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Is high-fidelity simulation based education effective in enhancing learning and performance among undergraduate medical students?

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ABSTRACT

Background: Simulation is an all-inclusive term about incorporating an educational approach that links a learner to a situated environment for the purpose of learning. The efficacy of simulation in undergraduate medical education is now well established as it reduces the number of safety concerns in managing the patients.-It helps learners to try out and acquire new knowledge and confidence for effective management of patients. The study was done to analyse the effectiveness of high-fidelity simulation (HFS) based education in enhancement of knowledge and performance for management of acute trauma in terms of self-assessment scores.

Methods: It was a pre-test and post-test mediated quasi-experimental time series study which involved 347 undergraduate medical students. During simulation sessions, students were divided into groups and their acquisition of knowledge and performance were evaluated individually with self-assessed pre-test and post-test scores. Mean, Standard Deviation and Standard Error of Mean were used for quantitative analysis and Repeated Measure of Analysis of Variance (ANOVA) was used for comparison. Friedman test was used for assessment of individual components in simulation. The scores were compared to note the difference in knowledge and performance. P value < 0.001 was considered to be statistically significant.

Results: The study showed that learning and performance had progressively improved with each session of simulation in the management of acute trauma.

Conclusion: Students' self-assessment showed that HFS based education had made a difference with enhancement of knowledge and performance over time in the management of acute trauma.
Key words: High-fidelity simulation (HFS), simulation in healthcare, simulation based medical education, high fidelity simulators, high fidelity mannequins, simulation assessment.

1. INTRODUCTION

The healthcare systems around the world demand newly certified doctors to have sufficient knowledge, skills and attitudes in order to be 'fit for practice' [1]. Nowadays, the practice of medicine has become more complicated as residents are getting less work experience due to fewer patients in the wards. One of the effective strategies of simulation in healthcare education is to improve patient safety through proper training [2]. Research has shown that simulation training results in long-term retention of increased knowledge, skills and confidence with the benefit of reduced anxiety [3]. Medical simulation exposes the learners to participate in high-stake situations where they can practice under controlled atmosphere. This helps them to develop effective coordination and communication skills for working in a team [4]. The paucity of real patients and short clinical rotations are always a constraint for the learners in acquiring adequate knowledge and training in high-risk, low-incidence clinical scenarios [5]. This shortcoming may be mitigated with integrated teaching methods using high-fidelity simulators, if acknowledged standards are followed [6]. HFS based teaching imitates the physiological parameters of real patients that helps the students for giving and receiving feedback on repetitive actions and consequently allows the transformation from theoretical knowledge to life-like experience within a safe learning environment [7]. The ever-changing technological advancements of high-fidelity simulators have helped in the assessment and improvement of knowledge and performance in a variety of acute clinical settings [8,9]. A recent study has demonstrated the importance of HFS based education across a broad range of acute care settings by incorporating the latest evidences on its impact on education and patient care [10]. A study by Kodikara K.G et al. (2020) demonstrated that HFS may provide a conducive atmosphere for an appropriate educational experience to learn medical emergencies and a great opportunity of translating theory into practice [11]. HFS has demonstrated that students' learning outcomes in the form of self-confidence, knowledge and performance have enhanced by means of deliberate practices, engaging them in gradually augmented difficult tasks and providing feedback [12]. HFS based teaching is an efficient educational method that complements conventional medical education in acute care settings [13]. It has become an essential teaching-learning tool in medical education as it provides the opportunity to participate in acute care settings in a controlled environment without any risk to the patient or learner [10,12,14,15]. HFS based educational model may help to bridge the actual gaps between conventional medical education, other teaching-learning methodologies, technological advancement, and learning outcomes [16]. There are some studies that documented the importance of HFS in enhancing learning outcomes of medical students, but most of them had a smaller number of participants. In this context, our study was set to explore the best available evidence on the incorporation and application of HFS based education in the management of acute trauma and evaluating its effectiveness in terms of improvement of knowledge and performance by students' perception and self-assessment. The study involved 347 final year under-graduate medical students to overcome the bias of small sample size. We had analysed several factors in the use of simulation with ultimate aim is to define how it may benefit the students in real life.

2. MATERIALS AND METHODS

Type of study and General Design: Quasi-experimental time series design with pre-test and post-test interventional study.

Eligibility criteria for the participants:

Inclusion criteria: The final year undergraduate medical (Bachelor of Medicine and Bachelor of Surgery - MBBS) students at our institute who had consented to participate in the study.

Exclusion criteria: Students who refused to participate in this study.

Study population and Sample size: G*Power 3.1 analyses indicated that a sample size of 340 participants would allow detection of moderate effect size of 0.25 on a F-test with a power of 0.90 for one-way repeated measure ANOVA [17].

