieyan, Z., Qorbani, M., Asayesh, H., & Jafaraliloo, H. (2014). Relationship between the educational stage of PRECEDE model and quality of life improvement in the elderly affiliated with Tehran culture house for the aged. *Iranian Journal of Diabetes and Metabolism*, 13(6), 469-478.
- Risser, R. (1985). Behavior in traffic conflict situations. *Accident Analysis & Prevention*, 17(2), 179-197. [https://doi.org/10.1016/0001-4575\(85\)90020-x](https://doi.org/10.1016/0001-4575(85)90020-x)

- Sarrab, M., Alzahrani, A., Alwan, N. A., Alfarraj, O. (2014). From traditional learning into mobile learning in education at the university level: undergraduate students perspective. *International Journal of Mobile Learning and Organisation*, 8(3-4), 167-186. <https://doi.org/10.1504/ijmlo.2014.067014>
- Sekhvat, Y., Alizadeh, F., & Roohi, S. (2021). Traffic-Sim: Investigating the effect of attending intelligent virtual instructor on the efficacy of learning traffic rules. *Technology of Education Journal*, 15(2), 239-248.
- Senserrick, T., & Haworth, N. (2005). *Review of literature regarding national and international young driver training, licensing and regulatory systems*. (No. 239).
- Shen, B., Qu, W., Ge, Y., Sun, X., & Zhang, K. (2018). The relationship between personalities and self-report positive driving behavior in a Chinese sample. *PloS ONE*, 13(1), e0190746. <https://doi.org/10.1371/journal.pone.0190746>
- Shokohiyekta, M., Akbari Zardkhaneh, S., Mahmoudi, M. (2015). Effectiveness of psychosocial skills training on driver's aggression and anger. *Psychological Methods and Models*, 6(21), 23-40. <https://www.sid.ir/en/journal/ViewPaper.aspx?ID=658915>
- Siero, S., Boon, M., Kok, G., & Siero, F. (1989). Modification of driving behavior in a large transport organization: A field experiment. *Journal of Applied Psychology*, 74(3), 417-423. <https://doi.org/10.1037/0021-9010.74.3.417>
- Solhi, M., Azar, F. E. F., Abolghasemi, J., Maheri, M., Irandoost, S. F., Khalili, S. (2020). The effect of educational intervention on health-promoting lifestyle: Intervention mapping approach. *Journal of Education and Health Promotion*, 9, 196. [https://doi.org/10.4103/jehp.jehp\\_768\\_19](https://doi.org/10.4103/jehp.jehp_768_19)
- Solhi, M., Hamedan, M. S., & Salehi, M. (2016). A PRECEDE-PROCEED based educational intervention in quality of life of women-headed households in Iran. *Medical Journal of the Islamic Republic of Iran*, 30, 417.
- Spielberger, C. (1988). Professional manual for the State-Trait Anger Expression Inventory. Odessa FL. *Psychological Assessment Resources, Spielberger CD*.

- Spielberger, C. D., & Reheiser, E. C. (2010). The nature and measurement of anger. In *International handbook of anger* (pp. 403-412). Springer.
- Stephens, A. N., & Groeger, J. A. (2019). Driven by anger: The causes and consequences of anger during virtual journeys. In *Advances in traffic psychology* (pp. 3-16). CRC Press.
- Stephens, A. N., Trawley, S. L., Madigan, R., & Groeger, J. A. (2013). Drivers display anger-congruent attention to potential traffic hazards. *Applied Cognitive Psychology*, 27(2), 178-189.  
<https://doi.org/10.1002/acp.2894>
- Tahmasby, F., Zamani Alavijeh, F., Rostam niakan, S. H. & Asadolahi, A. (2015). Investigation of Influencing Factors of Taxi Drivers' Risky Behavior in Ahvaz in 2013. *Journal of Ilam University of Medical Science*, 22(6), 143-151. URL: <http://sjimu.medilam.ac.ir/article-1-1391-en.html>
- Taubman–Ben-Ari, O., Lotan, T., Prato, C. G. (2017). Young male drivers' risky driving 15 months after licensure–The role of intervention, attitudes towards accompanied driving, and parents' risk. *Transportation research part F: Traffic Psychology and Behaviour*, 51, 73-80.  
<https://doi.org/10.1016/j.trf.2017.09.005>
- Ulleberg, P., & Rundmo, T. (2003). Personality, attitudes and risk perception as predictors of risky driving behaviour among young drivers. *Safety Science*, 41(5), 427-443. [https://doi.org/10.1016/s0925-7535\(01\)00077-7](https://doi.org/10.1016/s0925-7535(01)00077-7)
- Wang, Y. C., Foss, R. D., O'Brien, N. P., Goodwin, A. H., & Harrell, S. (2020). Effects of an advanced driver training program on young traffic offenders' subsequent crash experience. *Safety Science*, 130, 104891. <https://doi.org/10.106/j.ssci.2020.104891>
- Whatnall, M., Patterson, A., & Hutchesson, M. (2019). A brief web-based nutrition intervention for young adult university students: Development and evaluation protocol using the precede-proceed model. 8(3), e11992. <https://doi.org/10.2196/11992>
- Young, K. L. & Salmon, P. M. (2012). Examining the relationship between driver distraction and driving errors: A discussion of theory, studies and methods. *Safety Science*, 50(4), 165-174.  
<https://doi.org/10.1016/j.ssci.2011.07.008>

