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Comparison of Two Guidelines for Road Traffic Crash Bystanders: A Randomized Controlled Simulation Study

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Abstract

Bystanders of road traffic crashes (RTC) can provide lifesaving first aid and assistance to injured individuals. Emergency medical dispatchers can guide these bystanders. This study aimed to investigate the effectiveness of guidelines for emergency medical dispatchers in instructing bystanders at road traffic crash scenes to administer first aid through a simulation.

The authors compared two sets of guidelines for emergency dispatchers to advice bystanders providing first aid for road traffic crashes (RTC) in an Iranian city. A “Step by Step Guideline” (SBSG) was considered standard, while a “Road Traffic Crash Bystander Guideline” (RTCBG) served as a more thoughtfully designed alternative. Two dispatchers with at least a year of experience received 3 hours of training on SBSG, and two other dispatchers were trained for 3 hours on RTCBG. Sixty-four non-medical voluntary subjects attempted to provide first aid in RTC simulations and were randomly assigned to be advised by dispatchers trained in either SBSG or RTCBG.

30 subjects were in the RTCBG group and 31 subjects in the SBSG group. In terms of the main outcome of the study, the total score of the participants in the RTCTBG group was significantly higher than that of the SBSG group (mean: 56.60 vs 44.06, P <0.001). In first aid, standard precautions (mean: 3.40 VS 1, P <0.001), airway protection (mean: 2.43 VS 1, Haines recovery position (mean: 2.57 VS 1, P <0.001), rapid evacuation (mean: 2.13 VS 1, P <0.001), splinting (mean: 3.10 VS 1, P <0.001), scene management (mean: 2.90 VS 1, P <0.001), movement (mean: 2.93 VS 2.58, P = 0.04), RTCTBG group scored higher than SBSG group (Table 2). There was a significant difference between the two groups in terms of the accuracy of performing airway protection, Haines recovery position, rapid evacuation, scene management, splinting, and standard precautions (P <0.001). The difference between the two groups was significant in terms of execution time (P <0.001).

The voluntary subjects assigned to a dispatcher trained with RTCBG performed better on average than those assigned to a dispatcher trained with SBSG. Participants guided by RTCBG demonstrated higher quality first aid compared to those guided by SBSG. RTCBG's guidance led to an improvement in the participants' quality score during the simulated traffic crash scene.

Keywords: Road traffic crashes, Bystander, Simulation, Emergency Medical Dispatch

Introduction

Worldwide, 1.35 million people die each year as a result of road traffic crashes (RTC) (1). In Iran, from 2006 to 2010, where were a total of 59,231 deaths and 69,523,346 years of potential life lost due to road traffic crashes (2). It was estimated that the economic costs of these events in 2011 was more than $ 4.44 billion in Iran (3). Most deaths from RTCs occur at the scene of the crash. Therefore, by providing timely and appropriate first aid to RTC victims, the probability of survival can be increased while mortality and morbidity can be reduced (4).

For trauma victims, the chain of survival has been defined; the first link includes action by RTC bystanders who can limit the amount of damage until the ambulance arrives. However, limited studies have been conducted in this regard (5). At the traffic crash scene, various reasons, such as the presence of strangers, social influence, pluralistic ignorance, self-safety, the victim's unstable condition, and lack of awareness, cause bystanders not to intervene and not to help the injured (6). Lack of awareness is one of the causes that prevent bystanders from helping the injured. Previous studies have reported that in most cases, bystanders have not received first aid training, and that training them can increase competence, response rate, and provide prompt and adequate first aid to the injured (7). Many fatalities in RTC result from airway obstruction, and bystanders can prevent death by performing simple airway maneuvers, such as the jaw thrust (8). Legally and medically, dispatchers of emergency medical dispatch centers (EMDCs) have to guide scene bystanders using the guidelines. In practice, there are challenges with guiding bystanders (9). Limited studies have been conducted on the subject of dispatch protocols and guidelines in road crash injury (10).

