

Original Research

Antenatal Pelvic Floor Muscle Training Combined With Perineal Massage Significantly Reduces Episiotomy Rates: A Randomized Controlled Trial

Ilyas Turan¹, Erhan Okuyan^{2,*}, Özgür Ozan Ceylan³, Şahide Akbulut⁴,
Mülaim Sizer⁵, Nihan Erdoğan Atalay⁶

¹Department of Gynecologic Oncology, Private Zilan Hospital, 72060 Batman, Turkey

²Department of Obstetrics and Gynecology, Private Zilan Hospital, 72060 Batman, Turkey

³Department of Obstetrics and Gynecology, VM Medicalpark Hospital, 35230 İzmir, Turkey

⁴Department of Nursing, Faculty of Health Sciences, Batman University, 72060 Batman, Turkey

⁵Department of Obstetrics and Gynecology, Batman Training and Research Hospital, 72070 Batman, Turkey

⁶Department of Obstetrics and Gynecology, Private Sakarya Adatıp Hospital, 54050 Sakarya, Turkey

*Correspondence: dreo06@hotmail.com (Erhan Okuyan)

Academic Editor: Michael H. Dahan

Submitted: 17 June 2026 Revised: 24 July 2026 Accepted: 29 July 2026 Published: 13 October 2026

Abstract

Background: Episiotomy rates remain high worldwide despite recommendations supporting restrictive use. Although antenatal pelvic floor muscle training (PFMT) and perineal massage have each demonstrated efficacy individually, their comparative effectiveness and their combined efficacy relative to other nonpharmacological interventions remain unclear. **Methods:** This randomized, assessor-blinded, controlled trial enrolled 431 low-risk pregnant women between 20–36 weeks of gestation. Participants were allocated to one of four study groups: PFMT alone (n = 132), PFMT + Swiss ball exercises (n = 58), PFMT + perineal massage (n = 88), and standard care (n = 153). The primary outcome was the episiotomy rate. Logistic regression analysis was performed to identify independent predictors of episiotomy. **Results:** The rates were 5.7% in the PFMT + perineal massage group, 58.6% in the PFMT + Swiss ball group, 68.6% in the control group, and 85.6% in the PFMT-alone group. PFMT + perineal massage significantly reduced the risk of episiotomy compared with both the control group and the PFMT-alone group ($p < 0.001$ for both). However, there was no significant difference in episiotomy rates between the PFMT + perineal massage group and the PFMT + Swiss ball group ($p > 0.05$). In contrast, PFMT alone was associated with a higher episiotomy rate than standard care ($p = 0.001$). Younger maternal age (adjusted odds ratio [aOR] = 0.89, 95% confidence interval [CI]: 0.85–0.93) and nulliparity (aOR = 25.4, 95% CI: 10.5–60.1) were strongly associated with episiotomy ($p = 0.001$). **Conclusion:** Combining antenatal PFMT with perineal massage dramatically lowered episiotomy rates. In contrast, isolated PFMT without perineal preparation may paradoxically increase episiotomy risk, potentially due to pelvic floor hypertonia. Antenatal education should therefore emphasize both pelvic floor strengthening and perineal distensibility. **Clinical Trial Registration:** This trial was retrospectively registered with ClinicalTrials.gov (registration link: <https://clinicaltrials.gov/study/NCT07626333>, registration number: NCT07626333).

Keywords: episiotomy; pelvic floor muscle training; perineal massage; Swiss ball

1. Introduction

Episiotomy, a surgical incision of the perineum during the second stage of labor, was historically advocated to prevent severe perineal lacerations. However, accumulating evidence indicates that routine episiotomy increases the risk of posterior perineal trauma, dyspareunia, perineal pain, and postpartum hemorrhage [1]. The World Health Organization recommends a restrictive episiotomy approach, targeting rates below 10% [2]. Despite these recommendations, episiotomy rates remain high in many settings, particularly among nulliparous women [3].

Perineal trauma is a common occurrence during vaginal delivery. As stated in the Introduction of Reference [4], approximately 53–79% of women who undergo vaginal delivery experience some degree of perineal injury [4].

Short-term sequelae include pain, bleeding, and infection, whereas long-term consequences involve urinary and fecal incontinence, pelvic organ prolapse, and sexual dysfunction [5]. Consequently, effective strategies for perineal protection are critically important.

Pelvic floor muscle training (PFMT) is among the most extensively studied antenatal interventions for perineal protection. A systematic review and meta-analysis by Zhang et al. [6] demonstrated that PFMT during pregnancy significantly reduces urinary incontinence as well as third- and fourth-degree perineal tears; however, its effect on episiotomy rates was not statistically significant (relative risk [RR] = 0.95, 95% confidence interval [CI]: 0.85–1.07). Sobhghol et al. [7] further confirmed that antenatal PFMT shortens the second stage of labor and lowers the incidence of severe perineal trauma.



Perineal massage, whether performed antenatally or during the second stage of labor, is intended to improve tissue elasticity and distensibility. Abdelhakim et al. [8] reported that antenatal perineal massage significantly reduced both episiotomy rates (RR = 0.79, 95% CI: 0.72–0.87) and perineal tears. Venugopal et al. [9] further demonstrated that intrapartum perineal massage reduces severe perineal trauma, although its independent effect on episiotomy rates has been inconsistent across studies.

The Swiss ball is a widely accessible tool for promoting pelvic mobility during labor. Delgado et al. [10] found that active pelvic movements performed on a Swiss ball reduced the duration of both the first and second stages of labor, decreased pain intensity, maternal fatigue, and anxiety, as well as lowered the risk of cesarean delivery. Similarly, Terres et al. [11] confirmed that birthing ball exercises significantly reduce cesarean delivery rates and alleviate labor pain.

Despite the individual promise of these modalities, few studies have evaluated their combined effects on episiotomy rates. Because PFMT primarily targets muscle strengthening and proprioception, perineal massage improves tissue distensibility and desensitization, and Swiss ball exercises enhance pelvic mobility and maternal positioning, their concurrent use may yield synergistic benefits. However, comparative evidence evaluating PFMT alone versus PFMT combined with Swiss ball exercises or perineal massage remains limited.

