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ORIGINAL PAPER

The effect of a leadership and teamwork experiential learning module on managing shoulder dystocia with high-fidelity simulation training: a randomized controlled study

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Abstract

Aim: To explore the effect of leadership and teamwork training when managing shoulder dystocia. *Design:* Randomized-controlled-trial. *Methods:* We randomized midwifery students attending a one-day workshop into groups A (intervention) and B (controls). Shoulder dystocia training and assessment was performed with a high-fidelity computerized birthing-simulator. The intervention involved a two-hour leadership and teamwork experiential learning module. All students participated in a pre-training assessment and theoretical and practical training and completed a post-training assessment. Group A students received the intervention following their theoretical and practical training, but prior to the final post-training assessment. *Results:* Fifty-one students participated (mean age 21.9 ± 3.1 years); 25 were randomly assigned to group A and 26 to group B. Before training, both groups showed similarly low baseline scores for successful deliveries, maneuver performance, confidence, communication, teamwork, and leadership skills. Students in both groups achieved similarly high post-training scores for successful deliveries (> 92%), maneuvers (> 16/20), and confidence (8/10). Compared with controls, participants receiving the intervention showed a trend toward higher teamwork (3.1 ± 2.4 vs 2.1 ± 2.1; p = 0.08) and leadership scores (3.8 ± 2.7 vs 2.6 ± 2.3; p = 0.08) at the end of the workshop. *Conclusion:* Our findings support the inclusion of a teamwork and leadership training module during shoulder dystocia simulation.

Keywords: high-fidelity simulation, leadership, parturition, shoulder dystocia, teamwork.

Introduction

Shoulder dystocia is a rare but serious obstetric emergency characterized by the inability to deliver the fetal shoulders following delivery of the head with standard gentle axial traction, thereby necessitating the application of additional obstetric maneuvers to complete the birth (Royal College of Obstetricians and Gynecologists [RCOG], 2012; Sokol & Blackwell, 2003). This complication may present unexpectedly even in the absence of any risk factors and may lead to significant neonatal morbidity and mortality such as brachial plexus injury, ischemic encephalopathy and neonatal death. Compression of the umbilical cord between the fetus and the maternal pelvis restricts blood flow to the fetal brain, thus resulting in significant hypoxia. Current evidence indicates that 47% of neonatal deaths occur when the head-to-body delivery interval is greater than five minutes (Maternal and Child Health Research Consortium, 1998; RCOG, 2012). Shoulder dystocia has been described as a highly traumatic childbirth complication for both women and attending midwives, with reports indicating that up to 35% of midwives may experience symptoms consistent with post-traumatic stress disorder (Aydın & Aktaş, 2021; Minooee et al., 2021). Given its low reported incidence, ranging from 0.58% to 0.70% in several studies (RCOG, 2012; Youssefzadeh et al., 2023), the acquisition of skills for managing shoulder dystocia by healthcare providers is most effectively

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achieved through simulation-based training.

The literature indicates that simulation-based training is effective for the acquisition of both technical and non-technical skills required for the management of shoulder dystocia (Crofts et al., 2007; Gurewitsch, 2018; Papoutsis et al., 2024a), with most studies on neonatal outcomes demonstrating a clear and clinically significant reduction in birth-related neonatal injury (Gurewitsch, 2018). Shoulder dystocia management requires both technical skills in terms of the appropriate obstetric maneuvers to be performed in order to dislodge the anterior fetal shoulder from behind the symphysis pubis, and non-technical skills such as teamwork, leadership, and communication, since an obstetric emergency is primarily a team effort (Gurewitsch, 2018; Kuzovlev et al., 2021; Tsikouras et al., 2024). Evidence from resuscitation education shows that leadership and teamwork skills are closely linked to team performance and contribute to improved patient safety and outcomes (Cooper & Wakelam, 1999; Kuzovlev et al., 2021; Rosen et al., 2018). Based on this evidence, the European Resuscitation Council (ERC) incorporated the training of non-technical skills – including teamwork, leadership, and structured communication – into its 2015 guidelines as an essential complement to basic technical skills training (Soar et al., 2015). According to a systematic review conducted in 2021, a critical gap in the literature remains the lack of randomized controlled trials examining the influence of teamwork and leadership training on patient outcomes (Kuzovlev et al., 2021). In obstetrics, while the literature on the necessity and importance of non-technical skills training as an integral part of simulation-based shoulder dystocia training is limited (Gurewitsch, 2018; RCOG, 2012; Tsikouras et al., 2024), there is even less evidence regarding its independent effect on shoulder dystocia management and maternal – neonatal outcomes in clinical practice.

Aim

This randomized controlled trial (RCT) aimed to address a gap in the obstetrics literature by evaluating the effect of an additional leadership and teamwork training module alongside standard shoulder dystocia training. We hypothesized that this add-on module would further enhance participants' skills in managing shoulder dystocia in simulation settings. Our objectives were to quantify the magnitude of any improvement and to assess whether these gains could be retained over time.

Methods

Design

This randomized controlled trial (RCT) was conducted at the University of Western Macedonia in Greece, to evaluate the impact of a leadership and teamwork training module on the improvement of skills in a simulated shoulder dystocia scenario. The study was approved by the Ethics Committee of the University of Western Macedonia, Greece (No. 266/2023-31.08.2023) and was conducted in accordance with CONSORT (Consolidated Standards of Reporting Trials) guidelines (Hopewell et al., 2025). All participants provided written informed consent. The study has been listed on the ISRCTN registry with the study registration number ISRCTN85105943.

