EVALUATING THE IMPACT OF HYBRID SIMULATION IN ENHANCING THE LEARNING DOMAINS OF MEDICAL UNDERGRADUATES: A QUASI-EXPERIMENTAL STUDY

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INTRODUCTION

Medical education is a complex and dynamic field that requires a thorough understanding of physiological processes and clinical application, faces limitations in traditional methods. Simulation-based training addresses this gap, providing a secure environment for hands-on skill practice. The objectives of the study are to (1) evaluate the impact of simulation on enhancing the learning domains of medical undergraduates and (2) gauge students’ perceptions of simulation-based medical education (SBME) through a pre-validated, pre-designed questionnaire.

Methods: A quasi-experimental study, involving 60 medical undergraduates, selected by convenient sampling. The study began after obtaining approval from the Institutional Human Ethics Committee and obtaining informed consent from students. A pre-test was conducted for all 60 students followed by a lecture on simulation and then a post-test. The students were then divided into two groups: Group A – SBME using part-task trainers and standardized patients and Group B – (non-SBME) with video lectures on simulation. After 1 month, an assessment of all domains, namely cognitive, affective, and psychomotor, was done by post-test and objective structured clinical examination, respectively. Perception was obtained using the pre-validated questionnaire.

Results: The assessment scores of all domains of Group A (SBME) showed significant improvement p<0.05 except cognitive domain.

Conclusion: SBME is an effective teaching method for improving the learning domains of medical undergraduates.

Keywords: Hybrid simulation, Learning domain, Medical undergraduate, Perception.
2. Gauge students’ perceptions of simulation-based medical education (SBME) through a pre-validated, pre-designed questionnaire.

Intervention
Video lecture versus simulation.

Outcome measures
Pre-test and post-test score after the video lecture and after simulation for the cognitive domain.

Affective and psychomotor skill assessment using objective structured clinical examination (OSCE) checklist.

The perception of the students was gauged using a pre-designed pre-validated questionnaire.

METHODS

This quasi-experimental study conducted at a tertiary medical center, involving 2nd-year MBBS students as the subjects. Convenient sampling utilized to select a sample size of 60 participants who met the inclusion criteria of providing consent for participation. Exclusion criteria included, students who were absent on the days of the study.

The study focused on demographic variables such as age and sex, as well as outcome variables comprising pre-test and post-test scores, along with OSCE checklist scores. Data collection took place from August 20th to September 20th, 2022.

To collect data, pre-test and post-test assessments administered to evaluate students’ knowledge levels. In addition, skills were assessed using the OSCE method, utilizing a standardized checklist of basic life support procedures. Furthermore, a pre-validated and pre-designed questionnaire was distributed to gather additional information related to the study variables.

Overall, this methodology aimed to systematically investigate the impact of certain interventions on the knowledge and skills of 2nd-year MBBS students within the specified study duration.

Data collection procedure
The study began after obtaining approval from the Institutional Human Ethics Committee. (Annexure: I). Informed consent was taken from the students for both audio and video recording and its publication (Annexure: II). Pre-test was conducted for all 60 students followed by a lecture on SBME. Post-test-I was conducted for both groups to assess the cognitive domain (Table 1).

The students were then divided into two groups. One group controls and the other group undergoes simulation practices. Group A students underwent training in simulation, which included SP and manikins, and Group B students (control) received video lectures. Post-test-II was conducted for both groups after their sessions either in simulation or video lectures, to assess the cognitive domain. Attitude and psychomotor domain assessment of both groups were done by OSCE using the standard checklist for cardiopulmonary resuscitation (CPR) (Annexure: III). For observing uniformity in assessment, the skill of the students only in CPR was taken for this study. At the end of the study, the perception of the students was obtained using a pre-validated pre-designed questionnaire.

RESULTS

Sixty medical undergraduates participated in the study. For analysis, statistical significance was considered for a confidence interval of 95% or p<0.05. The mean scores of the pre-test and post-test were analyzed using a non-parametric test, the Wilcoxon signed-rank test (Table 2).