The total number of students enrolled in the study was 375. The proportion of students who had completed the training course was 347 (92.53%). The number of students dropped out from the study was 26 (6.93%). Two students (0.54%) declined to participate in the study.

Study area: Clinical Skills and Simulation Lab of ours institute.

Study period: October 2015 to September 2017 (24 months).

Intervention: A fully wireless and tether-less, adult High-Fidelity Simulator (HFS) with modelled physiology named METIman Pre-Hospital (Serial number: MMP-0418; CAE Healthcare, USA) was used for the training sessions.

Methods: Before the main study, a pilot study was done with 50 students. It was conducted to explore the time management, feasibility, acceptability, and validation of the questionnaires for assessment of enhanced knowledge and performance in terms of students' perception. In the first week of the surgical posting, informed consent was taken from the final year students who volunteered to take part in our study. For each session, a group of 12 to 15 students were enrolled who were further divided into three teams of 4 to 5 students each to participate in the training course. On the first day of each session, all the participants were briefed on the course, learning objectives, simulation sessions and expected learning outcomes. The Advanced Trauma Life Support (ATLS) is the standardized protocol for the management of trauma and therefore, we adopted its principles during our study. The objective of the study was to assess students' perception about the effectiveness of HFS in enhancing knowledge and performance in managing trauma following ATLS guidelines. The enhancement in knowledge and performance as perceived by the students in the management of acute trauma (hypovolaemic shock, tension pneumothorax and head injury) after engaging the students in three sessions of HFS was the expected learning outcome. As a part of the briefing process, the participants were apprised about the confidentiality of the HFS sessions and the ethical issues involved. They were explained about the environment and the functions of the high-fidelity simulator to avoid undue stress caused by unfamiliar settings of the simulation sessions. An assurance was given to the students that the training course was not part of the evaluation process for the surgical curriculum. After briefing, a validated set of self-assessment questionnaire (Pre-test) was used for evaluation of participants' baseline knowledge and perception of prior simulation performance experience on the management of acute trauma following the principles of ATLS. It was immediately followed by an interactive lecture delivered by an investigator on the management of acute trauma (hypovolemic shock, tension pneumothorax and head injury) following ATLS protocol. All the three teams of that group then participated in the first simulation session, one team after another on the same day. The time allocated for each simulation session was as follows: Pre-brief (10 minutes), Simulation (20 minutes) and Debriefing (20 minutes). The same teams then participated in the second simulation session after 1 week and in the third simulation session after 3-4 weeks' time from the second simulation session. A thorough debriefing was conducted after completion of each simulated session. The HFS scenarios were standardized among all students. The goals were also identical for all the participants. The investigators constructed the standardized scenarios after arriving at a consensus following detailed discussion. These scenarios were then implemented in the pilot study. After reviewing the feedback from the pilot study, the HFS scenarios were finalized for use in the main study.

The individual students' perception of improvement in their short-term to medium-term retention of knowledge and performance on the management of acute trauma after completion of each HFS session was assessed by using the validated self-assessment questionnaires (Post-tests) which were identical as that of Pre-test questionnaire.

Therefore, the participants' perception of knowledge improvement was assessed four times (Pre-test simulation knowledge assessment, Post-test simulation knowledge assessment I, Post-test simulation knowledge assessment II and Post-test simulation knowledge assessment III). Similarly, the participants' perception of improvement in simulation performance was assessed four times (Pre-test simulation performance assessment, Post-test simulation performance assessment I, Post-test simulation performance assessment II and Post-test simulation performance assessment III).

The self-assessment knowledge questionnaire contained four items which were used to compare the progress in knowledge as perceived by the participants. We used an ordinal scale (1 to 5) to rate the self-assessment as follows: No knowledge (1), Poor knowledge (2), Average knowledge (3), Good knowledge (4) and Excellent knowledge (5).

The self-assessment simulation performance questionnaire contained twelve items, and the briefing and debriefing questionnaire contained four items which were used to compare the progress in performance as perceived by the students. It was an ordinal scale (1 to 5) used by the participants to rate the assessment as follows: Strongly disagree (1), Tend to disagree (2), Neither agree or disagree (3), Tend to agree (4) and Strongly agree (5).

The self-assessment questionnaires were developed by our faculty based on the principle of Modified Simulation Evaluation Test (SET-M) as described by Leighton K et al. (2015) [18]. We checked the content and the face validity of all the questionnaires. The validation was done by six experts in the field of medical education who reviewed the items and rated on their suitability, clarity, and relevance. The questionnaires were then administered to 50 final year medical students as a part of the pilot study to test its feasibility. The students who had participated in the pilot study were excluded from the main study. Based upon the experts' feedback and the outcome of the pilot study, the questionnaire sets were finalized for use in the main study. For internal consistency, Cronbach's alpha coefficient of the questionnaires was calculated. It was 0.872 and 0.880 for the knowledge assessment questionnaire and the simulation performance assessment questionnaire respectively.