Sample

Final-year midwifery students in the final semester of their undergraduate program at the University of Western Macedonia, Greece, were invited to participate in a one-day workshop conducted between November and December 2024. The undergraduate midwifery curriculum at our university is a four-year program that integrates theoretical with clinical training throughout all academic years. The program begins with foundational sciences and research methodology, progressively advancing toward specialized areas such as prenatal, intrapartum, and postnatal care, neonatal care, and high-risk obstetrics in the later stages of study. Clinical practice constitutes a core component of the curriculum and commences after the first year, enabling students to acquire practical experience through clinical placements in hospital and community settings. By their final year – like the participants in this study – students have already completed two years of clinical practice, including exposure to high-risk obstetrics during the second and third years of their undergraduate program. The students were subsequently randomized into groups A (intervention) or B (controls). The simulation training and assessment in shoulder dystocia was performed with a high-fidelity computerized birthing-simulator. All students completed a 30-minute pre-training assessment, participated in 30 minutes of theoretical and practical training, and undertook a 30-minute post-training assessment. Students in group A received the intervention after completing the theoretical and practical training and immediately before the final post-training assessment at the end of the workshop. The intervention consisted of a two-hour leadership and teamwork experiential learning module. Finally, the students from both groups (intervention-controls) were invited to attend a single follow-up assessment in shoulder dystocia management one week later in order to assess retention of skills. The study flow diagram, presented in accordance with the CONSORT statement, is shown in Figure 1.

The birthing simulator employed in this study was the computerized high-fidelity fetal mannequin and pelvic model, "PROMPT Flex Birthing Simulator™". This simulator features an integrated force-monitoring system that provides numerical measurements of the forces (in Newtons) applied to the fetal head during traction at childbirth. Using this system, we recorded both the total peak traction force and the resting force applied to the fetal head. The resting force was defined as the force on the fetal head resulting from stretching of the fetal neck against the pelvic mannequin perineum when the anterior shoulder was impacted behind the symphysis pubis, without any hands contacting the head. The resting force was measured immediately prior to the initiation of the simulated delivery attempt. This numerical value was then subtracted from the total peak traction force to determine the actual peak traction force exerted by the midwifery student.

On the day of the workshop, students attended the Simulation Suite and were instructed to perform a simulated shoulder dystocia delivery. In this scenario, successful delivery of the fetal mannequin required the delivery of the posterior arm. Delivery was considered successful only if the posterior arm was removed within a five-minute interval. If the participant was unable to achieve this or abandoned the attempt, the simulated delivery was recorded as unsuccessful.

