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Nighat Shah
Jinnah Sindh Medical University, Karachi

Lubna Baig
Jinnah Sindh Medical University Karachi

Nusrat Shah
Dow University of Health Sciences, Karachi

Riffat Parveen Hussain
Aga Khan University, riffat.hussain@aku.edu

Syed Moyn Shah
College of Medicine, Taif University, Saudi Arabia

ORIGINAL ARTICLE

Simulation based medical education; teaching normal delivery on intermediate fidelity simulator to medical students

Nighat Shah,[1] Lubna Baig,[2] Nusrat Shah,[3] Riffat Hussain,[4] Syed Moyn Aly[5]

Abstract

Objective: To assess the effectiveness of medium fidelity simulator in teaching normal vaginal delivery to medical students.

Methods: The quasi-experimental study was conducted at the professional development centre of the Jinnah Sindh Medical University, Karachi, from June to December 2015, and comprised medical students. Third-year medical students were included. They were divided into two groups. Group A was taught normal delivery through traditional PowerPoint and group B through simulator. The instruments used for assessing knowledge were pre-test and post-test, for skills of labour/delivery checklist of performance was used, and perception forms were filled to evaluate workshops/learning environment by students.

Results: Of the 76 participants, there were 36(47.4%) in group A and 40(52.6%) in group B. The overall mean age of the participants was 20.86±0.76 years in group B and 20.60±0.95 years in group A (p=0.19). The mean grade point average of the participants was 2.89±0.47 in group A and 2.87±0.48 in group B (p=0.81).Group B performed much better in skill of delivery having a mean score of 8.91±3.20compared to group A which had mean of 5.67±1.84 (p<0.01).

Conclusion: Simulation-based skill learning showed significantly better results.

Keywords: Simulation, Medical education, Intermediate fidelity, Maternal mortality. (JPMA 67: 1476; 2017)

Introduction

A simulation is a virtual reality, an experience that may reproduce reality events or phenomena.[1] Modern medical education greatly values simulation as it replicates reality without associated risks and harm.[2] Trial and error on human patients is morally and ethically unacceptable. Since the Hippocratic days, the medical mantra stays the same: first, do no harm. The patient safety movement based on research highlights a huge number of avoidable patient injuries due to medical management. This has re-established the principle of "first, do no harm" in policy discussions and debates.[3] Simulation offers a suitable alternative.[4]

Globally, around 289,000 maternal deaths, 2.6 million stillbirths and 2.4 million newborn deaths occur each year, with the majority of them occurring at the time of childbirth. Most maternal and newborn deaths are preventable. There is a need to have health care providers who are well versed in the management of pregnancy and childbirth.[5,6]

[1,2]Appna Institute of Public Health, Jinnah Sindh Medical University, Karachi, [3]Department of Obstetrics & Gynecology, Dow University of Health Sciences, Karachi, [4]Department of Radiology, Aga Khan University Hospital, Karachi, Pakistan, [5]Department of Medical Education, College of Medicine, Taif University, Saudi Arabia.

Correspondence: Nighat Shah. Email: nighat.shah@aku.edu

Preventing maternal and neonatal morbidity and mortality is a universal priority, especially in Pakistan where maternal mortality is second highest in the region at 276/100,000, according to Pakistan Demographic and Health Survey (PDHS) of 2013.[6] All health care providers need to learn the art and science of normal delivery to save precious lives.[7]

Learning delivery is stressful in a labour room and can conflict with the safety of mother/neonate. Furthermore, in our conservative society many women do not generally consent to be examined by male students. Medical simulation has been proposed as a technique to bridge this educational gap.[4]

The current study was conducted to assess the effectiveness of medium fidelity simulator in teaching normal vaginal delivery to medical students.

Subjects and Methods

The quasi-experimental study was conducted at the professional development centre (PDC) of the Jinnah Sindh Medical University (JSMU), Karachi, from June to December 2015, and comprised medical students.

Approval was obtained from the institutional review board (IRB). Two groups of students were compared on their knowledge, skills and perceptions with regards to the traditional and new teaching method. Group A

comprised controls who were taught normal delivery through PowerPoint interactive lecture, while the experimental group B was taught normal delivery on medium fidelity simulator.

JSMU has Sindh Medical College for undergraduate medical education and is affiliated with Jinnah Postgraduate Medical Centre (JPMC), National Institute of Cardiovascular Diseases (NICVD) and National Institute of Child Health (NICH).

