

COMPARISON OF BIRTH BALL EXERCISES AND THE LEFT LATERAL POSITION ON CERVICAL DILATION RATE AND THE DURATION OF THE ACTIVE PHASE OF THE FIRST STAGE OF LABOR

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Abstract

Prolonged labor remains a contributor to maternal and neonatal morbidity and mortality. Safe and accessible nonpharmacological interventions are needed to facilitate labor progression. Birth ball (gymball) exercises and the left lateral position are two nonpharmacological approaches used in physiological childbirth care; however, direct comparisons of their associations with cervical dilation rate and the duration of the active phase of the first stage of labor remain limited. This study aimed to compare birth ball exercises with the left lateral position in terms of cervical dilation rate and active phase duration. A quantitative, quasi-experimental study with a two-group pretest-posttest design was conducted among 60 women in the active phase of the first stage of labor at the delivery unit of Grobogan Community Health Center. Participants were recruited through convenience sampling and allocated to a comparison group (n = 30) or an intervention group (n = 30). Data were analyzed using t-tests and multiple linear regression. The findings indicated faster cervical dilation and a shorter first stage of labor in the birth ball exercise group than in the left lateral position group (t = 4.696). Multivariable analyses showed that birth ball exercise remained significantly associated with a higher cervical dilation rate and a shorter active-phase duration. In this single-center quasi-experimental study, women in the birth ball exercise group exhibited faster cervical dilation and a shorter active phase of the first stage of labor than those in the left lateral position group during physiological childbirth care.

Keywords: Active Phase Of First-Stage Labor; Birth Ball Exercise; Cervical Dilation; Left Lateral Position

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1. INTRODUCTION

Labor is a complex physiological process influenced by interactions among maternal and fetal factors, the birth canal, the force of uterine contractions, and the mother's psychological condition. Normal labor is expected to result in optimal maternal and neonatal outcomes. Conversely, prolonged labor may increase the risk of serious complications for both mother and infant, including postpartum hemorrhage, puerperal infection, uterine rupture, maternal exhaustion, operative delivery, neonatal asphyxia, and maternal or neonatal death (1,2).

Maternal mortality remains a major public health concern globally and nationally. An estimated 260,000 maternal deaths occurred worldwide in 2023 (2). The 2025 Intercensal Population Survey (SUPAS), as reported in the source manuscript, indicated a decline in Indonesia's maternal mortality ratio to 144 per 100,000 live births (3), although this remains well above the Sustainable Development Goals target. In Central Java, maternal deaths remained high, with approximately 427–428 cases in 2024, while 270 maternal and infant deaths were recorded through June 2025, underscoring the need to strengthen maternal healthcare services and referral systems.

Data from the Indonesian Ministry of Health's Maternal Perinatal Death Notification (MPDN) system recorded 4,005 maternal deaths in 2022,

increasing to 4,129 in 2023; the leading causes included hypertensive disorders of pregnancy (preeclampsia/eclampsia) and hemorrhage (3). These figures highlight the continuing need for innovative strategies to reduce maternal mortality, particularly by improving the quality of intrapartum care. In Central Java Province, 438 maternal deaths were reported in 2023, while Grobogan Regency recorded 22 maternal deaths, primarily attributable to hypertensive disorders of pregnancy, obstetric complications, cardiac disease, and infection (3).

Records from Grobogan Community Health Center indicate that 377 deliveries occurred between October 2023 and September 2024. Of these, 183 were managed at the health center, whereas the remainder were referred to hospitals. Common reasons for referral included premature rupture of membranes, severe preeclampsia, and prolonged labor. A preliminary assessment identified 26 cases of prolonged labor in 2023. This situation is concerning because prolonged labor may increase maternal and neonatal morbidity and the demand for obstetric referrals.

Nonpharmacological approaches to labor management have attracted considerable interest because they may improve maternal comfort and support labor progression without increasing exposure to pharmacological interventions. One commonly used method is exercise on a gym ball, also known as a birth ball.

A birth ball is a large, flexible exercise ball that allows women to move and change position during labor. Movements such as pelvic rocking, gentle bouncing, pelvic rotation, and upright positioning may enhance pelvic mobility, support postural balance, facilitate fetal head descent, and leverage gravity. This approach is consistent with World Health Organization recommendations encouraging mobility and upright positions for women with low-risk pregnancies, given their potential benefits for labor and the reduction of certain obstetric interventions.

Available research suggests that birth ball exercises have potential clinical benefits. A meta-analysis of 10 randomized controlled trials involving 1,008 women in labor found that birth ball exercises were associated with reduced pain, lower cesarean delivery rates, and a shortening of the first stage of labor by more than two hours, although no significant differences were observed in the duration of the second stage or in several other obstetric interventions (4). Another randomized trial involving 200 women found that active pelvic movements on a Swiss ball shortened the first stage by approximately 179 minutes, reduced pain intensity by around two points on a 0–10 scale, and lowered the risk of cesarean delivery (5). Together, these findings suggest that birth balls may offer benefits beyond comfort and

could form part of strategies to support physiological labor progression.