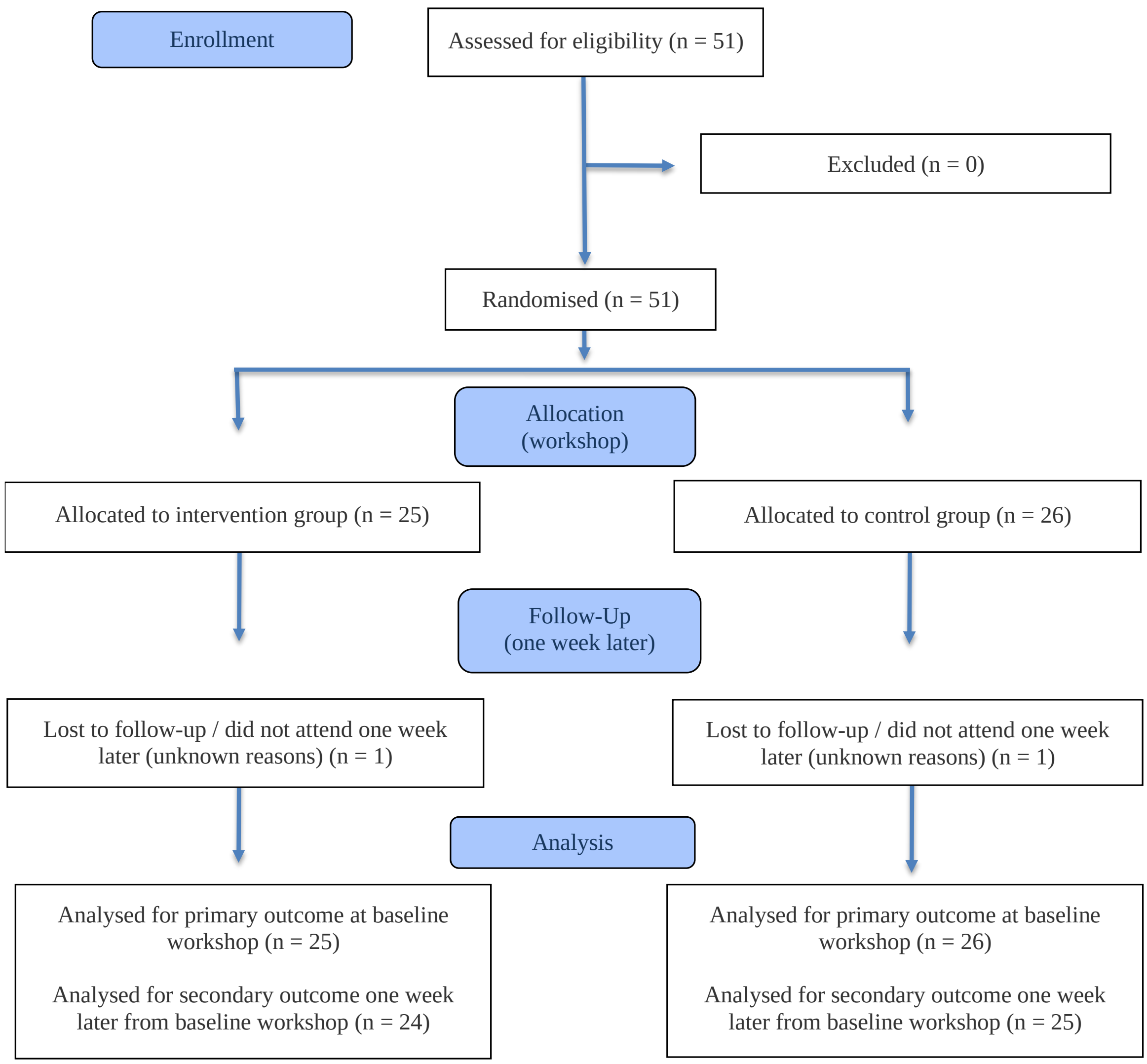

Figure 1 CONSORT 2025 Flow diagram

The intervention for group A consisted of a two-hour experiential learning module on leadership and teamwork. It began with a presentation introducing key concepts, including leadership styles and stages of team development. Students then participated in experiential activities with guided reflection, designed to consolidate their learning and relate it to real-life scenarios. The session concluded by reinforcing the key principles of leadership and teamwork and highlighting their relevance to managing shoulder dystocia during childbirth.

All the training and assessments of the outcome measures in the workshops were carried out by the instructor DP, who has been certified and trained in the accredited PROMPT (PRactical Obstetric Multi-Professional Training) and ALSO (Advanced Life Support in Obstetrics) international courses. Additionally, at the time of the study, the instructor (DP) had over 10 years of experience leading shoulder dystocia training workshops.

The two-hour leadership and teamwork experiential learning module was delivered by the instructor AT, a registered neuropsychologist with over 10 years of experience conducting experiential learning courses focused on leadership and teamwork skills.

Data collection

In this trial, we recorded the age of the students and their prior participation in similar workshops. During both the baseline workshop and the follow-up session one week later, the following outcomes were assessed: (a) simulated delivery success, as previously defined; (b) maneuver performance in managing shoulder dystocia; (c) actual head-to-delivery time, measured objectively using the birthing simulator; (d) self-reported perception of delivery time; (e) force applied to the fetal head; (f) communication skill scores; (g) self-reported confidence levels; (h) leadership skill scores; and (i) teamwork skill scores.

The performance of obstetric maneuvers during shoulder dystocia was assessed using an Objective Structured Assessment of Technical Skills (OSATS) form (score range: 0–20), based on the Royal College of Obstetricians and Gynecologists guidelines for shoulder dystocia management (Table 1) (RCOG, 2012).

The instructor (DP) assessed the quality of communication with the simulated birthing woman – no real patient was involved – the quality of communication with team members during the simulation, and the quality of leadership and teamwork skills. Assessments were made using a 10-point Likert scale, with points awarded for each clearly demonstrated item, and a total score was generated for each skill at both the baseline workshop and the follow-up session one week later (Table 2).

At the end of the workshop, midwifery students were asked to rate their confidence at both the start and the end of the baseline session using a 10-point Likert scale (1 = lowest confidence, 10 = highest confidence). The same assessment was repeated one week later to capture any changes in self-reported confidence.

The primary objective of this study was to evaluate the impact of an added leadership and teamwork training module on midwifery students' performance during high-fidelity simulation of shoulder dystocia. Pre- and post-training values were recorded for all predetermined outcomes in both the intervention group and the control group during the baseline workshop. By comparing these outcome measures before and after training within each group, we assessed the extent to which the intervention contributed to improvements in students' skills.

The secondary objective was to evaluate the potential retention of skills one week later in both groups by comparing outcome measures with the post-training values recorded at the end of the baseline workshop.

Data analysis

The quantitative variables were expressed as mean values (standard deviation) and as median (interquartile range), while the categorical variables were expressed as absolute and relative frequencies. The quantitative variables were tested for normality by using the Kolmogorov-Smirnov criterion. Fisher's exact test was used to compare the proportions of students who had previously attended a workshop and the proportions of successful deliveries between the two groups. McNemar's test was applied to compare proportions of successful deliveries across time points (pre-training, post-training at the workshop, and one week later). Student's t-test was used to compare age between the groups. The Mann–Whitney test was used to compare continuous variables between groups at each time point. Mixed linear models, with study measurements as dependent variables, were employed to evaluate changes over time throughout the study period.

Adjusted regression coefficients (β) with standard errors (SE) were computed from the results of the mixed models. Logarithmic transformations were used in the mixed linear models due to the lack of normal distribution. All reported p values were two-tailed. Statistical significance was set at $p < 0.05$ and analyses were conducted using the SPSS statistical software (version 27.0) and STATA (version 15.0).

