

***The Effect of Thermal Care Workshop on EMS Staff Readiness in Managing Accidental Hypothermia in Trauma Patients***

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**Abstract**

**Background:** Hypothermia is a common complication in trauma patients. Studies show that the management of hypothermia in trauma patients in the pre-hospital phase may be underestimated.

**Objectives:** The purpose of this study was to evaluate the effect of thermal care workshop on the staff readiness to manage hypothermia in trauma patients.

**Methods:** This quasi-experimental study utilized convenience sampling after obtaining the approval of the Research Ethics Committee and involved 60 qualified EMS staff who were divided into two groups including: intervention group (30 technicians) and control group (30 technicians). The intervention group received the treatment in the form of a workshop. Nonetheless, the control group did not receive any educational intervention. The data were collected before, immediately after and 45 days after the workshop to determine EMS staff readiness using a validated researcher-made questionnaire. In this study, the significance level was 0.5.

**Results:** There was a significant difference between the posttest results of the control group and the intervention group ( $p < 0.001$ ). Moreover, in the intervention group, there were significant differences between the pretest results and the two posttest results ( $p < 0.001$ ). Finally, the readiness gained after the workshop lasted for 45 days.

**Conclusion:** The thermal care workshop enhanced the readiness of emergency medical personnel. The generalization of the results of this study is restricted due to the fact that random selection and random assignment of participants were not possible in the present study. It is recommended that more robust studies be designed to evaluate, prevent and manage hypothermia in trauma patients in the pre-hospital phase.

**Keywords:** *accidental hypothermia, emergency medical services (EMS), emergency medical technicians (EMT), readiness, trauma care, workshop*

**Introduction**

Hypothermia is common in trauma patients [1-5]. In the United States, the prevalence of trauma-induced hypothermia has been reported to be between five to 47 percent [6]. Moreover, it has been reported that two-third of the patients with severe trauma suffer hypothermia [7]. All patients

in the pre-hospital phase can suffer hypothermia due to illness or injury. About 1.500 people die from primary hypothermia each year [8]. There are not any exact statistics on the prevalence of accidental hypothermia in trauma patients in Iran. Hypothermia refers to a central temperature below 35 degrees Centigrade [9]. In trauma patients,

accidental hypothermia refers to a drop in central body temperature below 36 degrees Centigrade and is categorized as: mild (34-36°C), moderate (32-34°C), and severe (below 32°C) [7,10,11]. Hypothermia can be caused by trauma, infection or other diseases. Hypothermia in trauma can be caused by exposure to the environment or the reduction of the thermoregulatory responses of the body. Moreover, it can occur during resuscitation in emergency situations [12]. Accidental hypothermia in emergency situations can occur in people who are out for work or leisure activities, the homeless people, natural disasters, or in war situations. This type of hypothermia also occurs in any season or weather condition, including tropical or subtropical regions [12,13].

Accidental hypothermia is a serious threat to pre-hospital patients, and especially injured patients, since it can create a vicious cycle of hypothermia, acidosis and coagulation disorders known as lethal triad [13-15]. The main cause of accidental hypothermia in injured patients is heat loss due to exposure to the environment, administration of cold intravenous fluids, hemorrhagic shock, and the effects of anesthetic or sedative drugs on body thermoregulation [16]. In the pre-hospital phase, the hypothermia risk factors in trauma patients include Revised Trauma Score (RTS), ambulance cabin temperature, intravenous fluids temperature, and wet clothes [17].

Trauma patients usually suffer hypothermia before they arrive at hospital. Hypothermia can worsen the patient's consciousness and increase mortality even when it is moderate [18,19]. Therefore, early diagnosis of hypothermia is necessary [20]. In order to reduce the rate of trauma-related deaths and to minimize its associated complications and disabilities, it is necessary to properly organize the care and treatment of these injured patients. This arrangement begins with pre-hospital care and will lead to rehabilitation centers [21]. It is important for the care team to have a deep understanding of hypothermia, including its risk factors, complications, prevention and treatment [22].