Data Analysis:

For data entry Microsoft Excel and for data analysis SPSS software (SPSS Inc. Released 2009. PASW Statistics for Windows, Version 18.0. Chicago: SPSS Inc.) were used. The values for descriptive statistics such as frequency and percentage for categorical data, mean and standard deviation for total score of knowledge and simulation performance assessments were calculated. Median, 1st quartile (Q1) and 3rd quartile (Q3) were calculated for each individual item in knowledge and simulation performance assessments. The one-way repeated measure ANOVA with Bonferroni post-hoc analysis was applied to determine the statistically significant difference in total scores of both knowledge and simulation performance assessments. Friedman test was applied to determine the statistically significant difference in individual items of knowledge and simulation performance assessments. P value < 0.001 was considered to be statistically significant.

3. RESULTS

Table 1 demonstrates the total scores of knowledge assessment that were progressively increased from 7.99 (SD 3.28) at pre-test knowledge assessment to 11.66 (SD 2.92) at post-test knowledge assessment I, 12.52 (SD 2.89) at post-test knowledge assessment II and 13.33 (SD 2.84) at post-test knowledge assessment III. The assumption of sphericity had been violated [$\chi^2(5) = 80.492$, $p < 0.001$] in Mauchly's test of sphericity. The one-way repeated measures ANOVA was corrected by the application of Greenhouse & Geisser method. The total score of knowledge was significantly increased over time, F (2.48, 679.79) = 257.52, $p < 0.001$. Post-hoc analysis with Bonferroni adjustment showed that total scores in knowledge assessment were significantly different ($p < 0.001$) in between the sessions as shown in Table 2. Table 3 showed that there was statistically significant difference ($p < 0.001$) in scores of individual items in knowledge assessments (Friedman test). The one-way repeated measures ANOVA with Bonferroni post-hoc analysis was conducted to determine whether there was a statistically significant difference in simulation performance assessment over time during the simulation sessions. Table 4 demonstrates that the differences in total scores of simulation assessments at pre-test simulation performance assessment (Pre-test SPA), post-test simulation performance assessment I (Post-test SPA I), post-test simulation performance assessment II (Post-test SPA II) and post-test simulation performance assessment III (Post-test SPA III) were statistically significant ($p < 0.001$). Mauchly's test of sphericity indicated that the assumption of sphericity had been violated [χ^2 (5) = 11.776, $p = 0.038$]. Greenhouse & Geisser method was used to correct the one-way repeated measures ANOVA. The total score of simulation performance assessments was significantly increased over time, F (2.92, 784.88) = 1272.33, $p < 0.001$. It was increased from 30.12 (SD 5.19) at Pre-test SPA to 52.75 (SD 7.59) at Post-test SPA I, 52.19 (SD 7.06) at Post-test SPA II and 52.35 (SD 7.57) at Post-test SPA III. Post-hoc analysis with Bonferroni adjustment for simulation performance assessments revealed that Pre-test SPA score was significantly different ($p < 0.001$) from Post-test SPA I, Post-test SPA II and Post-test SPA III scores, but there were no statistically significant differences in simulation performance scores between Post-test SPA I when compared with Post-test SPA II and Post-test SPA III scores. Also, there was no statistically significant differences in simulation performance scores between Post-test SPA II when compared with Post-test SPA III scores (Please see Table 5). Friedman test of simulation performance assessments for individual items revealed that there were significant differences of assessment scores over time in items A2, A4, A5, A6, A7, A8, A10, A11, A12 and B1 as shown in Table 6.

