Effectiveness of targeted multiple injuries nurses' training on emergency department nurses' knowledge and triage skills: a randomized control trial

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Abstract: **Objective:** The study's objective was to evaluate the effectiveness of a multiple injuries triage advanced trauma nursing course/ advanced trauma care for nurses programme on knowledge and skill among emergency nurses. **Methods:** One hundred and twelve emergency nurses from two government hospitals in the West Bank participated in a single-blinded randomised control trial, the data were gathered using a self-administered structured questionnaire. The advanced trauma nursing course was delivered to the experimental group using a practice-first approach followed by theory in two days (8 am- 4 pm), while advanced trauma care for nurses was delivered to the control group with with a theory-first approach followed by practice in two days (8 am- 4 pm). The material for both groups was PowerPoint, two videos, a low-fidelity simulation, two scenarios, and a group discussion. **Results:** There were significant mean score differences between the experimental and control groups in the pairwise comparisons of the groups in terms of knowledge and skill. There were significant mean score differences in knowledge between the baseline and post-intervention in the experimental group (mean difference=0.57; P-value<0.001), as well as between the baseline and the three-month follow-up (mean difference=0.26; P-value<0.001), and the post-intervention and three-month follow-up (mean difference= - 0.30; P-value<0.001). There was no significant mean difference in the knowledge and skill between the post-programme (mean difference=0.08; P-value=0.383) and three-month follow-up (mean difference=0.02; P-value=1.000) in the control group. **Conclusion:** Nurses attending the two-day training advanced trauma nursing course can improve their knowledge and skills in multiple injuries triage in the emergency department compared to advanced trauma care for nurses' programme. Emergency nurses should regularly undergo retraining in the multiple injuries triage programme to evaluate and improve their skill level every two years.

Keywords: Advanced Trauma Care for Nurses; Advanced Trauma Nursing Course; ATCN; ATNC; Knowledge; Skill

1. Introduction

Multiple injuries (head, chest, and abdomen) include a concurrent injury or persistent injury to more than two bodily locations or areas caused by the same injury, with at least one location having a serious injury (1). Head, chest, and abdominal are the most prevalent and critical causes of injuries-related death and disability globally (2). Multiple injuries triage is the process of prioritizing and categorizing patients who have sustained multiple traumatic injuries based on the severity of their condition and the urgency of care required. It involves assessing factors such as airway, breathing, circulation, consciousness, and other vital signs to make rapid, informed decisions (1). The number of injured patients registered in hospitals worldwide has increased from 1.5 million in 2015 to 5 million in 2017, and then to 7 million by 2020 (3,4). Remarkably, most multiple injuries patient fatalities happen within the first four hours of hospital admission if prompt care is not provided (4). The concept of the "golden hour" emphasizes the increased risk of death and the necessity of quick action in the first hour after a patient's multiple injuries are diagnosed (5).

Emergency nurses perform incorrect or insufficient multiple injuries triage due to the system's weakness and the rise in the number of multiple injuries patients in hospitals (6). Multiple injuries patient are triaged into the most appropriate assessment and treatment areas using the knowledge and skills of emergency nurses (7). Nevertheless, previous studies in Palestine, Indonesia, and Ethiopia showed that emergency nurses had a poor to moderate level of triage knowledge and skill (3,8). Therefore, studies on multiple injuries triage among emergency nurses are required to evaluate the effectiveness of a multiple injuries triage educational programmes on the knowledge and skills of emergency nurses in the Middle East (3,8).

The advanced trauma nursing course (ATNC) and the ad-

vanced trauma care for nurses (ATCN) are two specialized programs aimed at equipping nurses with advanced trauma management skills. ATNC, developed in the United Kingdom, is designed to provide a comprehensive understanding of trauma care through a European lens, focusing on a structured, team-based approach to managing trauma patients, including initial assessment, advanced airway management, and resuscitation techniques. ATCN, on the other hand, is a globally recognized course developed by the society of trauma nurses (STN) in collaboration with the American college of surgeons. It aligns with the advanced trauma life support (ATLS) principles, emphasizing a multidisciplinary approach to trauma care (10).

