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Obstetric emergencies course: influence on learning among Medical interns in Bahia

Curso de emergências obstétricas: influência no aprendizado de internos de Medicina na Bahia

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ABSTRACT

Introduction: Maternal mortality remains high in Brazil, partly due to insufficient practical training of healthcare professionals in managing obstetric emergencies.

Objective: This study aimed to evaluate the impact of an obstetric emergencies course using realistic simulation methodology on the theoretical and practical performance of medical internship students.

Methods: It was a randomized controlled trial involving 355 students from higher education institutions in Salvador, Bahia. Participants were allocated to a control group (theoretical instruction via recorded video lectures) or an intervention group (in-person course with realistic simulation and practical stations), both with 7 hours of total duration. Theoretical knowledge was assessed through tests at three time points (pre-test, immediate post-test, and delayed post-test), and practical skills were measured via OSCE.

Results: The intervention group showed significantly better performance in the immediate post-test (median 14 vs. 12 correct answers; p<0.001) and in the practical assessment (OSCE: 7.31 vs. 5.58 points; p<0.001), but there was no difference in theoretical knowledge retention after four weeks (p=0.96).

Conclusion: These results suggest that realistic simulation improves immediate learning and consolidates practical skills for managing obstetric emergencies, even if theoretical knowledge levels converge over time. It is concluded that the systematic inclusion of simulation in medical curricula may enhance essential competencies and contribute to the quality of obstetric care.

Keywords: Education, Medical. Simulation Training. Obstetrics. Students, Medical.

RESUMO

Introdução: *A mortalidade materna permanece elevada no Brasil, em parte devido à insuficiente formação prática de profissionais para o manejo de emergências obstétricas.*

Objetivo: *Este estudo teve como objetivo avaliar o impacto de um curso de emergências obstétricas com metodologia de simulação realística no desempenho teórico e prático de estudantes de Medicina em internato.*

Método: *Trata-se de um ensaio randomizado e controlado, realizado com 355 estudantes de Medicina de instituições de ensino superior de Salvador, na Bahia. Os participantes foram alocados em grupo controle (ensino teórico via videoaula) ou grupo intervenção (curso presencial com simulação realística e estações práticas), ambos com sete horas de carga horária. Avaliaram-se conhecimento teórico por testes em três momentos (pré, pós-imediato e pós-tardio) e habilidades práticas por OSCE.*

Resultado: *O grupo intervenção apresentou desempenho significativamente superior no pós-teste imediato (mediana 14 versus 12 acertos; p < 0,001) e na avaliação prática (OSCE: 7,31 versus 5,58 pontos; p < 0,001), mas não houve diferença na retenção teórica após quatro semanas (p = 0,96).*

Conclusão: *Esses resultados sugerem que a simulação realística melhora o aprendizado imediato e consolida habilidades práticas no manejo de emergências obstétricas, mesmo que o conhecimento teórico se iguale no longo prazo. Conclui-se que a inclusão sistemática da simulação no currículo médico pode aprimorar competências essenciais e contribuir para a qualidade da atenção obstétrica.*

Palavras-chave: *Educação Médica; Treinamento por Simulação; Obstetrícia; Estudantes de Medicina.*

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INTRODUCTION

The high maternal and neonatal mortality rates in Brazil highlight shortcomings in the quality of healthcare, inadequate care provision and a failure to recognise this situation as a major social problem [1]. Between 2000 and 2023, the maternal mortality rate in the country showed a downward trend, remaining at around 50 deaths per 100,000 live births. During the COVID-19 pandemic, however, this index increased significantly, reaching 113.14 deaths per 100,000 live births in 2021, before returning to pre-pandemic levels in 2022 and 2023 [2].

Preventing these deaths requires not only the establishment of a more efficient healthcare system, but also the adoption of strategies to improve the training of healthcare professionals and students. There are evident shortcomings in the training process, particularly in terms of the ability to identify risks immediately and intervene at an early stage – measures that are essential for reducing the high number of preventable deaths [3]. Therefore, training should begin as early as undergraduate level, ensuring that general practitioners are able to act swiftly and effectively in emergency situations.

In this context, simulation in medical education emerges as a valuable teaching tool, supporting students' practice on inanimate models and protecting patients from exposure to trainee healthcare professionals[4]. Furthermore, the use of active learning methods allows for the controlled repetition of skills, with immediate feedback, thereby promoting a consolidated theoretical and practical learning [5].

In view of the importance of active learning methods for knowledge acquisition, the effectiveness of simulation in medical education and the need to train professionals capable of managing obstetric emergencies, the Obstetric Emergencies Course was established for clinical year students from various medical schools in Bahia.

It is hoped that the implementation of this course will have a positive impact both on students' training – by fostering the development of essential practical skills – and on reducing adverse obstetric outcomes, thereby helping to improve maternal and neonatal health indicators in the region. The aim of this study was to assess how an obstetric emergencies course based on realistic simulation methodology impacted the theoretical and practical performance of medical internship students. The proposal aims to address gaps in medical training by presenting an innovative strategy that is socially relevant and has the potential to be replicated in other settings.

METHOD

This is an experimental, analytical and comparative study with a parallel-group randomised design.

Population

The study sample consisted of medical students duly enrolled in their ninth to twelfth semesters at higher education institutions located in Salvador, Bahia. Following the signing of the Free and Informed Consent Form (FICF), eligible students were randomised into two groups by electronic draw.

In total, the participants included were distributed equally amongst the groups:

Control Group (G1): Comprised of students who took part in a theoretical course delivered via video lessons. The course was divided into two modules, each lasting three hours, covering the topics of obstetrics and emergency care respectively. The programme also included a 30-minute break between modules and a final 30-minute questions and answers session, bringing the total duration to seven hours. The programme content was standardised and identical to that used in the intervention group.