In order to prevent and manage the severe condition of the hypothermic patient, treatment should be initiated at the pre-hospital phase [13]. Treatment strategies focus on prevention of heat loss, fluid resuscitation, and implementation of

appropriate warming techniques and management of cardiac dysrhythmias [23]. Weaknesses in the assessment of patient's body temperature and limited staff knowledge of the management of patients with hypothermia have been identified in several studies [22,24,25]. Recording temperature in trauma patients is an essential requirement to help the physician make informed decisions to manage hypothermia and to evaluate the effectiveness of the rewarming method. Observations have shown that the recording of the temperature of trauma patients is disregarded in the emergency department. The results of a survey regarding the evaluation of the knowledge of the staff about accidental hypothermia in trauma patients showed that nurses and physicians were not certain about the definition of hypothermia and lacked the skills needed to prevent heat loss or rewarm the patient's body using simple methods [26]. The ability of service providers to identify risk factors and adopt appropriate interventions to prevent hypothermia is critical [27].

The emergency medical system is one of the main elements of service delivery in all of the countries of the world. The most important goal of this system is to provide services in the shortest possible time, in accordance with the latest evidence in literature and to reduce patient mortality. The responsibility of pre-hospital emergency technicians is becoming more sophisticated and complex every day and working in this field requires more knowledge and skills [28]. Emergency medical technicians' readiness for the trauma patient's temperature care is crucial due to the fact that they are at the forefront of dealing with trauma patients. There is evidence which shows the deficiencies in the knowledge and performance of the trauma patient care team in the prevention, evaluation, and effective management of accidental hypothermia. This issue highlights the urgent need to adopt measures to empower this team, including physicians, nurses, and pre-hospital service staff, in the form of in-service interventions and workshops. Most of the studies have been conducted in hospital sections including emergency departments, operating rooms and intensive care units and have involved physicians and nursing staff. There are not any studies which have focused on the empowerment of the Emergency Medical

Services (EMS) staff in the pre-hospital phase in Iran. The purpose of this study was to determine the effect of thermal care workshop on the readiness of EMS staff to manage accidental hypothermia in trauma patients.

### Methods

The present study was a quasi-experimental study which was conducted based on a pretest-posttest design. The participants of this study were 60 EMS staff who worked in the urban and road emergency centers of Zanjan province. After obtaining the approval of the Research Ethics Committee and the sampling licenses, 60 qualified EMS staff were selected by convenience sampling method and were divided into two groups including: intervention group (N=30) and control group (N=30). The intervention group received the treatment in the form of a workshop. Nonetheless, the control group did not receive any instructional intervention. The data were collected before, immediately after, and 45 days after the workshop to determine EMS staff readiness. The research tool was a researcher-made questionnaire whose content validity was evaluated and approved by nine experts in the field of emergency medicine and trauma care. The reliability of this questionnaire was examined using a test-retest method. To this end, 30 emergency medical staff members who were not among the selected participants of the study completed the questionnaire twice within a ten-day period. Spearman's rho correlation coefficient between the two test sessions showed a complete correlation ( $r=0.925$  &  $p<0.001$ ).

This instrument was developed by a review of various texts and articles in the field of trauma and the management of trauma and hypothermic patients. It had two sections. The first section was related to demographic and occupational characteristics (marital status, age, level of education, type of degree, work experience, work hours per month, and workplace) of emergency medical staff. The second part of this instrument involved 30 multiple-choice items about different areas of hypothermia management in trauma patients (definitions, types and levels of hypothermia, trauma patients' evaluation, instruments and methods for measuring central body temperature, risk factors and methods of preventing hypothermia, and types and methods

of rewarming the patient's body). In the control group, the researcher collected the pretest data at the emergency center during a one-week period. In the intervention group, the researcher administered the questionnaire to the participants and collected the pretest data in one session. After that, a one-day thermal care workshop was held for this group at the provincial emergency medical center. In this one-day workshop, an emergency medicine specialist, an associate professor of critical care nursing, and a master's student in emergency nursing delivered educational content in the form of a workshop in four two-hour sessions. The control group did not receive the intervention. The first posttest was administered to the intervention group immediately after the relevant workshop. Moreover, the second posttest was given to this group after 45 days in order to examine its members' long-term learning. The posttest was also administered to the control group at their workplace within a week after their pretest session. The research team undertook to conduct a thermal care workshop for the control group after the completion of the study. The data were analyzed by means of descriptive statistics (absolute and relative frequency, mean, and standard deviation) and inferential statistics (Mann-Whitney U, Wilcoxon and Friedman tests). SPSS 16 was utilized for data analysis. Finally, in this study, the significance level was 0.05.