The ATNC/ATCN includes early assessment, management of airways, stabilization, and transport of multiple injuries patient (9). The ATNC/ATCN is rated as the best popular programme of injuries triage dealing with multiple injuries compared to other injury care programmes (10). The benefits of ATNC/ATCN include a synchronized, learning, and cooperative approach to multiple injuries treatments as injury nurses share knowledge and skills with multidisciplinary teams regarding multiple injury triages in the emergency department (ED) (10). However, there is a paucity in multiple injury outcomes concerning the knowledge and skill among emergency nurses regarding the ATNC/ATCN programme due to limited previous research (10). The lack of knowledge and skill of ATNC/ATCN programme among emergency nurses has the potential to harm the patient's outcome in multiple injury cases (10). To date, no recent research has been conducted in the Middle East to evaluate the effectiveness of a multiple injuries (head, chest, and abdomen) triage educational programmes on the knowledge and skills among emergency nurses. The paper's objective is to evaluate the effectiveness of multiple (head, chest, abdomen) injuries triage ATNC/ATCN programme on the knowledge and skills of emergency nurses.

Numerous studies highlight the importance of specialized training programmes in enhancing the knowledge and skills of emergency nurses, yet many focus solely on either theoretical or practical aspects, often overlooking their integration (9,10). This study addresses this gap by comparing two recognized multiple trauma triaging programmes—ATNC and ATCN—evaluating their effectiveness in improving both theoretical knowledge and practical skills. While previous research emphasizes the need for advanced trauma education, there is limited empirical evidence comparing different training methodologies regarding real-world patient outcomes (9,10). This study demonstrates that the hands-on, practice-first approach of the ATNC programme fosters greater competency and confidence among emergency nurses compared to the theory-first approach of ATCN. Additionally, it aims for broader applicability by encompassing diverse healthcare environments, addressing the limitations of prior studies that focused on specific regions. Overall, this research not only fills existing gaps in the literature but also offers actionable recommendations for enhancing multiple trauma nursing programme to improve patient care in emergency settings.

2. Methods

The current paper followed the "consolidated standards of reporting trials (CONSORT)" guideline as shown in figure 1 (11).

Ethical approval was obtained from the Jawatankuasa Etika Universiti Penvelidikan Melibatkan Manusia (JKEUPM) with the reference number UPM/ TNCPI/ RMC/1.4.18.2 (JKE-UPM) and was registered at the Iranian registry of clinical trials (IRCT) on 28 June /2020 with reference number IRCT20200626047926N1.

2.1. Study design

A single-blinded randomised control trial (RCT) was conducted to evaluate the effectiveness of a multiple injuries (head, chest, and abdomen) triage ATNC/ATCN programme on the knowledge and skill scores among emergency nurses at pre-, post-, and 3-month follow-up of the intervention.

2.2. Participants

Emergency nurses in a government hospital affiliated with the Palestinian Ministry of Health who were fully employed with at least one year's working experience in the ED. The main sampling unit was ED used for the experimental and control groups out of selected government hospitals in the West Bank of Palestine.

2.3. ATNC/ATCN

The inclusion of comprehensive evaluation methods, such as skills assessments and knowledge check, ensures that emergency nurses can demonstrate their competency in the essential areas of multiple trauma triage. However, the ATNC programme places a greater emphasis on advanced trauma assessment and management techniques, offering an in-depth exploration of topics such as multiple trauma systems, patient stabilization, and interprofessional collaboration. Additionally, the ATNC programme employs a wider range of teaching methods, including immersive simulations and hands-on practical sessions that replicate real-life scenarios. This approach allows emergency nurses to practice their skills in a safe environment, thereby boosting their confidence and competence. Furthermore, the ATNC programme frequently adopts an emergency nurse- centred pedagogical approach that emphasizes active learning, critical thinking, and problem-solving, encouraging emergency nurses to take responsibility for their education and apply their knowledge to case studies and practical situations.

The ATNC programme was administered to the experimental group with a practice-first approach followed by theory, while the ATCN programme was delivered to the control group with a theory-first approach followed by practice in the current study. ATNC was carried out in two days (8 am

– 4 pm) via PowerPoint, two videos, a low-fidelity simulation, two scenarios, and a group discussion on multiple injuries triage. The emergency nurses practiced the simulation and the scenarios on the nursing interventions, head assessment, chest assessment, and abdomen assessment on injuries. Thereafter, the trainer gave the right procedure for each of the nursing interventions, head assessment, chest assessment, and abdomen assessment of the multiple injuries triage.

The ATNC/ATCN programme materials used articles, validity of the ATNC/ATCN by six experts at the Arab American University in Palestine and the Palestinian Ministry of Health, and the eleven edition of the ATNC/ATCN book (12). Based on the literature review, no previous study used all these materials (PowerPoint, videos, a low-fidelity simulation, scenarios, and group discussion) as a package in the ATNC/ATCN programme for knowledge and skills in their studies and recommended that they should be used as a package (12-15).

