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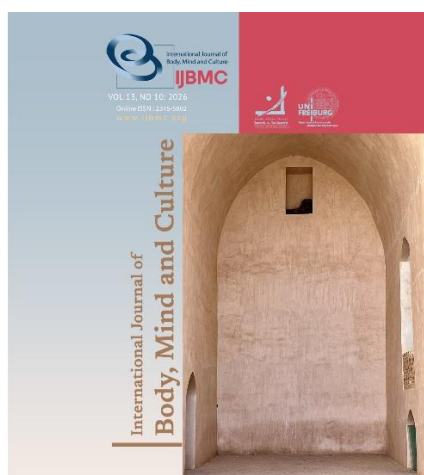
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Effectiveness of Virtual Reality and Stress-Ball Distraction for Pain During Episiotomy Repair: A Four-Arm Randomized Controlled Trial

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ABSTRACT

Objective: This study compared the effectiveness of virtual reality (VR), stress-ball distraction, their combination, and routine care in reducing pain during episiotomy repair.

Methods and Materials: A four-arm, parallel-group randomized controlled trial was conducted in two hospitals in Al-Muthanna Governorate, Iraq, between December 2025 and February 2026. The final analysis included 112 postpartum women allocated equally to VR, stress-ball distraction, combined VR and stress-ball distraction, or routine care ($n = 28$ per group). Pain intensity was assessed immediately after episiotomy repair using a 0–10 Visual Analogue Scale. Between-group differences were analyzed using one-way ANOVA followed by Tukey HSD comparisons in SPSS 26.

Findings: Mean pain scores were 3.82 ± 1.24 for VR, 5.46 ± 1.10 for stress-ball distraction, 3.48 ± 1.38 for combined treatment, and 7.39 ± 1.49 for routine care. The overall between-group difference was significant, $F(3,108) = 52.18$, $p < .001$, $\eta^2 = .592$. Compared with routine care, VR ($MD = 3.57$), stress-ball distraction ($MD = 1.93$), and combined treatment ($MD = 3.91$) significantly reduced pain (all $p < .001$). Both VR and combined treatment were superior to stress-ball distraction ($p < .001$). However, the difference between VR alone and combined treatment was nonsignificant ($p = .768$).

Conclusion: VR significantly reduced pain during episiotomy repair. Combining VR with stress-ball distraction provided no statistically significant additional benefit, while stress-ball distraction remained an effective, low-cost alternative.

Keywords: Virtual Reality, Stress-Ball Distraction, Episiotomy Repair, Procedural Pain, Randomized Controlled Trial.

Introduction

Episiotomy remains a clinically important perineal procedure in selected vaginal births, and repair can be accompanied by substantial acute pain. Contemporary evidence supports restrictive rather than routine use of episiotomy and careful attention to maternal comfort and recovery (Abdelgalil et al., 2025); (Singh et al., 2016). Pain during and after perineal repair can affect mobility, comfort, early postpartum functioning, and satisfaction with care (Choudhari et al., 2022).

Pain is not only a sensory event; attention, anxiety, expectation, context, and prior experience can influence how procedural pain is perceived. A biopsychosocial perspective therefore supports combining appropriate medical care with psychologically informed, low-risk supportive strategies when feasible (Seyed Alitabar, 2025). Non-pharmacological approaches such as breathing, music, tactile distraction, and immersive visual distraction have been studied across painful procedures (Fadhil & Ali, 2019); (Shawq et al., 2025).

Virtual reality provides an immersive competing stimulus that can redirect attentional resources away from nociceptive input. Randomized studies have reported reductions in pain or pain-related distress during childbirth and other procedures (Gür & Apay, 2020; Kjeldgaard Pedersen et al., 2023; Rodriguez et al., 2025). In episiotomy repair specifically, VR accompanied by music has reduced perceived pain and improved postpartum comfort (Gökdoğan Keleş & Altinkaya, 2025), and another randomized trial found beneficial effects of VR glasses during episiotomy repair (Orhan & Bülez, 2023). A recent nursing study likewise demonstrated clinically meaningful procedural-pain reduction with VR during burn dressing changes (Watheeg Kharbot & Mohammed, 2025).

Stress balls provide a low-cost tactile distraction strategy that can be implemented without specialized infrastructure. Evidence from other invasive procedures suggests that stress-ball use may reduce pain or distress in some settings (Tosun et al., 2025). However, direct comparison of VR, stress-ball distraction, and their combination during episiotomy repair remains limited. Technology-supported care should also be

evaluated for practicality, acceptability, and integration with routine clinical workflows rather than adopted solely because it is novel (Seyed Alitabar, 2025).

