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Effectiveness of Educational Intervention on Improving Preventive Behaviors in Fireworks Injuries: Applying the Extended Parallel Process Model

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ABSTRACT

Aims Charshanbeh Suri is one of the most important Iranian ceremonies every year when many people are injured due to the use of explosives on the day. The present study aimed to investigate the effectiveness of the developed parallel process model in injury prevention in students.

Materials & Methods This experimental study was conducted in 2020-21 with 240 male students in Sanandaj who were randomly and equally divided into experimental and control groups. The intervention consisted of two 90-minute training sessions in the form of lectures, questions, and answers, group discussions, and screenings of related videos. The researcher-made questionnaire based on the model constructs of the developed parallel process, the validity, and reliability of which were confirmed, was used before the intervention and two months after the intervention. Data were analyzed by independent t-test and logistic regression analysis using SPSS 16 software.

Findings The mean age of students was 15.82±1.05 years. There was no significant difference in fireworks behavior between the two groups before the intervention, and 88% of the students used explosives during the Charshanbeh Suri ceremony. The results of the logistic regression test before the intervention showed that the perceived threat predicted the non-use of incendiary materials. The effectiveness of the educational intervention caused the students in the experimental group to be in the path of risk control, and the use of incendiary substances after the intervention in the experimental group was significantly reduced ($p<0.001$).

Conclusions Education with the content of sensitization and fear and efficiency is an appropriate educational intervention in reducing Charshanbeh Suri events in adolescents.

Keywords Explosives; Students; Extended Parallel Process Model; Charshanbeh Suri

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Introduction

Fireworks are commonly celebrated on cultural and national holidays, including independence day in the United States, Divali in India, new year in China and Italy, the birth of the Prophet in Libya, and the last Wednesday of the year in Iran since the early 1970s. The date of Charshanbeh Suri in Iran dates back to 1725 BC. This ancient Iranian festival is held at the end of the solar year (the last Tuesday night of the year). The traditions have evolved gradually, but fireworks have always been a part of the celebration. In recent years, fireworks have become increasingly common among young people using illegal devices or homemade explosive material [1]. Every year, many people are seriously injured through exposure to fireworks. These injuries may lead to permanent disability such as amputation or blindness and other long-term problems in a person's life and impose exorbitant costs on the individual and society [2]. Even though incendiary substances can cause severe mental and physical harm, these materials are used to express joy in celebrations; as a result, firecracker injuries have become a national problem in various countries [3].

The high rate of use of incendiary substances in the celebration of Charshanbeh Suri (especially handmade incendiary substances) leads to an increase in people's injuries. According to the United States Annual Report (CPSC), the estimated rate of fireworks-related, emergency department-treated injuries was 9100 individuals in 2018 [4]. Out of 3285 incidents related to the Charshanbeh Suri celebration in 2017, the highest rate was in the cities of Qazvin and Kurdistan [5].

The researcher reported that people between the ages of 19 and 10 were at the highest risk of fire injuries, with 6.4 injuries per 1,000 people in Tehran in 2006, and the male gender was identified as a risk factor for fire injury behaviors [6]. The study results in Iran have shown that the most injuries are in men as in other countries, and most pedestrians and passers-by are affected by these injuries [7].

Since most of the dangerous events are related to behavioral factors, some interventions about correcting high-risk behaviors can be effective in this regard. Based on the health change studies, risk perception is a key concept [8-10]. Studies have shown that risk perception has a strong predictive effect in preventing events and accidents [11]. (Parallel Process Model-EPPM Extended developed in 1992 by Kim Witte [12] is one of the models that have been used in recent years to provide health messages, disease prevention, and high-risk behaviors. In this model, there are two main elements to understand risk: evaluation of fear or threat and evaluation of adaptation. Threat assessment is determined by perceived severity and perceived vulnerability. Efficiency is also a combination of perceived self-efficacy and response efficiency. According to this model, people follow one of the two paths of the risk control process and the fear control process in response to health messages. If both perceived threat content and perceived efficiency are high in a message, people follow the path of risk control to react to the threat with sufficient knowledge and use solutions to eliminate the threat. People, who receive the message with a high threat rate and low efficiency, accept the process of controlling fear, and fear of danger acts as a deterrent to adopting protective behavior (Figure 1) [12].