4. DISCUSSION

The studies on HFS have identified the benefits of this modality of teaching ~~in~~ learning and evaluating knowledge and skills of medical students, but a lack of standardized and validated methodologies has resulted in heterogeneous findings [10]. Overall, the results of our study showed that HFS based education had created a conducive atmosphere and demonstrated enhanced learning and performance as perceived by the students. Learning had significantly improved with each session of HFS and students' attitudes were supportive of this innovative teaching method. This is consistent with the findings of Ruokamo H et al. (2017) [19]. Most of the students had agreed that the level of HFS sessions was appropriate to their initial background knowledge though not statistically significant. Their perception of HFS sessions being similar to real life conditions were in accordance with the findings of a study done by Founds SA et al. (2011) [20]. HFS sessions resembled real life situations which helped them to think quickly and made them confident of managing a trauma scenario which was consistent with the findings of Really A et al. (2007) [21]. One of the feedbacks from the students was regarding limited time of the simulation sessions which was taken care of by increasing the simulation session time in our later studies. There was improvement in knowledge with HFS as perceived by our students which corroborates to the findings of Cortegiani A et al. (2015) [22]. Their study demonstrated that HFS had a beneficial effect on knowledge acquisition in medical students. The same was echoed in another study by Massoth C et al. where the participants showed a significant enhancement of knowledge in the post-test as compared to the pre-test [23]. The participants' scores on the post-test after HFS had improved considerably [24,25]. HFS demonstrated higher performance scores in response to a self-report post-test questionnaire and the learners indicated a more positive attitude toward the sessions, particularly about its responsiveness and realism [26]. This was also reflected in our study. A key issue for safe and effective patient care is teamwork. Efficient teamwork is very important for providing optimal patient care in acute care settings. This has a positive effect on knowledge acquisition that may lead to better patient outcome [24,27,28]. Similarly, our participants enjoyed working in a team that resulted in enhanced performance with improved learning outcome. There was a generalized consensus among our students that HFS sessions were enjoyable which encouraged their active participation. They also wanted further sessions for better understanding of clinical problems and acquisition of knowledge. There were two main areas of concern in the findings of our study: "Clinical management more easily learned" was not agreed by the students ($p < 0.996$). It demonstrated that HFS did not necessarily help in better understanding of management of clinical problems. The second area of concern was the ineffective debriefing sessions. Though the time for pre-brief was adequate, the students felt that time for debriefing was inadequate and ineffective debriefing style was a hindrance to better learning outcome. This is an area of utmost concern and we admit our deficiency in the debriefing process which is absolutely crucial for better learning outcome. We had taken steps to overcome this important shortcoming to avoid its further recurrence in our future endeavors.

Limitations of this study: An individual's perception is highly subjective and likely to vary among the participants. These assessments are particularly hard to blind as the evaluation of the learning outcomes was mostly done by comparing the scores of self-assessment pre-tests and post-tests. There is likelihood of unmeasurable confounding factors and selection bias could be present due to volunteer nature of the inclusion criteria. Finally, this was a single centre study and only final year medical students had participated, and as such the findings may not be applicable to other settings.

5. CONCLUSION

HFS based medical education is a feasible option for teaching undergraduate medical students in a wide variety of specialized acute settings. At present there is limited evidence to prove the efficacy of HFS based education on patient outcomes, its sustainability and cost-effectiveness. Our study design does not allow to extrapolate the findings to match with real practice but based on the understanding of students' perceptions about enhanced knowledge and performance with HFS, we conclude that this pedagogical methodology has a lot of potentials for further improvement which may be adjusted to the needs of the students. It remained unclear whether the enhancement of learning and performance acquired with this teaching methodology would translate into improved patient care.

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TABLES AND FIGURES

Table 1: Knowledge assessment (total score) at pre-test simulation assessment, post-test simulation assessment I, post-test simulation assessment II and post-test simulation assessment III.

Assessment	Knowledge Assessment (total score)		P value
	Mean	(SD)	
Pre-test simulation knowledge assessment	7.99	(3.28)	< 0.001*

Post-test simulation knowledge assessment I	11.66	(2.92)	
Post-test simulation knowledge assessment II	12.52	(2.89)	
Post-test simulation knowledge assessment III	13.33	(2.84)	
[a] One-way repeated measure ANOVA			* Significant

Figure 1: Knowledge assessment (total score) at pre-test simulation assessment, post-test simulation assessment I, post-test simulation assessment II and post-test simulation assessment III.