This study tested the hypothesis that, among pregnant women completing weekly nurse-led pelvic floor education until delivery, adding Swiss ball exercises or perineal massage would reduce episiotomy rates. The primary objective was to compare the four interventions, PFMT alone, PFMT + Swiss ball exercises, PFMT + perineal massage, and standard care, on episiotomy and related obstetric outcomes.

2. Material and Methods

2.1 Study Design

This randomized, assessor-blinded, controlled trial was conducted at the obstetrics and gynecology clinics of Batman training and research hospital between January 2024 and January 2025. The study protocol followed was developed in accordance with the Consolidated Standards of Reporting Trials (CONSORT) guidelines and approved by the institutional ethics committee (Approval No.: 2023/12-45). Written informed consent was obtained from all participants. The study was conducted in accordance with the principles of the Declaration of Helsinki.

2.2 Study Population and Eligibility Criteria

Inclusion criteria were as follows: (1) age ≥ 18 years; (2) no prior exposure to study interventions; (3) gestational age 20–36 weeks at enrollment; (4) no previous episiotomy; (5) estimated fetal weight 2800–4200 g; (6) no labor induction; (7) absence of systemic disease complicating preg-

nancy; (8) no regular medication use other than multivitamins; and (9) pre-pregnancy body mass index (BMI) 18.5–34.9 kg/m². Exclusion criteria were: (1) prior pelvic floor surgery; (2) current urinary tract infection; (3) inability to perform Kegel exercises; (4) multiple gestation; or (5) planned cesarean delivery.

2.3 Sample Size Determination

The sample size was calculated using G*Power software (version 3.1; Heinrich Heine University Düsseldorf, Düsseldorf, North Rhine-Westphalia, Germany) for a chi-square test with four groups (df = 3), with a medium effect size ($w = 0.25$), a two-sided $\alpha = 0.05$, and 80% power. The required sample size was 206 participants. Accounting for an anticipated 20% attrition rate, the target enrollment was revised to 260 participants. However, due to higher-than-expected recruitment and to increase precision for subgroup analyses, a total of 431 pregnant women were enrolled. The unequal group sizes resulted from simple randomization without blocking.

2.4 Randomized Group Assignment and Blinding

The randomization sequence was generated using a computer-based random number generator by a statistician who was not involved in participant recruitment or outcome assessment. Participants were not fully blinded to the intervention received due to the visible nature of the interventions (e.g., Swiss ball use); however, they were not informed of the specific study hypothesis regarding episiotomy. Therefore, the study was classified as assessor-blinded, with outcome assessors and statisticians masked to group allocation. To ensure allocation concealment, group assignments were placed in opaque, sequentially numbered, sealed envelopes that were opened by the attending nurse-midwife only after the participant had provided written informed consent. The trial was registered retrospectively due to administrative delays at the host institution's ethics board. However, the study protocol, primary outcome measure (episiotomy rate), and statistical analysis plan were established and finalized prior to the enrollment of the first participant, and no changes were made to these elements during the study period. We clarified that participants were not informed of the specific study hypothesis regarding episiotomy; however, due to the visible nature of the interventions (e.g., Swiss ball use), they could not be fully blinded to the treatment received. Eligible participants were randomly assigned using sealed envelopes (bag technique) to one of the four groups: control ($n = 153$), PFMT + perineal massage ($n = 88$), PFMT + Swiss ball ($n = 58$), or PFMT alone ($n = 132$). Participants were blinded to group allocation. Outcome assessors, including data collectors and statisticians, were blinded to group assignment. Attending clinicians could not be blinded due to the nature of the interventions (e.g., visible Swiss ball use, reported perineal massage practice), which represents a study limitation (Fig. 1).

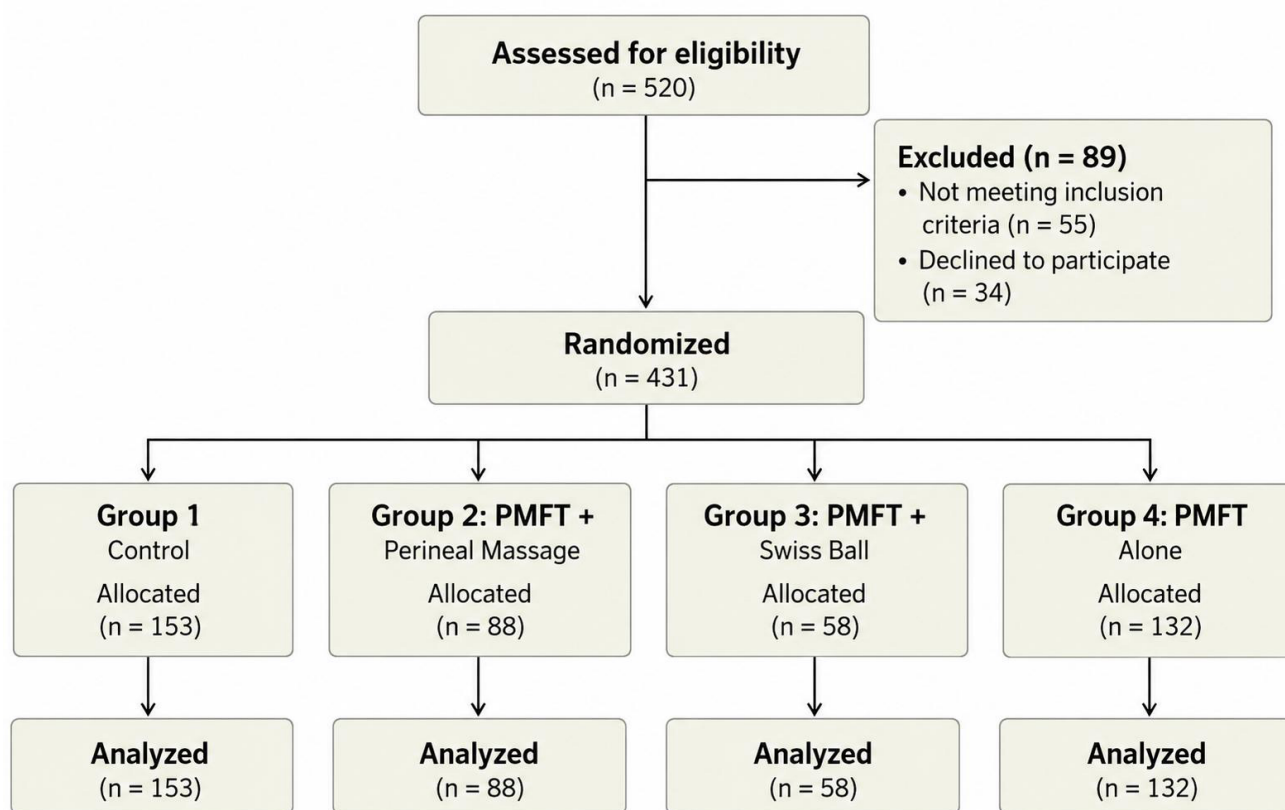


Fig. 1. CONSORT flow diagram of the randomized controlled trial. CONSORT, Consolidated Standards of Reporting Trials; PFMT, pelvic floor muscle training.