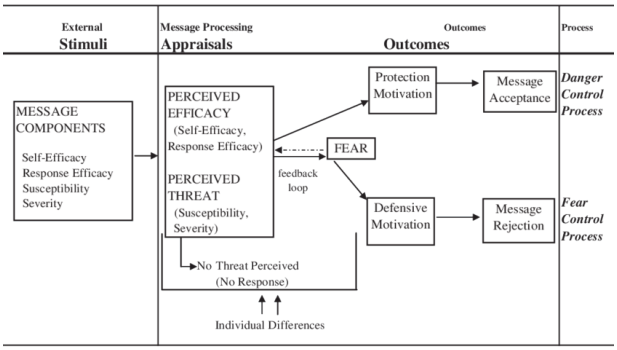

Figure 1) Extended Parallel Process Model

Due to the high rate of injuries on Charshanbeh Suri in adolescent boys [12-15], the present study aimed to investigate the effectiveness of the developed parallel process model in detecting risky behavior (no use of incendiary substances) in this group of society.

Materials & Methods

This experimental study was carried out between 240 male students from February 2019 to April 2020 in Sanandaj City, Iran. The sample size of the study was estimated at 120 people for each experimental and control group using the formula of comparing the average of two independent groups with a maximum error of the first type of 5%, the study power of 90%, and considering the statistical decline of 10%, [16]. The study groups were selected by drawing lots among the names of secondary schools in the second district of Sanandaj city (n=11). In this

way, one high school was selected as the experimental and one high school as the control group. Students were also randomly selected using random numbers table (Figure 2). According to the health record, male students who were in high school and had acceptable mental health were included in the study. Individuals who filled out more than 10% of the questionnaire incompletely were excluded from the study.

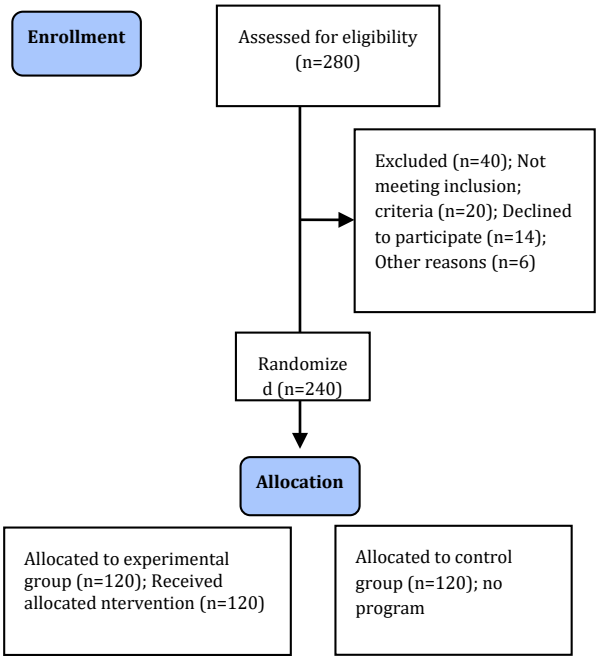

Figure 2) Flow chart of study participants in the control and experimental group

The data collection tool was a researcher-made questionnaire designed based on the estended parallel process model constructs [12]. The content validity of the tool was performed using the opinions of 8 experts in the field of health and health promotion, and the necessary corrections were applied (CVI=0.91, CVR=0.85). Also, before starting the main process, the questionnaire was filled out by the participation of 25 students as a pilot duration of 10 days. Finally Cronbach's alpha retest was confirmed for each construct (perceived sensitivity=0.90, perceived intensity=0.90, perceived efficiency=0.92, perceived self-efficacy=0.92). In addition to demographic questions, the questionnaire consisted of model constructs (by 5 Likert scale arranged in the options of strongly agree=5 to strongly disagree=0). The constructs were: perceived sensitivity (e.g., if I use incendiary substances, I am at risk of burns), perceived severity (e.g., burns from incendiary materials can be fatal), response efficiency (e.g., the skill of saying no is a factor in preventing accidents caused by incendiary substances), self-efficacy (for example, I do not use incendiary substances, even if my friends insist). Also, the behavior was asked through a question about the use of incendiary substances. In order to evaluate the perceived threat, the sum of perceived sensitivity and perceived severity scores and the sum of perceived response efficiency and perceived self-efficacy were used. Also, to determine which process of risk control or fear control students are in, the difference between perceived threat score and perceived efficiency was used. If the score is positive, it indicates the risk control path, and the negative number indicates the fear control path [12]. Before the intervention, the pre-test was completed in both experimental and control groups, and the content of the intervention was designed according to the data analysis and predictability of the perceived threat structure and the placement of students in the fear control path. For this purpose, in the designed messages and increasing the perceived threat, increasing the efficiency of the perceived response and self-efficacy in the students were considered by the researchers to change the path of fear control to risk control.