Consistency in delivering the ATNC programme across various settings and trainers was essential for obtaining reliable results. When the programme was implemented uniformly, it ensured that all emergency nurses received the same level of training, minimizing the impact of external factors such as differences in teaching styles or learning environments. Treatment fidelity is linked to the research procedures used to measure the degree to which a programme is implemented as planned. It served as a checklist to assess the level of programme implementation. The sampling was homogeneous, allowing for the control of covariates. The method used a "pre-test" to predict post-treatment outcomes, which is particularly useful for rescaling. Covariates were applied in regression to reduce variations in emergency nurse characteristics and groups, as well as to minimize result variability.

Twenty emergency nurses were independently evaluated using the fidelity checklist, which yielded a score of 0.90 (90%), indicating that the ATNC/ATCN was acceptable and applied correctly in terms of multiple trauma triage among emergency nurses. Throughout the programme, documentation was collected through videos and pictures. The researcher developed comprehensive training manuals and standardized curricula that outline the core components and objectives of the -programs, providing a clear framework for trainers to follow. Additionally, the researcher conducted training sessions for trainers to ensure they fully understood the program's methodologies and could deliver content uniformly. Regular assessments and feedback mechanisms have been established to monitor the effectiveness of the training sessions and identify any discrepancies in delivery.

To provide guidance, encouragement, and extra instructions as needed, as well as to remind participants twice a week about multiple injuries triage, a WhatsApp group was created for the experimental/control group. The researcher distributed booklets on programmes during the follow-up.

2.4. Measurement tools

The tools used in this study were validated and adapted through a systematic process that involved both expert review and pilot testing. Initially, a panel of experts in trauma care and nursing education evaluated the tools for content validity, ensuring that the items accurately reflected the constructs being measured. Feedback from these experts led to necessary revisions to enhance clarity and relevance. Following this, the tools were pilot-tested with a small group of participants to assess their reliability and effectiveness in capturing the desired data. Based on the pilot results, further adjustments were made to refine the tools, ensuring they were appropriate for the study population and aligned with the specific objectives of the research. This rigorous validation process provided confidence in the tools' ability to yield meaningful and reliable results in the context of the study.

The valid and reliable questionnaire from Duko et al. (2019); Fathoni, Sangchan, & Songwathana (2013), and Kerie, Tilahun, & Mandesh (2018) was revised and adopted as the data collection tool. Three main sections made up the questionnaire: sections A, B, and C. Sections A and B evaluated the emergency nurses' knowledge and skills, respectively, and section C contained information about the emergency nurses. There were 17 questions in this questionnaire regarding knowledge of injury triage, including triage priority and the color-coded waiting for treatment. There were three dimensions to the 25 items in the triage skill questionnaire: patient allocation, patient categorization, and quick assessment. The cut-off points to knowledge and skill scores are divided into three classes; a score of less than 60% is low, while a score of 60-80% is moderate, and a score of more than 80% is high (16–18). In the current paper the content validity index for the knowledge and skills scale for emergency nurses it was 0.83 and the internal consistency of reliability was 0.863.

2.5. Procedure

2.5.1. Randomisation and contamination bias

Simple random sampling was implemented; clustered all ED in the public hospitals (n=11) and then low knowledge and skill of ED hospitals (n=5) was selected to random sampling to select two ED hospitals (n=2).

The average knowledge and skill levels across the selected hospitals were calculated. Hospitals with scores below this average were subsequently included in the study. Emergency nurses were randomised using a lottery method. Each emergency nurse was assigned a unique number upon enrollment, which was then placed in a sealed container. A third-party individual, not involved in the study, randomly drew numbers, assigning participants to either the intervention or control group. Even-numbered draws were allocated to the experimental group, and odd-numbered draws were allocated to the control group. Allocation concealment was ensured by having a researcher, independent of the study, conduct the random draw. The individual performing

the lottery was unaware of any participant details or study outcomes, maintaining the integrity of the randomisation process. The assignment was concealed from participants and researchers until after randomisation. The lottery method was used by researcher in which the hospital and participants were blinded. The first box consisted of each selected hospital (n=5) using small pieces of paper that were covered, while the second box consisted of either the experimental or the control group, also written on small pieces of paper and covered. Next, the pieces of paper were randomly drawn from the first box to determine the hospital and likewise from the second box to determine whether it be for the experimental or the control group. Then the second paper was randomly drawn from the first box to determine the hospital while for the second box the remaining paper automatically determined whether it was the experimental or the control group.