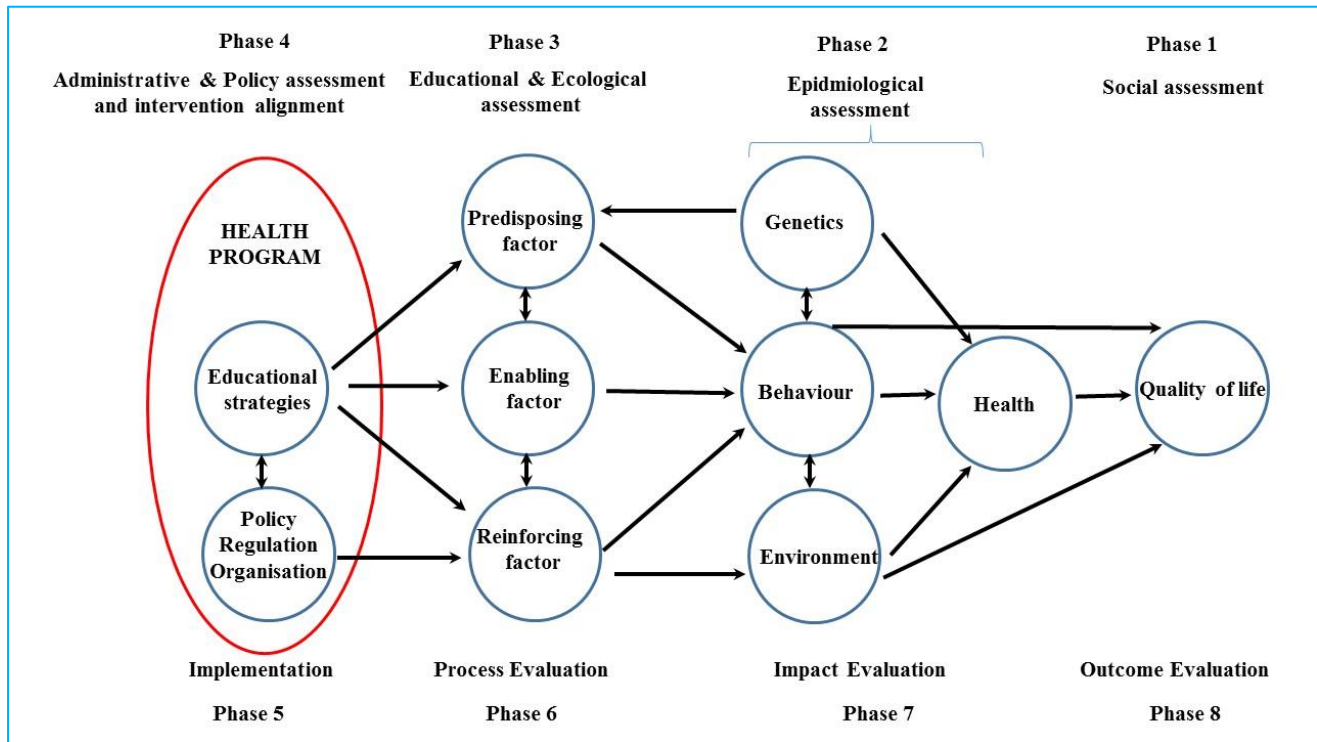
**Figure 1**

CONSORT diagram of the operational process of experiment



**Figure 2**

The PRECEDE-PROCEED model (adapted from Green and Kreuter (2005, p. 10))