2.5 Interventions

All intervention groups attended weekly nurse-led pelvic floor education sessions (60 minutes) from enrollment until delivery. Sessions covered pelvic floor anatomy, correct pelvic floor muscle contraction (Kegel exercises: 3 sets of 10 contractions daily, each held for 6 seconds with 6-second rest), and diaphragmatic breathing. All participants in the PFMT + perineal massage group initiated the massage protocol at 34 weeks of gestation. Participants who experienced preterm delivery before initiation of the protocol were excluded from the final analysis. Correct PFMT performance was verified and corrected weekly by the attending nurse-midwife using digital palpation and visual assessment of the levator ani muscle contraction. The specific protocols for each group were as follows:

PFMT-alone group: Performed supervised PFMT weekly plus home exercises (3 sets of 10 contractions daily). Progress was monitored via diary.

PFMT + perineal massage group: In addition to PFMT, participants were taught digital perineal massage from 34 weeks until delivery: once daily for 5–10 minutes, using thumb or partner's finger, lubricated, applying U-shaped pressure to the posterior vaginal wall.

PFMT + Swiss ball group: In addition to PFMT, participants performed active pelvic movements on a Swiss ball (65 cm diameter) during labor: anteversion, retrover-

sion, lateral tilts, and circular hip movements (5–10 repetitions per contraction, guided by midwife).

Control group: Received standard antenatal care (routine check-ups, no structured PFMT, perineal massage, or Swiss ball instruction).

2.6 Data Collection Instruments

A structured Personal Information Form was used to collect sociodemographic and obstetric characteristics. A clinical follow-up form was used to record labor outcomes: episiotomy (yes/no), degree of perineal laceration (if no episiotomy), duration of labor stages, neonatal birth weight, Apgar scores, and postpartum complications.

2.7 Statistical Analysis

Analyses were performed using IBM SPSS Statistics (version 26; IBM Corp., Armonk, NY, USA) was used for all statistical analyses. Normality was assessed with Kolmogorov-Smirnov test. Continuous variables were compared using one-way analysis of variance (ANOVA) (parametric) or Kruskal-Wallis (non-parametric). Categorical variables used chi-square or Fisher's exact test. Multi-variable logistic regression was performed to identify independent predictors of episiotomy, including group allocation, age, parity, BMI, gestational age, and birth weight. Normality was assessed using the Kolmogorov-Smirnov

test, supplemented by the Shapiro-Wilk test and visual inspection of quantile-quantile plots (Q-Q plots) and histograms, to account for the sensitivity of the Kolmogorov–Smirnov test in large samples. For variables with mild skewness, median and interquartile range (IQR) are reported alongside mean $\pm$ standard deviation (SD). A two-tailed $p < 0.05$ was considered statistically significant. Post hoc pairwise comparisons used Bonferroni correction. Multicollinearity was assessed using the variance inflation factor (VIF), and all variables included in the final model had a VIF < 1.7 and tolerance > 0.6 , indicating that multicollinearity did not significantly affect the regression coefficients. Levene’s test was used to assess homogeneity of variances for continuous variables. Firth’s penalized likelihood logistic regression was applied to handle quasi-complete separation. Model diagnostics, including VIF, calibration plots, and receiver operating characteristic (ROC) curves, are reported alongside the Hosmer–Lemeshow test. The analysis was performed as per-protocol, analyzing only participants who completed the intervention until delivery. Furthermore, because the data were analyzed per-protocol rather than by intention-to-treat and excluded preterm deliveries before 34 weeks (which prevented full perineal massage application), we recognize that this may introduce selection bias. We have acknowledged this limitation and recommend that future studies incorporate an intention-to-treat analysis if feasible.

3. Results

3.1 Baseline Characteristics

A total of 431 pregnant women were enrolled. Table 1 presents the baseline characteristics stratified by intervention group. No significant differences were observed among the groups for age, BMI, gestational age, parity, or birth weight (all $p > 0.05$), indicating successful randomization. Attendance at the weekly nurse-led sessions was 94.2% overall, and home exercise diaries indicated that 82.4% of participants performed PFMT on at least 6 days per week. The mean frequency of perineal massage was 5.3 sessions per week. The overall mean maternal age was 26.8 ± 5.3 years, the mean BMI was 28.3 ± 2.8 kg/m², the mean gestational age at delivery was 38.8 ± 1.4 weeks, and the mean neonatal birth weight was 3262 ± 435 g. Nulliparous women represented 36.4% of the study population.

3.2 Episiotomy Rates by Intervention Group

The PFMT + perineal massage group exhibited the lowest episiotomy rate (5.7%), followed by the PFMT + Swiss ball group (58.6%), the control group (68.6%), and the PFMT-alone group (85.6%). Post-hoc pairwise comparisons revealed that the PFMT + perineal massage group had significantly lower episiotomy rates compared to the control group and the PFMT-alone group ($p < 0.001$ for both, Table 2, Fig. 2; ROC analysis in Fig. 3). However, the episiotomy rate in the PFMT + Swiss ball group did not dif-

fer significantly from the control group ($p = 0.171$) or the PFMT-alone group ($p = 0.112$). In contrast, PFMT alone was associated with a significantly higher episiotomy rate than standard care ($p = 0.001$).