A sample size and power analysis was conducted for a design with two levels of the between-subjects factor (study groups) and three levels of the within-subjects factor (time). For this design, 50 participants (25 per group) were sufficient to achieve 95% power for detecting a within-subjects main effect at an effect size of 0.23 or greater, as well as 95% power for detecting an interaction effect at the same effect size.

Table 1 Objective Structured Assessment of Technical Skills (OSATS) checklist using 20 items to test the performance of maneuvers in managing shoulder dystocia with high-fidelity simulation

Item	Yes (points = 1)	No (points = 0)
1. Calls for help (Pediatrician, Senior Midwife, Anesthetist, Senior Obstetrician etc.)		
2. Discontinues oxytoxin infusion		
3. McRobert's maneuver (the participant attempts to perform the maneuver)		
4. McRobert's maneuver (the participant performs it correctly)		
5. Suprapubic pressure maneuver (the participant attempts to perform the maneuver)		
6. Suprapubic pressure maneuver (the participant performs it correctly)		
7. Evaluates for episiotomy		
8. Acknowledges the need for internal maneuvers		
9. Rubin II maneuver (the participant attempts to perform the maneuver)		
10. Rubin II maneuver (the participant performs it correctly)		
11. Wood's maneuver (the participant attempts to perform the maneuver)		
12. Wood's maneuver (the participant performs it correctly)		
13. Reverse Wood's maneuver (the participant attempts to perform the maneuver)		
14. Reverse Wood's maneuver (the participant performs it correctly)		
15. Removal of posterior arm (the participant attempts to perform the maneuver)		
16. Removal of posterior arm (the participant performs it correctly)		
17. Describes the rolling over of the patient to the "all-fours" position		
18. Describes cleidotomy (deliberate fracture of posterior fetal clavicle) when all the above have failed		
19. Did the participant apply axial traction to the head of the fetal mannequin?		
20. Did the participant correctly identify the anterior shoulder of the fetal mannequin (right or left shoulder)?		
	Total Score (range: 0–20)	

Table 2 The assessment by the instructor of the skills of communication, leadership and teamwork in accordance to the items clearly stated by the student during the shoulder dystocia scenario (Part 1)

Item	Score (points)	
Communication to the birthing woman	**Yes**	**No**
a. *"There is a shoulder dystocia."*	2	0
b. *"You should stop maternal pushing."*	2	0
c. *"Let me explain – we will change your body position."*	2	0
d. *"Let me explain – we will level the bed, remove the lower part of the bed, remove the cushions."*	2	0
a. *"Let me explain – I will insert my hand into your vagina."*	1	0
b. *"Let me explain – I will now do an episiotomy."*	1	0
	Total Score (range: 0–10)	

Table 2 The assessment by the instructor of the skills of communication, leadership and teamwork in accordance to the items clearly stated by the student during the shoulder dystocia scenario (Part 2)

Item	**Score (points)**	
Communication to the team members	**Yes**	**No**
a. *"There is a shoulder dystocia."*	2	0
b. *"Discontinue the oxytocin IV infusion."*	2	0
c. *"I would like you to go the maternal right or left and flex the maternal thighs to her abdomen."*	2	0
d. *"I would like you to go the maternal right or left and apply suprapubic pressure."*	2	0
a. *"Elevate the bed and I will kneel to apply the internal maneuvers."*	1	0
b. *"I would like you to stop the suprapubic pressure as I insert my hand into the vagina for the internal maneuvers."*	1	0
	Total Score (range: 0–10)	
Leadership skills	**Yes**	**No**
a. clear-concise communication to woman	2	0
b. clear-concise communication to team members	2	0
c. correct judgement under pressure-correct application of maneuvers	2	0
d. assigning tasks to team members	2	0
a. maintaining constructive team environment and cohesion throughout the emergency scenario	1	0
b. staying resilient and calm throughout the stressful scenario	1	0
	Total Score (range: 0–10)	
Teamwork skills	**Yes**	**No**
a. verbalizing information clearly and clarifying any misunderstandings	2	0
b. working jointly with the other team members	2	0
c. maintaining focus on resolving safely / efficiently the shoulder dystocia despite confusion / stress in the room	2	0
d. clear assignments to team members	2	0
a. supporting and complementing team members' efforts	1	0
b. respectful behavior throughout the stressful scenario	1	0
	Total Score (range: 0–10)	

Results

A total of 51 midwifery students were recruited from 70 initially invited (response rate: 72.9%), with 25 randomized to receive the intervention and 26 assigned to the control group. The mean age in the total cohort was 21.9 ± 3.1 years, with no significant differences found regarding age between the two groups (intervention: 22.5 ± 4.3 years vs controls: 21.5 ± 1.4 years; $p = 0.24$). There was no significant difference between the groups in prior attendance at a shoulder dystocia workshop (intervention: 4/25 vs. control: 1/26; $p = 0.19$). Of the 51 students who attended the baseline workshop, 49 participated in the follow-up shoulder dystocia assessment one week later.

There was no difference in the proportion of students from the two groups accomplishing a successful simulated delivery, as previously defined, either pre-training (intervention: 0/25 or 0% vs controls: 3/26 or 11.5%; $p = 0.23$) or post-training (intervention: 23/25 or 92% vs controls: 25/26 or 100%; $p = 0.61$). Both groups showed a statistically significant increase in the proportion of successful deliveries post-training compared with pre-training (intervention: 92% increase, $p < 0.001$; control: 84.7% increase, $p < 0.001$). The reasons for unsuccessful delivery at the pre-training assessment were failure to remove the posterior arm (intervention: 60.9%; controls: 64%) and students abandoning the delivery (intervention: 39.1%; controls: 36%) (data not shown).