Dispatch guidelines have weaknesses that require significant changes and improvements, particularly in terms of simplification, comprehensiveness, and community acceptance. These guidelines are ineffective in practice, with low execution speed, and face challenges related to word choice and terminology. Modifying the guidelines can enhance dispatchers' ability to identify the first aid needed for injured individuals, as previous studies have shown improved efficiency and effectiveness (11, 12). Previous studies have also shown that dispatchers hardly follow algorithm-based guidelines, complicating the quality improvement and research processes for these guidelines (13). There is limited knowledge about the role and activities of bystanders and the type of first aid they provide at the RTC scenes, as well as the rate of usage, the evaluation results, and the validity of EMDC guidelines (4, 10, 13). This simulation study aims to investigate the impact of guidelines for EMDC dispatchers on guiding RTC scene bystanders in providing first aid. In Iran, the number of pre-hospital emergency medical services is 115, operated under the Ministry of Health and Medical Education. All phone calls are directly connected to the EMDCs.

Method

Study design

This study is part of a doctoral (PhD) dissertation conducted as a two-group, randomized, controlled, double-blind, prospective, simulation study. A common scenario was used to simulate a road crash scene with simulated injured cases and basic first aid equipment. The participants were randomly divided into intervention and control groups. They provided first aid for simulated injuries via telephone guidance by the EMDCs dispatchers in two groups: Step by Step Guideline (SBSG) and Road Traffic Crash Bystander Guideline (RTCBG). The study was initially conducted as a pilot test and took place from May to July 2020 in three urban areas of Mashhad City, Iran.

Study setting

Mashhad City is the second largest city in Iran and the capital of Khorasan Razavi province, with a population of 3,372,660 people (based on the 2016 census). Dispatchers are graduates of

nursing, midwifery, or emergency medical technician programs. They review emergency calls and dispatch ambulances as needed.

Participants and ethical considerations

A convenience sampling method was used to select the participants. The inclusion criteria were the participants' willingness to consent to participate in the study, being over 18 years of age, and having no history of first aid training. Participants were from different age groups. The exclusion criteria included failure to follow the dispatcher's guidelines and physical limitations of the participants and health care professionals. The participants did not know how to perform the simulation, and they were not aware that they belonged to the intervention or control group. First, oral consent was obtained from the participants, and then they completed and signed a written informed consent form, according to the rules of the Ethics Committee, School of Public Health, University of Medical Sciences, Tehran, Iran, with the ethics code IR.TUMS.SPH.REC.1398.101.

Dispatchers

Dispatchers record the caller's information and emergency status in the Asayar software. This software is native and has been installed and developed since 2017 in EMDs and ambulances in different cities of Iran. Four dispatchers (four women with a bachelor nursing) with work experience of more than one year were included in the study. Two dispatchers were placed in the SBSG group, and the other two were placed in the RTCBG group. First, two study guidelines were taught separately, theoretically (2 hours) and practically (1 hour) for each group. The theory session was a group discussion, and the dispatchers then practiced the implementation of the guide, so they could provide pre-arrival instructions correctly and based on the specific guidelines of each group. Dispatchers were unaware of the content of the other guideline.

Guidelines

Two guidelines, SBSG and RTCBG, were used in this study. The SBSG contains the latest (2018) version issued to the EMDCs by the Ministry of Health and Medical Education. In Iran, the SBSG is the current guideline in the real-world setting. It is in written form and includes basic questions, such as emergency address, patient consciousness, patient breathing, emergency status, and pre-arrival instructions. The RTCBG was designed based on a systematic review, along with a Delphi study and an expert panel. In scientific databases, available scientific evidence for bystanders' measures and first aid in RTC scenes was identified and then developed during three Delphi rounds and by an expert panel. Components of the RTCBG includes scene safety, universal precautions and personal protection, consciousness assessment, respiration, cardiopulmonary resuscitation (CPR), bleeding control, Haines recovery position, splinting, rapid evacuation, scene management, transfer, triage, spinal cord injury prevention and immobilization, movement of the injured, psychological support, prevention of hypothermia, water and food and protection of amputated limbs. In SBSG, pre-arrival instructions have one sentence, but in RTCBG, pre-arrival instructions have several sentences to give a complete explanation to guide the participant. In SBSG, it is recommended to perform a recovery position (including: make the patient one-sided), but in RTCBG, in several steps, it asks the participant to place the casualty in the Haines recovery position.

