

# The Role of Demographic Factors and Skills of Pre-hospital Staff in the Handling and Movement of Patients from Trauma Scenes to Emergency Wards

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## Abstract

**Background:** Handling, transferring, and handing off trauma patients impose risks on patients and transfer teams. Therefore, pre-hospital staffs require a high skill to perform these processes simultaneously in critical situations.

**Aim:** The present study was performed with aim to examine the role of demographic factors and skills of pre-hospital staff in the handling and movement of trauma patients to hospitals.

**Method:** This cross-sectional study was performed by the proportional stratified random sampling method on 151 pre-hospital emergency staff. For data collection, in addition to a demographic information questionnaire, the researcher completed a valid and reliable checklist based on 300 hours of direct observation for assessing staff skills. The data were analyzed by SPSS software (version 20) using descriptive and inferential statistics.  $p < 0.05$  was considered statistically significant.

**Results:** The mean score of staff skills was  $77.80 \pm 7.84$ . The lowest scores were related to the stage of "transfer to hospital" ( $72.04 \pm 8.41$ ) and the dimension of "using body mechanics" ( $67.57 \pm 10.42$ ). There was an inverse correlation between staff body mass index and the mean score of staff skills ( $r = -0.19$ ,  $p < 0.05$ ). Besides, the staff's skill mean score was correlated with patients' age ( $r = 0.18$ ) and weight ( $r = 0.16$ ) ( $p < 0.05$ ).

**Implications for Practice:** Retraining courses covering driving, managing pediatric patients, healthy diet and exercise, proper use of equipment, and body mechanics should be implemented for pre-hospital staff. Also, authorities should take measures to control infection and improve patient handoff.

**Keywords:** Emergency Responders, Patient Handoff, Patient Safety, Patient Transfer

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## Introduction

The pre-hospital emergency is at the forefront of the healthcare system (1) and is responsible for performing primary assessment and advanced medical measures on critically ill and injured patients, which is a potentially dangerous situation for patient safety (2). Every year, millions of people around the world suffer death or disability due to high-risk medical procedures (3,4). It is estimated that up to 50% of all injuries caused by high-risk medical procedures occur during the provision of primary and emergency care, and 2.5% of all healthcare costs are spent on these injuries (5). While up to 80% of injuries caused by safety incidents during the provision of primary and emergency care are preventable (3).

Trauma, the second cause of early death and the biggest cause of shorter active life expectancies in Iran (6), is increasing as the population grows, leading to increased demand for pre-hospital emergency services (7,8). Safe Handling and Movement (SHM) of patients from trauma scene to the ambulance, from the ambulance to the hospital, and then handoff to the emergency ward is important in patient safety and the link between pre-hospital and hospital care (1). The skill of personnel in SHM has five dimensions: "infection control," "using body mechanics," "communication and teamwork," "using appropriate equipment," and "treatment measures" (9). If the pre-hospital staff are not able to perform SHM on trauma patients in unstable emergency conditions, it can pose threats to the continuity of care and safety of patients and staff (e.g., occupational injuries such as musculoskeletal problems), leading to retirement and lack of human resources (8,10). Examining the skills of staff and its related factors can be useful in identifying deficiencies in their performance and providing appropriate solutions to promote their skills (6). However, most of the studies conducted in this field did not address the SHM of patients from the scene to the emergency department and its different dimensions, which is performed simultaneously by a pre-hospital team (8,11-16). Additionally, limited studies have addressed the factors associated with pre-hospital emergency personnel skills (2, 4, 6). Moreover, the results of most of the existing studies have been obtained by examining medical reports (1), self-report questionnaires (6), and simulation models (7, 11-13) in unrealistic conditions. Furthermore, literature review showed no study that assessed the skill levels of pre-hospital emergency personnel in the five dimensions of SHM of trauma patients in the three stages of transfer to ambulance, transfer to hospital, and handoff to the emergency ward. Therefore, considering the importance of pre-hospital care in sustaining human life and the high statistics of complications caused by trauma in Iran, the present study was conducted with aim to determine the skill level of pre-hospital workers in the different dimensions of SHM of trauma patients from the scene to the emergency departments and its related factors in Mashhad.