Intervention Group (G2): Comprised of students who took part in the 'Obstetric Emergencies Course', which is structured in two modules. The first module, lasting four hours, consisted of a realistic clinical case simulation, combined with lectures and group discussions. Following a 30-minute break, the second module lasting 2 hours and 30 minutes, focused on practical training at skills stations. The total duration of the training for this group was also seven hours, with content equivalent to that of the theoretical course.

Eligibility criteria

The study included medical students aged 18 or over who were duly enrolled in their ninth to twelfth semesters at their respective educational institutions, located in the state of Bahia.

Variables collected

The participants' socio-demographic and academic characteristics were collected via a structured, self-administered questionnaire, covering variables such as gender, age, self-declared skin colour or race, marital status, monthly household income, place of origin, current paid employment, whether they had children, home institution, mode of admission to university, current semester of study, current rotation in the clinical placement, history of failing modules, completion of an extracurricular work placement, academic performance coefficient and mark achieved in the Obstetrics module.

The variables related to theoretical and practical knowledge were measured by means of a three-stage assessment process: (1) a pre-test, administered before the intervention; (2) an immediate post-test, administered at the end of the course; and (3) a delayed post-test, carried out four

weeks after the intervention. The theoretical instrument was developed by the authors on the basis of the course syllabus and reviewed by experts in the field to ensure the clarity, relevance and suitability of the items in relation to the study's objectives. Each questionnaire contained 15 true or false questions, with 1 point awarded for each correct answer, and the total score subsequently converted to a scale of 0 to 10. Both the total score and performance by subject area were analysed for each test, which was divided into three areas: hypertensive emergencies (6 questions), postpartum haemorrhage (6 questions) and cardiopulmonary arrest during pregnancy (3 questions).

Clinical performance was assessed using the OSCE, which was conducted four weeks after the intervention. The students were presented with a simulated, structured scenario and were assessed on the basis of a marking scheme drawn up for the study and reviewed by experts in the field, with final marks ranging from 0 to 10 points. All assessments were repeated at the end of each cycle of the theoretical and practical courses.

Data collection

Data was collected in successive course delivery cycles, in line with the academic calendar of the participating institutions. Following randomisation, the students were asked to attend on the specific dates allocated to their respective groups, thereby ensuring smooth logistics and preventing any overlap between participants in the control and intervention groups.

Approximately 40 students took part in each cycle of the course: 20 in the Control Group and 20 in the Intervention Group, who were being assessed as part of the practical intervention. These cycles were repeated until the total sample of 355 students had been completed. This organisation enabled the activity to be offered on an ongoing basis to all eligible students, ensuring compliance with the academic schedule.

The theoretical assessments (pre-test, immediate post-test and delayed post-test) were administered electronically using standardised forms on an online platform, ensuring that responses were recorded securely and in a traceable manner. The pre-test was administered on different dates for each group, in line with the timetable for each academic cycle. The OSCE was conducted in person, four weeks after the procedure, through direct observation structured by trained examiners, using a previously validated scoring scale. The full sequence of activities carried out by each group, including the administration of tests, pedagogical interventions and practical assessment, is illustrated in Figure 1A.

Structure of the theoretical course

The theoretical course, corresponding to the intervention applied to the Control Group (G1), was organised as an asynchronous programme, with video lessons made available on a single day via the Google Classroom platform. The lessons were pre-recorded using the software Microsoft Office Professional Plus PowerPoint 2019, ensuring high audiovisual quality and standardised content for all participants. The platform automatically recorded students' access to and time spent on the materials, calculating attendance on the course and monitoring participation.

The course content was divided into two main modules, totalling seven hours' teaching time. Module 1 – Obstetrics (lasting 3 hours) covered the topics 'Hypertension in pregnancy' and 'Postpartum haemorrhage'. Module 2 – Emergency (also lasting 3 hours) focused on 'Haemorrhagic shock' and 'Cardiopulmonary arrest during pregnancy'. There was a 30-minute break between the two modules, as well as a further 30 minutes at the end of the course set aside for participants to submit questions via the online platform. The questions submitted by the students were answered directly by the lecturers, in accordance with the requests made.

Before the video lessons began, participants completed an online pre-test consisting of 10 true or false questions covering the course content. Immediately after the lessons had finished, the immediate post-test was administered, using the same set of questions, also on Google Classroom.