**Table 1**

Content of the educational sessions

<b>Session</b>	<b>Focus</b>	<b>Duration</b>	<b>Content</b>	<b>Goals</b>	<b>Domains</b>
<b>1</b>	Effective communication	1-1.5 hours	Effective communication and how to establish it	Expressing the components of effective interpersonal communication	Predisposing, enabling, and reinforcing factors
<b>2</b>	Anger management	1-1.5 hours	The concept of anger and the factors inducing it	Introducing the concept of anger and anger management	Predisposing factors
<b>3</b>		1-1.5 hours	Anger assessment skills and selection of anger control strategies	Specifying the level of anger on a spectrum Anger management and control techniques	Predisposing, enabling, reinforcing factors, and behavior attitudes
<b>4</b>	Aggressive driving	1-1.5 hours	Aggressive driving and strategies to prevent it	Introducing aggressive driving and impulsive factors during driving	Predisposing, enabling, reinforcing factors, and behavior attitudes
<b>5</b>	Stress management	1-1.5 hours	Problem-solving methods, educational in breathing skills, relaxation, and visualization	Problem-solving skills and positivism Relaxation and breathing skills, bud lip breathing techniques	Attitudes and behavior
<b>6</b>	Driving behaviors	1-1.5 hours	Risky behaviors and their causes, safe driving behaviors	Introducing risky behaviors during driving, safe driving, and driving regulations	Predisposing, enabling, reinforcing factors, and behavior attitudes
<b>7</b>	Overview	1-1.5 hours	A review of the instructions provided in the previous sessions		

**Table 2**

Baseline characteristics of traditional (n = 38) and online intervention (n = 38) groups

Variables	Traditional		Online		<i>p</i> <sup>*</sup>	
	Frequency	Percent	Frequency	Percent		
<b>Marital status</b>	Single	8	21.1	8	21.1	.842
	Married	28	73.7	30	78.9	
	Others	2	5.2	31	81.6	
<b>Educational level</b>	Illiteracy	3	7.9	8	21.1	.268
	Elementary	7	18.4	20	52.6	
	Under diploma	13	34.3	10	26.3	
	Academic education	15	39.5	2	5.3	
<b>Smoking</b>	Yes	9	23.7	25	65.8	.329
	No	29	76.3	6	15.8	
<b>Drug abuse</b>	Yes	3	7.9	32	84.2	.588
	No	35	92.1	6	15.8	
<b>Poor Eyesight</b>	Yes	9	23.7	33	86.8	.237
	No	29	76.3	37	97.4	

\*Chi-square or Fisher's Exact Tests

**Table 3**

The mean scores of the research variables in the baseline, follow-up 1, and follow-up 2

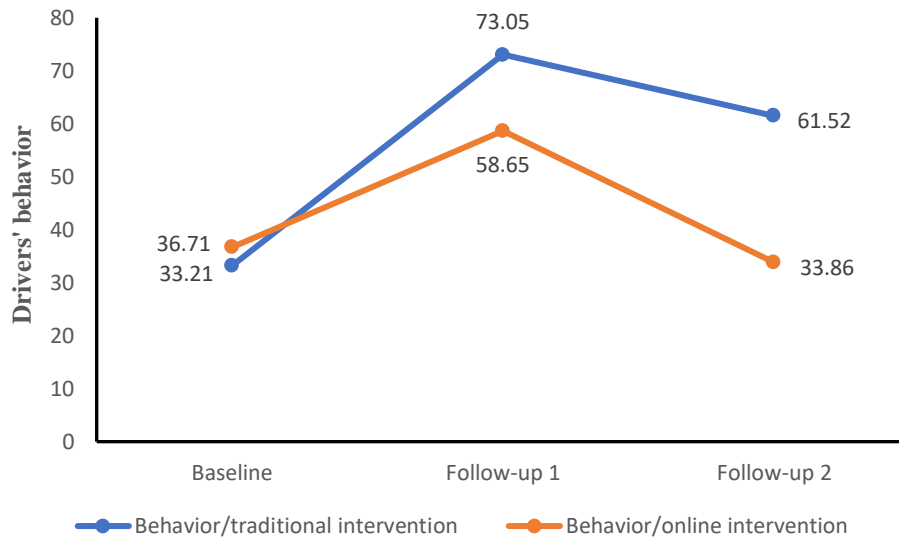
<b>Variables</b>	<b>Time of intervention</b>	<b>Intervention group</b>	<b>Mean</b>	<b>SD</b>	<b>F</b>	<b>t</b>	<b>p</b>	<b>Mean Difference</b>
<b>Knowledge</b>	Baseline	Traditional	4.50	1.39	1.51	2.43	.017	.71
		Online	5.21	1.14				
	Follow-up 1	Traditional	8.63	1.34	12.5	.106	.916	.02
		Online	8.60	.71				
	Follow-up 2	Traditional	8.55	1.38	5.05	.389	.698	.10
		Online	8.48	.921				
<b>Enable factors</b>	Baseline	Traditional	21.18	5.94	.21	3.21	.002	4.39
		Online	25.57	5.96				
	Follow-up 1	Traditional	29.02	4.02	.22	.79	.430	.68
		Online	29.71	3.47				
	Follow-up 2	Traditional	26.39	3.20	3.60	1.41	.161	1.28
		Online	27.68	4.60				
<b>Reinforcement factors</b>	Baseline	Traditional	28.47	8.14	.87	3.28	.002	6.21
		Online	34.68	8.33				
	Follow-up 1	Traditional	34.86	5.06	.09	6.58	< .001	7.18
		Online	42.05	4.42				
	Follow-up 2	Traditional	32.68	3.98	11.19	4.06	< .001	5.34
		Online	38.02	7.06				
<b>Attitude</b>	Baseline	Traditional	185.97	12.58	39.20	.443	.659	2.34
		Online	201.31	30.07				
	Follow-up 1	Traditional	215.97	16.58	4.11	3.68	< .001	18.05
		Online	224.02	25.24				
	Follow-up 2	Traditional	197.92	19.57	.853	1.05	.293	5.26
		Online	200.18	23.57				
<b>Behavior</b>	Baseline	Traditional	33.21	12.91	.084	1.21	.228	3.50
		Online	36.71	12.17				
	Follow-up 1	Traditional	73.05	9.24	2.81	5.52	< .001	14.39
		Online	58.65	13.14				