### Results

The data which were collected based on the 60 (30 in the intervention group and 30 in the control group) EMS staff completed questionnaires were analyzed. Table 1 provides the demographic characteristics of emergency medical staff at urban and road emergency centers.

The between-group analysis of demographic characteristics revealed that the mean and standard deviation of age and work experience in the control group were higher than the intervention group. Moreover, Mann-Whitney U test showed that this difference was statistically significant. However, there was not a significant difference between the monthly work hours of the intervention group and the control group. The results of Chi-square test showed a significant difference between the qualitative variables of

these groups (marital status, educational level, type of degree, and workplace). These results are

shown in Table1.

**Table 1: Distribution of Demographic Characteristics of Emergency Medical Staff**

Demographic characteristics		Control		Intervention		P value
		Mean	SD	Mean	SD	
Age (years)		36.37	8.16	31.37	7.84	*0.011
Monthly work hours (hours)		236.97	33.73	228.53	29.37	*0.306
Experience (years)		12.03	7.35	7.27	6.71	*0.019
		n	percent	n	percent	
Marital status	Single	2	6.7	12	40	**<0.001
	Married	28	93.3	18	60	
Level of education	Diploma	1	3.3	1	3.3	**<0.001
	Associate degree	15	50	21	70	
	Bachelor's degree	14	46.7	6	20	
	Other	-	-	2	6.7	
Type of degree	Medical Emergency	15	50	24	80	**<0.001
	Relief and Rescue	5	16.7	-	-	
	Nursing	10	33.3	6	20	
Workplace	Urban Center	23	76.7	11	36.7	**<0.001
	Road Center	6	20.1	13	43.3	
	Other	1	3.3	6	20	

\*Mann-Whitney U test

\*\*Chi square test

The results of the Kolmogorov-Smirnov test showed that the data were not normally distributed. Consequently, non-parametric statistical tests were utilized to examine the difference between the mean values of the relevant groups and the mean values of each of the groups on the relevant test sessions.

Mean and standard deviation of pretest readiness scores were 16.13+/-4.61 and 18.33+/-2.45 respectively. Mann-Whitney U test did not show the significance of this difference. On the other hand, the difference between the mean readiness score of the first posttest of the intervention group 22.37+/-1.88 and the control group 15.77+/-4.449 was significant ( $p<0.001$ ) (Table 2).

**Table 2: Between-Group Comparison of the Mean and Standard Deviation of the Readiness Scores of the Intervention and Control Group**

Tests	Intervention		Control		P value
	Mean	SD	Mean	SD	Mann-Whitney U test
Pretest	18.33	2.45	16.13	4.61	0.095
Posttest 1	22.37	1.88	15.77	4.49	<0.001
Posttest 2	22.53	1.65	-	-	-

The within-group analysis of the difference between the pretest scores 16.13+/-4.61 and posttest scores 15.77+/-4.449 of the control group by means of Wilcoxon test did not show a significant difference ( $p=0.088$ ). Nonetheless, the results of the Friedman test showed that the mean and the standard deviation differences between

the pretest readiness scores of the intervention group 18.33+/-2.45 and its first posttest 22.37+/-1.88 and second posttest 22.53+/-1.65 were significant ( $p<0.001$ ). Moreover, the readiness which was gained after the workshop was maintained for 45 days (Table 3).

**Table 3: Within-Group Comparison of the Mean and Standard Deviation of the Readiness Scores of the Intervention Group and Control Group**

Groups		Pretest	Posttest 1	Posttest 2	P value
Intervention	Mean	18.33	22.37	22.53	0.001
	SD	2.45	1.88	1.65	Friedman test
Control	Mean	16.13	15.77	-	0.088
	SD	4.61	4.49	-	Wilcoxon test

## Discussion

The analysis of the findings of the present study showed that holding a thermal care workshop significantly increased the readiness of the EMS staff in the intervention group in comparison with the control group. Moreover, the analysis of differences between the EMS staff' readiness scores within the groups indicated the improvement of the scores of intervention group before and after the workshop. The intervention group members' readiness continued for 45 days after the workshop.