3.3 Factors Associated With Episiotomy

Table 3 compares maternal characteristics according to episiotomy status. Women who underwent episiotomy were significantly younger (25.37 ± 4.73 vs. 28.95 ± 5.3 years, $p < 0.001$). Nulliparity was strongly associated with episiotomy, with 99.4% of nulliparous women undergoing episiotomy compared with 36.9% of multiparous women ($p < 0.001$). BMI, gestational age, and birth weight did not differ significantly between groups.

Multivariable logistic regression (Table 4) confirmed that group allocation, younger age, and nulliparity were independent predictors of episiotomy. The reported values are Firth’s penalized likelihood estimates, in order to correct for quasi-complete separation. Operative vaginal delivery was excluded from the multivariate model as it is considered a collider on the causal pathway rather than a true confounder, and its inclusion would result in overadjustment.

3.4 Subgroup Analysis: Nulliparous Women in the PFMT-Alone Group

Among the 48 nulliparous women in the PFMT-alone group, all 48 (100%) underwent episiotomy. In the control group, 55 of 56 nulliparous women (98.2%) underwent episiotomy. In the PFMT + perineal massage group, only 2 of 32 nulliparous women (6.3%) underwent episiotomy. Thus, the paradoxical increase in episiotomy associated with PFMT alone compared with the control group was driven by multiparous women: among multiparous women, episiotomy rates were 60.7% in the PFMT-alone group (51/84) vs. 50.5% in the control group (49/97) ($p = 0.169$) (Table 2). Because one subgroup included no women without episiotomy, resulting in a 100% episiotomy rate in the PFMT-alone nulliparous subgroup, Fisher’s exact test was applied for these comparisons. This finding should therefore be interpreted with caution.

We analyzed secondary maternal and neonatal outcomes to determine whether the marked reduction in episiotomy rates was associated with a compensatory increase in severe spontaneous perineal trauma. As shown in Table 5, the PFMT + perineal massage group exhibited the highest rate of intact perineum (48.2%) among women who did not undergo episiotomy, compared with 16.7% in both the control and PFMT + Swiss ball groups, and 10.5% in the PFMT-alone group ($p < 0.001$). Severe perineal lacerations (third- and fourth-degree) were extremely rare overall; however, the incidence of third-degree tears was significantly lower in the PFMT + perineal massage group (1.2%) compared with the control (8.3%) and PFMT-alone (10.5%) groups ($p = 0.042$). No fourth-degree tears were observed in any of the intervention groups, whereas only one case occurred in the control group. Regarding neonatal outcomes,

Table 1. Baseline characteristics stratified by intervention group*.

Variable	Control (n = 153)	PFMT + perineal massage (n = 88)	PFMT + Swiss ball (n = 58)	PFMT alone (n = 132)	p-value	Test statistic (df)
Age (years), mean $\pm$ SD	25.9 $\pm$ 5.1 (26.0, 22.0–30.0)	28.2 $\pm$ 5.3 (28.0, 24.0–31.0)	26.5 $\pm$ 5.2 (30.0, 25.0–33.0)	25.6 $\pm$ 4.7 (25.0, 22.0–29.0)	<0.001	F(3, 11.432)
Pre-pregnancy BMI (kg/m ²), mean $\pm$ SD	28.9 $\pm$ 2.9 (28.9, 27.2–30.4)	27.8 $\pm$ 1.2 (27.7, 27.1–28.5)	27.7 $\pm$ 1.3 (27.7, 27.0–28.6)	28.1 $\pm$ 3.7 (27.5, 25.7–30.4)	0.009	F(3, 3.870)
Gestational age at delivery (weeks), (median, IQR)	39.0, (38.0–40.0)	39.0, (38.0–40.0)	39.0, (38.0–40.0)	39.0, (38.0–40.0)	0.476	KW (3; 2.497)
Birth weight (g), (median, IQR)	3210, (2972–3500)	3210, (3000–3600)	3310, (3152–3595)	3250, (3000–3630)	0.368	KW (3, 3.155)
Nulliparous, n (%)	88 (57.5)	0	23 (39.7)	46 (34.8)	<0.001	$\chi^2(3) = 80.211$
Multiparous, n (%)	65 (42.5)	88 (100)	35 (60.3)	86 (65.2)	-	
Previous vaginal delivery (among multiparous), n (%)	153 (100)	70 (79.5)	58 (100)	132 (100)	<0.001	$\chi^2(3) = 73.216$
Gestational diabetes mellitus (GDM), n (%)	8 (5.2)	5 (5.7)	3 (5.2)	7 (5.3)	0.98	$\chi^2(3) = 0.03$
Epidural analgesia use, n (%)	67 (43.8)	38 (43.2)	25 (43.1)	58 (43.9)	0.99	$\chi^2(3) = 0.02$
Neonatal sex (male), n (%)	75 (49.0)	43 (48.9)	28 (48.3)	65 (49.2)	0.99	$\chi^2(3) = 0.01$

*Levene's test was used to assess homogeneity of variances for continuous variables, and all comparisons yielded non-significant results ($p > 0.05$ for all), confirming the appropriateness of one-way ANOVA. BMI, body mass index; GDM, gestational diabetes mellitus; SD, standard deviation; IQR, interquartile range; ANOVA, analysis of variance.

Table 2. Episiotomy rates by intervention group with Bonferroni-adjusted p-values.

Group	No episiotomy, n (%)	Episiotomy, n (%)	Adjusted p-value*	χ^2 (df = 1) vs. control**
Control (n = 153)	48 (31.4)	105 (68.6)	REF	REF
PFMT + perineal massage (n = 88)	83 (94.3)	5 (5.7)	<0.001	89.219
PFMT + Swiss ball (n = 58)	24 (41.4)	34 (58.6)	0.171	1.873
PFMT alone (n = 132)	19 (14.4)	113 (85.6)	0.001	11.360

* p-values presented are Bonferroni-Adjusted for multiple pairwise comparisons vs. control group. ** χ^2 test (df = 1) versus the control group. REF, Reference.

Table 3. Maternal and obstetric characteristics by episiotomy status.