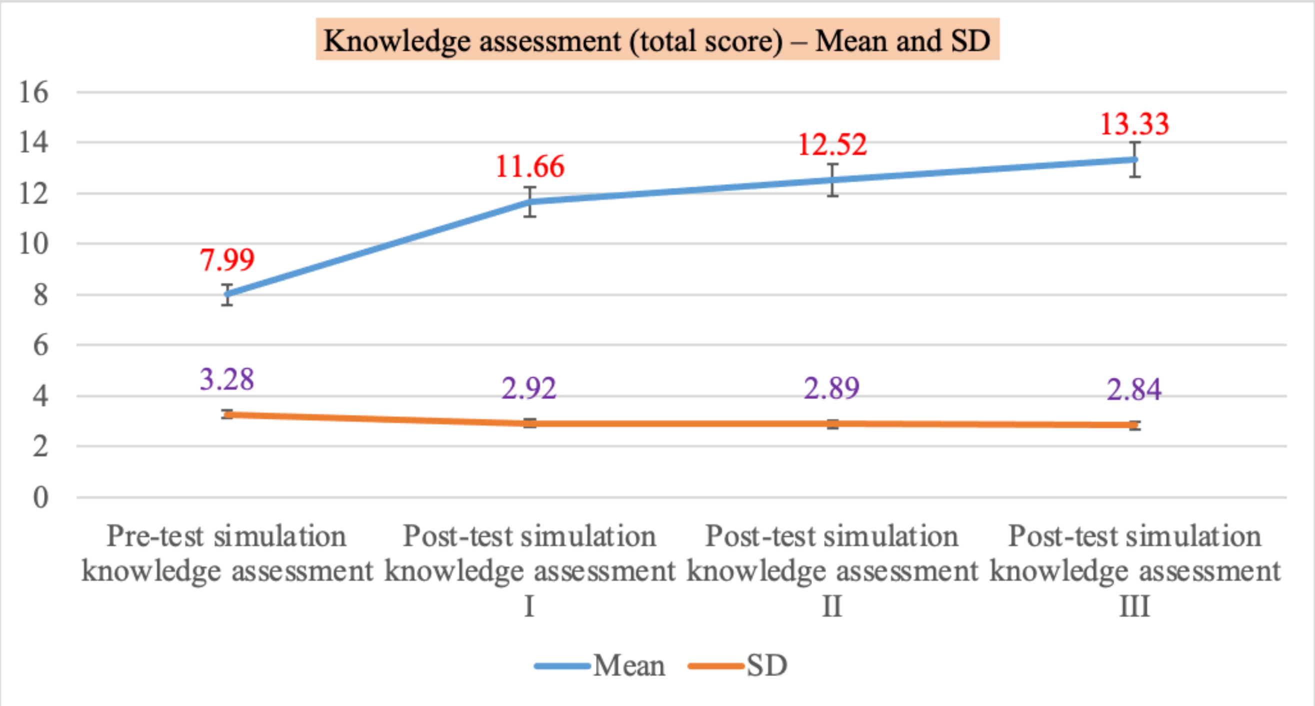

Table 2: Pairwise comparison of knowledge assessment (total score) with Bonferroni adjustment.

Assessment		Knowledge Assessment Mean difference - (95% confidence interval)	P value
Pre-sim[a]	Post-sim I[b]	-3.66 (-4.23, -3.10)	< 0.001*
	Post-sim II[c]	-4.52 (-5.16, -3.89)	< 0.001*
	Post-sim III[d]	-5.33 (-5.99, -4.67)	< 0.001*
Post-sim I[b]	Post-sim II[c]	-0.86 (-1.36, -0.35)	< 0.001*
	Post-sim III[d]	-1.65 (-2.15, -1.18)	< 0.001*

Post-sim II[c]	Post-sim III[d]	-0.81 (-1.24, -0.39)	< 0.001*

[a] Pre-test simulation knowledge assessment
[b] Post-test simulation knowledge assessment I
[c] Post-test simulation knowledge assessment II
[d] Post-test simulation knowledge assessment III

* Significant

Table 3: Knowledge assessment (individual item)[1] at pre-test simulation assessment, post-test simulation assessment I, post-test simulation assessment II and post-test simulation assessment II.

Knowledge Assessment Item	Knowledge Median (Q1, Q3)				P value
	Pre-sim[a]	Post-sim I[b]	Post-sim II[c]	Post-sim III[d]	
The ATLS protocol for management of acute trauma	3.0 (2.0, 3.0)	3.0 (3.0, 4.0)	4.0 (3.0, 4.0)	4.0 (3.0, 4.0)	< 0.001*
The management of Hypovolemic Shock	3.0 (2.0, 3.0)	4.0 (3.0, 4.0)	4.0 (3.0, 4.0)	4.0 (4.0, 4.0)	< 0.001*
The management of Tension Pneumothorax	3.0 (2.0, 3.0)	4.0 (3.0, 4.0)	4.0 (3.0, 4.0)	4.0 (4.0, 4.0)	< 0.001*
The management of Head Injury	2.0 (2.0, 3.0)	3.0 (3.0, 4.0)	3.0 (3.0, 4.0)	4.0 (3.0, 4.0)	< 0.001*

1 - No knowledge.
2 - Little knowledge
3 - Average knowledge
4 - Good knowledge
5 - Excellent knowledge

[a] Pre-test simulation assessment
[b] Post-test simulation assessment I
[c] Post-test simulation assessment II
[d] Post-test simulation assessment III

[1]Friedman test

* Significant

Table 4: Simulation performance assessment (total score)[a] at pre-test simulation performance assessment, post-test simulation performance assessment I, post-test simulation performance assessment II and post-test simulation performance assessment III.