Describing the intervention and simulation

Simulations were performed at three sites of Mashhad City urban district 5, which has a high population density, to ensure the accuracy of the simulation. A pilot test was performed based on the scenario, and possible weaknesses were eliminated. First, the participant who met the inclusion/exclusion criteria entered the waiting room. After obtaining written and oral consent, his/her demographic information was recorded. The participants then took turns entering the simulation room. In the crash scene simulation room, there was a car with two simulated injured (a person with injured makeup and a full-body

manikin) and equipment (bandage, clean cloth, sheets, disposable plastic gloves, a simulated amputated finger, and a wooden board). An evaluator and a cameraman were present in the room with the participant, who were not aware of the goal and method of conducting the study (Figure 1).

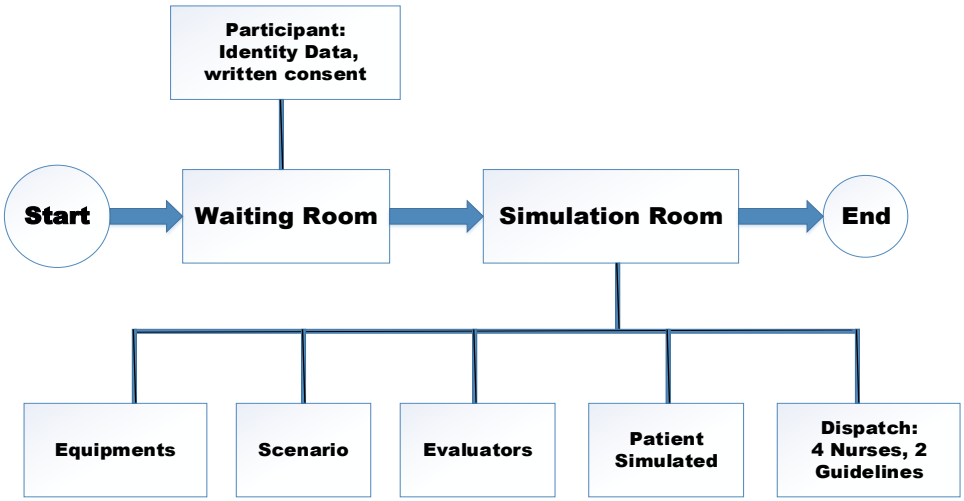

Figure 1. Conceptual model from different stages of simulation

The coordinator researcher read the scenario to the participant. The scenario was that the participant was driving on the street and arrived at the crash scene. After parking the car, he/she went to help the injured alone. He/she sees two simulated injuries lying on the ground. The participant was then asked to call the EMDC with a mobile phone. After calling, the phone was put on speaker. The phone call connected randomly to one of the dispatchers of the SBSG or RTCBG groups. Preliminary information about the crash was given to the dispatcher by the participant, and then guidance was given. Dispatchers were asked not to ask for the address of the crash and to provide first aid for CPR, Haines recovery position, rapid evacuation, and airway protection only on the moulage. When the participant did not understand the dispatcher's guidance, it was repeated. The coordinator, researcher, evaluator, and cameraman did not provide any feedback or assistance to the participant. Evaluators assessed the quality of the participants' first aid using a checklist (the validity and reliability of which were confirmed). When the simulation was finished, the participant left the room and did not have contact with other participants. By examining the simulation video, the time of each first aid was determined. After completing the simulation, evaluation forms were entered into IBM SPSS software, Excel, and Graphpad Prism 8 separately by two researchers.

Describing the study outcome

The main outcome of the study was the quality of the participants' first aid. This quality was determined by the evaluators' score on each person's performance. To assess the quality, evaluators used a four-point Likert scale checklist. The maximum checklist score for each first aid was 4, and the minimum was 1. The second outcome of the study was the accuracy of performing first aid. A score of 1 or 2 meant that the first aid was not done properly, and a score of 3 or 4 meant that the first aid was done correctly. The third outcome of the study was the time intervals between implementing each first aid. Dispatcher's guidance was recorded from the start of guidance to its end for each first aid.