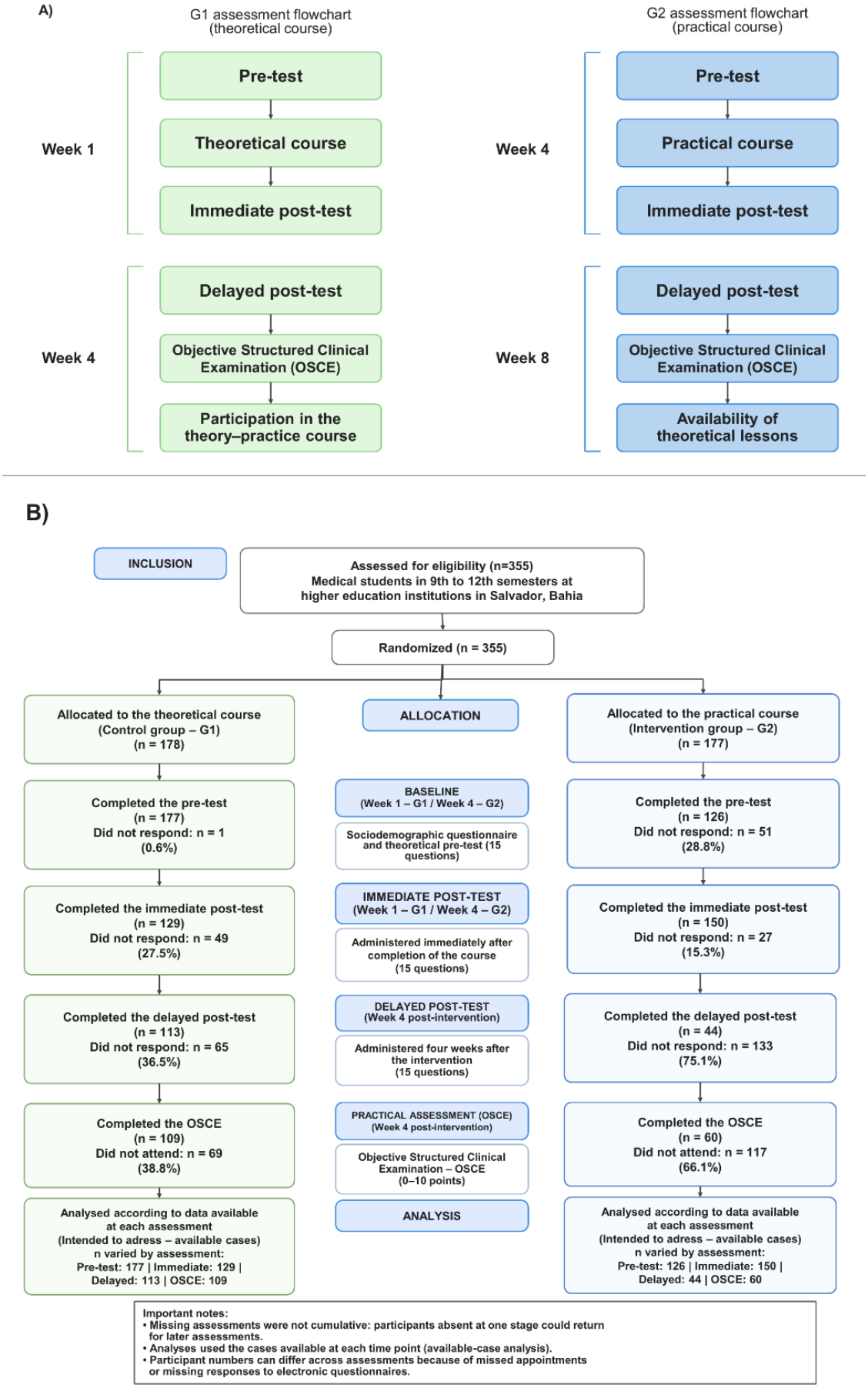
Four weeks after the initial intervention, the participants sat the delayed post-test, again comprising the same 10 questions, and also took part in an OSCE in a simulated setting to assess the practical skills they had acquired. All assessment tools were standardised in advance and aligned with the course's educational objectives.

In order to ensure educational equity amongst the participants and once the data had been collected, the students in the Control Group were also invited to take part in the face-to-face practical course identical to that given to the Intervention Group.

Details of the practical intervention

The practical session took place in Salvador, Bahia, on the premises of the Federal University of Bahia, in a facility designed for clinical simulation. Patient simulators designed to facilitate interaction with students were used for the activities, supporting the structured delivery of training scenarios in obstetric emergencies, in line with the course syllabus.

Figure 1. (A) Sequence of activities executed by the control and intervention groups during the study. (B) CONSORT (2010) flowchart showing participant allocation in the study.



Source: Prepared by the author.

At the end of the sessions, a debriefing was held with the participants, featuring a guided discussion on the performance observed, the expected behaviour and the key areas for improvement. The sessions were led by doctors specialising in gynaecology and obstetrics, with an approximate ratio of one instructor to every five students, with the aim of ensuring standardised training and providing pedagogical support during practical sessions.

Randomisation and blinding

Participants were allocated to the intervention and control groups by simple randomisation, without prior stratification. Randomisation was carried out electronically using the online platform "www.sorteador.com.br". In each course cycle, all eligible students who had given their consent were listed in a single spreadsheet, and random allocation to the Control Group (G1) or Intervention Group (G2) was carried out via an electronic draw, ensuring a balanced distribution across the different instances at which the academic activity was offered.

No allocation confidentiality procedure was used, as the logistics of organising the courses required the team responsible to have prior knowledge of the groups. Furthermore, neither the participants nor the assessors were blinded, as the nature of the intervention – involving face-to-face, realistic simulation activities – made it impossible to mask the experimental conditions.

Despite the absence of blinding, an attempt was made to reduce potential biases by standardising the syllabus content, the use of validated protocols for practical assessment (OSCE) and the use of identical theoretical test instruments in both groups. The occurrence of missing data was mainly due to the study being conducted across multiple training cycles, the absence of some students from specific assessments, and the failure to complete certain electronic forms. Consequently, the number of participants varied across the different stages of the study, which is why the analyses were performed using the cases available at each assessment. The flowchart for the selection and analysis of participants is shown in Figure 1B.

Statistical analysis

Descriptive and inferential analyses compared the performance of medical students assigned to a control group (G1) and an intervention group (G2) at different assessment points (pre-test, immediate post-test, delayed post-test and OSCE). First, a descriptive analysis of the socio-demographic and academic characteristics of the sample produced absolute frequencies, percentages, medians and interquartile ranges (IQR) for categorical and continuous variables.

Comparisons between the groups were made using the Wilcoxon (Mann-Whitney) rank-sum test, taking into account the non-parametric distribution of the quantitative variables. The corresponding p-values were presented to assess statistical significance.

Performance on the questionnaires was analysed across four main domains (hypertensive emergencies, postpartum haemorrhage, cardiopulmonary arrest) and also in terms of the total number of correct answers at each stage (pre-test, immediate post-test and delayed post-test). The overall OSCE score was compared between the intervention and control groups to assess the effect of the intervention on practical skills. The analyses were performed on an intention-to-treat basis, taking into account cases for which data were available in each comparison; missing values were described in tables but were not imputed. Consequently, the inferential analyses were conducted on an available-case basis for each comparison. The number of valid observations for each variable and time point is shown in the relevant tables.