	Follow-up 2	Traditional	61.52	21.11	14.62	6.98	< .001	27.65
		Online	33.86	12.25				
<b>Anger</b>	Baseline	Traditional	40.65	6.26	1.96	1.07	.288	1.473
		Online	42.32	5.71				
	Follow-up 1	Traditional	26.92	8.16	1.74	.71	.477	1.23
		Online	27.67	6.85				
	Follow-up 2	Traditional	28.00	8.79	.04	5.16	< .001	10.60
		Online	38.72	9.09				
<b>Performance</b>	Baseline	Traditional	27.71	9.09	1.63	3.27	.002	4.15
		Online	31.86	6.05				
	Follow-up 1	Traditional	22.71	5.90	.080	2.58	.012	3.78
		Online	26.50	6.85				

Independent samples t-test

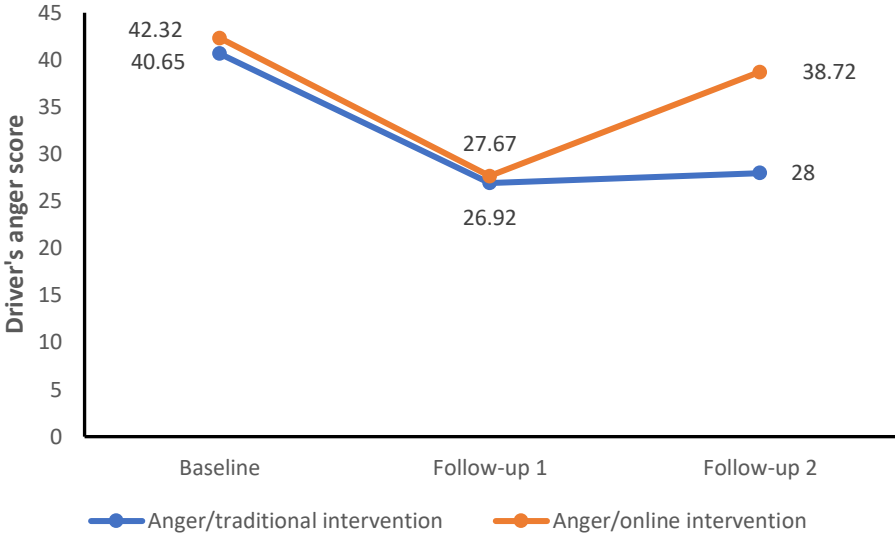
**Figure 3**

Comparison of mean score changes in self-reporting behavior between traditional and online intervention groups



**Figure 4**

Comparison of anger changes between traditional and online intervention groups



**Figure 5**

Comparison of mean performance changes between traditional and online intervention groups