Third-year medical students were included in the study.

This study gave equal priority to both male and female students. The only reason there were more females in both groups was that the class had 75% girls. Non-probability, convenience sampling was used. It is important that students who had just started and those who will start rotation in obstetrics and gynaecology (OB/GYN) should be enrolled for the workshops, as the learning will be strengthened in labour ward. The sample was based on the number of medical students available at that time; all medical students who were rotating through the obstetrics and gynaecology clerkship during that time frame were included in the control group. The experimental group students were to be posted in OB/GYN a month later, so that the skill taught on mannequin could be reinforced.

Medical students who had already learnt normal delivery or completed their rotation in OB/GYN were excluded.

This was a medical education intervention study, comparing the most appropriate method of transferring obstetrics delivery skills. In medical education intervention studies, it is not possible to do random sampling because it is not possible to control for the contamination and blinding.

The groups and batches were already made for rotations and as per objective of the study the group which was posted in OB/GYN and the one about to be posted in OB/GYN were asked to participate in the study so that the skills learnt on the simulator were observed and learnt on real patient. Further simulators are resource intense and hands-on practice to transfer skills has to be on limited number of participants for optimum learning.

On the sample size, a study done on evaluating and researching the effectiveness of educational interventions says:

In educational research, especially in postgraduate and continuing medical education, the numbers that can be enrolled in a study may not be large to allow researchers to achieve statistically significant quantitative results.[8]

A study on "surgical skills training: simulation and multimedia combined" had 14 participants in 3 groups.[9]

Another study conducted on the undergraduate inter-professional education using high-fidelity paediatric simulation also had the sample size of 49 participants in each group.[10]

The number of participants in each group in the current study was similar to other studies. A study on vicarious learning during simulations quoted 33 students in each group.[11]

Informed consent was obtained from all participants. The teaching/learning workshops then started with the introduction of faculty and participants. Faculty for the sessions included primary investigator and 2 lecturers. Primary researcher conducted the teaching session. An objective structured clinical examination (OSCE) was conducted by lecturers to reduce bias. The students were introduced to the teaching session for normal delivery, which gave them the brief of process and also informed them that no personal data will be shared. The data generated was analysed and used in aggregate only for research purposes. A pre-test was conducted before the start of the workshop. This test consisted of basic labour delivery knowledge component. It also had some demographic questions like name, age, sex, prior experience of performance of normal delivery and students grade point average (GPA). The questions were based on the stages of labour and management of all three stages of labour. The post-test was the same, because the purpose was to see the change in knowledge.

The workshop in control group started with PowerPoint having essential evidence based information about labour/delivery. It covered global maternal morbidity and mortality data, Pakistan data and then stages of labour and management of the stages of labour. When discussing management, two short videos of steps of delivery were also shown. The session was highly interactive and was paced as per needs of learners.

The experimental group teaching was through simulator. This was through intermediate fidelity simulator, which was partially mechanical and partially manual. On moving the wheel on one side the baby performed the essential second stage rotations and delivered through maternal birth canal mimicking normal birth. The simulator had an anterior view having baby and maternal abdomen (Figure). The students were then exposed to simulator exercise. The students were asked to believe that the simulator was the birthing mother (R) and they were to

interact with this mother as a real patient. They learnt and practised labour and delivery and also communication skills and worked in teams. The students adjusted the movements of simulator as per their own learning and practised till they were fully satisfied.

After this learning workshop, both the groups had to perform skill-based exam to demonstrate their skill. Under direct supervision of faculty, the students had to effectively communicate with virtual patient, which was low fidelity simulator and also perform the steps of normal delivery. This process was marked as per standardised checklist.

In the end, all students filled perception forms. These were standard evaluation forms including, knowledge, procedural skills, and communication skills.

Data collection was through checklist, pre-test and Post-test and students' perception forms of education experience. These instruments were formed after reviewing medical education research literature and expert review for face and content validity.

The data was cross-validated by random checking. SPSS was used for data analysis. Categorical variables were summarised by frequencies and percentages, while for continuous variables means and standard deviation was used. For all statistical analyses, $p \leq 0.05$ was considered significant.