Variable	No episiotomy (n = 174)	Episiotomy (n = 257)	p-value	Test statistic (df)*
Age (years), mean $\pm$ SD	28.95 $\pm$ 5.30	25.37 $\pm$ 4.73	<0.001	t (429) = 7.329
BMI (kg/m ²), mean $\pm$ SD	28.14 $\pm$ 2.36	28.41 $\pm$ 3.10	0.333	t (429) = -0.968
Gestational age (weeks), median (IQR)	39 (38–40)	39 (38–40)	0.117	U = 20,441.5
Birth weight (g), median (IQR)	3220 (3000–3582.5)	3250 (2995–3555)	0.812	U = 22,057.0
Nulliparous, n (%)	1 (0.6)	156 (99.4)	<0.001	$\chi^2(1) = 161.968$
Multiparous, n (%)	173 (63.1)	101 (36.9)	<0.001	-

BMI, body mass index; SD, standard deviation; IQR, interquartile range.

mean Apgar scores at 1 and 5 minutes were consistently high across all groups, with no statistically significant differences ($p > 0.05$ for both), indicating that the interventions did not adversely affect neonatal well-being.

4. Discussion

This randomized controlled trial demonstrates that combining antenatal PFMT with perineal massage reduced

the episiotomy rate to 5.7%, which was significantly lower than the rates observed with PFMT + Swiss ball (58.6%), PFMT alone (85.6%), and standard care (68.6%). The protective effect was substantial, corresponding to a 97% reduction in adjusted odds ratios (aORs). Equally important, PFMT alone was associated with higher odds of episiotomy than standard care, a paradoxical finding that requires careful interpretation.

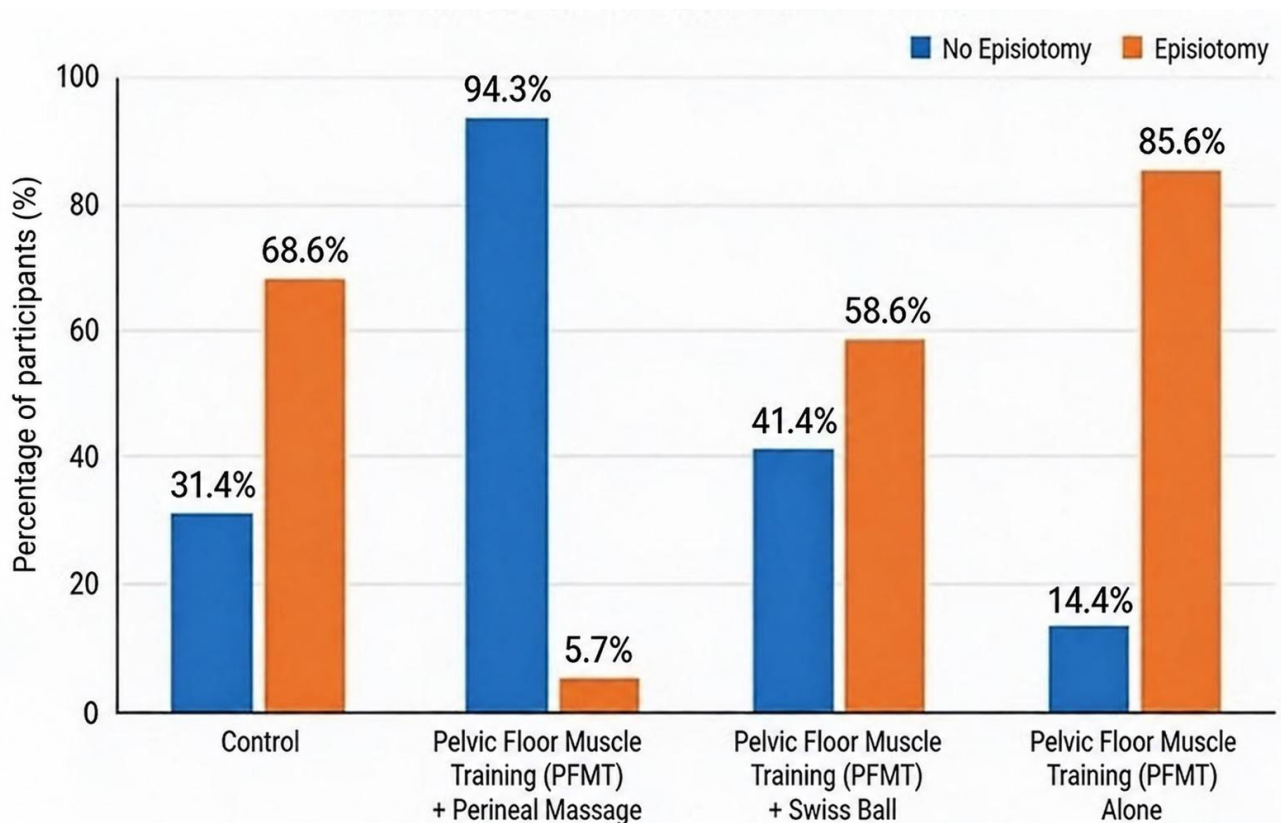


Fig. 2. Episiotomy rates across groups.

Table 4. Multivariable logistic regression for episiotomy using Firth's penalized likelihood estimates*.

Variable	aOR (Firth-corrected)	95% CI (Firth-corrected)	p-value	β	SE (β)	Wald χ^2
Group (Ref.: control)						
PFMT + perineal massage	0.03	0.01–0.08	<0.001	3.506	0.530	43.8
PFMT + Swiss ball	0.62	0.33–1.15	0.158	0.478	0.314	2.32
PFMT alone	2.80	1.52–5.20	0.001	1.030	0.316	10.6
Age (per year)	0.89	0.85–0.93	0.001	0.116	0.023	25.4
Nulliparity (Ref.: multiparous)	25.40	10.50–60.10	0.001	3.234	0.437	54.8
BMI (per unit)	1.00	0.94–1.06	0.618	0.000	0.028	0.00
Birth weight (per 100 g)	1.01	0.96–1.06	0.732	0.010	0.025	0.16
Operative vaginal delivery	3.80	1.90–7.40	<0.001	1.335	0.339	15.5
Epidural analgesia	1.20	0.80–1.80	0.351	0.182	0.207	0.77

*Adjusted for group allocation, age, nulliparity, BMI, birth weight, operative vaginal delivery, and epidural analgesia. aOR, adjusted odds ratio.