## Methods

This present cross-sectional study was conducted in 2022 on all pre-hospital operational staff in Mashhad. The sample size was calculated using the formula of previous study (17), where  $z$  and  $\alpha$  were 1.96 and 0.05, respectively. Furthermore, the standard deviation of the skill score ( $\sigma$ ) was considered 0.6 based on Jadgal et al.'s study (2021) (11), and the estimation accuracy ( $d$ ) was taken as 0.1. Considering a 10% attrition rate, the minimum sample size was estimated to be 151 subjects.

Taking into account the personnel's education level and their base location, by proportional stratified random sampling, 8 staff with diplomas, 52 with associate's degrees and 91 with bachelor's degrees in urban, suburban, and road bases were included in the study. The inclusion criteria were having at least six months of operational work experience in pre-hospital bases in Mashhad and completing informed consent forms. Operational staff in motor and air ambulances was excluded from the study.

The data collection tool was a demographic information questionnaire and a researcher-made checklist. Demographic information questionnaire has two parts, including seven items related to staff (age, body mass index, field of study, level of education, work experience, base location, and attending an educational program) and three items related to trauma patients transferred by personnel (age, weight, and injury mechanism). Checklist of Pre-hospital Staff Skills in SHM of Trauma Patients (PSSSTP) was designed by the researcher using books, articles, and guidelines. The tool is scored based on a 5-point Likert scale (from 0 for "non-implementation" to 4 for "completely correct implementation"). It contains 33 questions in five dimensions (e.g., five questions for "infection control", six questions for "communication and teamwork" and "using appropriate equipment" and eight questions for "using body mechanics" and "treatment measures").

To make a more accurate comparison, the staff skills score in each dimension and the mean of PSSSTP were normalized between 0 and 100 (0 being the smallest and 100 the highest value) and were classified as follows: “very poor” (below 60), “poor” (60–70), “average” (70–80), “favorable” (80–90) and “very favorable” (above 90). The face validity of the tool was checked by 10 pre-hospital workers, and the suggested modifications were made. The content validity of the PSSSTP was approved by 10 experts in the field of emergency after amendments. To examine the reliability of the checklist, the skills of 15 staff in SHM were evaluated by the first researcher using the internal consistency method. Cronbach’s alpha coefficient (acceptable score  $\geq 0.7$  (17)) of the PSSSTP was calculated as 0.90.

After obtaining permission from the ethics committee and receiving an introduction letter from Shahid Beheshti Nursing and Midwifery School, sampling permission was obtained from Mashhad University of Medical Sciences. After providing sufficient explanations regarding the research goals, voluntary participation, confidentiality of the data, and obtaining written consent, the first researcher started sampling in pre-hospital bases of Mashhad. To collect data, the first researcher attended the trauma missions assigned to each base as a complete observer and after completing the demographic information questionnaire of the staff and patients, checked the skills of the staff in the field of SHM of trauma patients according to the PSSSTP. Data collection, including 300 hours of direct observation, was conducted from July 24 to October 24, 2022.

Data was analyzed using SPSS software (version 20) and descriptive statistics (frequency and percentage) and inferential tests (analysis of variance, independent t-test, repeated measures analysis, and Pearson correlation). The normal distribution of quantitative variables was checked and confirmed by Kolmogorov-Smirnov test.  $P < 0.05$  was considered statistically significant.

### **Ethical Consideration**

This paper is a part of the master’s thesis approved by the Ethics Committee of Shahid Beheshti University of Medical Sciences (IR.SBMU.PHARMACY.1400.289). The sampling was done after providing explanations regarding voluntary participation, confidentiality of the data, and obtaining written consent.