Different groups were assigned to geographically distant locations, with the experimental group placed in the northern West Bank of Palestine and the control group in the southern region. The location of the hospital made it more difficult for participants from both groups to connect and share experiences. Also, these hospitals were randomly selected through lottery methods.

2.5.2. Sample size estimation

The calculation of the sample size was based on the formula for testing the mean between the two groups of population (19,20). The highest calculated sample size for the knowledge and skill scores of the nurses was selected as the sample size of the current study.

$$n = 2\sigma^2 \times (Z\alpha/2 + Z\beta)^2 / (d)^2$$

σ^2: The standard deviation (SD) of the outcome of the dependent variable. The SD is found using the following formula:

$$\sigma^2 = (n_1-1)\sigma_1^2 + (n_2-1)\sigma_2^2 / n_1+n_2-2$$

$Z\alpha/2$: 1.96 (21).
$Z1-\beta$ β: Beta error 20%; power desired 80%; $Z1-\beta = 0.84$ (22). Based on the previous calculation, the highest estimated sample size was 120 emergency nurses in the two groups.

2.5.3. Data collection technique

Step one: the data was gathered through an English-written questionnaire and followed the inclusion criteria. The emergency nurses were given approximately 30 minutes to finish answering the questionnaire for the experimental and control groups (23).

Step two: the ATNC/ATCN programme was delivered to the experimental/control group through the trainer in two days. At the end of the second day of the ATNC/ATCN programme, the researcher distributed the questionnaire to the emergency nurses for the second time for the experimental/control group.

Step three: at the end of the 3-month follow-up, the researcher distributed the questionnaire for the third time to both the experimental and the control groups.

2.5.4. Data analysis

data were analysed using the SPSS software programme Version 25.0. Descriptive statistics, Chi-squared test, and independent T-test were conducted to compare both groups for "participant characteristics" and study outcomes at baseline. A per-protocol (PP) analysis for the interpretation of the randomised clinical trial results, which removes data from patients who did not comply with the protocol (24).

3. Results

3.1. Response rate

Overall, 126 emergency nurses took part in the baseline assessment, with 63 in the experimental group and 63 in the control group. Out of the 126 enrolled emergency nurses, all completed the post-programme and 120 completed the three-month follow-up (95.2%). The response rate in the experimental groups was 100% (63 out of 63), while the response rate in the control group was 90.0% (57 out of 63) at the pre-programme.

The current study used a PP analysis for the interpretation of the randomised clinical trial results, which removes data from patients who did not comply with the protocol (25). The researcher examined the effect of receiving the assigned treatment strategies during the complete follow-up time, as defined in the trial protocol, using the PP analysis. At the end of the trial, the current study showed that there were six cases of missing values (attrition rates=4.8%) among the 126 participants. Previous studies showed that respondents who had no data after randomisation and/or who never started the programme and/or a small number of emergency nurses due to missing data are unlikely to change the results of the study (26,27).

3.2. Socio-demographic characteristics between the experimental and control groups at the baseline

The response rate in the experimental groups was 100% (63 out of 63), while the response rate in the control group was 90.0% (57 out of 63) at the PP. Table 1 shows that training section was a significant difference in multiple injuries triage between the experimental and the control group ($X^2 = 11.407$; P-value<0.001).

Table 1 Baseline comparison between the experimental and control groups on the emergency nurses' socio-demographic characteristics (n=120)

Socio-demographic characteristics	Experimental group n= 63, n (%)	Control group n= 57, n (%)	Test-statistic (X^{2} ^{a}/t ^{b})	P value
Age (M ± SD)	30.98± 7.45	30.56± 0.69	0.346^{b}	0.730
Gender				
Male	43 (68.3)	37 (64.9)	0.150^{a}	0.698
Female	20 (31.7)	20 (35.1)		
Marital status				
Single	23 (36.5)	16 (28.1)	1.126^{a}	0.570
Married	35 (55.6)	37 (64.9)		
Divorced or widowed	5 (7.9)	4 (7.0)		
Education				
Diploma	18 (28.6)	16 (28.1)	0.963^{a}	0.618
Bachelors	36 (57.1)	36 (63.2)		
Postgraduate	9 (14.3)	5 (8.8)		
Monthly income (ILS) (M ± SD)	2.27 ± 0.63	2.35 ± 0.61	-0.715^{b}	0.476
Working experience (Years)				
1 to < 3 years	18 (28.6)	16 (28.1)	0.555^{a}	0.907
3 to < 5 years	19 (30.2)	20 (35.1)		
5 to 7 years	12 (19.0)	11 (19.3)		
> 7 years	14 (22.2)	10 (17.5)		
Have trained				
Yes	37 (58.7)	16 (28.1)	11.407^{a}	< 0.001*
No	26 (41.3)	41 (71.9)		