The actual peak traction force increased significantly post-training at the end of the workshop compared with pre-training in both groups (control: $\beta = 0.15$, $SE = 0.07$, $p = 0.03$; intervention: $\beta = 0.11$, $SE = 0.05$, $p = 0.02$) (Table 3). There were no differences in actual peak traction force between the intervention and control groups at either the pre-training or post-training time points. One week after the workshop, peak traction force increased numerically in both groups, but the difference between groups remained non-significant. In the total cohort, actual peak traction force exceeded 100 Newtons in 4/51 (7.8%) students pre-training, 5/51 (9.8%) post-training, and 6/49 (12.2%) one week later (data not shown).

There were no differences in the values of the actual head-to-delivery time between the intervention and control group at the pre-training and post-training time-point measurements (Table 3). However, students in the intervention group reported a significantly shorter perceived delivery time compared with controls at both the pre-training and post-training workshop assessments. The difference between self-reported perceived time and actual time of delivery decreased significantly in both groups ($\beta = -0.15$; $SE = 0.07$; $p = 0.02$ for the control group, and $\beta = -0.15$; $SE = 0.07$; $p = 0.03$ for the intervention group).

Maneuver performance scores increased nearly threefold post-training compared with pre-training in both the intervention group (pre-training: 5.8 ± 3.1 vs. post-training: 16.2 ± 2.6; $p < 0.001$) and the control group (pre-training: 6.6 ± 3.7 vs. post-training: 16.6 ± 2.2; $p < 0.001$). There were no significant differences in maneuver performance scores between the intervention and control groups at either the pre-training or post-training assessments (Table 3).

Confidence scores nearly doubled post-training compared with pre-training in both the intervention group (pre-training: 3.7 ± 1.7 vs. post-training: 7.9 ± 1.0; $p < 0.001$) and the control group (pre-training: 3.6 ± 1.97 vs. post-training: 8.1 ± 0.8; $p < 0.001$). There were no significant differences in confidence scores between the intervention and control groups at either the pre-training or post-training assessments (Table 4).

Scores for communication with the simulated birthing woman increased significantly post-training, nearly threefold in the intervention group (pre-training: 1.2 ± 0.6 vs. post-training: 3.6 ± 2.9; $p < 0.001$) and almost twofold in the control group (pre-training: 1.4 ± 1.0 vs. post-training: 2.9 ± 2.3; $p = 0.001$). There were no significant differences between the intervention and control groups at either the pre-training or post-training assessments. (Table 4).

Scores for communication with the team increased significantly post-training, nearly threefold in the intervention group (pre-training: 1.2 ± 0.6 vs. post-training: 4.4 ± 2.8; $p < 0.001$) and almost threefold in the control group (pre-training: 1.0 ± 0 vs. post-training: 3.1 ± 2.3; $p < 0.001$). There were no significant differences between the intervention and control groups at either the pre-training or post-training assessments (Table 4).

Leadership skill scores increased significantly post-training, nearly threefold in the intervention group (pre-training: 1.1 ± 0.5 vs. post-training: 3.8 ± 2.7; $p < 0.001$) and almost twofold in the control group (pre-training: 1.0 ± 0 vs. post-training: 2.6 ± 2.3; $p < 0.001$). There was a trend toward higher post-training leadership scores in the intervention group compared with the control group ($p = 0.08$) (Table 4).

Teamwork skill scores increased significantly post-training, nearly threefold in the intervention group (pre-training: 1.0 ± 0.2 vs. post-training: 3.1 ± 2.4; $p < 0.001$) and almost twofold in the control group (pre-training: 1.0 ± 0 vs. post-training: 2.1 ± 2.1; $p = 0.001$). There was a trend toward higher post-training teamwork scores in the intervention group compared with the control group ($p = 0.08$) (Table 4).

At the one-week follow-up, there were no significant differences in any measured outcomes between the two groups (Tables 3 and 4). Compared with post-training values at the end of the baseline workshop, both groups showed further numerical increases in actual peak traction force and maneuver performance scores. No significant changes were observed for actual time-to-delivery, self-reported delivery time, the difference between self-reported and actual delivery time, or communication scores. Confidence scores, however, increased significantly in both groups at one week. Leadership and teamwork scores decreased significantly in the intervention group but remained not significantly different from the control group (Table 4).