Assessment	Skills Assessment (total score)		P value
	Mean	(SD)	
Pre-test simulation performance assessment	30.12	(5.19)	< 0.001*
Post-test simulation performance assessment I	52.75	(7.59)	
Post-test simulation performance assessment II	52.19	(7.06)	
Post-test simulation performance assessment III	52.35	(7.57)	

[a] One-way repeated measure ANOVA

* Significant

Figure 2: Simulation performance assessment (total score) at pre-test simulation performance assessment, post-test simulation performance assessment I, post-test simulation performance assessment II and post-test simulation performance assessment III.

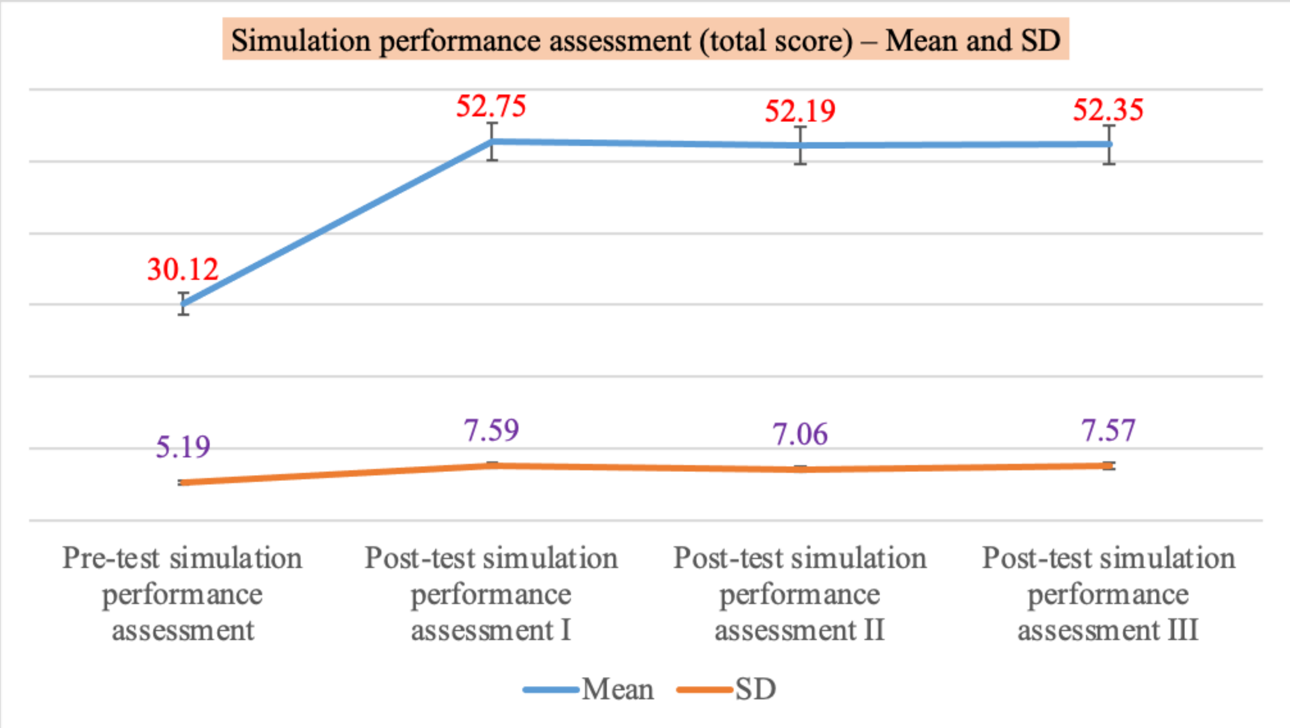

Table 5: Pairwise comparison of simulation performance assessment (total score) with Bonferroni adjustment.

Assessment		Knowledge Assessment Mean difference - (95% confidence interval)	P value
Pre-sim[a]	Post-sim I[b]	-22.63 (-23.81, -21.45)	< 0.001*
	Post-sim II[c]	-22.06 (-23.20, -20.92)	< 0.001*
	Post-sim III[d]	-22.23 (-23.47, -20.98)	< 0.001*
Post-sim I[b]	Post-sim II[c]	0.57 (-0.54, 1.68)	0.999
	Post-sim III[d]	0.40 (-0.97, 1.67)	0.999
Post-sim II[c]	Post-sim III[d]	-0.16 (-1.26, 0.94)	0.999

* Significant

[a] Pre-test simulation performance assessment
[b] Post-test simulation performance assessment I
[c] Post-test simulation performance assessment II
[d] Post-test simulation performance assessment III

Table 6: Simulation performance assessment (individual item)[1] at pre-test simulation performance assessment, post-test simulation performance assessment I, post-test simulation performance assessment II and post-test simulation performance assessment II.