Given the baseline difference observed between the groups in the pre-test, an analysis of covariance (ANCOVA) was carried out to compare performance in the immediate post-test between the control and intervention groups, using the total number of correct answers in the immediate post-test as the dependent variable, the allocation group as a fixed factor and the total number of correct answers in the pre-test as a covariate. This analysis was used to estimate the effect of the group, adjusted for baseline performance, thereby minimising the influence of initial differences between participants. The model's assumptions were tested, including the linearity of the relationship between the covariate and the outcome, the homogeneity of the regression slopes and the goodness of fit of the residuals. The model-estimated adjusted means were calculated for each group.

All statistical analyses were conducted using the R software (version 4.3.1), utilising specific packages such as tidyverse and ggplot2 for the organisation, visualisation and analysis of the data. Microsoft Excel® 365 was used to organise and tabulate the raw data, whilst Canva® was used to create and edit the maps and illustrative figures. A significance level of 5% ($p < 0.05$) was adopted for all statistical tests.

Ethical Considerations

This study was approved by the Research Ethics Committee of the Faculdade de Medicina da Bahia (Bahia Faculty of Medicine), under number 7,012,744. All procedures were assessed and authorised in advance by Plataforma Brasil, in accordance with the protocol submitted to the system, in full compliance with the ethical guidelines set out in the Declaration

of Helsinki and Resolution No. 466/2012 of the National Health Council, which regulates research involving human subjects in Brazil. Student participation was voluntary; students were only included after providing detailed information about the aims, procedures, risks and benefits of the research.

All participants signed the Free and Informed Consent Form (FICF) prior to any intervention or data collection, thereby ensuring that the autonomy and confidentiality of those involved were respected. After completion of the final test, both groups were given access to the theory course and the practical course, depending on the group they had been initially assigned to.

RESULTS

A total of 355 medical students were included in this study, divided between the control group (G1, n=178) and the intervention group (G2, n=177). A higher proportion of female participants was observed in the total sample (59%), with 63% in Group 1 and 54% in Group 2. The median age was 26 years (IQR: 24– 29) the G1 and 25 years (IQR: 24–27) in G2, with an average of 25 years (IQR: (24–29) across the entire sample. Further details are set out in Table 1.

Table 2 shows the basic academic characteristics of the 355 medical students who took part in the study, divided between the control group (G1, n=178) and the intervention group (G2, n=177). Students from the Faculty of Medicine of Bahia accounted for the majority of the total sample (72%), with 67% in Group 1 and 78% in Group 2. As regards the admissions process, approximately half of the students were admitted through the open selection process based on performance in the national secondary education exam (49% in total, 50% in Group 1 and 48% in Group 2). In terms of their semester of study, the majority of students were in their ninth semester (55% in total, 53% in Group 1 and 58% in Group 2).

Table 1. Sociodemographic characteristics of the students participating in the study (n = 355).

Characteristics	Theoretical Course [n (%); Median (IQR)] N = 178	Simulation [n (%); Median (IQR)] N = 177	Total [n (%); Median (IQR)]
Gender			
Female	111 (63)	78 (54)	189 (59)
Male	66 (37)	66 (46)	132 (41)
Missing data	1	33	34
Age	26 (24 – 29)	25 (24 – 27)	25 (24 – 29)
Missing data	1	35	36
Colour			
White	70 (40)	56 (39)	126 (39)
Mixed race	78 (44)	68 (48)	146 (46)
Black	29 (16)	19 (13)	48 (15)
Missing data	1	34	35
Marital Status			
Married	16 (9.0)	12 (8.4)	28 (8.8)
Other circumstances (widowed or divorced/ separated)	3 (1.7)	1 (0.7)	4 (1.3)
Single	152 (86)	126 (88)	278 (87)
Civil Partnership	6 (3.4)	4 (2.8)	10 (3.1)
Missing data	1	34	35
Household income			
1 to 3 times the minimum wage	58 (33)	45 (32)	103 (32)
4 to 6 times the minimum wage	49 (28)	35 (25)	84 (26)
7 to 9 times the minimum wage	31 (18)	25 (18)	56 (18)
More than 10 times the minimum wage	39 (22)	36 (26)	75 (24)
Missing data	1	36	37

Continued...

Table 1. Continuation.

Characteristics	Theoretical Course [n (%); Median (IQR)] N = 178	Simulation [n (%); Median (IQR)] N = 177	Total [n (%); Median (IQR)]
Working?			
No	146 (82)	108 (77)	254 (80)
Yes	31 (18)	33 (23)	64 (20)
Missing data	1	36	37
A parent?			
No	163 (92)	133 (94)	296 (93)
Yes	14 (7.9)	8 (5.7)	22 (6.9)
Missing data	1	36	37
Origin			
A city in another Brazilian state	21 (12)	13 (9.1)	34 (11)
Smaller town in Bahia state	60 (34)	40 (28)	100 (31)
Salvador and the metropolitan area	95 (54)	90 (63)	185 (58)
Missing data	2	34	36

Source: Prepared by the author.

Table 2. Academic characteristics of the students participating in the study (n = 355).