Table 3 Numerical values of outcomes for each group of students (n = 51; 25 in intervention group and 26 in control group)

		Pre-training		**Post-training**		**1 week later**		**Post-training – Pre-training comparison**				**1 week later – Post-training comparison**			
	Group	**Mean (SD)**	**Median (IQR)**	**Mean (SD)**	**Median (IQR)**	**Mean (SD)**	**Median (IQR)**	**Mean (SD)**	**Median (IQR)**	**β (SE)[2]**	**p-value**	**Mean (SD) [a]**	**Median (IQR) [a]**	**β (SE) [2]**	**p-value**
Actual peak traction force	**Control**	48.46 (27.55)	47.5 (30–61)	60.65 (22.47)	59.5 (45–81)	70.84 (23.1)	73 (50–81)	12.19 (37.69)	19 (-14–34)	0.15 (0.07)	0.030*	9.72 (22.76)	9 (-5–24)	0.08 (0.04)	0.035*
	Intervention	62.48 (32.54)	56 (41–77)	74.68 (25.85)	64 (59–92)	70.79 (20.63)	68 (57.5–77)	12.2 (39.24)	17 (-6–35)	0.11 (0.05)	0.020*	-2.13 (24.79)	-3 (-11–10.5)	-0.01 (0.03)	0.648
	P[1]	0.132		0.092		0.756									
Actual head-to-delivery time (in seconds)	**Control**	132.54 (37.46)	125.5 (103–147)	144.04 (28.63)	139.5 (120–165)	148.4 (28.98)	147 (126–166)	11.5 (39.5)	22.5 (-3–38)	0.04 (0.02)	0.058	4.72 (33.57)	3 (-18–19)	0.01 (0.02)	0.439
	Intervention	115.12 (27.16)	117 (89–133)	141.84 (26.56)	136 (124–151)	142.83 (33.66)	134.5 (120.5–158)	26.72 (29.18)	23 (7–47)	0.10 (0.02)	< 0.001*	1.04 (30.73)	0.5 (-16–22.5)	0.00 (0.02)	0.919
	P[1]	0.109		0.836		0.357									
Self-reported perceived time of delivery (in seconds)	**Control**	216.54 (80.55)	220 (150–240)	190.15 (63.39)	180 (124–240)	199.8 (86.1)	180 (147–240)	-26.38 (50.98)	-13 (-60–0)	-0.05 (0.02)	0.021*	14.04 (62.04)	0 (-30–60)	0.02 (0.03)	0.599
	Intervention	150.4 (75.86)	120 (120–210)	140.6 (55.12)	120 (120–180)	155.63 (40.66)	150 (120–185.5)	-9.8 (79.3)	0 (-60–60)	0.00 (0.05)	0.981	16.67 (50.09)	5.5 (0–30)	0.06 (0.03)	0.054
	P[1]	0.006*		0.005*		0.084									
Difference in self-reported perceived time – actual head-to-delivery time (in seconds)	**Control**	84 (84.19)	73 (20–121)	46.12 (64.99)	31.5 (3–102)	51.4 (76.97)	33 (-5–74)	-37.88 (66.33)	-40 (-61– -4)	-0.15 (0.07)	0.022*	9.32 (60.35)	18 (-32–40)	0.06 (0.07)	0.346
	Intervention	35.28 (75.32)	25 (-25–81)	-1.24 (45.81)	-3 (-31–24)	12.79 (32.23)	5.5 (-8–31.5)	-36.52 (80.84)	-30 (-10–16)	-0.15 (0.07)	0.039*	15.63 (35.95)	25 (-4–41)	0.13 (0.07)	0.087
	P[1]	0.025*		0.003*		0.066									
Maneuver performance score	**Control**	6.65 (3.7)	6 (5–8)	16.62 (2.28)	17 (15–18)	17.44 (1.61)	18 (16–18)	9.96 (3.32)	10 (8–12)	0.42 (0.05)	< 0.001*	0.76 (2.03)	0 (0–2)	0.02 (0.01)	0.045*
	Intervention	5.8 (3.12)	6 (4–9)	16.24 (2.65)	16 (15–18)	16.75 (2.35)	17 (15–19)	10.44 (2.53)	10 (8–12)	0.47 (0.05)	< 0.001*	0.58 (1.82)	1 (-1–2)	0.02 (0.01)	0.089
	P[1]	0.608		0.797		0.301									

[1] p-value from Mann-Whitney test, for group comparisons; [2] regression coefficient (SE – Standard Error) for time effect from mixed linear model (after having logarithmically transformed the dependent variables); [a] computed in 49 participants who had both measurements; SD – standard deviation; IQR – Interquartile Range

Table 4 Numerical scores of skills (confidence, communication, leadership, teamwork) for each group of students (n = 51; 25 in intervention group and 26 in control group)