N: Number; %: percentage; a: Chi-square test; b: Independent sample test; M: Mean; SD: Standard deviation; ILS 1: USD 0.30

Table 2 Comparison of the mean differences in the knowledge and skill scores between the experimental and control groups across the time points (n=120)

Source of variation	Variable	F	P-value	$\eta2$
Group	Knowledge	430.07	< 0.001*	0.78
	Skill	269.00	< 0.001*	0.69
Time	Knowledge	11.88	< 0.001*	0.09
	Skill	6.34	< 0.001*	0.05
Time × group	Knowledge	105.14	< 0.001*	0.47
	Skill	26.65	< 0.001*	0.18

F: F-ratio; P-values <0.05; $\eta2$: partial ETA square/Effect Size; Box's M test: 34.294; Sphericity assumption was met (P-value= 0.161).

**Table 3** Pairwise comparison for the knowledge within the experimental and control groups (n=120)

Dependent variables	Time (I)	Time (J)	Mean difference (I-J)	Standard error	95% CI Lower	Upper	P-value
Knowledge (experimental group))							
	T1	T2	0.57	0.03	0.49	0.65	< 0.001*
	T1	T3	0.26	0.04	0.15	0.38	< 0.001*
	T2	T3	- 0.30	0.03	- 0.39	- 0.20	< 0.001*
Knowledge (control group)							
	T1	T2	-0.29	0.45	- 0.40	- 0.18	< 0.001*
	T1	T3	0.21	0.03	- 0.31	0.120	< 0.001*
	T2	T3	0.08	0.05	- 0.04	- 0.20	0.383

T1: Baseline; T2: Post-intervention; T3: 3months-follow-up; CI: Confidence interval; P-value was adjusted using the bonferroni test; P-values <0.05

Table 4 Pairwise comparison for the skill within the experimental and control groups (n=120)

Dependent variables	Time (I)	Time (J)	Mean difference (I-J)	Standard error	95% CI Lower	Upper	P-value
Skills (experimental group)							
	T1	T2	- 0.28	0.05	- 0.43	- 0.14	< 0.001*
	T1	T3	- 0.07	0.06	- 0.23	- 0.07	< 0.001*
	T2	T3	0.21	0.06	0.04	0.37	0.008*
Knowledge (control group)							
	T1	T2	0.38	0.07	0.20	0.56	< 0.001*
	T1	T3	0.40	0.07	0.22	0.58	< 0.001*
	T2	T3	0.02	0.06	- 0.14	- 0.19	1.000