Material

The draft checklist was developed based on existing literature. Related items were extracted and presented to ten faculty members. The validity of the checklist was confirmed using item-level content validity (I -CVI). The modified kappa statistic coefficient above 0.74 was the criterion for placing each item in the checklist. To confirm the checklist's reliability, two evaluators (emergency medical experts) evaluated the performance of 20 participants (ten in each group).

Sample size

Sample size was calculated for 17 people using G-Power software and the results of the pilot study (RTCBG group 1 and SBSG group 2) μ1=52, sd1=5, μ2=20, sd2=442, α=0.05, power=95%. Taking into account a drop-out rate, the final sample size was determined to be 30 people for each group (Figure A1 in Online Appendix). Finally, 30 people in the RTCBG group and 31 people in the SBSG group were included.

Randomization

The participants entered into four 15-person blocks with a 1:1 allocation ratio and random sequence, and one of 6 people entered one of the RTCBG and SBSG groups. The coordinator researcher monitored the random division of the participants into two groups. Registration, random sequence generation, and division of the participants into relevant groups were performed by the coordinator researcher. Each participant was assigned a number to hide the group. The participants were not aware of the outcome of the study. Research personnel were blinded to the assigned group.

Statistical analysis

Mean, standard deviation, and first and third quarters were calculated for both groups. Differences were calculated with a 95% confidence interval. Statistical tests were performed to test the null hypothesis that there was no difference between the means of the two groups. For continuous variables, mean and mid-quarter amplitude were calculated. Based on the statistical distribution and type of variables, for continuous variables t-test was calculated, and when the variables were not normally distributed, a Mann-Whitney test was calculated. Chi-square and Fisher tests were used to compare ranking variables between the two groups. The Kruskal-Wallis test was used to evaluate the differences in the performance quality of participants in different age groups. The data were reported according to CONSORT guidelines and were analyzed using SPSS software version 21.

Results

Out of 68 volunteer participants, 64 people met the inclusion criteria. Two participants from the RTCBG group and one participant from the SBSG group did not complete the simulation, resulting in 30 people in the RTCBG group and 31 people in the SBSG group (Figure A1 in Online Appendix). There was no significant difference between the two groups in terms of demographic variables (Table 1). In terms of the main outcome of the study, the total score of RTCBG group participants or the sum of the scores that the evaluators gave to the participants for first aid was higher than SBSG group (mean: 56.60 VS 44.06, P <0.001) (Figure 2).

RTCBG participants scored higher than SBSG group In universal precautions (mean: 3.40 VS 1, P <0.001), airway protection (mean: 2.43 VS 1, Haines recovery position (mean: 2.57 VS 1, P <0.001), rapid evacuation (mean: 2.13 VS 1, P <0.001), splinting (mean: 3.10 VS 1, P <0.001), scene management (mean: 2.90 VS 1, P <0.001), movement (mean: 2.93 VS 2.58, P = 0.04), (Table 2: a simplified version of Table A1 in online Appendix).

Regarding the second outcome of the study, the RTCBG group participants performed first aid more accurately. There was a significant difference between the two groups in terms of accuracy performing first aid (p<0.001), such as airway protection, Haines recovery position, rapid evacuation, scene management, splinting, and universal precautions (Figure 4). Regarding

the third outcome of the study, the mean total time of first aid in the RTCBG group was 514 (462-566) seconds vs. 315 (296-334) in the SBSG group. In terms of execution time, the difference between the two groups was significant (P <0.001) (Figure 3).

The highest scores obtained in the RTCBG group were universal precautions, water and food, and in the SBSG group were water and food and prevention of hypothermia. The lowest scores obtained in the RTCBG group were rapid evacuation and the rate of chest compressions in CPR, and in the SBSG group were airway protection and Haines recovery position.