The striking benefit of combining perineal massage with PFMT is biologically plausible. Perineal massage enhances tissue elasticity, increases pelvic floor musculature extensibility, and promotes desensitization to stretching sensations during crowning [8,9]. PFMT improves proprioceptive awareness and the capacity for voluntary relaxation [6]. Together, these interventions may produce a pelvic floor that is sufficiently strong to support descending fetal head while remaining compliant enough to distend without tearing. A network meta-analysis by Cao et al. [12] (2023) similarly found that combined PFMT + perineal massage was superior to either intervention alone for preventing episiotomy, consistent with our findings.

The PFMT-alone group had the highest episiotomy rate (85.6%), significantly exceeding the control group (68.6%). This counterintuitive finding has been reported previously. Zhang et al. [6] reported that PFMT alone did not reduce episiotomy rates (RR = 0.95, 95% CI: 0.85–1.07). Similarly, a prospective trial by İncebıyık et al. [13] found no significant difference in episiotomy rates following antenatal PFMT. Our subgroup analysis revealed that the paradoxical increase was confined to multiparous women: among multiparous women, PFMT alone had an episiotomy rate of 68.0% vs. 50.5% in the control group. One plausible explanation is that intensive pelvic floor strengthening without relaxation training may induce a hy-

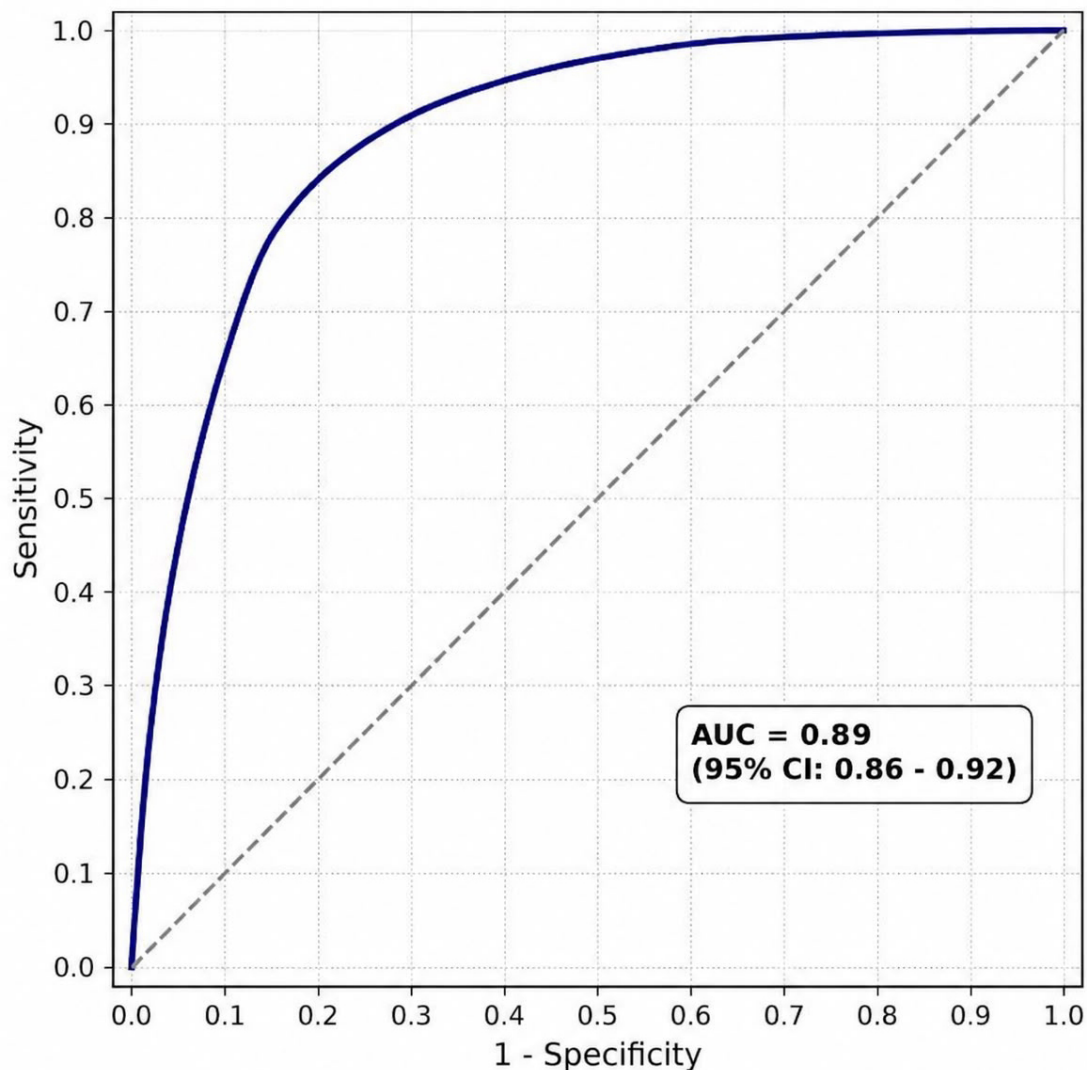


Fig. 3. ROC curve of the multivariate logistic regression model for predicting episiotomy (AUC = 0.89, 95% CI: 0.86–0.92, $p < 0.001$). The model includes all independent variables found to be significant in the multivariate analysis (Table 4). ROC, receiver operating characteristic; AUC, area under the curve; CI, confidence interval.

pertonic state, particularly in women with prior vaginal delivery who may have some degree of perineal laxity but develop excessive pelvic floor tone. Clinicians may perceive such a rigid perineum as an impediment to spontaneous delivery, thereby lowering their threshold for performing episiotomy. However, pelvic floor tone was not objectively measured in this study, which represents a limitation.

The PFMT + Swiss ball group did not differ significantly from the control group (58.6% vs. 68.6%). Swiss ball exercises improve pelvic mobility, promote upright positioning, and reduce pain and anxiety [10,11], but these mechanisms do not directly alter perineal tissue elasticity. A systematic review by Terres et al. [11] noted that although birthing balls improve maternal comfort, their effects on perineal integrity are inconsistent. Thus, Swiss ball exercises should not be relied upon as a primary episiotomy reduction strategy, although they may provide other obstetric benefits.