	Assessment Item	Pre-sim[a]	Post-sim I[b]	Post-sim II[c]	Post-sim III[d]	P value
		Median (Q1, Q3)				
		1 - strongly disagree 2 - tend to disagree 3 - neither agree or disagree 4 - tend to agree				
A1	The session level was appropriate to my present level of knowledge and	4.0 (3.0, 4.0)	4.0 (4.0, 4.0)	4.0 (4.0, 4.0)	4.0 (4.0, 4.0)	0.018*
A2	It encouraged my active participation	4.0 (4.0, 4.0)	4.0 (4.0, 5.0)	4.0 (4.0, 5.0)	4.0 (4.0, 5.0)	< 0.001*
A3	Clinical management more	4.0 (4.0, 5.0)	4.0 (4.0, 5.0)	4.0 (4.0, 5.0)	4.0 (4.0, 4.0)	0.470
A4	The training session resembled a real-life	4.0 (4.0, 5.0)	4.0 (4.0, 5.0)	4.0 (4.0, 5.0)	4.0 (4.0, 4.0)	< 0.001*
A5	It helps me to think quickly	4.0 (4.0, 5.0)	4.0 (4.0, 5.0)	4.0 (4.0, 5.0)	4.0 (4.0, 4.0)	< 0.001*
A6	Repetition of the scenario during training is essential	4.0 (4.0, 5.0)	4.0 (4.0, 5.0)	4.0 (4.0, 5.0)	4.0 (4.0, 5.0)	< 0.001*
A7	The training session was enjoyable	4.0 (4.0, 5.0)	4.0 (4.0, 5.0)	4.0 (4.0, 5.0)	4.0 (4.0, 5.0)	< 0.001*
A8	It helps me to work in a team	3.0 (2.0, 3.0)	2.0 (2.0, 4.0)	2.0 (2.0, 4.0)	2.0 (2.0, 4.0)	< 0.001*
A9	Time for the scenario was adequate	-	4.0 (3.0, 4.0)	4.0 (3.0, 4.0)	4.0 (4.0, 340)	0.205
A10	I want to have further sessions on the simulator	-	5.0 (4.0, 5.0)	4.0 (4.0, 5.0)	4.0 (4.0, 5.0)	< 0.001*
A11	I feel that simulation is essential to train in	-	5.0 (4.0, 450)	4.0 (4.0, 5.0)	4.0 (4.0, 5.0)	< 0.001*
A12	I am confident of managing a trauma scenario in real life	-	3.0 (3.0, 4.0)	4.0 (3.0, 4.0)	4.0 (3.0, 4.0)	< 0.001*
	Briefing and Debriefing:					
B1	Time for pre-briefing was	4.0 (4.0, 5.0)	4.0 (3.0, 4.0)	4.0 (4.0, 4.0)	4.0 (4.0, 4.0)	< 0.001*

B2	Time for debriefing was adequate	-	4.0 (3.0, 4.0)	4.0 (4.0, 4.0)	4.0 (4.0, 4.0)	0.007
B3	Debriefing helped me to learn better	-	4.0 (4.0, 4.0)	4.0 (4.0, 4.0)	4.0 (4.0, 4.0)	0.225
B4	The debriefing style was effective	-	4.0 (3.0, 4.0)	4.0 (4.0, 4.0)	4.0 (4.0, 4.0)	0.296

[a] Pre-test simulation performance assessment [1]Friedman test
* Significant
[b] Post-test simulation performance assessment I
[c] Post-test simulation performance assessment II
[d] Post-test simulation performance assessment III

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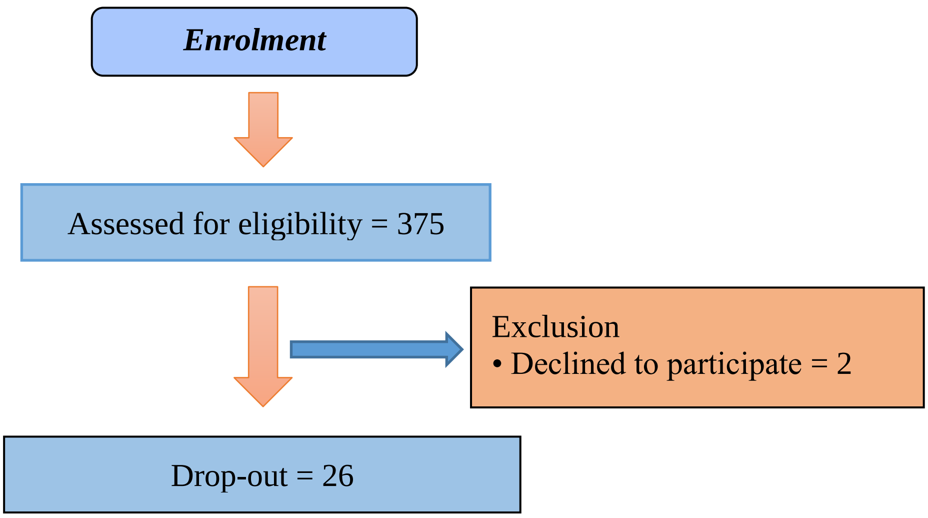
ETHICAL CONSIDERATIONS