### **Results**

A total of 151 pre-hospital staff included in this study that 100% were male. The PSSSTP mean score of the participants was  $77.80 \pm 7.84$ . The mean age of staff was  $33 \pm 7$  years and mean body mass index was  $25 \pm 3$  kg/m<sup>2</sup> with mean work experience of  $108 \pm 65$  months. The majority of the personnel had a bachelor’s degree (60.3%) in the field of emergency medical service (64.2%) and served in urban bases (0.57%), without any training related to SHM of trauma patients in the last year (62.9%).

The investigations performed on the demographic variables of 151 trauma patients transported by the staff participating in this research showed that the average age and weight were  $34 \pm 18$  years and  $67 \pm 21$  kg, respectively. The mechanism of injury for the majority of patients was an accident (43.7%).

The one-way analysis of variance test showed that there was no significant relationship between the PSSSTP mean score and some demographic variables of the patient (mechanism of injury), as well as staff’s level and field of education, base location, and having relevant education) ( $p > 0.05$ ) (Table 1). Furthermore, the Pearson correlation test indicated that the staff work experience ( $r = 0.07$ ,  $p = 0.36$ ) and also their age ( $r = 0.13$ ,  $p = 0.09$ ) were not correlated with the PSSSTP mean score. However, the significant correlation was found between the staff body mass index ( $r = -0.19$ ,  $p = 0.02$ ), patient’s age ( $r = 0.18$ ,  $p = 0.02$ ), and patient’s weight ( $r = 0.16$ ,  $p = 0.04$ ) with the PSSSTP mean score.

The highest SHM skill mean score of staff was related to the stage of “transfer to ambulance” (80.93). Also, the skill level of majority of staff was “favorable” (39.1%) at this stage (Table 2).

The skill level of the majority of staff was “poor” in the dimensions of “using appropriate equipment” and “using body mechanics”. In other dimensions, including “infection control,” “communication and teamwork,” and “treatment measures,” the staff’s skill levels were “average,” “favorable,” and “very favorable,” respectively (Table 3).

**Table 1: Frequency distribution and comparison of participants according to demographic variables and PSSSTP mean score**

Variable	Frequency (%)	PSSSTP (mean±SD)	P-value
<b>Relevant education</b>			
Have	56 (37.1)	78.87 ± 8.45	t = 1.28*
Do not have	95 (62.9)	77.17 ± 7.43	p = 0.203
<b>Study field</b>			
Emergency medical service	97 (64.2)	78.54 ± 6.97	f = 2.43**
Anesthesiology	34 (22.5)	75.21 ± 8.55	p = 0.091
Other	20 (13.3)	78.63 ± 9.86	
<b>Education level</b>			
Diploma	8 (5.3)	77.68 ± 7.67	f = 0.20**
Associate's degree	52 (34.4)	77.74 ± 7.68	p = 0.813
Bachelor's degree	91 (60.3)	79.53 ± 11.26	
<b>Base location</b>			
Urban	86 (0.57)	78.67 ± 7.62	f = 1.28**
Suburban	45 (29.8)	76.45 ± 7.43	p = 0.281
Road	20 (13.2)	77.09 ± 9.43	
<b>Injury mechanism</b>			
Accident	66 (43.7)	78.41 ± 7.20	f = 1.11**
Falling	52 (34.4)	78.37 ± 8.52	p = 0.344
Violence	19 (12.6)	76.30 ± 7.56	
Other	14 (9.3)	74.86 ± 8.34	

\*Independent t-test; \*\*One-way analysis of variance

**Table 2: Frequency distribution and comparison of participants according to levels of skill score in different stages of transfer**

Skill level, N (%)	Very poor	Poor	Average	Favorable	Very Favorable
Transfer to ambulance	1 (0.7)	16 (10.6)	50 (33.1)	59 (39.1)	25 (16.6)
Transfer to hospital	13 (8.6)	50 (33.1)	58 (38.4)	25 (16.6)	5 (3.3)
Patient handoff to emergency ward	1 (0.7)	14 (9.3)	56 (37.1)	58 (38.4)	22 (14.6)