Nulliparity was strongly associated with episiotomy, with only one nulliparous woman (0.6%) avoiding episiotomy. This is consistent with the literature showing that primiparous women have greater perineal resistance and are significantly more likely to undergo episiotomy [14]. The apparent protective effect of older age is likely confounded by parity, as multiparity increases with age. After adjustment for parity in the regression model, age remained significantly associated with episiotomy, although the effect was modest (aOR = 0.89 per year).

The overall episiotomy rate of 59.6% in this study is high relative to the World Health Organization's (WHO) <10% target [2], reflecting the routine liberal episiotomy use in many middle-income regions. The reduction to 5.7% in the PFMT + perineal massage group demonstrates that a simple, low-cost antenatal intervention can achieve restrictive targets even in settings with high baseline rates. Health systems seeking to reduce episiotomy rates should invest

Table 5. Secondary maternal and neonatal outcomes by intervention group*.

Variable	Control (n = 153)	PFMT + perineal massage (n = 88)	PFMT + Swiss ball (n = 58)	PFMT alone (n = 132)	p-value	Test statistic
Episiotomy performed, n (%)	105 (68.6)	5 (5.7)	34 (58.6)	113 (85.6)	<0.001	$\chi^2(3) = 148.56$
No episiotomy, n (%)	48 (31.4)	83 (94.3)	24 (41.4)	19 (14.4)	<0.001	$\chi^2(3) = 148.56$
Spontaneous perineal laceration among no episiotomy, n (%)^						
Intact perineum	8 (16.7)	40 (48.2)	4 (16.7)	2 (10.5)	<0.001	Fisher's exact
1st-Degree laceration	20 (41.7)	30 (36.1)	10 (41.7)	7 (36.8)	0.845	Fisher's exact
2nd-Degree laceration	15 (31.2)	12 (14.5)	8 (33.3)	8 (42.1)	0.011	Fisher's exact
3rd-Degree laceration	4 (8.3)	1 (1.2)	2 (8.3)	2 (10.5)	0.042	Fisher's exact
4th-Degree laceration	1 (2.1)	0 (0.0)	0 (0.0)	0 (0.0)	0.514	Fisher's exact
Neonatal Apgar scores, mean $\pm$ SD						
1-minute Apgar	8.4 $\pm$ 1.1	8.7 $\pm$ 0.9	8.5 $\pm$ 1.0	8.3 $\pm$ 1.2	0.124	KW = 89.026
5-minute Apgar	9.6 $\pm$ 0.7	9.8 $\pm$ 0.5	9.7 $\pm$ 0.6	9.5 $\pm$ 0.8	0.091	KW = 76.696

*Data are presented as n (%) or mean $\pm$ SD. *p*-values for categorical variables were calculated using the chi-square test, or Fisher's exact test when expected cell frequencies were less than 5. *p*-values for continuous variables were derived from one-way ANOVA across the four groups.

^Fisher's exact test was used for comparing spontaneous perineal laceration rates among women without episiotomy due to small expected frequencies.

in programs teaching perineal massage as an integral component of antenatal care alongside PFMT. PFMT may potentially contribute to a relative increase in pelvic floor tone rather than definitively inducing hypertonia, and emphasize that this hypothesis requires objective biomechanical validation.

While the magnitude of the observed effect is strikingly large, it may be partially explained by the high baseline episiotomy rate (68.6%) in the control group, which may magnify the relative risk reduction, as well as the potential influence of clinician decision-making. Because the attending staff were not blinded to group allocation, their perceptions of a rigid perineum may have lowered the threshold for performing episiotomy.

The external validity of our findings warrants careful consideration. The baseline episiotomy rate of 68.6% observed in our control cohort contrasts markedly with the WHO's recommendation to maintain this intervention below 10%. Consequently, although our combined antenatal regimen reduced the episiotomy rate to 5.7%, the magnitude of this effect may be partially contingent upon the local clinical context, where episiotomy use is substantially more frequent than currently recommended. It is therefore reasonable to assume that direct extrapolation of these results to institutions with pre-existing restrictive episiotomy policies, or to settings in which obstetric care is predominantly midwifery-led and thresholds for operative delivery differ, may not be straightforward. Future validation in settings with lower baseline episiotomy rates is essential to determine whether the observed benefits are reproducible across diverse clinical contexts.

Limitations

This study has several limitations that warrant careful consideration when interpreting the findings. First, the inherent nature of the interventions precluded blinding of the attending clinicians, introducing the potential for performance bias; however, the assessor-blinded design mitigated detection bias. Second, the use of simple randomization without blocking or stratification resulted in unequal group sizes, reducing statistical power in the smaller arms and increasing the potential for baseline imbalances. Third, the sample was recruited from two hospitals within a single region, limiting the external validity of our results, particularly their generalizability to settings with lower baseline episiotomy rates or different models of obstetric care.

Moreover, we acknowledge that our assessment of adherence to perineal massage and PFMT relied primarily on attendance logs and self-reported diaries rather than objective measures such as biofeedback or ultrasound, which limits the precision of our intervention fidelity estimates. It should also be noted that we did not systematically collect data on the severity of spontaneous perineal lacerations when episiotomy was avoided, and the indications for episiotomy were not formally standardized across clinicians. Despite adjusting for operative vaginal delivery in our statistical model, we recognize that unmeasured confounders, such as fetal distress, duration of the second stage of labor, and individual clinician thresholds, may have influenced decision-making and could not be fully accounted for.

Furthermore, our observation that PFMT alone was associated with a higher episiotomy rate should not be interpreted as evidence of a causal relationship. The proposed mechanism of pelvic floor hypertonia remains spec-

ulative and warrants validation in future studies employing objective electromyographic or ultrasound assessments. Additionally, the inherent heterogeneity in the timing of the interventions, with Swiss ball exercises delivered intrapartum and PFMT and perineal massage administered antenatally, necessitates cautious interpretation when comparing the groups. Finally, the exceptionally wide CI observed for nulliparity reflects quasi-complete separation resulting from only one nulliparous woman delivering without an episiotomy, underscoring the need for cautious interpretation of this specific estimate.