		Pre-training		Post-training		1 week later		Post-training – Pre-training comparison				1 week later – Post-training comparison			
	Group	**Mean (SD)**	**Median (IQR)**	**Mean (SD)**	**Median (IQR)**	**Mean (SD)**	**Median (IQR)**	**Mean (SD)**	**Median (IQR)**	**β (SE)[2]**	**P**	**Mean (SD) [a]**	**Median (IQR) [a]**	**β (SE)[2]**	**P**
Confidence	**Control**	3.65 (1.98)	4 (2–5)	8.19 (0.8)	8 (8–9)	8.64 (0.64)	9 (8–9)	4.54 (1.96)	4 (3–6)	0.43 (0.06)	< 0.001*	0.52 (1)	1 (0–1)	0.02 (0.01)	0.025*
	Intervention	3.72 (1.72)	4 (2–5)	7.96 (1.02)	8 (8–9)	8.38 (0.71)	8 (8–9)	4.24 (1.61)	4 (3–5)	0.38 (0.04)	< 0.001*	0.46 (0.72)	0 (0–1)	0.02 (0.01)	0.002*
	P[1]	0.833		0.705		0.186									
Communication skills with woman	**Control**	1.46 (1.03)	1 (1–1)	2.96 (2.34)	1.5 (1–5)	4.04 (2.78)	3 (1–7)	1.5 (2.28)	0 (0–4)	0.23 (0.07)	0.001*	1.16 (2.54)	0 (0–2)	0.15 (0.08)	0.058
	Intervention	1.24 (0.66)	1 (1–1)	3.64 (2.93)	3 (1–7)	3.75 (2.94)	3 (1–6)	2.4 (2.94)	0 (0–6)	0.35 (0.07)	< 0.001*	0.25 (2.31)	0 (0–1)	0.02 (0.07)	0.765
	P[1]	0.455		0.428		0.649									
Communication skills with team	**Control**	1 (0)	1 (1–1)	3.19 (2.33)	3 (1–5)	4.52 (3.69)	3 (1–9)	2.19 (2.33)	2 (0–4)	0.37 (0.06)	< 0.001*	1.24 (2.73)	0 (0–2)	0.11 (0.08)	0.183
	Intervention	1.24 (0.66)	1 (1–1)	4.4 (2.89)	5 (1–7)	3.5 (2.77)	3 (1–5)	3.16 (2.91)	4 (0–6)	0.46 (0.07)	< 0.001*	-0.88 (2.89)	0 (-2.5–0)	-0.11 (0.08)	0.179
	P[1]	0.071		0.123		0.430									
Leadership skills	**Control**	1 (0)	1 (1–1)	2.65 (2.33)	1 (1–3)	3.08 (2.68)	1 (1–7)	1.65 (2.33)	0 (0–2)	0.28 (0.06)	< 0.001*	0.36 (1.91)	0 (0–2)	0.04 (0.08)	0.619
	Intervention	1.16 (0.55)	1 (1–1)	3.88 (2.7)	3 (1–7)	2.5 (2.15)	1 (1–3)	2.72 (2.62)	2 (0–4)	0.43 (0.06)	< 0.001*	-1.33 (2.24)	0 (-2.5–0)	-0.20 (0.07)	0.004*
	P[1]	0.145		0.085		0.576									
Teamwork skills	**Control**	1 (0)	1 (1–1)	2.15 (2.15)	1 (1–3)	2.28 (2.3)	1 (1–3)	1.15 (2.15)	0 (0–2)	0.19 (0.06)	0.001*	0.08 (2.6)	0 (0–0)	0.01 (0.08)	0.860
	Intervention	1.04 (0.2)	1 (1–1)	3.16 (2.44)	3 (1–5)	2.08 (1.95)	1 (1–3)	2.12 (2.49)	2 (0–4)	0.35 (0.07)	< 0.001*	-1 (2.36)	0 (-2–0)	-0.17 (0.07)	0.017*
	P[1]	0.308		0.088		0.940									

[1] p-value from Mann-Whitney test, for group comparisons; [2] regression coefficient (SE – Standard Error) for time effect from mixed linear model (after having logarithmically transformed the dependent variables); [a] computed in 49 participants who had both measurements; SD – standard deviation; IQR – Interquartile Range

Discussion

We found a significant post-training improvement in the success rates of simulated delivery (> 92%) in both groups of our cohort, with a low percentage of students (9.8%) applying excessive traction force of more than 100 Newtons at the end of the workshop. This finding indicates that the final-year students achieved competence in performing an efficient and safe simulated childbirth. These high rates of successful delivery have been reported in other studies that included not only midwifery students but also registered midwives with previous clinical experience and exposure to shoulder dystocia (Papoutsis et al., 2024a). Both in vivo and in vitro studies have demonstrated that peak traction forces on the fetal head exceeding 100 Newtons are associated with a high risk of neonatal injury, including clavicle fractures and brachial plexus injury (Allen et al., 1991; Gonik et al., 1989). In our study, approximately 9.8% of students applied forces exceeding 100 Newtons, which is markedly lower than the 39% reported in a recent high-fidelity simulation study of shoulder dystocia training using an integrated force-monitoring system, in which this proportion remained unchanged before and after training (Papoutsis et al., 2024a).

Our study demonstrated a two- to three-fold increase in both groups of students in the scores for maneuver performance, confidence, communication, leadership, teamwork, and time perception at the end of the baseline workshop. The improvement in maneuver performance scores is particularly important, as the NHS Litigation Authority in England reports that 46% of neonatal brachial plexus injuries are associated with substandard care, often due to healthcare providers' inadequate performance of the required maneuvers to resolve shoulder dystocia (Menjou et al., 2003). Recent studies have reported comparable improvements in confidence, time perception – defined as the difference between self-reported and actual delivery time – and communication skills in populations including midwifery students and registered midwives (Papoutsis et al., 2024a; Papoutsis et al., 2024b; Papoutsis et al., 2025).