In comparing the age groups, the participants aged between 19-30 years had the best quality score in scene safety and CPR (rate of compressions). The participants aged between 61-75 years obtained the lowest scores in CPR (chest recoil, hand position, and compression depth), airway protection, and respiration. Comparing the genders did not show a significant difference in terms of the total score. The participants with higher levels of education scored higher quality scores than others, and the results were significant. There was no significant difference between the two groups in CPR; however, the RTCBG group had a higher mean score in hand position, depth, and rate of compressions compared to the SBSG group.

Table 1. Baseline Demographics

	Traffic Crash Bystander Guideline (n=30)	**Step by Step Guideline (n=31)**	**P-value**
Variable	**Mean (SD), N (%)**	**Mean (SD), N (%)**	**P-Value**
Age (Years)	38 (24.52)	39 (25.53)	0.83
Sex (Male)	18 (60%)	19 (61%)	0.92
Education			0.58
Primary	7 (23%)	8 (26%)	
High school	20 (67%)	17 (55%)	
University	3 (10%)	6 (19%)	

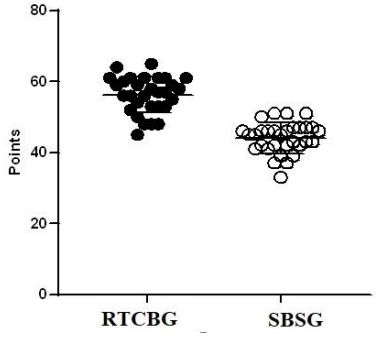

Figure 2. Comparison of two groups: SBSG and RTCBG by total score of first aid performance- The white circles show the total scores of the SBSG group participants and the black circles show the total scores of the RTCBG group participants (p<0.001).

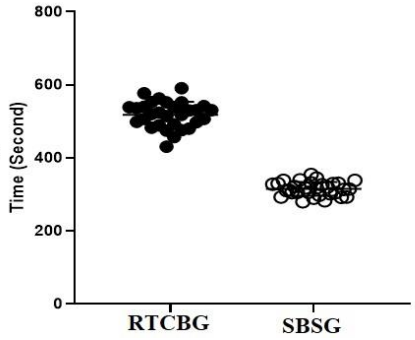

Figure 3. Comparison of two groups: SBSG and RTCBG by total time of first aid implementation- The white circles show the total time of the SBSG group participants and the black circles show the total time of the RTCBG group participants (p<0.001).

Table 2. Comparison of the two groups in terms of performance scores of participants in the implementation of first aid- *Calculated by Chi-square test

Guideline Item	Step by Step Guideline Score Mean (SD)	Traffic Crash Bystander Guideline Score Mean (SD)	P-Value*
Scene Safety	2.84 (2.02-3.66)	3.07 (2.20-3.94)	0.18
Universal Precaution	1	3.4 (2.84-3.96)	0.001
Respiration	2.77 (2.01-3.53)	2.87 (2.01-3.73)	0.52
Airway Protection	1	2.43 (1.80-3.06)	0.001
Hand Position (CPR)	2.39 (1.39-3.39)	2.47 (1.50-3.44)	0.75
Rapid Evacuation	1	2.13 (1.23-3.03)	0.001
Bleeding Control	2.94 (2.26-3.62)	3.10 (2.49-3.71)	0.37
Prevention of Hypothermia	3.06 (3.16-4.04)	3.27 (2.58-3.96)	0.07
Scene Management	1	2.90 (2.35-3.45)	0.001
Positioning	2.58 (1.86-3.3)	2.93 (2.48-3.38)	0.04
Total Score	44.06 (39.78-48.34)	56.60 (51.48-61.72)	0.001