The post-test score was significant p<0.001 compared to the pre-test score (Fig. 1).

Analysis of the mean of the post-test score of the two groups compared by Mann–Whitney U test. The increase in the cognitive domain in SBME group after the intervention was not significant, p=1.11 (Fig. 2).

However, after SBE, the post-test score (cognitive domain) increased from 20.11 to 20.88 (intervention group) but for the control group, there was a reduction from 19 to 17.23 (Fig. 3). Psychomotor skill assessment score of both groups analyzed using independent t-test. In the skill assessment between the groups, SBME group showed a significant improvement in the score p=0.0001 (Fig. 4). From the perception of the students, 49% had the opinion that simulation supports the development of clinical skills and 40.8% opined simulation-based learning (SBL) should be integrated into the medical education curriculum. However, 32.7% had the opinion that constant usage of SBL will lead to deterioration of communication skills with real patients (Table 3).
Non-parametric tests were used in all analyses as the values did not follow normal distribution. Normality tests were done using SPSS using the tests Kolmogorov–Smirnov and Shapiro–Wilk.

**DISCUSSION**

Hybrid simulation can be as effective as high-fidelity simulators in certain training scenarios [9]. According to Scalese et al. [10], SBE allows trainees to hone their skills in a risk-free environment. Large-scale, multiple-modality, hybrid simulation during medical student field training by Goolsby and Deering [11] is an achievable educational model with positive learning outcomes and student satisfaction. The findings of the study by Oh et al. [12] suggest that simulation-based learning using SPs might have a positive impact on self-efficacy and learning motivation that affects knowledge and clinical skill acquisition. In our study, improvement in cognitive domain was not significant. However, when the post-test scores (cognitive) of Group A after the hybrid simulation were analyzed, apparent improvement in the cognitive domain was shown after the hybrid simulation. However, on statistical analysis by Mann-Whitney U test, it was found to be insignificant p=0.917.

Some studies done elsewhere suggest that simulation-based learning is effective in enhancing affective learning, improving self-assessment abilities, and promoting students’ achievement outcomes [13-16]. Hybrid simulation has been shown to improve psychomotor domain skills in medical students during emergency medicine clerkship [17,18]. There are studies which suggest that simulation-based learning is effective in improving psychomotor skills, decreasing anxiety, and increasing self-efficacy and learning motivation in various educational settings.
settings [19]. A hybrid model for teaching pediatric and gynecology examination is feasible and greatly accepted by the trainees. Such a model of training can improve trainees’ skills. It could be potentially used in teaching more difficult procedures [20].

Our study also confirmed the improvement in psychomotor skills of the students when the hybrid simulation was used for learning (Figs. 5-7).

Simulation-based learning helped in the development of clinical skills, even SBL minimized the stressful learning environment and improved the confidence of the students in acquiring better psychomotor skills. This innovative approach has notably heightened the affective and psychomotor competencies of aspiring medical students. Proficiency in psychomotor skills is particularly vital for primary care physicians who serve as the initial point of contact for patients seeking medical assistance.

Limitation

- Period of the present study was shorter: If simulation-based learning is integrated into the medical education curriculum, the outcome will be better
- Initial investment for acquiring manikins is on the higher side but there will be a notable impact on skill development in the long run
- It takes much time for giving simulation training to each student. Furthermore, training a person to function as a SP also will take time in the early stages. If there is an increase in the faculty strength, this also can be overcome.

CONCLUSION

SBME is an effective teaching method for improving the learning domains of medical undergraduates, especially the affective and psychomotor skills.

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee, Karuna Medical College, Palakkad, Kerala, India (IHEC No. KMCH/ IHEC/11/2022).

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AUTHORS’ CONTRIBUTION

Regina Roy contributed to the conceptualization, methodology, formal analysis of the data, validation of the study and writing of the original draft. Indla Ravi contributed to the data collection, supervision, review, and editing of the manuscript. Thangam C. contributed to the data collection and supervision.