Haske et al. (2014) argued that training programs were effective in enhancing the performance of the trauma care team. In their study, the knowledge and skills of this team were also evaluated after one year, and the pretest and posttest results confirmed the improvement of the team members' knowledge and skills [29]. Although the findings of the study by Haske et al. (2014) mainly focused on empowering the trauma care team to care for trauma patients, they are in line with the results of the present study. In the study by Haske et al. (2014), in addition to emergency medical staff, emergency physicians took part in the study. In addition to knowledge and skills, the interaction and communication of the team were also explored. It utilized a questionnaire to evaluate the staff members. Other similar studies whose results corroborate the findings of the present study have often been conducted in hospital sections such as emergency departments, operating rooms and intensive care units, and have involved physicians and nursing staff. Mendoza et al. (2012) examined the impact of instruction on the improvement of surgical nurses' knowledge of thermal care. In this study, the mean value of the nurses' knowledge was significantly different after instructional intervention [30]. Saxe-Rockoff et al. (2018) completed an evidence-based project on the improvement of the trauma patients' temperature

regulation and reported that the implementation of an evidence-based instructional intervention improved the emergency nurses' performance in regard to patient thermal care [24]. Other studies have often focused on the inadequacy of the knowledge and performance of physicians, nurses, and the other people who are involved in trauma patient care and have emphasized the need to take effective measures to improve staff information and skills for the optimal management of hypothermia in these patients. The study by Ireland et al. (2006) showed that nurses and physicians were not sure about the definition of hypothermia and simple strategies for warming the patient's body. Moreover, they were unaware of the important consequences of hypothermia, such as coagulopathy and metabolic acidosis. These researchers highlighted the importance of staff training and the need for access to guidelines for recording central body temperature as well as managing body temperature in trauma patients [26].

The findings of the study by Giuliano et al. (2017) also showed that continuous interventions to increase awareness and to promote practical methods for the prevention and control of accidental hypothermia are absolutely essential [25]. Hegarty et al. (2009) examined the nurses' awareness of the prevention of accidental hypothermia in the operating room and reported that less than half of nurses routinely monitored patients' body temperature. Nurses provided very different definitions of hypothermia and normothermia and reported several risk factors. These researchers also emphasized the need for educational interventions and the adoption of practical guidelines in the clinical field [22].

The literature in the field of trauma care shows that most of the medical staff members do not provide the same definition of hypothermia and the strategies for warming the trauma patient's body. Recording patients' vital signs, especially

their central body temperature, is a primary requirement which is often overlooked. Available evidence suggests that there is a lack of awareness and a poor performance among the care team members in the pre-hospital and hospital phases in regard to the management of hypothermia in trauma patients.

The between-group analysis of quantitative and qualitative demographic variables of emergency medical personnel revealed that the groups were significantly different in terms of the distribution of some variables. The reason behind these differences was the lack of a suitable control group in the study, which is also reported as the major limitation of the study. Notwithstanding, the improvement of the readiness score of the intervention group in the first posttest and the second posttest can be attributed to the intervention effect due to the fact that both of the groups took the pretest and the result of the between-group analysis of pretest scores was not significant.

One of the important limitations of the study was the inability to select an appropriate control group. The problems of work shift coordination and workplace dispersal of the study participants (urban and road centers) and the inability to assemble the participants for a workshop prevented the use of random sampling in the first step and the random assignment of the participants to the intervention group and the control group in the following step. Therefore, the generalization of the results of the study to similar groups has some limitations. It is recommended that future studies use random sampling to select the participants and randomly assign the participants to the groups of the study. Similar studies may also provide more accurate results using observational tools and methods in the pre-hospital and hospital phases. Conducting a thermal care workshop significantly enhanced EMS staff readiness to manage accidental hypothermia in trauma patients. The application of new instructional methods enhances the readiness of emergency staff to deal with hypothermia in trauma patients in the short term. This kind of readiness can continue for a long time. The findings of this study and other similar studies emphasize in-service training courses in the form of job-related workshops which were not provided for the individuals during college.

Although hypothermia management (especially in trauma patients) is extensively discussed in the emergency literature, it is still neglected by the pre-hospital and even hospital care team. In addition to readiness, proper care in this area depends on the identification and proper control of other effective factors in the development of hypothermia. Providing and equipping ambulance units with precise tools for detecting central body temperature and having intelligent heating systems in the ambulance cabin as well as basic facilities for warming the injured patient's body are among the things which should be furnished by the emergency managers and emergency units to provide optimal care.

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### Conflict of interest

The authors have no conflicts of interest.

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