Previous studies have not yielded entirely consistent findings. One randomized controlled trial involving 60 primiparous women reported significant pain reduction with birth ball use but no significant difference in the duration of the active phase. In addition, most studies have assessed birth ball exercise as a single intervention, whereas the mechanisms and individual contributions of specific movements, particularly pelvic rocking, bouncing, and pelvic rotation, to cervical dilation, fetal head descent, pain intensity, and the duration of the first stage have not been fully standardized. The present study used a structured birth ball exercise protocol combining pelvic rocking, bouncing, and pelvic rotation during the active phase, with attention to intervention timing, frequency, duration, and safety.

Rather than evaluating birth ball use in general, it examined a standardized, measurable exercise protocol and two objective indicators of labor progression: cervical dilation rate and active phase duration. Such an approach may help establish a more structured, replicable, affordable, and practical nonpharmacological intervention for midwifery care and generate more specific evidence regarding pelvic mobilization during physiological labor.

A randomized controlled trial by Aslantaş and Çankaya involving 120 primiparous women also found that birth ball exercise significantly shortened the interval from active labor to full cervical dilation compared with the control group (6). Jha et al., studying 60 primigravid women, reported a mean labor duration of 14.4 hours in the birth ball group versus 19.2 hours in the control group, together with a faster cervical dilation rate (7). Similarly, a randomized trial by Delgado et al. found that active pelvic movements on a Swiss ball significantly shortened labor and reduced pain, fatigue, and anxiety (5); another study also reported significant reductions in anxiety and pain intensity following birth ball use during labor (8,9).

In addition to birth ball exercise, the left lateral position is a nonpharmacological intervention frequently used in midwifery practice. This position may reduce compression of the inferior vena cava, thereby improving venous return to the heart, uteroplacental perfusion, and fetal oxygen supply while supporting effective uterine contractions (10,11). It has therefore long been recommended as a physiological maternal position during labor.

Studies directly comparing birth ball exercise and the left lateral position in terms of cervical dilation rate and the duration of the active phase of the first stage of labor remain relatively

scarce, particularly in primary healthcare settings. Furthermore, Indonesian studies of birth ball use have generally focused more on reducing labor pain than on objective indicators such as cervical dilation rate and active-phase duration, despite the importance of these measures in assessing labor progression using a partograph. These two outcomes were selected because they are routinely recorded on a partograph, can be measured by health professionals in primary care, and are directly relevant to prolonged labor, a local concern at the study site. Accordingly, this study aimed to compare birth ball exercises with the left lateral position in relation to cervical dilation rate and active-phase duration among women giving birth in the delivery unit of Grobogan Community Health Center.

The contribution of this study lies in three areas. First, recent meta-analyses and international randomized trials (4-7) have reported benefits of birth ball exercises for labor pain and duration, but the available evidence has largely come from referral hospitals, whereas evidence from Indonesian primary healthcare facilities, particularly community health centers, using a physiologically relevant active comparator such as the left lateral position remains limited (12,13). Second, previous Indonesian studies (11,13–15) have generally emphasized subjective outcomes such as pain reduction; the present study specifically

assessed two objective, partograph-based indicators of labor progression, namely cervical dilation rate (cm/hour) and active phase duration, to provide measurable and potentially replicable findings. Third, the study directly compared a standardized birth ball exercise protocol with an active comparison intervention, the left lateral position, rather than a passive or no-treatment control. The results therefore address the relative associations of birth ball exercises and a common physiological childbirth

2. METHOD

This quantitative study used a quasi-experimental, two-group pretest–posttest design (14) to compare birth ball exercise with the left lateral position in terms of cervical dilation rate and the duration of the active phase of the first stage of labor. Participants in the intervention group performed birth ball exercises during the active phase in accordance with a standard operating procedure (SOP), whereas participants in the comparison group adopted the left lateral position as part of physiological childbirth care. Participants were not randomly allocated to the two groups.

Measurements were recorded at two points: the pretest, when participants entered the active phase with cervical dilation of 4-6 cm, and the posttest, when full dilation (10 cm) was reached, as detailed in the Data Collection section. Labor progression was monitored using a partograph until full cervical dilation.

care practice in Indonesia (10). In summary, this study adds a direct comparison of a standardized birth ball protocol and the left lateral position using objective partograph-based outcomes in a primary care setting. It may help address the evidence gap concerning mobilization-based nonpharmacological interventions in primary care and provide preliminary evidence to inform consideration of birth ball exercise as an option in physiological childbirth care.