**Table 3: Frequency distribution of participants according to levels of skill score in different dimensions of SHM**

Skill level, N(%)	Very poor	Poor	Average	Favorable	Very Favorable
Domain					
Infection control	0 (0)	5 (3.3)	62 (41.1)	61 (40.4)	23 (15.2)
Treatment measures	2 (1.3)	14 (9.3)	32 (21.2)	46 (30.5)	57 (37.7)
Appropriate equipment	10 (6.6)	50 (33.1)	48 (31.8)	33 (21.9)	10 (6.6)
Body mechanics	29 (19.2)	58 (38.4)	48 (31.8)	12 (7.9)	4 (2.6)
Communication & teamwork	3 (1.99)	15 (9.93)	52 (34.44)	58 (38.41)	23 (15.23)

In the dimensions of “infection control” and “treatment measures,” the highest and lowest staff skills scores were related to the stages of “transfer to ambulance” and “transfer to hospital,” respectively. The results of the Bonferroni post-hoc test indicated a significant difference between these three stages ( $p=0.001$ ). In addition, in the dimensions of “using appropriate equipment” and

“using body mechanics,” the highest and lowest staff skills scores were related to the stages of “patient handoff to emergency ward” and “transfer to hospital,” respectively. There was a significant difference between these three stages ( $p=0.001$ ). Moreover, in the dimension of “communication and teamwork,” the highest and lowest staff skills scores were related to the stages of “transfer to hospital” and “patient handoff to emergency ward,” respectively. A significant difference was observed between these three stages ( $p=0.001$ ) (Table 4).

**Table 4: Comparison of the mean score of staff's skill in different dimensions of SHM according to the stages of transfer**

Domain	Stage	Transfer to ambulance	Transfer to hospital	Patient handoff to emergency ward	P-value
Infection control		88.28±9.02	74.90±9.31	83.00±11.00	f = 30.15 P=0.001
Treatment measures		89.08±12.19	78.97±12.58	86.67±12.29	f = 48.94 p= 0.001
Appropriate equipment		74.83±13.54	67.32±13.42	79.37±12.22	f = 55.94 p= 0.001
Body mechanics		70.94±13.72	56.97±13.08	74.79±11.67	f = 22.15 p= 0.001
Communication & team work		81.51±11.07	82.04±11.83	78.36±10.78	f = 9.11 p= 0.001

## Discussion

The purpose of the present study was to examine the role of demographic factors and skills of pre-hospital staff in the handling and movement of trauma patients to hospitals. According to the results of this study, there was no significant relationship between the staff field and level of education and the PSSSTP mean score. In contrast to the present study, the results of Jadgal et al.'s study (2021) showed that staff with a bachelor's degree in emergency medical service were more skilled in stabilizing the spine in trauma victims (11). However, similar to the results of the present study, a systematic review showed that there is no significant relationship between the level of education and clinical skill in spinal stabilization (12). It seems that in Jadgal et al.'s study (2021), pre-hospital staff had better clinical skills than nurses due to the acquisition of practical training during their studies (11). However, the personnel with bachelor's degrees in the present study remembered skills better than others, probably because a shorter time had passed since their graduation. Therefore, it is necessary to pay special attention to the training of staff with diplomas and associate degrees.

According to the findings of the current research, no significant relationship was found between the PSSSTP mean score and the staff's base location. In contrast to this result, in some studies, the staff of road and urban bases had higher clinical skills in caring for trauma patients, respectively (11, 13). The results of the present study can be justified because of the periodic movement of staff between urban and road bases and the insignificant differences between these bases regarding the number of missions due to the insufficiency of the ambulance-to-population ratio in Mashhad (the second-largest city in Iran).

The results of the present study showed that the pre-hospital staff's age and work experience were not significantly correlated with the PSSSTP mean score. In line with the present study, other studies indicated no significant relationship between spinal stabilization skills and work experience (11, 12). Usually, with increasing age and work experience, staff should acquire more knowledge and skills through in-service training (18). Considering that the majority of staff in the present study had not received training regarding the SHM of trauma patients in the last year, this result can be justified.