T1: Baseline; T2: Post-intervention; T3: 3months-follow-up; CI: Confidence interval; P-value was adjusted using the bonferroni test; P-values <0.05
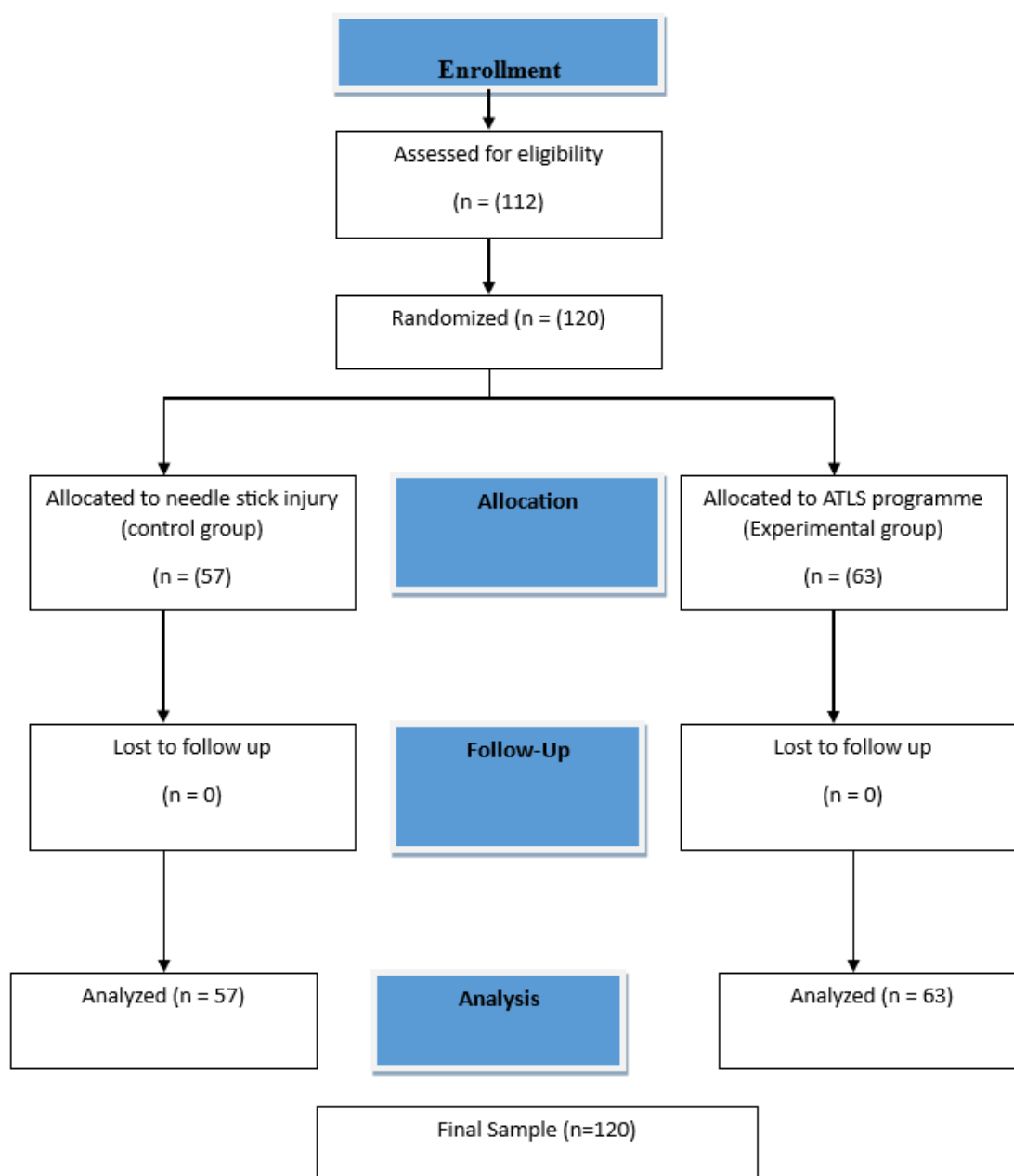
Figure 1 The CONSORT flow diagram

3.3. Comparison of the mean differences in the knowledge and skill scores between the experimental and the control group across the time points

Table 2 shows that there was a significant mean difference in the knowledge between the experimental and the control group (F= 430.07; P-value< 0.001; $\eta2$= 0.78), time (F=11.88; P-value<0.001; $\eta2$=0.09), and interaction between groups and time (F=105.14; P-value< 0.001; $\eta2$= 0.47). There was a significant mean difference in the skills between the experimental and control groups (F=269.00; P-value< 0.001; $\eta2$=0.69), time (F=6.34; P-value<0.001; $\eta2$=0.05), and interaction between groups and time (F=26.65; P-value<0.001; $\eta2$=0.18).

The pairwise comparison of knowledge at three-time points within groups is shown in table 3. In the experimental group, there was a significant mean difference in the knowledge between the baseline and PP (mean difference=0.57; P-value<0.001), the baseline and three-month follow-up (mean difference=0.26; P-value< 0.001), and the post-programme and three-month follow-up (mean difference=-0.30, P-value<0.001). In the control group, there was no significant mean difference in the knowledge between the post-programme and three-month follow-up (mean difference=0.08; P-value=0.383).

The pairwise comparison for the skills at three-time points within groups is shown in table 4. In the experimental group, there was a significant mean difference in the skill between the baseline and post-programme (mean difference= - 0.28; P-value<0.001), the baseline and three-month follow-up (mean difference= - 0.07; P-value<0.001), and the post-programme and three-month follow-up (mean difference= 0.21; P-value=0.008). In the control group, there was no significant mean difference in the skill between the post-programme and three-month follow-up (mean difference= 0.02; P-value=1.000).

4. Discussion

The effects of groups (experimental vs. control), main time (PP, post-programme, and three-month follow-up), and group-by-time interaction on the knowledge and skill scores were significant. As anticipated, the results for the knowledge and skill scores were consistent in terms of the condition effect, time effect, and groups by time effect. The reason could be attributed to a variety of considerations, including the ATNC programme materials that primarily used simple and clear language, proper teaching methods, interactive sessions, emergency nurses' practice, and consistency of the ATNC programme among emergency nurses in the experimental group.