Students who received the intervention showed a trend toward higher teamwork (3.1 ± 2.4 vs. 2.1 ± 2.1; $p = 0.08$) and leadership scores (3.8 ± 2.7 vs. 2.6 ± 2.3; $p = 0.08$) compared with controls at the end of the workshop. The intervention we utilized in our study was a two-hour leadership and teamwork experiential learning module, that consisted of an initial presentation of key concepts followed by experiential activity with guided reflection, with the purpose of solidifying their learning and reinforcing the key messages of leadership and teamwork in relation to shoulder dystocia management at childbirth. A systematic review conducted in 2021 examining the impact of team and leadership training in emergency care identified a variety of training methods, including e-learning, video-based instruction, demonstration, and both low- and high-fidelity simulation (Kuzovlev et al., 2021). However, the review concluded that there is currently no evidence to identify the most effective educational approach for delivering team and leadership training. In obstetrics, a large retrospective observational study from Finland reported that teamwork, leadership, and communication were discussed during each training session alongside technical skills training; however, the study did not specify the exact content of these discussions or quantify their individual effects (Kaijomaa et al., 2023). In a randomized controlled study comparing virtual reality-based simulation with high-fidelity simulation for managing shoulder dystocia, teamwork and leadership were not emphasized or included in the trial (Falcone et al., 2024). Nevertheless, the authors noted that all relevant non-technical skills should be considered when designing such trials, as they can significantly influence performance and outcomes (Falcone et al., 2024). A Cochrane systematic review in 2020 reported a significant heterogeneity in study designs investigating the improvement in shoulder dystocia management following simulation-based training (Fransen et al., 2020). The review highlighted inconsistencies in definitions and a lack of clear, consistent data on the training and assessment methods used, although team performance – assessed through leadership and teamwork skills – was a secondary outcome in the included studies (Fransen et al., 2020).

Our study showed that one week after the baseline workshop, both groups of students retained their communication and time-perception skills and demonstrated higher confidence levels and improved maneuver performance. However, the leadership and teamwork skills, which had been higher in the intervention group at the end of the workshop, had declined by the one-week follow-up and were no longer different from those of the control group. We can hypothesize that the higher leadership and teamwork scores observed in the intervention group at the end of the workshop reflect an "immediate post-teaching effect," as reported in the literature (Crofts et al., 2007).

Conversely, the decline in these scores one week later, returning to levels similar to the control group, may indicate a lack of "deep learning" from the simulation-based training in the intervention group.

This issue should be carefully acknowledged, so that future study designs focus not only on the "immediate post-teaching effect" but also explore educational strategies that promote "deep learning" rather than "surface learning," thereby enhancing retention and the lasting acquisition of critical skills (Hattie & Donoghue, 2016). Another possible explanation comes from a 2021 systematic review, which found that it remains unclear how learners at different levels of clinical experience – such as students versus specialists – benefit from short interventions in teamwork and leadership training (Kuzovlev et al., 2021). Students may have different learning styles compared with specialists and may therefore require a tailored approach to leadership and teamwork training. This should be further investigated in future research.

Limitation of study

There are some limitations of this study that should be taken into account. First, the student participation rate in our study was 72.9%. Although relatively high, this still excludes nearly 30% of invited students, potentially introducing selection bias, as those who participated may have been more experienced or highly motivated. Second, successful delivery was defined in our study as the removal of the posterior arm within five minutes of head delivery. In most shoulder dystocia cases, the impacted shoulder can often be released earlier using other basic maneuvers applied prior to posterior arm extraction (Baxley & Gobbo, 2004; Tsikouras et al., 2024). Had we defined successful delivery differently, allowing completion of the simulated birth using these earlier maneuvers, the results might have differed. Third, we were unable to account for any self-directed reading or preparation by students prior to the workshop, which could have influenced performance. As a pragmatic study, participants were not restricted from engaging in independent learning before the simulation.

The principal strength of this study lies in its provision of novel insights, emphasizing the importance of incorporating a leadership and teamwork training module in the management of shoulder dystocia. This was a pragmatic study, and we selected students from the same semester in their final year of undergraduate studies. This approach ensured that all participants had been exposed to the same background knowledge and skills throughout their studies, minimizing potential confounding effects from students in earlier semesters who may have had lower or more variable levels of knowledge and skills in shoulder dystocia management.

Conclusion

We found that students in our study achieved competence in performing an efficient and safe simulated childbirth, as reflected by high simulated delivery success rates (> 92%) and a low proportion of students (9.8%) applying excessive traction force (> 100 Newtons) at the end of the workshop. The high-fidelity simulation training resulted in a two- to three-fold increase in the score of maneuver performance, confidence, communication, leadership skills, and teamwork skills in all students at the end of the baseline workshop. Our study showed that the intervention, consisting of the added experiential learning module, led to a trend toward higher leadership and teamwork scores in the students who received it compared with controls at the end of the workshop; however, this effect was not retained one week later.

Since this study represents a novel analysis of simulation-based shoulder dystocia management, further research with larger sample sizes is warranted. Future studies should investigate the potential interaction between teamwork and leadership training and assess whether leadership training for the designated team leader has a greater impact than training provided to the entire team. Additionally, future research should investigate whether competencies acquired through structured leadership and teamwork training translate into measurable improvements in real-world maternal and neonatal outcomes in shoulder dystocia management, beyond the simulation environment.

Ethical aspects and conflict of interest

The study was approved by the Ethics Committee of the University of Western Macedonia, Greece (No. 266/2023-31.08.2023) and was conducted in accordance with CONSORT (Consolidated Standards of Reporting Trials) guidelines. All participants provided written informed consent. The study has been listed on the ISRCTN registry with the study registration number ISRCTN85105943.

The authors have no conflicts of interest to declare.

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Author contributions

Conception and design (AT, DP), data analysis and interpretation (AT, DP, NC, CT), manuscript draft (AT, DP), critical revision of the manuscript (AT, DP, NC, CT), final approval of the manuscript (AT, DP, NC, CT).

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