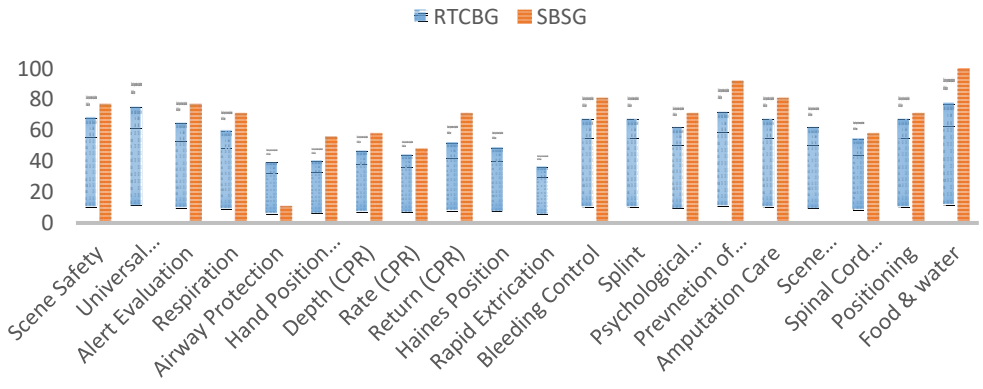

Figure 4. Comparison of the two groups in terms of correct performance of participants in the implementation of first aid

Discussion and conclusion

To the best of the authors' knowledge, the present study was the first simulation of first aid delivery at a RTC with the guidance of the EMDCs. Another strength of the study was the presence of participants from different age groups and with different levels of education; since various people are present at a real RTC scene. Clinically providing first aid to injured people in real-life situations by ordinary people is a difficult and challenging task. Achieving a better score by the group will have a high clinical impact on improving and saving the lives of the injured. Because seconds are their lifesavers.

In general, the results of the present study showed that by upgrading the guidelines of the medical emergency dispatch center, the quality of bystanders' performance at road traffic crash scenes can be improved. Previous studies have shown that researchers can't be present in the first moments of road traffic crashes in the real world and evaluate the bystanders' performance.

Overall, RTCBG participants had a higher total first aid quality score compared to SBSG. The difference between the two groups was significant in some types of first aid, including personal protection and universal precautions, airway protection, Haines recovery position, rapid evacuation, splinting, and scene management. In the RTCBG guideline, the execution time was 8 minutes and 34 seconds, which was 3 minutes and 19 seconds longer than SBSG, probably due to having more guidelines and sentences. Given the average 10-minute ambulance response time, the longer execution time isn't a problem. Telephone guidance is time-consuming, and it takes a long time for bystanders to simply follow the written text of the guideline and read it. In the study of Bakke et al., the dispatcher's guidance had no significant effect on bystanders' first aid. They studied the dispatcher's guidance in only airway opening, CPR, recovery position, and prevention of hypothermia; while the present study examined the possibility and quality of 20 first aid in bystanders.

The performance quality of RCTBG participants in airway protection was better. However, despite the guidance of the EMDC, only 12% of the participants performed the jaw thrust maneuver correctly, but 62% of them performed the Head tilt/Chin lift maneuver correctly. This may be because the jaw thrust maneuver is difficult to perform for those who are not trained. In Chamberlain and the Ertl and Chris studies, 33% and 36.5% of the participants could open the airway, respectively (14). However, in the present study, 51% of participants were able to open the airway, which is higher than the results of the mentioned studies (14, 15). More participants (63%) performed the Haines recovery position correctly. In the study of Bakke, in 75% of the cases, bystanders performed the recovery position correctly in real casualties, which is higher than the findings of the present study (16). The findings of the present study are similar to those of Ertl and Chris's study, in which 63.5% of the participants obtained the recovery position score (15).

In the RTCBG group, the participants' scores were moderate (3.03-1.23), 2.13, and about half of them (47%) performed this first aid correctly. In the study of Pelinka et al., 65% of untrained participants performed the evacuation correctly, which is higher than the present study (17). In the study of Thierbach et al., in 83% of the cases, bystanders performed evacuation of the casualty, which is higher than the findings of the present study (18). In many crash scenes, police officers are not present, and they also do not have the skills to manage the crash scene. One of the ways to improve scene management and even scene safety is to train bystanders present at the scene. Trained bystanders are more intelligent in their actions at the scene (7, 19). The difference in scores between the two groups was significant, and in 80% of the cases, the participants performed it correctly.

The use of personal protective equipment (PPE) and universal precautions reduces the risk of unnecessary exposure, and possible infection and disease transmission (19, 20). In the RTCBG

group, 97% of the participants considered personal protection precautions;

But the SBSG team did not use personal protective equipment, as the SBSG guideline does not recommend personal protection.