The study by Ding et al., (2016) (28) examined injury triage using a different programme than the current paper, which focuses on multiple injuries triage using the royal college of surgeons (29–31). The main focus of the ATNC programme is during the "golden hour," when prompt identification, med-

ical intervention, and frequent functional action greatly increase safety and lower the associated morbidity (32). Therefore, the programme utilized may have an impact on a nurse's evaluation of the effectiveness of the knowledge and practice/skill scores related to injuries triage (29–31). For both government and private hospitals, the ATNC programme's techniques are now considered the gold standard for early multiple injuries diagnosis and management (33–39). It may potentially be the first study that used the ATNC programme among emergency nurses on multiple injuries triage in the Middle East.

The knowledge and skills of emergency nurses to deliver an accurate diagnosis and immediately assess trauma patients are necessary for a multiple injuries triage programme to be successful (40). The ATNC programme is an effective programme among nurses related to multiple injuries triage and has shown statistical significance in improving their knowledge and skill scores on multiple injuries triage compared to ATCN (41–44).

Multiple injuries are the most prevalent and important causes of trauma-related death and disability worldwide (45). Nurses' knowledge regarding multiple injuries patient triage can be enhanced by the ATNC programme. Nevertheless, skills take time to develop, so ongoing research is needed to assess the effectiveness of teaching methods and demonstrate improvements in the multiple injuries triage team's overall performance, including both knowledge and skills (46). Regarding the management of patients with multiple injuries and the importance of quickly responding to life-threatening situations, ATNC programme has established a gold standard (47,48). In contrast to studies that concentrate on triaging brain or spinal cord injuries, the review of the current paper is more concerned with the ATNC/ATCN programme's knowledge and the skills of nurses regarding the triaging of multiple injuries patient.

In the past, different teaching methods were used in delivering ATNC programmes to emergency nurses to enhance their practice. For instance, videos and fidelity simulation were used by Massoth et al. (2019), scenario groups were used by Delnavaz et al. (2018), and PowerPoint and group discussion were used by Seliman et al. (2014). Most of the above-mentioned studies used a single and/or double teaching approach (12,13,15). However, no previous study used all these materials (PowerPoint, videos, a low-fidelity simulation, scenarios, and group discussion) as a package to show the improvement in the knowledge and skills among emergency nurses in the ATNC programme. Thus, the current paper differed from other studies by using a power point, videos, low-fidelity simulation, scenarios, and group discussion to show the mean differences score of the knowledge and skills of emergency nurses at three different time points within and between the experimental and control groups.

The findings of the current study on the ATNC programme could have a significant impact on emergency nursing training and patient care by emphasizing the critical role of spe-

cialized training in enhancing clinical competency and improving patient outcomes. By demonstrating that targeted ATNC programme enhances multiple trauma care skills, these findings could encourage healthcare institutions to adopt similar advanced triaging programs for their emergency nursing staff, thereby fostering a culture of excellence in emergency response. Additionally, the evidence of improved patient outcomes could motivate policy-makers to prioritize funding and resources for ongoing professional development in multiple trauma triage. As more emergency nurses become equipped with advanced skills and knowledge, the overall quality of emergency care is likely to improve, leading to better patient experiences and outcomes in high-pressure situations (47,48).

The implications of the ATNC programme for practice, policy, and future research are profound. Practically, the programme underscores the necessity of integrating advanced multiple trauma triaging into emergency nursing curricula and ongoing professional development, thereby enhancing the skills of emergency care providers. Policymakers are encouraged to allocate resources and funding to support such training initiatives, recognizing their potential to improve patient outcomes and overall healthcare quality. Additionally, future research should focus on longitudinal studies to assess the long-term effects of the ATNC programme, exploring how sustained training influences clinical practice and patient care over time. Investigating the ATNC program's adaptability across diverse healthcare settings could further inform its implementation, ensuring that multiple trauma nursing education remains relevant and effective in evolving medical landscapes (41-44).

The recent study employed a randomised control trial (RCT) design to assess treatment efficacy by comparing groups, blinding to reduce performance bias, randomising to reduce allocation bias, and reducing confounding factors. Several studies used a quasi-experimental design free of bias and control factors (41-44,46). Moreover, the past studies' research design was a one-group (pre-post) program without a control group, RCT, or evaluation carried out at three separate stages of the ATNC programme (41-44,46). In these prior investigations, emergency nurses' lack of knowledge and skills in multiple injuries triages for long-term programme evaluation may have been caused, in particular, by the research design, sample size, and high risk of bias.