Characteristics	Theoretical Course [n (%); Median (IQR)] N = 178	Simulation [n (%); Median (IQR)] N = 177	Total [n (%); Median (IQR)]
Institution of origin			
Faculty of Medicine of Bahia	118 (67)	113 (78)	231 (72)
UFRB	11 (6.2)	5 (3.4)	16 (5.0)
UNEB	20 (11)	10 (6.9)	30 (9.3)
UNIFACS	2 (1.1)	1 (0.7)	3 (0.9)
UniFTC	26 (15)	16 (11)	42 (13)
Missing data	1	32	33
Mode of admission			
Open selection based on national exam	88 (50)	69 (48)	157 (49)
Interdisciplinary Bachelor's degree	36 (20)	20 (14)	56 (18)
Affirmative action policies	53 (30)	54 (38)	107 (33)
Missing data	1	34	35
Current semester			
10	56 (32)	44 (32)	100 (32)
11	16 (9.0)	11 (7.9)	27 (8.5)
12	5 (2.8)	1 (0.7)	6 (1.9)
9	93 (53)	81 (58)	174 (55)
Pre-internship	7 (4.0)	2 (1.4)	9 (2.8)
Missing data	1	38	39

Continued...

Tabela 2. Continuation.

Characteristics	Theoretical Course [n (%); Median (IQR)] N = 178	Simulation [n (%); Median (IQR)] N = 177	Total [n (%); Median (IQR)]
Internship rotation			
Surgery	28 (16)	26 (18)	54 (17)
Internal Medicine	6 (3.4)	5 (3.5)	11 (3.4)
Emergency	14 (7.9)	11 (7.6)	25 (7.8)
Gynaecology	3 (1.7)	1 (0.7)	4 (1.2)
Internship/Pre-internship	4 (2.3)	1 (0.7)	5 (1.6)
Family medicine	5 (2.8)	6 (4.2)	11 (3.4)
Obstetrics	83 (47)	78 (54)	161 (50)
Others	5 (2.8)	3 (2.1)	8 (2.5)
Paediatrics	13 (7.3)	9 (6.3)	22 (6.9)
Psychiatry	16 (9.0)	4 (2.8)	20 (6.2)
Missing data	1	33	34
Have you ever failed a subject?			
No	141 (80)	126 (89)	267 (84)
Yes	36 (20)	16 (11)	52 (16)
Missing data	1	35	36
Have you ever done an extracurricular work placement?			
No	54 (31)	40 (28)	94 (30)
Yes	122 (69)	102 (72)	224 (70)
Missing data	2	35	37
Grade Point Ratio	8.35 (7.90 – 8.88)	8.40 (7.90 – 8.90)	8.40 (7.90 – 8.88)
Missing data	12	43	55
Grade in the obstetrics module	8.60 (7.80 – 9.10)	8.50 (8.10 – 9.00)	8.60 (8.00 – 9.05)
Missing data	15	48	63

[a]n (%); Median (IQR)
Source: Prepared by the author.

With regard to the current rotation programme for the internship, Obstetrics was the most common (50% overall, 47% in Group 1 and 54% in Group 2). Around 16% of students overall reported having failed a subject (20% in Group 1 and 11% in Group 2). The majority stated that they had already undertaken an extracurricular work placement (70% in total, 69% in Group 1 and 72% in Group 2). The overall performance coefficient had a median of 8.40 (IQR: 7.90–8.88) in total, with a mean of 8.35 (IQR: (7.90–8.88) in G1 and 8.40 (IQR: 7.90–8.90) in G2. The mark for the Obstetrics module had a median of 8.60 (IQR: (8.00–9.05) in total, 8.60 (IQR: (7.80–9.10) in G1 and 8.50 (IQR: 8.10–9.00) in G2.

In all the areas assessed, the intervention group achieved a higher median number of correct answers, with statistically significant differences ($p<0.001$). For questions on hypertensive emergencies, Group 1 had a median of 4 correct answers (IQR: 3–5), whereas Group 2 achieved 5 correct answers (IQR: 4–5). As regards questions on postpartum haemorrhage, G1 also achieved a median of 4 correct answers (IQR: 3–5) compared to 5 correct answers (IQR: 4–5) in G2. On questions relating to cardiopulmonary arrest (CPA), Group 1 had a median of 1 correct answer (IQR: 1–2) and Group 2 a median of 2 correct answers (IQR: 1–3). Taking into account the total number of correct answers in the pre-test, the control group achieved a median of 9 correct answers (IQR: 7–10), whereas the intervention group achieved 11 correct answers (IQR: 10–13).

In the immediate post-test questionnaire, when comparing the control group (G1, n=178) with the intervention group (G2, n=177), a significant difference was observed in the total number of correct answers between the groups, with $p<0.001$. For the questions on hypertensive emergencies, both groups had a median of 6 correct answers, although the interquartile range was narrower in Group 2 (6–6) than in Group 1 (5–6), resulting in $p = 0.002$. In relation to questions on

postpartum haemorrhage and CPA, no statistically significant differences were observed between the groups (p=0.73 and p=0.95, respectively), with both groups returning a median of 6 correct answers (IQR: 5–6) for postpartum haemorrhage and 3 correct answers (IQR: 2–3) for CPA. Taking into account the total number of correct answers in the immediate post-test, the intervention group performed better, with a median of 14 correct answers (IQR: 13–15), whereas the control group achieved a median of 12 correct answers (IQR: (10–14), a statistically significant difference (p<0.001).

In the delayed post-test, no statistically significant differences were generally observed between the groups for any of the areas assessed. For the questions on hypertensive emergencies, both groups achieved a median of 6 correct answers (IQR: 5–6), with p = 0.85. Similarly, for the questions on postpartum haemorrhage, the median number of correct answers was 6 (IQR: 5–6) in both groups (p = 0.56). For questions relating to cardiopulmonary arrest (CPA), the median number of correct answers was 3 (IQR: 2–3) for both groups, with p = 0.72. Taking into account the total number of correct answers in the delayed post-test, the median was 14 correct answers (IQR: (13–15) in both groups, with no statistically significant difference (p=0.96).