The present trial therefore compared four conditions—VR, stress ball, combined VR plus stress ball, and routine care—with pain intensity during episiotomy repair as the primary outcome.

Methods and Materials

Study design and setting

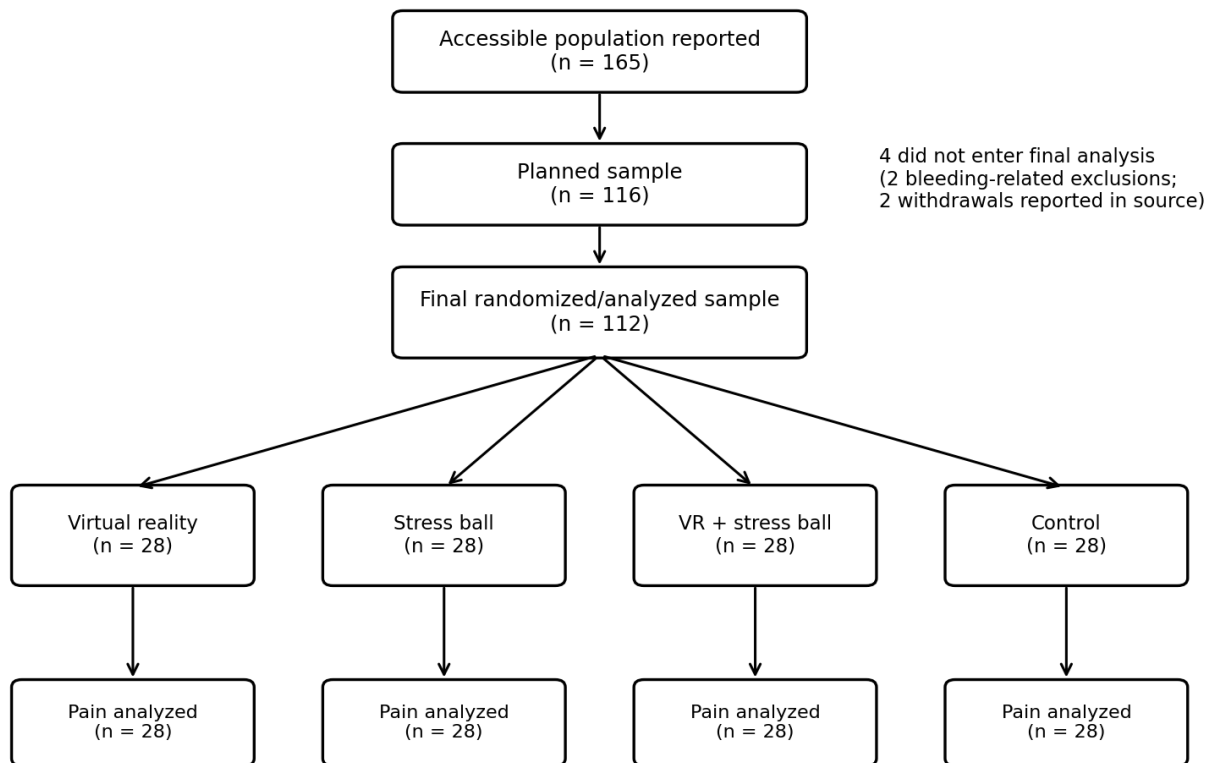
This study was conducted as a four-arm parallel-group randomized controlled trial in the labor and delivery wards of Feminine and Children Teaching Hospital and Al-Rumaitha Hospital in Al-Muthanna Governorate, Iraq. Data collection occurred from 16 December 2025 to 13 February 2026. The trial is registered at ClinicalTrials.gov as NCT07499011 (ClinicalTrials.gov, 2026). The registry entry was first posted after study completion; therefore, the registration should be regarded as retrospective rather than prospective.

Participants and allocation

The accessible population was reported as 165 postpartum women undergoing episiotomy repair after vaginal delivery. The source protocol identified a target sample of 116 using a finite-population formula. Four women did not contribute to the final analysis because of bleeding-related exclusion or withdrawal, leaving 112 participants. The analytic sample comprised 28 women in each of four groups. The participant-flow information was harmonized with the final group sizes used throughout the statistical tables; Figure 1 summarizes this process.