Palestine possesses unique contextual factors that may limit the generalizability of the research findings to other regions. These factors include socio-political dynamics, healthcare infrastructure, and cultural norms that significantly influence how health interventions are received and implemented. For instance, the ongoing conflict and its impact on healthcare accessibility create challenges that may not be present in more stable regions. Additionally, variations in healthcare policies, resource availability, and population demographics further differentiate the Palestinian context from other areas. As a result, findings derived from studies conducted in Palestine should be interpreted with caution when considering their applicability to different geographical or cultural settings, emphasizing the need for localized research to better understand the specific challenges and opportunities within those contexts.

5. Implications, limitations, and recommendations

The findings regarding the effectiveness of the ATNC program in improving knowledge and skill in the ED can benefit nurses. Emergency nurses should be trained in the ATNC program to improve practice in the field of clinical treatment for multiple injuries triage, additionally, emergency nurses should retrain on the multiple injuries triage program regularly to assess and raise their level of skill every two years.

For limitation, the insufficient budget and equipment shortage faced by the Palestinian ministry of health prevented it from repeating the ATNC program. In addition, one of the requirements for applying to the hospital's ATNC program was the shortage of emergency nurses and the conflict with Israel. The long-term sustainability of the ATNC programme faces several limitations; one key challenge is skill attrition, as emergency nurses may gradually lose proficiency without regular practice or refresher courses. Additionally, staff turnover can diminish the program's lasting impact, as trained personnel may leave, requiring constant retraining of new staff. Variations in clinical environments and resource constraints can also hinder the consistent application of ATNC skills, reducing their effectiveness in different settings. Furthermore, without ongoing support, follow-up evaluations, or updates to the program, the training may become outdated or less relevant as healthcare practices evolve. These factors collectively pose a challenge to maintaining the long-term benefits of the ATNC program.

For recommendation, future RCT research may investigate the program's effectiveness on multiple injuries triage results, such as trauma complication, allocation of trauma patients in treatment, and treatment priority. Also, RCT research could include additional dependent variables, such as trauma patient satisfaction and emergency nurses' attitudes. Longer follow-up evaluation periods, such as six-month and 12-month follow-ups, may be considered in future RCT studies to obtain information on the sustainability and maintenance of ATNC program's effectiveness.

Future research could explore the long-term impact of the ATNC program on patient outcomes in various emergency settings and use mixed methods approaches to gain deeper insights into the experiences of emergency nurses. they should also consider demographic factors, such as age and prior experience, that may affect the effectiveness of multiple trauma training. Actionable recommendations for EDs and training institutions include adopting the ATNC program as a standard training protocol for new emergency nurses, focusing on hands-on practice to enhance their confidence and skills. Additionally, establishing partnerships between edu-

6. Conclusion

cational institutions and healthcare facilities could support ongoing professional development and ensure that nurses receive updated training in multiple trauma triage.

The ATNC programme is one of the most effective ways in the ED in the Middle East for nurses to improve their knowledge and skills in multiple injuries triage in the ED. Overall, the mean knowledge and skill scores in the experimental group were a significant mean difference in all stages while in the control group, there was no significant mean difference in some stages. The findings from this study highlight the superiority of the ATNC programme in enhancing the knowledge and skills of emergency nurses compared to the ATCN program. This evidence suggests that implementing the ATNC program more widely could significantly influence future training protocols for multiple trauma triage, leading to improved competency among emergency nursing professionals. As emergency nurses become more adept at managing complex trauma cases, patient outcomes are likely to improve through more effective and timely interventions. The emphasis on hands-on practice followed by theoretical learning in the ATNC program equips nurses with the practical skills to respond to emergencies efficiently.

This shift in training methodology not only fosters a higher level of preparedness in nurses but also enhances the overall quality of care delivered to trauma patients, potentially reducing morbidity and mortality rates in emergency settings. Thus, integrating the ATNC program into ongoing professional development for emergency nurses could play a crucial role in advancing multiple trauma triaging standards and optimizing patient outcomes in the future.

7. Declarations

7.1. Acknowledgement

7.2. Authors' contribution

Conceptualization, methodology, validation, questionnaire design, investigation, data curation, writing-original draft, writing-review editing: KA; Conceptualization, methodology, validation, software, formal analysis, investigation, writing-review editing, supervision, project administration: NA; Conceptualization, methodology, validation, investigation, writing-review editing, supervision, project administration: NA, KA.

7.3. Conflict of interest

None.

7.4. Funding

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