Table 3 shows the overall performance of the students taking part in the study in the theoretical questionnaires (pre-test, immediate post-test and delayed post-test) and in the practical assessment (OSCE), comparing the control group (G1) with the intervention group (G2).

In the pre-test, the intervention group performed significantly better, with a median of 11 correct answers (IQR: 10–13), compared with 9 correct answers (IQR: 7–10) in the control group (p<0.001). In the immediate post-test, Group 2 continued to perform better, with a median of 14 correct answers (IQR: 13–15) compared with 12 correct answers (IQR: 10–14) in G1 (p<0.001).

In the delayed post-test, however, there was no statistically significant difference between the groups, both of which had a median of 14 correct answers (IQR: 13–15; p= 0.96).

In relation to the practical assessment in the OSCE, the intervention group achieved a significantly higher score, with a median of 7.31 (IQR: 6.06–7.88) compared with 5.58 (IQR: 4.62–6.92) in the control group (p<0.001).

In the analysis of covariance (ANCOVA), using the total number of correct answers in the immediate post-test as the dependent variable, the allocation group as the factor and the total number of correct answers on the pre-test as the covariate, a statistically significant effect of the group on performance in the immediate post-test was observed, after adjustment for baseline performance, F(1.229) = 45.79; p < 0.001. The covariate relating to the total number of correct answers in the pre-test did not have a statistically significant effect in the model: F(1.229) = 0.52; p = 0.471. The estimated adjusted means were 9.72 correct answers for the control group (SE = 0.24; 95% CI: (9.24–10.19) and 13.70 correct answers for the intervention group (EP = 0.22; 95% CI: (13.25–14.15), indicating superior performance by the intervention group in the immediate post-test, even after adjustment for the baseline score.

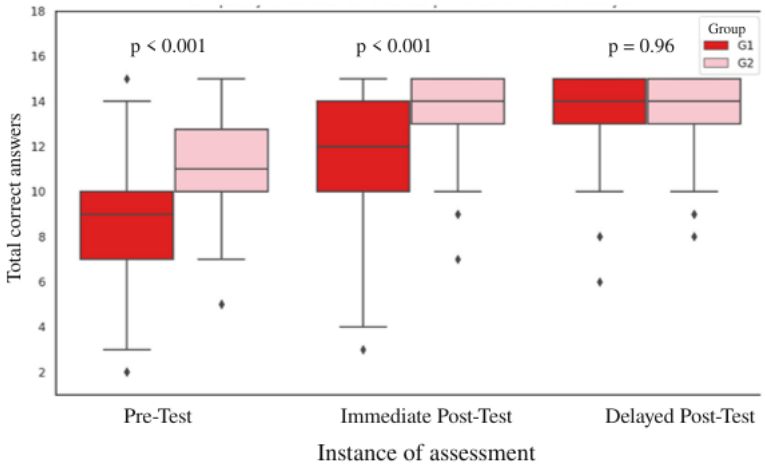
Figure 2 shows a comparison of the total number of correct answers achieved in the theory questionnaire by students in the control group (G1) and the intervention

Table 3. Overall performance in the written tests and the practical assessment (OSCE) (total number of correct answers in the tests and OSCE mark; comparison between groups).

Characteristics	Theoretical Course [n (%); Median (IQR)] N = 178	Simulation [n (%); Median (IQR)] N = 177	p-Value (Wilcoxon)
Total correct answers in pre-test			<0.001
Median (Q1 – Q3)	9.00 (7.00 – 10.00)	11.00 (10.00 – 13.00)	
Missing data	1	51	
Total correct answers in immediate post-test			<0.001
Median (Q1 – Q3)	12.00 (10.00 – 14.00)	14.00 (13.00 – 15.00)	
Missing data	49	27	
Total correct answers in delayed post-test			0.96
Median (Q1 – Q3)	14.00 (13.00 – 15.00)	14.00 (13.00 – 15.00)	
Missing data	65	133	
OSCE Mark	5.58 (4.62 – 6.92)	7.31 (6.06 – 7.88)	<0.001
Missing data	69	117	

Source: Prepared by the author.

Figure 2. Comparison of the total number of correct answers between the control and intervention groups across the assessment time points.



Source: Prepared by the author.

group (G2) at the three assessment points: pre-test, immediate post-test and delayed post-test. Evidently, in the pre-test, the intervention group (G2) performed better, with higher median scores than the control group (G1); this difference was statistically significant (p<0.001). Similarly, in the immediate post-test, G2 maintained a higher median number of correct answers than G1, again with a significant difference (p<0.001). On the other hand, in the delayed post-test, the medians for correct answers across the groups were similar, with no statistically significant difference (p=0.96), indicating convergence of the results between G1 and G2 at this stage of assessment.

DISCUSSION

In this study, the use of simulation-based medical education (SBME) proved to be significantly effective in improving immediate knowledge of obstetric emergencies, as the intervention group achieved a higher number of correct answers in the immediate post-test compared with the control group. However, this difference was not seen in the delayed post-test, suggesting a possible loss of effect over time. Despite this lack of difference in knowledge retention, it was observed that the intervention group performed significantly better in the OSCE, suggesting that SBME may have helped to develop practical skills even as theoretical knowledge acquisition waned over time.