This study was approved by the Ethics Committee of the Vice Chancellor for Research of Kurdistan University of Medical Sciences. The intervention program started in the first week of February. The intervention was carried out in schools, and the interval between the first and second sessions was one day. Table 1 consisted of two training sessions in the form of lectures, questions, and answers, group discussions, and screenings of related films. In the first question and answer session, students' perceived sensitivity and intensity were generally assessed, and the discussions by students were used to design a message tailored to the perceived threat (For example, the issue of non-acceptance by friends and the skill of saying no were among the issues that were considered).

Three text messages were designed one week after the training sessions and were sent to parents or students' mobile phones as a reminder. Finally, post-test questionnaires were filled out by students in both groups in April 2020. Data were analyzed by SPSS 16 software using independent T and logistic regression tests.

Table 1) Details content of "prevention of Fireworks injuries" module in the experimental group (Educational Time=90min)

Sessions	Objectives	A summary of topics and activities
1	Improving the knowledge of Statistics accidents caused by explosives at a Charshanbeh Suri and improving perceived threat	- Showing movies about Fireworks injuries among teenagers. - Group discussion on the effects of Fireworks injuries on human life - Distribution of educational pamphlets
2	Improving perceived self-efficacy and response efficiency to reduce firework behavior	- Group discussion about barriers and the role of peers - Teaching about problem-solving skills for overcoming obstacles (skills of saying no) - Modeling - Role-play - Verbal encouragement

Findings

The mean age of 240 participants was 15.82±1.05 years. 88% of students used explosives during the Charshanbeh Suri. 63% of their fathers and 46% of their mothers had intermediate education. 54% of the fathers were unemployed, and 81.5% of the mothers were housewives. There was no significant difference between the two groups regarding demographic variables (p<0.05; Table 2).

Table 2) Comparison of frequency of demographic variables between experimental and control groups

Characteristics	Experimental groups N (%)	Control groups N (%)	p-value
Father's education			
illiterate	15 (12.5)	16 (13.3)	0.492
Primary school	7 (5.83)	5 (4.1)	
Middle school	65 (54.2)	61 (50.8)	
High school	18 (15)	19 (15.9)	
Academic	15 (12.5)	19 (15.9)	
Mother's education			
illiterate	21 (17.5)	22 (18.3)	0.811
Primary school	15 (12.5)	22 (18.3)	
Middle school	50 (41.7)	42 (35)	
High school	13 (10.8)	12 (10)	
Academic	21 (17.5)	22 (18.3)	
Father's job			
Employee	29 (24.2)	24 (20)	0.863
Unemployed	55 (45.8)	53 (44.2)	
Other	36 (30)	43 (35.8)	
Mother's job			
Housekeeper	94 (78.3)	99 (82.5)	0.251
Employee	26 (31.2)	21 (17.5)	

The logistic regression analysis results showed that among the constructs of the developed parallel process model, the threat perceived as an independent variable predicted the non-use of incendiary substances (dependent variable) in students (Table 3).

Table 3) Results of logistic regression analysis of extended parallel process model constructs

Constructs	β	Exp	Confidence interval 95%		p-value
			Upper	Lower	
Perceived threat	0.307	1.359	1.669	1.107	0.001
Perceived efficacy	0.124	0.856	1.216	0.644	0.600

There was a significant difference between the scores of the developed parallel process model constructs and behavior in the experimental group after the intervention, except for the perceived response efficiency construct (p<0.05; Table 4).

Table 4) Comparison of mean±SE scores in the experimental and control groups before and after intervention

Constructs	Before the intervention	After the intervention	p-value
Perceived susceptibility			
Experimental group	11.81±4.46	20.40±5.56	0.001
Control group	14.70±4.55	16.30±4.70	0.160
p-value	0.630	<0.001	-
t-value	0.54	44.50	-
Perceived Severity			
Experimental group	13.46±6.84	24.23±7.58	0.001
Control group	17.15±5.76	18.45±7.06	0.230
p-value	0.630	<0.001	-
t-value	3.48	13.76	-
Perceived threat			
Experimental group	25.27±10.73	44.67±11.96	0.001
Control group	31.84±10.18	34.44±10.08	0.190
p-value	0.860	<0.001	-
t-value	24.56	52.23	-
Response efficacy			
Experimental group	13.02±5.07	18.52±6.03	0.001
Control group	16.48±4.64	15.16±4.78	0.190
p-value	0.060	0.480	-
t-value	2.15	9.88	-
Self-efficacy			
Experimental group	12.36±4.36	19.37±5.90	0.001
Control group	15.46±4.06	16.11±5.84	0.170
t-value	0.140	0.020	-
t-value	0.690	0.490	-
Perceived efficacy			
Experimental group	2.30±0.48	8.06±1.51	0.001
Control group	2.75±0.80	3.99±0.90	0.160
p-value	0.900	<0.001	-
t-value	24.6	52.3	-
Behavior			
Experimental group	1.08±0.25	1.71±0.42	0.001
Control group	1.18±0.35	1.30±0.42	0.210
p-value	0.060	<0.001	-
t-value	-1.95	-5.32	-

Before the educational intervention, students in both the experimental and control groups were on the path of fear control; but after the

intervention, the experimental group entered the risk control path, and the control group remained in the fear control path (Table 5).