The descriptive categorical variables of the participants (gender, level of experience) were compared for both groups by applying chi-square test. Independent sample t-test was used for comparing descriptive continuous variables (age, 1st-year GPA). Fisher's exact test was applied for categorical variables when there were less than 5 participants in any category. Internal reliability of instrument items was conducted through Cronbach's alpha.

The data analysis was done on SPSS version 20.

Results

Of the 76 participants, there were 36(47.4%) controls in group A and 40(52.6%) in the experimental group B. Overall, 65(85.5%) of them were girls and 11(14.5%) were boys.

The overall mean age of the participants was 20.86±0.76 years in the control group and 20.60±0.95 years in the experimental group (p=0.19). The mean GPA of the participants was 2.89±0.47 in group A and 2.87±0.48 in group B (p=0.81) (Table-1).

The pre- test mean score was 3.33±1.45 in the control and 3.58±1.74 in the experimental group (p=0.51). The mean post-session test scores were 7.11±1.30 and 6.95±1.68 in groups A and B, respectively (p=0.64). The perception forms were scored through Likert scale from 0-5. Both the groups rated teaching experience and environment highly, with the mean score of 91.83±8.46 among controls and 90.45±7.87 in the experimental group (p=0.47). The skill was assessed by checklist/OSCE scores; the experimental group had a mean score of 8.91±3.20 as compared to the control group which had a mean score of 5.67±1.84 (p<0.01) (Table-2).

Table-1: Characteristic of participants (n=76).

Characteristics	Control Group (n=36) Mean±SD	Experimental Group (n=40) Mean±SD	P-value[1]
Mean Age (in years)	20.86±0.76	20.60±0.95	0.19
1st Professional GPA*	2.89±0.47	2.87±0.48	0.81
	n (%)	**n (%)**	**P-value[2]**
Gender			
Male	06 (16.7)	07 (17.5)	0.92
Female	30 (83.3)	33 (82.5)	
Level of Experience*			
Seen Normal Delivery	02 (5.7)	06 (15.4)	0.273
Never seen/performed Delivery	33 (94.3)	33 (84.6)	

*2 students did not answer
1P-value calculated using independent sample t-test.
2P-value calculated using Chi-Square test.
3Fisher's Exact Test.
GPA: Grade point average.
SD: Standard Deviation.

Table-2: Average scores of participants in all components (n=76).

Characteristics	Control Group (n=36) Mean±SD	Experimental Group (n=40) Mean±SD	P-value[1]
Pre-test Total Score	3.33±1.45	3.58±1.74	0.51
Post-test Total Score	7.11±1.30	6.95±1.68	0.64
Check-List Total Score	5.67±1.84	8.91±3.20	<0.01
Perceptions Total Score*	91.83±8.46	90.45±7.87	0.47

1P-value calculated using independent sample t-test.
SD: Standard Deviation.

Discussion

This study on simulation-based medical education determined innovative teaching method of simulation-based medical education (SBME) in obstetrics. The independent variable was teaching methodology,

Figure: Intermediate Fidelity Stimulator in my study.

traditional (PowerPoint presentation) vs. simulation on intermediate fidelity simulator (Power Point plus simulator) and the dependent variables were students' scores in pre-test, post-test, OSCE for skill performance, and students' perception forms.

Our study showed that teaching medical students on simulator provided much better learning experience as compared to controls. This has been shown in other studies as well, including those conducted by Deering et al.[13] and Issenberg et al.,[14] who showed improvement in performance of specific tasks/ skills when learning was conducted on simulator. Simulations are now in wide-spread use in medical education and provide many advantages as compared to didactic teaching/ learning methodology.[12-14] In a teaching process, which is focused on psychomotor processes the didactic or traditional methods of teaching has to be strengthened by hands on practice.[1] Teaching them first line on patients has many dilemmas and literature is now abundant on patient safety priority.[4]

In skill-based studies, the trend has been the same. The study on practice of caesarean section on an obstetrics simulator reported higher levels of confidence in residents regarding their skills to assist caesarean section and perform abdominal closure during caesarean section under minimal supervision.[15]

A growing body of evidence shows that clinical skills acquired in medical simulation laboratory settings transfer directly to improved patient care practices and better patient outcomes. Examples of improved patient care practices linked directly to simulation mostly includes emergency drills in obstetrics include studies of better management of difficult obstetrical deliveries, including shoulder dystocia.[16]