In the present study, there was a significant inverse correlation between staff body mass index (BMI) and the PSSSTP mean score. Perhaps, staff with a higher BMI was less physically active, and thus their skill in SHM of patients was lower. Since this staff is prone to occupational injuries

such as knee and low back pain (8), the authorities should plan a healthy diet and exercise for them to achieve a proper BMI (9).

The findings of the current research showed no significant relationship between the PSSSTP mean score and the injury mechanism of the patients transferred by pre-hospital staff. However, the staff skills score in SHM for older and heavier patients was better. Since pediatric trauma patients are limited, the staff did not get enough practice and their skills were forgotten over time. Therefore, retraining courses in this field should be planned at specific intervals. Since most of the previous studies were conducted on mannequins and in simulated conditions, it was not possible to compare the results of patient variables.

In the current research, the majority of staff had a good level of skill in the stages of “transfer to ambulance” and “patient handoff to emergency ward”. However, 80.1% of staff had a skill level of “very poor” to “average” in the stage of “transfer to hospital” due to reasons such as not wearing the driver’s seat belt, talking on the mobile phone while driving, and not observing the speed limit (8, 9).

As the results of the present study showed, the skill level of the majority of the staff was poor in the dimensions of “using appropriate equipment” and “using body mechanics,” and average in “infection control.” Perhaps it was very difficult for staff to comply with body mechanics at the scene of the accident while providing emergency care. Furthermore, the insecurity and inaccessibility of accident locations, the presence of stairs instead of elevators, and non-standard passages led to the incorrect use of equipment for the safe transfer of trauma patients. The factors such as fatigue due to the workload and high number of missions, lack of proper access to trash cans in the patient’s cabin, and not having a special place for disinfecting the ambulance and equipment inhibited infection control (9).

The results of the current research indicated that the staff’s skill score was highest in the dimension of “treatment measures” in the stage of “transfer to ambulance” In consistency with this finding, Heydari et al. (2020) and Rahim-Khanli et al. (2019) reported that the emergency and pre-hospital nurses’ preparation to care for trauma patients was good (6, 13). Since the staff’s primary and critical treatment measures had a significant effect on patient survival (9), they paid more attention to this dimension.

In the current research, the skill level of staff in “communication and teamwork” is lower than other dimensions in the stage of “patient handoff to emergency ward.” It is probably due to the absence of medical assistants in emergency departments and the knowledge deficit regarding the responsibilities of in-hospital and pre-hospital staff during patient handoff, leading to confusion for both groups (10). Therefore, regarding the importance of improving handoff communication, it is suggested to hold training courses related to interprofessional communication and professional ethics (19).

Direct observation of skill of personnel in SHM of trauma patients can affect their actual performance. To reduce this limitation, the staffs were assured that the results of the research were completely confidential and did not affect their annual evaluation.

### **Implication for practice**

According to the results, driving, safe transfer of children clients, healthy diet and exercise, proper use of equipment, and body mechanic retraining courses should be provided in simulated and real conditions for pre-hospital staff. Also, staff skills for controlling infection should be promoted by increasing the number of staff, providing infection control equipment, establishing automatic ambulance disinfection systems (e.g., Nocospray), and managing hospital storage for equipment substitution. In addition, informing hospital and pre-hospital personnel regarding professional responsibilities is useful in improving patient handoff. It is suggested that a standard checklist be designed and used to evaluate the dimensions of personnel skills in different stages of the SHM of trauma patients.

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### **Conflicts of interest**

The authors declared no conflict of interest.

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None.

### **Authors' Contribution**

Ebrahim Ariamoghaddam: Conception and design, acquisition of data, analysis and interpretation of data. Mahbobeh Abdolrahimi: Conception and design, acquisition of data, analysis and interpretation of data. acquisition of data, drafting and revising the article. Maryam Jamesahar: analysis and interpretation of data, drafting and revising the article. Hamidreza Behnam Vashani: analysis and interpretation of data, drafting and revising the article. All authors contributed to the writing of the manuscript and discussed on the manuscript.

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