The significant improvement in scores immediately following exposure to SBME may stem from the synergy of three key pedagogical mechanisms described in the literature with regard to the teaching and learning process in simulation-based training, namely intense cognitive activation, deliberate practice in a safe environment, and immediate, structured feedback. When faced with realistic obstetric scenarios, students need to reorganise and integrate new schemas whilst under a heavy workload, a process predicted by 'Cognitive Load Theory' and already validated in other medical simulation studies[6,7]. Furthermore, the ability to repeat potentially critical manoeuvres until they are mastered, without putting the patient at risk, follows the "deliberate practice" model. A previous meta-analysis demonstrated that SBME with this structure outperforms traditional teaching, and variants such as *'Rapid Cycle Deliberate Practice'* have been successfully applied in obstetric emergencies, immediately improving residents' performance and self-confidence[8]. Furthermore, providing students with corrective feedback during, and not just after, the task speeds up memory consolidation and reduces subsequent errors. In this regard, experimental studies suggest that immediate feedback (auditive or guided debriefing) requires fewer attempts to achieve SBME proficiency[5,9].

This immediate cognitive reinforcement, driven by active learning and structured feedback, highlights the effectiveness of SBME as a teaching tool. In the Brazilian context, the New National Curriculum Guidelines for medical degree programmes already encourage the use of active teaching methods, but there are still gaps in the systematic implementation of simulation in undergraduate courses[10]. Evidence suggests that incorporating simulation into the curriculum can raise standards of learning in critical skills, such as the management of obstetric emergencies[11]. The adoption of regulated simulation programmes, with regular cycles and integration with clinical placements, is in line with national medical education policies, promoting the consolidation of practical skills in real-world scenarios and contributing to better-prepared professionals and safer obstetric care.

In the field of obstetrics in particular, previous studies have sought to assess the impact of SBME on students' learning and performance. In Brazil, a course on obstetric emergencies led by Saylys et al. (2019)[12] demonstrated that the use of SBME increased scores by 55 to 69% immediately after each knowledge module, although it did not directly compare this with traditional theoretical teaching. Cikwanine et al. (2025)[13], also achieved better results in the group that undertook practical training; however, this was only the case in the delayed assessment. In another similar study evaluating the management of pre-eclampsia and eclampsia, better performance was demonstrated in the group that undertook practical training in both the delayed and immediate pre-tests [14].

In our study, the narrowing of the gap between the groups in the delayed follow-up test – although levels did not return to those prior to the course – can be attributed to the students' involvement in practical work during their clinical placement. As the delayed assessment took place four weeks after the theoretical intervention, it is likely that the practical training undertaken during that period contributed to increased knowledge in both groups. This additional practical experience may have acted in a similar way to that described by the Cognitive Load Theory, by facilitating the consolidation and reorganisation of mental schemas, thereby reducing previously observed differences[15].

The almost two-point difference in the OSCE achieved by the group exposed to SBME indicates that the cognitive gain observed immediately after the intervention was translated into measurable practical performance. Similar findings have been reported in different obstetric contexts, consistent with our results and demonstrating how SBME contributes to the advancement of practical knowledge beyond the theoretical [13,14].

Globally, recommendations from the World Health Organisation (WHO) endorse the use of simulation as a safe and effective practice for preparing teams to deal with obstetric emergencies, including as a strategy to reduce maternal mortality[12]. However, the number of randomised studies in academic settings remains limited. Against this backdrop, the present study stands out as one of the few randomised trials conducted in Brazil involving medical students, effectively comparing a control group with an intervention group. This methodological rigour, combined with assessment at three distinct stages and the use of standardised OSCEs, reinforces the robustness of the results and fills a crucial gap in the national literature. Based on international evidence, it is hoped that the systematic adoption of SBME in medical schools will contribute to improvements in academic and professional performance, as well as to higher levels of self-confidence and clinical competence, thereby benefiting the Brazilian healthcare system by producing physicians who are better prepared to deal with the complexities of obstetric care.

The findings of this study have practical implications for educational institutions seeking to improve training in obstetric emergencies. Similar programmes can be implemented using existing simulation centres or clinical skills laboratories, utilising obstetric simulators and standardised clinical scenarios. Although implementation requires investment in infrastructure, the procurement or provision of simulators, and the training of instructors to run the scenarios and the debriefing, a large proportion of these resources is already available at a number of Brazilian medical schools. Thus, the systematic incorporation of simulation-based training represents a viable strategy for strengthening practical teaching during the internship and helping to produce professionals who are better prepared to manage obstetric emergencies.

Study limitations

Despite the results obtained, certain factors may be associated with limited external validity of our findings. The study was conducted with students from higher education institutions located in Salvador, Bahia, within a specific geographical and educational context, which may limit the generalisability of the results to students from other regions, institutions with different curricular structures or different care settings. The difference observed in the pre-test results between the groups may be partly due to the different times at which each group undertook this assessment. The intervention group took the pre-test just four weeks after initial allocation, a period which coincided with the start of practical internship activities, whereas the control group took the pre-test in the very week they began the theoretical course, before they had gained significant practical experience. This time discrepancy implies that, at the time of the pre-test, the intervention group had a higher number of practical hours and, consequently, greater exposure to real clinical obstetric cases, which may have contributed to their initially superior performance. Added to this is the lack of blinding amongst the assessors, a factor which may introduce expectation bias into the scoring process. Furthermore, the practice effect must be taken into account, as the repetition of procedures in a simulated environment may improve performance in a controlled setting without guaranteeing an equivalent transfer to the actual clinical context. The variation in the number of participants across the different assessments, particularly in the intervention group, may have introduced selection bias if the students who completed all stages had different characteristics from those with missing data. Although an analysis based on available cases was carried out, this aspect should be borne in mind

when interpreting the results. Another limitation relates to the relatively short follow-up period, as the delayed post-test and the OSCE were conducted four weeks after the intervention. This timeframe allows only for the assessment of short-term retention; it is not possible to determine the persistence of the competencies acquired, their application in real-world clinical practice, or their impact on clinical outcomes. Consequently, this methodological difference may have introduced a measurement bias, possibly making it difficult to interpret, in isolation, the improvement attributable exclusively to the theoretical intervention. Future multicentre studies, involving different regions and educational institutions, with longitudinal follow-up and assessments over longer periods, are needed to verify the reproducibility of the findings, the retention of skills and the transfer of learning to obstetric care.