Inclusion criteria were age 18–42 years, ability to communicate and understand the study procedures, absence of visual/hearing/perceptual impairment, ability to squeeze a stress ball, absence of diabetes mellitus, and episiotomy repair after vaginal birth. Exclusion criteria included chronic pain conditions, third- or fourth-degree perineal tears, complications requiring deviation from the study procedure, lack of consent, and use of local anesthetic during the repair.

Eligible women were allocated using sealed envelopes containing color-coded assignments for VR, stress ball, combined VR plus stress ball, or control. Because participants and care providers could identify the intervention, the trial should be considered open-label rather than blinded.



Primary outcome: Visual Analogue Scale pain score immediately after episiotomy repair

Figure 1.

Participant flow and analytic sample

Outcome measure

Pain intensity was assessed with a 0–10 Visual Analogue Scale (VAS), where 0 represented no pain and 10 represented the worst pain. The VAS is widely used for pain assessment and has demonstrated excellent test–retest reliability in clinical populations (ICC approximately 0.97 in one validation study) (Alghadir et al., 2018). Pain was recorded immediately after completion of episiotomy repair.

Interventions

Virtual reality group. Participants used a Meta Quest 3 headset with calming natural scenes and music through

noise-reducing headphones for approximately 10–12 minutes during repair. Contact surfaces were disinfected between users.

Stress-ball group. Participants held a stress ball in the dominant hand and repeatedly squeezed and released it throughout suturing as a tactile distraction strategy.

Combined group. Participants received the VR and stress-ball interventions simultaneously using the same procedures described above.

Control group. Participants received routine episiotomy-repair care without either study distraction intervention.

Ethics and trial registration

The Research Ethics Committee of the College of Nursing, University of Baghdad approved the study (No. 46, 25 November 2025). Written informed consent was obtained before participation. The study was registered as NCT07499011 ([ClinicalTrials.gov](https://clinicaltrials.gov), 2026).

Statistical analysis

Analyses were performed in SPSS version 26. Frequencies, percentages, means, standard deviations, and ranges summarized the data. Categorical baseline characteristics were compared using chi-square tests and mean age using

one-way ANOVA. The primary outcome was compared across the four groups using one-way ANOVA followed by Tukey HSD pairwise comparisons. Statistical significance was set at $p < 0.05$. Based on the reported sums of squares, eta squared (η^2) was calculated for the overall pain-group effect as $SS_{\text{between}}/SS_{\text{total}}$.

Findings and Results

The final analytic sample consisted of 112 women, 28 in each trial arm. Participant age averaged 26.01 ± 5.65 years; 98.2% were married, and 80.4% were housewives. [Table 1](#) summarizes sociodemographic characteristics.

Table 1.

Sociodemographic characteristics by study group (N = 112)

Variable	Category	VR n (%)	Stress ball n (%)	Combined n (%)	Control n (%)	Total n (%)
Age	18–22	9 (32.1)	8 (28.6)	10 (35.7)	9 (32.1)	36 (32.1)
	23–27	10 (35.7)	8 (28.6)	8 (28.6)	12 (42.9)	38 (33.9)
	28–32	5 (17.9)	5 (17.9)	8 (28.6)	1 (3.6)	19 (17.0)
	33–37	3 (10.7)	5 (17.9)	2 (7.1)	4 (14.3)	14 (12.5)
	38–42	1 (3.6)	2 (7.1)	0	2 (7.1)	5 (4.5)
	Mean $\pm$ SD	25.57 $\pm$ 5.60	27.50 $\pm$ 6.17	25.30 $\pm$ 4.63	25.60 $\pm$ 6.10	26.01 $\pm$ 5.65
Marital status	Married	28 (100)	27 (96.4)	27 (96.4)	28 (100)	110 (98.2)
	Widowed	0	1 (3.6)	1 (3.6)	0	2 (1.8)
Education	Illiterate	2 (7.1)	3 (10.7)	4 (14.3)	6 (21.4)	15 (13.4)
	Primary	3 (10.7)	3 (10.7)	5 (17.9)	3 (10.7)	14 (12.5)
	Intermediate	10 (35.7)	6 (21.4)	4 (14.3)	9 (32.1)	29 (25.9)
	Secondary	6 (21.4)	6 (21.4)	4 (14.3)	5 (17.9)	21 (18.8)
	Bachelor's	6 (21.4)	9 (32.1)	9 (32.1)	5 (17.9)	29 (25.9)
	Postgraduate	1 (3.6)	1 (3.6)	2 (7.1)	0	4 (3.6)
Occupation	Housewife	21 (75.0)	21 (75.0)	23 (82.1)	25 (89.3)	90 (80.4)
	Employed	7 (25.0)	7 (25.0)	5 (17.9)	3 (10.7)	22 (19.6)

Obstetric characteristics are shown in [Table 2](#). Fifty-five percent of participants were in their first pregnancy, 54.5% had no previous deliveries before the index birth, 84.8%

delivered at term, and 60.7% had no history of previous episiotomy.