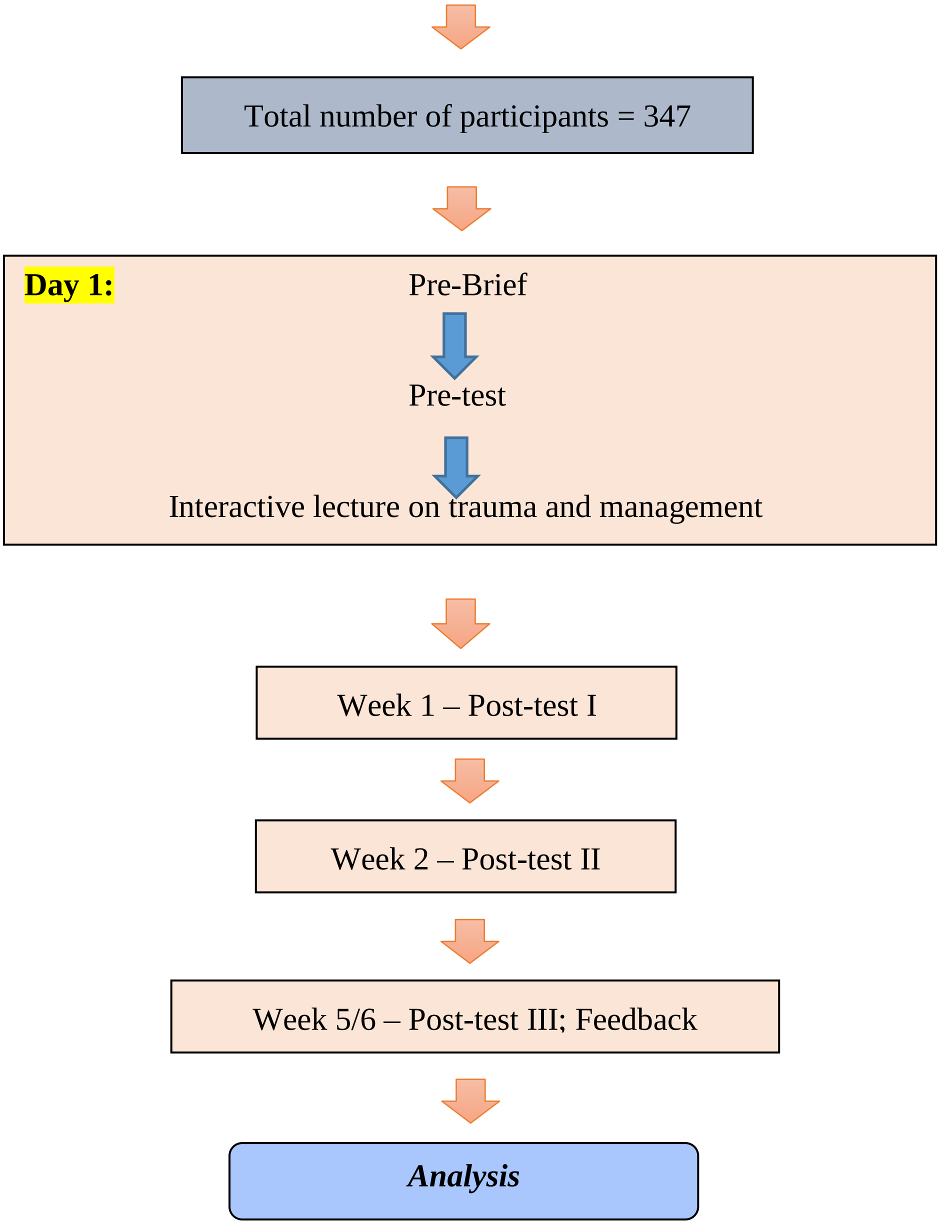
Ethical approval was obtained from the Ethical Committee / IRB of our institute. Informed consent was taken from all the participants. All information about the participants were kept confidential.

DECLARATION OF INTEREST

The researchers had not received any specific grant from funding agencies in the public, commercial, or not-for-profit sectors or elsewhere to conduct this study and had no conflicts of interest.

Appendix: FLOW CHART.




Total number of participants = 347
Day 1:
Pre-Brief
Pre-test
Interactive lecture on trauma and management
Week 1 – Post-test I
Week 2 – Post-test II
Week 5/6 – Post-test III; Feedback
Analysis