The results of the study by Tiska et al. showed that personal protection and universal precautions are very important and should be included in the training (19). Much attention was paid to this issue in the bystanders' guideline (20).

Due to the experimental nature of the study, the participants in the study were limited and specified based on the inclusion and exclusion criteria. The results of this study provide authentic evidence regarding the efficacy of the new guideline for guiding RTC bystanders; however, its effectiveness is not clear at the actual community level. Given that the sample of the present study may had volunteer bias; it is suggested that further studies be tested on larger samples of the general population and with more diversity in terms of education, participant-related experience, socioeconomic status, and multiple EMDCs. In this way the effectiveness of this intervention can be tested to a greater extent under normal circumstances and have a higher generalizability. It is suggested that future studies be conducted with a larger, more diverse sample (different regions, education levels). Of course, in the next stage of the study, a field trial has been conducted, the results of which will be published.

Limitations of the study

The simulation was performed only in one of the thirteen urban areas. People living in different urban areas, probably, are different in terms of culture and level of literacy, and the level of participants' cooperation in urban areas may be different. The presence of a cameraman in the simulated scene could cause stress to the participant, but Participants' stress levels were probably lower than the actual stress of people in real-life crash scenes. Another limitation was the use of a full-body manikin in simulating and performing some first aid on the manikin; most likely, the findings differ from those of a human injury. The small number of dispatchers (4 people) was another limitation of the study. Participants may have performed better due to the Hawthorne effect, which introduces bias into the study. Also, convenience sampling may limit generalizability.

Acknowledgement

Thanks are owed to the staff of Mashhad' EMDC and other emergency medical personnel, as well as all the participants, for their cooperation in this study.

Data availability:

The data that support the findings of this study are available from Tehran University of Medical Science, but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are, however, available from the authors upon reasonable request and with permission of Tehran University of Medical Science.

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Appendix:

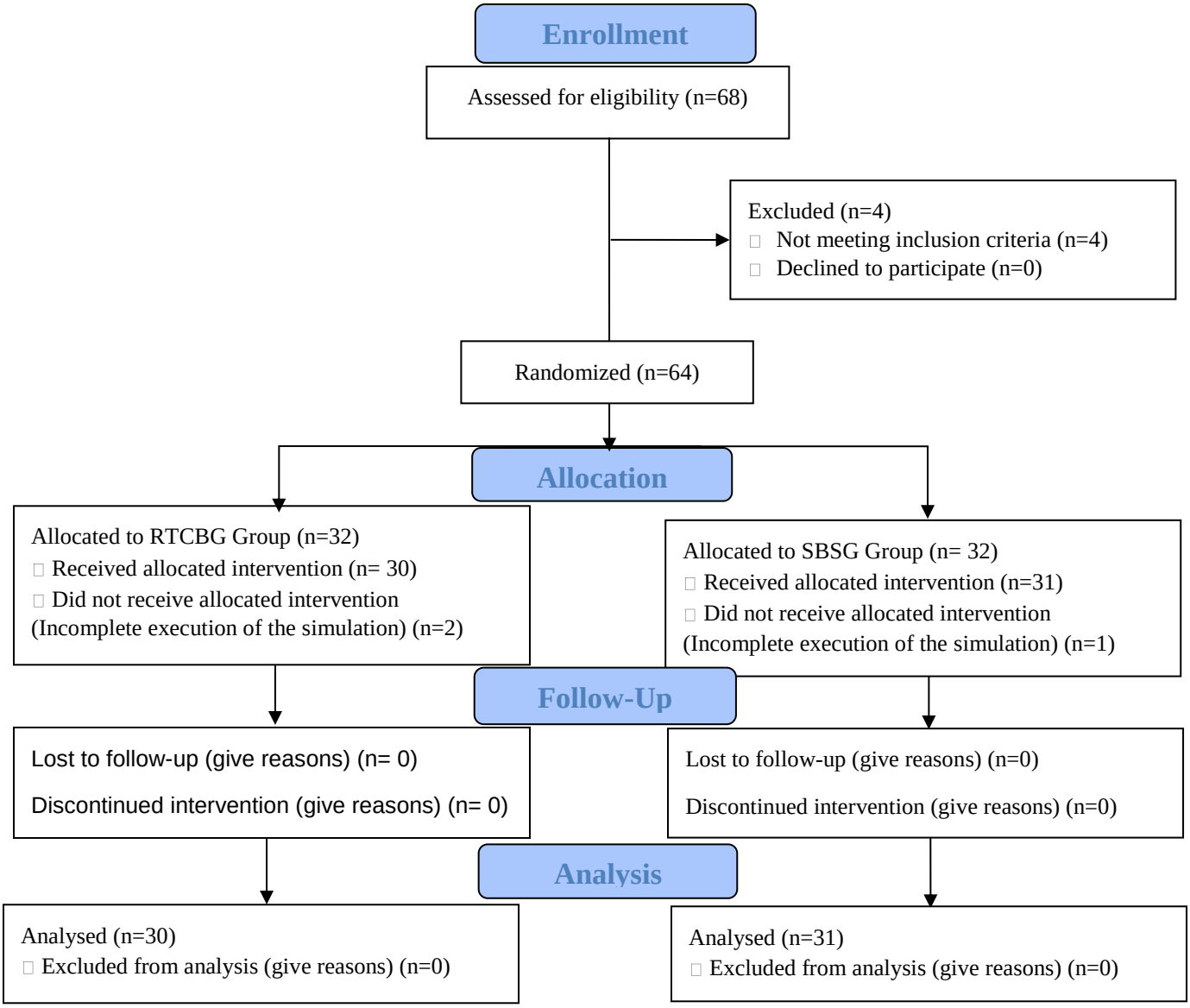

Figure A1. Consort Flow Diagram

Table A1 (Expanded version of table 2). Comparison of the two groups in terms of performance scores of participants in the implementation of first aid given by the Evaluators - *Calculated by Chi-square test

Guideline Item	Step by Step Guideline Score Mean (SD)	Traffic Crash Bystander Guideline Score Mean (SD)	P-Value*
Scene Safety	2.84 (2.02-3.66)	3.07 (2.20-3.94)	0.18
universal Precaution	1	3.4 (2.84-3.96)	0.001
Alert Evaluation	3 (2.23-3.77)	2.83 (1.92-3.74)	0.53
Respiration	2.77 (2.01-3.53)	2.87 (2.01-3.73)	0.52
Airway Protection	1	2.43 (1.80-3.06)	0.001
Hand Position (CPR)	2.39 (1.39-3.39)	2.47 (1.50-3.44)	0.75
Depth (CPR)	2.45 (1.56-3.34)	2.57 (1.71-3.43)	0.66
Rate (CPR)	2.29 (1.35-3.23)	2.37 (1.56-3.17)	0.69
Return (CPR)	2.61 (1.94-3.28)	2.57 (1.63-3.51)	0.99
Haines **recovery** Position	1	2.57 (1.67-3.47)	0.001
Rapid Evacuation	1	2.13 (1.23-3.03)	0.001
Bleeding Control	2.94 (2.26-3.62)	3.10 (2.49-3.71)	0.37
Splint	1	3.10 (2.39-3.87)	0.001
Psychological Support	2.71 (1.93-3.49)	3 (2.26-3.74)	0.15
Prevention of Hypothermia	3.06 (3.16-4.04)	3.27 (2.58-3.96)	0.07
Amputation Care	2.81 (2.06-3.56)	3.07 (2.38-3.76)	0.17
Scene Management	1	2.90 (2.35-3.45)	0.001
Spinal Cord Protection	2.48 (1.80-3.16)	2.67 (2.22-3.22)	0.29
Positioning	2.58 (1.86-3.3)	2.93 (2.48-3.38)	0.04
Food& Water	3.13 (2.79-3.47)	3.30 (2.53-3.47)	0.11
Total Score	44.06 (39.78-48.34)	56.60 (51.48-61.72)	0.001