Table 2.

Obstetric history and previous episiotomy by study group (N = 112)

Variable	Category	VR	Stress ball	Combined	Control	Total
Gravida	1	17 (60.7)	9 (32.1)	18 (64.3)	18 (64.3)	62 (55.4)
	2	10 (35.7)	13 (46.4)	10 (35.7)	9 (32.1)	42 (37.5)
	3	1 (3.6)	6 (21.4)	0	1 (3.6)	8 (7.1)
Prior deliveries	0	17 (60.7)	9 (32.1)	18 (64.3)	17 (60.7)	61 (54.5)
	1	11 (39.3)	16 (57.1)	10 (35.7)	10 (35.7)	47 (41.9)
	2	0	3 (10.7)	0	1 (3.6)	4 (3.6)

Gestational age	Preterm (<37 weeks)	4 (14.3)	4 (14.3)	4 (14.3)	5 (17.9)	17 (15.2)
	Term (≥37 weeks)	24 (85.7)	24 (85.7)	24 (85.7)	23 (82.1)	95 (84.8)
Previous episiotomy	No	18 (64.3)	14 (50.0)	19 (67.9)	17 (60.7)	68 (60.7)
	Yes	10 (35.7)	14 (50.0)	9 (32.1)	11 (39.3)	44 (39.3)

Baseline categorical comparisons did not show statistically significant group differences in age category, marital status, education, occupation, delivery history, gestational age, or

previous episiotomy (all $p > 0.05$; [Table 3](#), [Table 4](#), and [Table 5](#)). A nonsignificant baseline test should be interpreted as absence of a detected difference, not proof of equivalence.

Table 3.

Baseline sociodemographic comparisons across the four groups

Variable	χ^2	df	p
Age groups	10.219	12	0.597
Marital status	2.036	3	0.565
Educational level	10.611	15	0.780
Occupation	2.489	3	0.477

Table 4.

Comparison of mean age across the four groups (one-way ANOVA)

Source	SS	df	MS	F	p
Between groups	84.598	3	28.199	0.879	0.454
Within groups	3464.393	108	32.078		
Total	3548.991	111			

Table 5.

Baseline obstetric comparisons across the four groups

Variable	χ^2	df	p
Number of deliveries	11.565	6	0.072
Gestational age	0.208	3	0.976
Previous episiotomy	2.096	3	0.553

Pain outcomes differed markedly between groups. As shown in [Table 6](#), the control group had the highest mean VAS score (7.39 ± 1.49), while the combined group had the

lowest numerical mean (3.48 ± 1.38), closely followed by VR alone (3.82 ± 1.24).

Table 6.

Pain scores during episiotomy repair by study group

Group	Mean	SD	Minimum	Maximum
VR	3.821	1.241	1	6
Stress ball	5.464	1.097	4	8
VR + stress ball	3.482	1.384	1	6
Control	7.393	1.493	5	10
Total	5.040	2.026	1	10

Table 7.

One-way ANOVA for pain scores

Source	SS	df	MS	F	p
Between groups	269.578	3	89.859	52.179	<0.001
Within groups	185.991	108	1.722		
Total	455.569	111			

Effect size: $\eta^2 = 0.592$, calculated from the reported sums of squares.**Table 8.**

Tukey HSD pairwise comparisons of pain scores

Comparison	Mean difference	SE	p
Control vs VR	3.571	0.351	<0.001
Control vs stress ball	1.929	0.351	<0.001
Control vs combined	3.911	0.351	<0.001
Stress ball vs VR	1.643	0.351	<0.001
Stress ball vs combined	1.982	0.351	<0.001
VR vs combined	0.339	0.351	0.768

The omnibus ANOVA was statistically significant, $F(3,108) = 52.179$, $p < 0.001$, with a large overall effect ($\eta^2 = 0.592$; Table 7). Tukey comparisons (Table 8) showed lower pain in the VR and combined groups than in both the control and stress-ball groups (all $p < 0.001$). Stress-ball use also produced lower pain than control ($p < 0.001$). The VR-alone and combined groups did not differ significantly ($p = 0.768$). Therefore, although the combined group had the numerically lowest mean, the data do not support superiority of the combined intervention over VR alone.