CONCLUSION

In conclusion, this study demonstrated that the implementation of a course on obstetric emergencies based on realistic simulation was effective in improving medical students' immediate theoretical performance and practical skills, as evidenced by higher scores in the immediate post-test and in the OSCE, although there was no significant difference in theoretical retention after four weeks. These findings reinforce the value of simulation as a teaching strategy for imparting critical skills in obstetrics, suggesting that it should be systematically included in medical curricula as an intervention with the potential to have a significant impact on professional training and maternal safety.

CONTRIBUTION OF THE AUTHORS

Lídia Lima Aragão Sampaio contributed to the Conceptualization (Lead); Data curation (Lead); Formal analysis (Supporting); Methodology (Lead); Project administration (Lead); Supervision (Lead); Writing - original draft (Lead); Writing - review & editing (Equal).

Leila Souza Brito Santos Oliveira contributed to the Conceptualization (Supporting); Data curation (Supporting); Investigation (Supporting); Supervision (Lead); Writing - original draft (Supporting); Writing - review & editing (Supporting).

Murilo Araújo Oliveira contributed to the Data curation (Supporting); Formal analysis (Supporting); Investigation (Supporting); Writing – original draft (Supporting).

Victor Hugo de Oliveira Ribeiro contributed to the Data curation (Supporting); Investigation (Supporting); Methodology (Supporting); Writing – original draft (Supporting); Writing – review and editing (Supporting).

Vinícius Louzada Castro contributed to the Investigation (Supporting); Methodology (Supporting); Writing – original draft (Supporting); Writing – review and editing (Supporting)

Renata Lopes Britto contributed to the Conceptualization (Supporting); Data curation (Supporting); Investigation (Supporting); Methodology (Lead); Project administration (Lead); Supervision (Supporting); Validation (Supporting); Writing - review & editing (Lead).

CONFLICT OF INTEREST

We declare no conflict of interest.

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We declare that there is no funding.

DATA AVAILABILITY STATEMENT

Research data is only available upon request.

REFERENCES

1. Carlo WA, Travers CP. Maternal and neonatal mortality: time to act. J Pediatr (Rio J). 2016;92:543-5.
2. Siqueira GL, Oliveira Fontes GR de, Silva AG da, Gomes CRG, Ferreira FM, Siqueira Guida JP de, et al. The effect of the Covid-19 pandemic on the maternal mortality rate and the achievement of the Sustainable Development Goal in Brazil. BMC Public Health. 2025;25:2005.
3. Chern I, Antalan C, Aeby T, Hiraoka M. The effect of a targeted educational activity on obstetrics and gynecology resident in-training examination scores. Hawaii J Med Public Health. 2018;77:161-5.
4. Dourado ASS, Giannella TR. Ensino baseado em simulação na formação continuada de médicos: análise das percepções de alunos e professores de um hospital do Rio de Janeiro. Rev Bras Educ Med. 2014;38:460-9.
5. McGaghie WC, Issenberg SB, Petrusa ER, Scalese RJ. A critical review of simulation-based medical education research: 2003-2009. Med Educ. 2010;44:50-63.
6. McGraw R, Chaplin T, Rocca N, Rang L, Jaeger M, Holden M, et al. Cognitive load theory as a framework for simulation-based, ultrasound-guided internal jugular catheterization training: once is not enough. CJEM. 2019;21:141-8.
7. Fraser KL, Ayres P, Sweller J. Cognitive load theory for the design of medical simulations. Simul Healthc. 2015;10:295-307.
8. McGaghie WC, Issenberg SB, Cohen ER, Barsuk JH, Wayne DB. Does simulation-based medical education with deliberate practice yield better results than traditional clinical education? A meta-analytic comparative review of the evidence. Acad Med. 2011;86:706-11.
9. Al Fayyadh MJ, Hassan RA, Tran ZK, Kempenich JW, Bunegin L, Dent DL, et al. Immediate auditory feedback is superior to other types of feedback for basic surgical skills acquisition. J Surg Educ. 2017;74:e55-e61.
10. Ferreira MJM, Ribeiro KG, Almeida MM, Sousa MS, Ribeiro MTAM, Machado MMT, et al. New National Curricular Guidelines of medical courses: opportunities to resignify education. Interface (Botucatu). 2019;23(Supl 1):e170920. doi: https://doi.org/10.1590/interface.170920.
11. Elendu C, Amaechi DC, Okatta AU, Amaechi EC, Elendu TC, Ezeh CP, et al. The impact of simulation-based training in medical education: a review. Medicine (Baltimore). 2024;103:e38813.
12. Siaulys MM, Cunha LB da, Torloni MR, Kondo MM. Obstetric emergency simulation training course: experience of a private-public partnership in Brazil. Reprod Health. 2019;16:24.

13. Cikwanine JPB, Mukwege D, Mongwa J, Mapatano Shalamba E, Maroyi R, Yoyu JT, et al. An assessment of the effects of simulation training on management of postpartum hemorrhage: short- and long-term impact on knowledge retention, skills and teamwork in the Democratic Republic of Congo. BMC Med Educ. 2025;25:774.

14. Cikwanine JPB, Yoyu JT, Mapatano ES, Lebdai S, Mukwege D, Martin L. Benefits of simulation on multidisciplinary management of severe pre-eclampsia/severe eclampsia in 15 health districts in eastern Democratic Republic of Congo: a randomized educational trial. Int J Gynecol Obstet. 2025;168:762-73.

15. Peixoto JM, Santos SME, Faria RMD de. Processos de desenvolvimento do raciocínio clínico em estudantes de Medicina. Rev Bras Educ Med. 2018;42:75-83.

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