Table 5) Comparison of individuals in danger control and fear control process before and after intervention

Intervention	Danger control process	Fear control process	p-value
Before			
Experimental group	46 (19.0%)	194 (81.0%)	0.210
Control group	40 (16.5%)	200 (83.5%)	
After			
Experimental group	140 (58.3)	100 (41.0%)	0.001
Control group	54 (22.5%)	186 (77.5%)	

Discussion

This study aimed to investigate the application of an extended parallel process model in reducing incendiary material accidents during Charshanbeh Suri. According to the findings of this study, the perceived threat was one of the important predictors of behavior that was similar to the study of Hajian *et al.* [17]. Also, in the study of Happiness *et al*., The higher perceived risk was associated with less risky behavior during the fireworks festival [18].

Increasing the score of the extended parallel process model constructs after the intervention in the experimental group and subsequently reducing the use of explosives indicated the effectiveness of the intervention in reducing the risk behavior of using explosives in the Charshanbeh Suri. This result was similar to the findings of the intervention studies [19, 20], which show the effectiveness of using an extended parallel process model in reducing high-risk exposure. However, in this regard, the role of simultaneous interventions of other organizations (education, firefighting, radio, etc.) is ineffective. Every year, various organizations and institutions educate the community due to the high sensitivity and importance of events of Charshanbeh Suri, which often lead to irreversible adverse consequences (burns and amputations). In the study of Homay Rad *et al*. [21] in a study implemented a campaign to prevent Charshanbeh Suri incidents in Gilan and the number of injuries decreased in their target group, which was adolescents and young people. However, in our study, the final result was the use of incendiary substances, not the damage caused by them.

Despite the findings of this study, in the study of Naseripour *et al*. [22], to increase the perceived risk among the students by the distribution of educational videos in compact discs and color brochures containing educational messages, an educational intervention was not effective. There was no difference in the use of incendiary substances and the resulting injuries in the two groups, which may be due to the short duration of the intervention.

In this study, most students in both groups were in the process of controlling fear. However, after the intervention, 59% of the students in the experimental group entered the risk control path. The study of Ebrahimipour *et al*. Also showed that students were in the process of risk control process due to the complications of hookah use [23]. Therefore, to prepare health messages for people in the process of risk control, attention should also be paid to increasing perceived effectiveness and emphasizing the harmful effects. Most of the students were playing fireworks with their friends at the Charshanbeh Suri ceremony, which indicates the person's sense of belonging to the same age group [24]. Therefore, peer pressure and rejection by friends have special importance in a particular age group that should be considered [25, 26].

In this study, the educational strategy using an educational video to increase the perceived threat made the intervention more effective. In other words, the behavior of people changes through watching the videos of people injured in Charshanbeh Suri events or receive educational content with messages containing high fears and high efficiency; there are likely to be changed in their risk behavior, which has also been mentioned in the study of pilgrims [17]. Also, the high perceived self-efficacy of students was another effective factor in reducing the use of explosives by students; in the study of Ebrahimpour *et al*., the high self-efficacy score of students caused them not to use hookah [23].

Different countries have rules that respect the production (including quantity and type of explosives) of fireworks and their use by consumers. Countries that enforce restricting fireworks rules have significantly lower rates of firework injuries [27]. The approval of the rules and their implementation can be a useful solution in line with the theory of fear by punishing improvised explosive devices. However, certain laws include the import, production, and use of explosives; but these laws may not be fully implemented like in other countries [28, 29].

Data collecting by self-reporting method and the impossibility of observing behavior were the main limitations of this study. Therefore, it is suggested that in future studies, the experiences of victims should be used. A qualitative study of people's views regarding law enforcement and their awareness should be considered by researchers. The role of parents and their close supervision in these celebrations should also be examined.

Conclusion

Theory-based education with fear motivation content with high efficiency, using the developed parallel process model, is a suitable educational intervention in reducing Charshanbeh Suri injuries in adolescents. It is recommended that this model be studied in different groups of society.

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Conflicts of Interests: There is no conflict of interest.

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