Discussion and Conclusion

The primary finding is that immersive VR was associated with substantially lower procedural pain during episiotomy repair. This result is consistent with direct obstetric evidence showing that VR can reduce pain during episiotomy repair and childbirth-related procedures (Orhan & Bülez, 2023; Gökdoğan Keleş & Altinkaya, 2025; Mohammadi et al., 2023). The magnitude of the overall between-group effect in the present trial was large, although the estimate should be interpreted in the context of a modest sample and single-region recruitment.

The likely clinical mechanism is attentional competition rather than a direct anesthetic effect. Immersive VR can capture visual and auditory attention, reduce the cognitive

resources available for processing nociceptive input, and alter pain-related expectation and recall (Kjeldgaard Pedersen et al., 2023); (Rodriguez et al., 2025). This interpretation is compatible with a broader biopsychosocial understanding of pain, in which sensory input interacts with attention, affect, expectation, and context (Seyed Alitabar, 2025).

Stress-ball distraction also reduced pain relative to routine care, but the reduction was smaller than that observed with VR. Stress balls are inexpensive, portable, and require minimal infrastructure, which may make them useful where VR equipment is unavailable. Similar tactile-distraction approaches have shown benefit in other invasive procedures (Tosun et al., 2025). The present findings therefore support a tiered implementation approach: stress-ball distraction may be a pragmatic low-resource option, whereas VR may provide stronger analgesic distraction where equipment and infection-control procedures are feasible.

The combined intervention yielded the lowest numerical pain score, but it did not significantly outperform VR alone. This distinction is important because the original wording of the manuscript implied superiority of the combined method. The data instead indicate that adding a stress ball to VR did not provide a statistically demonstrable incremental benefit. From an implementation perspective, unnecessary

complexity should be avoided unless additional benefit is shown. Health-technology adoption should balance efficacy with usability, cost, staff burden, and patient preference (Kouijzer et al., 2023); (Seyed Alitabar, 2024).

A recent IJBMC trial using immersive VR during burn dressing changes also reported substantially lower procedural pain in the VR group, supporting the general relevance of immersive distraction in nursing pain management (Watheeg Kharbot & Mohammed, 2025). Nevertheless, transferability across age groups, procedures, and cultural settings should not be assumed without direct testing.

Limitations and Recommendations

Several limitations should be considered. First, the sample-size approach was based on the accessible population rather than an a priori intervention effect and power calculation. Second, the source participant-flow description was internally inconsistent with the final equal group sizes and the trial registry; the final analysis consistently contains 112 women (28 per arm), and this should be reconciled against the original CONSORT log before publication. Third, the trial was open-label and pain was self-reported immediately after the procedure, creating potential expectancy and reporting effects. Fourth, the registry entry was posted after study completion. Fifth, the analysis used a one-way four-group comparison rather than a factorial analysis capable of formally testing VR $\times$ stress-ball interaction. Sixth, clinically relevant outcomes such as analgesic rescue, anxiety, satisfaction, wound healing, and postpartum recovery were not assessed. Finally, recruitment from two hospitals in one governorate limits generalizability.

Future trials should use prospectively registered protocols, effect-size-based power calculations, concealed allocation with blinded outcome assessment where feasible, standardized reporting of co-interventions, and outcomes extending beyond immediate pain. Multicenter studies should also evaluate acceptability, cost, device hygiene, patient satisfaction, and whether VR reduces pharmacological analgesic requirements.

Conclusion

In this four-arm trial, VR alone and VR combined with a stress ball produced substantially lower pain scores during episiotomy repair than routine care and stress-ball distraction alone. Stress-ball use also reduced pain relative to control. The combined intervention was numerically lowest but did not differ significantly from VR alone, so the results support VR as the principal effective component rather than demonstrating a synergistic combined effect. VR may be a useful non-pharmacological adjunct to routine obstetric pain management when feasible, while stress balls remain a low-cost alternative.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

Ethical approval was granted by the Research Ethics Committee, College of Nursing, University of Baghdad (No. 46; 25 November 2025). Written informed consent was obtained from participants. The study was registered at ClinicalTrials.gov (NCT07499011).

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

All authors equally contribute to this study.

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