5. Conclusion

This randomized trial provides strong evidence that antenatal PFMT combined with daily perineal massage reduces episiotomy rates to levels meeting restrictive targets (<6%), even in settings with high baseline episiotomy use. Isolated PFMT without perineal preparation does not confer this benefit and may paradoxically increase the risk of episiotomy, particularly among multiparous women. Swiss ball exercises, while potentially beneficial for other labor outcomes, should not be considered a substitute for direct perineal preparation. These findings support a paradigm shift in antenatal education toward teaching women not only how to contract but also how to distend and relax the pelvic floor, which may be important for protecting the perineum during childbirth. Future studies should include objective measurements of pelvic floor tone and assess long-term pelvic floor function.

Availability of Data and Materials

The datasets are available from the corresponding author on reasonable request.

Author Contributions

IT, EO: concept and design; MS, NEA, ŞA, ÖOC: data collection and analysis; EO, IT: writing and critical revision. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by Batman Training and Research Hospital Ethics Committee (Approval No.: 2023/12-45). All participants provided written informed consent.

Acknowledgment

We would like to thank all the institutions and organizations that supported this study. We are also grateful to all the women's health professionals who supported the data collection process and facilitated access to the study environment.

Funding

This research received no external funding.

Conflicts of Interest

The authors IT, EO, and NEA are employed by private institutions. However, these private institutions had no involvement in the actual planning or interpretation of the article. The authors declare no other financial or non-financial competing interests.

Supplementary Material

We used the CONSORT reporting guideline (1) to draft this manuscript, and the CONSORT reporting checklist (2) during manuscript editing; the checklist is included in Supplement A. Supplementary material associated with this article can be found, in the online version, at <https://doi.org/10.31083/CEOG54962>.

References

- [1] Jiang H, Qian X, Carroli G, Garner P. Selective versus routine use of episiotomy for vaginal birth. The Cochrane Database of Systematic Reviews. 2017; 2: CD000081. <https://doi.org/10.1002/14651858.CD000081.pub3>
- [2] World Health Organization. WHO recommendations: Intrapartum care for a positive childbirth experience. WHO: Geneva. 2018.
- [3] Clesse C, Lighezzolo-Alnot J, Hamlin S, De Lavergne S, Schefler M. The practice of episiotomy in France 10 years after the recommendations of CNGOF: what inventory? *Gynécologie Obstétrique & Fertilité*. 2016; 44: 232-238. (In French) <https://doi.org/10.1016/j.gyobfe.2016.02.011>
- [4] Huang J, Lu H, Zang Y, Ren L, Li C, Wang J. The effects of hands on and hands off/poised techniques on maternal outcomes: a systematic review and meta-analysis. *Midwifery*. 2020; 87: 102712. <https://doi.org/10.1016/j.midw.2020.102712>
- [5] Bhandari Randhawa S, Rizkallah A, Nelson DB, Duryea EL, Spong CY, Pruszynski JE, et al. Factors associated with persistent sexual dysfunction and pain 12 months postpartum. *Sexual & Reproductive Healthcare*. 2024; 41: 101001. <https://doi.org/10.1016/j.srhc.2024.101001>
- [6] Zhang D, Bo K, Montejó R, Sánchez-Polán M, Silva-José C, Palacio M, et al. Influence of pelvic floor muscle training alone or as part of a general physical activity program during pregnancy on urinary incontinence, episiotomy and third- or fourth-degree perineal tear: Systematic review and meta-analysis of randomized clinical trials. *Acta Obstetrica Et Gynecologica Scandinavica*. 2024; 103: 1015–1027. <https://doi.org/10.1111/aogs.14744>
- [7] Sobhghol SS, Smith CA, Dahlen HG. The effect of antenatal pelvic floor muscle exercises on labour and birth outcomes: a systematic review and meta-analysis. *International Urogynecology Journal*. 2020; 31: 2189–2203. <https://doi.org/10.1007/s00192-020-04298-1>
- [8] Abdelhakim AM, Eldesouky E, Elmagd IA, Mohammed A, Farag EA, Mohammed AE, et al. Antenatal perineal massage benefits in reducing perineal trauma and postpartum morbidities: a systematic review and meta-analysis of randomized controlled trials. *International Urogynecology Journal*. 2020; 31: 1735–1745. <https://doi.org/10.1007/s00192-020-04302-8>
- [9] Venugopal V, Deenadayalan B, Maheshkumar K, Yogapriya C, Akila A, Pandiaraja M, et al. Perineal Massage for Prevention of Perineal Trauma and Episiotomy During Labor: A Systematic

- Review and Meta-Analysis. *Journal of Family & Reproductive Health*. 2022; 16: 162–169. <https://doi.org/10.18502/jfrh.v16i3.10575>
- [10] Delgado A, Amorim MM, Oliveira ADAP, Souza Amorim KC, Selva MW, Silva YE, et al. Active pelvic movements on a Swiss ball reduced labour duration, pain, fatigue and anxiety in parturient women: a randomised trial. *Journal of Physiotherapy*. 2024; 70: 25–32. <https://doi.org/10.1016/j.jphys.2023.11.001>
- [11] Terres MT, de Carvalho Souza MV, Costa LMO, Novaes L, de Avila MF, Barros SG, et al. Efficacy of birthing ball exercises to reduce labor pain and cesarean rates: an updated meta-analysis of randomized controlled trials. *Archives of Gynecology and Obstetrics*. 2025; 311: 1331–1341. <https://doi.org/10.1007/s00404-024-07930-3>
- [12] Cao X, Yang Q, Wang Q, Hu S, Hou L, Sun M, et al. PFMT relevant strategies to prevent perineal trauma: a systematic review and network meta-analysis. *Archives of Gynecology and Obstetrics*. 2023; 308: 387–401. <https://doi.org/10.1007/s00404-022-06769-w>
- [13] İncebiyık M, Palalı İ, Er Y, Tammı Ö, Kızıldemir YZ, Adak İH, et al. The effect of a pelvic floor training program on perineal trauma during birth: a patient-preference controlled clinical trial. *Scientific Reports*. 2026; 16: 16493. <https://doi.org/10.1038/s41598-026-47603-6>
- [14] Cunningham FG, Leveno KJ, Bloom SL, Spong CY, Dashe JS, Hoffman BL, et al. Perineal trauma and episiotomy. In Cunningham FG, Leveno KJ, Bloom SL, Spong CY, Dashe JS, Hoffman BL, et al. (eds). *Williams Obstetrics* (pp. 1025–1036). 25th ed. McGraw-Hill: New York. 2018.