The knowledge component in both groups improved significantly, as checked by pre-test and post-test. In the study by Clark and Paparello, the pre-test and post-test were skill-based and intervention was on simulator. The results of that study demonstrated significant improvement;[17] pre- and post-tests were knowledge-based pen and pencil tests and skill element was checked through practical assessment on low fidelity simulator (OSCE). There are, however, other studies like the one by Jude et al. where the skill was assessed by student's perception forms. The students rated high confidence in skill.[18]

The studies to date have aptly documented the effectiveness of simulation-based learning, especially in neonatal resuscitation and obstetric emergencies like post-partum haemorrhage,[19] eclampsia,[20,21] sepsis, cord prolapse,[22] breech delivery,[23] and shoulder dystocia.[24]

Normal delivery can be complicated by an emergency at any time, especially if it is not performed safely. Maternal morbidity and mortality is unpredictable and is highest during labour / delivery.[25] Skills and drills competency-based training is successful in improving knowledge and skills as seen in current study and international research. The skills and drills are most appropriately conducted by simulation-based education for emergency obstetrics and newborn care. As it allows reflection, trial and error practice, provides feedback and stress free controlled environment.[26]

Simulation is an expensive teaching modality, especially when its conducted for skills and assessment, it's important to conduct vigorous research to justify its routine use and the cost.[27] In index study found profound conceptual change in knowledge, significant difference in task performance along with soft skills like body language and communication skills. One randomised control trial found no difference in scores when comparing video / visual learning to simulation.[28]

In the performance of delivery the components were per-abdominal examination, per vaginal examination, showing the rotations of foetal head, recognising crowing and delivery of foetus. In all these components the experimental group performed much better and the results were statistically significant. This is also shown in many international studies that task performance improves significantly after learning on simulators.[29,30]

The students filled perception forms to evaluate the workshop and learning environment. The experimental group scored highly as is shown by literature as well. Students rate these opportunities of integrated learning

very highly. This included knowledge,[31] skills,[32,33] communication skills, teamwork, faculty support and teaching/leaning environment. Both groups rated it highly.[34,35]

The findings of this study regarding students' positive perceptions of SBME as a teaching strategy are consistent with data reported throughout the medical education literature.[36,37] Additionally, the control group was equal if not better satisfied with teaching session. This could be due to various reasons: firstly, their session was extremely interactive and thought-provoking, secondly, it had two videos, and thirdly, knowledge component was comprehensively dealt with and students were given individual attention. Last but not least, as students were not part of simulation workshop they didn't know that any better teaching modality exists. The very fact that their performance for conducting labour and delivery on low fidelity simulator checklist was less than experimental group confirms that they were not able to learn the skill well. This means learning skills requires different modality of teaching as compared to knowledge.[38]

The current study was not without its limitations. This was a small study, with limited resources and therefore low fidelity and intermediate fidelity simulators were used. The skills learnt were not assessed on real patients. In the present study, intermediate and low fidelity simulators were used due to cost and constraints of availability.

The skills that students learned in this workshop were assessed on simulator and not on real patients. Therefore, whether or not this skill will be translated to actual improvement in practice is not known and this is one area in which further research should be carried out.

Simulation-based education requires hands-on teaching and therefore only limited number of students can be accommodated at a particular time. This was because the teaching and learning workshops could not cater to large group for individualised teaching as is required in simulation-based learning. This is one drawback of this method of teaching as well in addition to being resource intense.

The study also had a few strengths. For instance, had a control group which was compared with the experimental group. The students learnt concepts of delivery and also performed in controlled environment. They gained confidence as shown through OSCE and perception forms. The study was conducted from different angles and data was collected through pre-test, post-test for knowledge improvement, checklist/OSCE to evaluate the confidence in performing the skill and finally students' own perceptions of learning.

Students rated the learning experience highly.

Conclusion

Simulation-based skill learning showed significantly better results as seen through performance in OSCE. It is known now for more than a decade that simulation-based medical education is evidence-based teaching learning modality. Unfortunately, it is still not incorporated in the undergraduate curriculum. Through this study we recommend regular use of low-cost simulators for obstetric curriculum. It translates into more confident skilled birth attendants.

Future research can be conducted to justify the need of high fidelity, computer-based simulators and whether they are essential and cost-effective in low-resource setting. Further research is also required to see if students can retain this skill and are confident in performing delivery in labour room on an actual patient.

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