Study Population and Sample

The study population comprised all women experiencing spontaneous labor in the active phase of the first stage at the delivery unit of Grobogan Community Health Center, Grobogan Regency, Central Java, during June-July 2025. Eligible women were enrolled after they met the inclusion and exclusion criteria and provided written informed consent.

The inclusion criteria were term pregnancy (37-40 weeks), active first-stage labor with cervical dilation of 4-6 cm, singleton pregnancy, cephalic presentation, stable maternal and fetal conditions, and the ability to follow study instructions. Birth ball exercise was provided to women meeting these criteria and remaining clinically stable. A 65 cm birth ball was used, with participants sitting upright, their feet shoulder-width apart and flat on the floor. Before exercise, participants received an explanation of the

procedure and underwent maternal and fetal assessment.

The exercise protocol consisted of three movements: pelvic rocking, gentle bouncing, and pelvic rotation. Each movement was performed slowly for 10 minutes according to maternal tolerance, giving a total session duration of 30 minutes. A researcher or midwife supervised the exercises to ensure safety and balance. Participants continued to receive standard intrapartum care throughout the intervention.

Maternal and fetal conditions were monitored during exercise. The intervention was discontinued in the event of dizziness, shortness of breath, bleeding, severe discomfort, changes in fetal heart rate, or any other condition requiring medical attention. All interventions followed the same SOP to ensure consistency. Labor progression was monitored by partograph until full cervical dilation. The exclusion criteria included obstetric complications, bleeding, preeclampsia/eclampsia, fetal malpresentation, an indication for operative delivery or referral, and any maternal or fetal condition requiring immediate intervention.

Participants were recruited using convenience sampling until the target sample size was reached. All eligible women presenting during the study period were approached for recruitment and, according to their order of arrival, assigned without randomization to either the birth ball exercise group or the left lateral

position group. The final sample consisted of 60 women, with 30 in each group. All 60 participants were included in the analyses. Convenience sampling was used throughout the recruitment process.

Data Collection

Data were collected prospectively during June-July 2025 in the delivery unit of Grobogan Community Health Center, Grobogan Regency, Central Java. Eligible women were informed about the study procedures and provided written informed consent. Baseline maternal and obstetric characteristics were recorded, including age, parity, gestational age, cervical dilation, and maternal and fetal condition.

At cervical dilation of 4-6 cm during the active phase of the first stage of labor, the initial measurement (pretest) was recorded. Participants then received the intervention corresponding to their group. Women in the intervention group performed a 30-minute exercise session using a 65-cm birth ball, including 10 minutes each of pelvic rocking, gentle bouncing, and pelvic rotation. Exercises were conducted while seated, with both feet flat on the floor, under the supervision of a researcher or midwife. Women in the comparison group adopted the left lateral position according to standard intrapartum care. The source protocol describes use of the left lateral position from 4 cm to 10 cm of cervical dilation, including 30-minute periods during

contractions, with minor adjustments in the angle of inclination and gentle mobilization encouraged before returning to the left lateral position. Maternal and fetal conditions were monitored using a partograph by midwives or other healthcare professionals.

Throughout the intervention, maternal and fetal conditions were monitored by midwives or other healthcare professionals. Subsequent cervical examinations were conducted according to standard clinical practice and documented on observation forms and the partograph. The researchers did not perform vaginal examinations; instead, they recorded findings obtained by the attending healthcare professionals.

The pretest comprised documentation of the initial cervical dilation (4-6 cm) and its time of recording at enrollment. The posttest comprised the time when full cervical dilation (10 cm) was documented on the partograph. Cervical dilation rate (cm/hour) was calculated as the difference between full dilation (10 cm) and baseline dilation divided by the time (in hours) required to reach full dilation. Active-phase duration (hours) was calculated from the time of the initial 4-6 cm assessment to the time when full dilation (10 cm) was reached.

Following delivery, the data were checked for completeness, coded, and analyzed statistically. Standard operating procedures were applied consistently across both groups to support

procedural consistency and reduce measurement bias.

Data Analysis

Statistical software was used for data analysis. Univariate analyses summarized participant characteristics and study variables. Categorical data were presented as frequencies and percentages, while normally distributed numerical data were reported as means $\pm$ standard deviations; non-normally distributed data were presented as medians and interquartile ranges (IQRs).

Normality tests informed the choice of bivariate analysis. Normally distributed data were analyzed using the independent-samples t-test. Results were reported as p-values and effect sizes with 95% confidence intervals (CIs). A p-value below 0.05 was considered statistically significant.

Multiple linear regression was used to assess the association between intervention group and both cervical dilation rate and active-phase duration after adjusting for maternal age, parity, and cervical dilation at baseline. Before modeling, regression assumptions were assessed, including linearity, residual normality, homoscedasticity, and influential observations. Linearity was evaluated by examining the relationships between predictors and outcomes; residual normality was assessed using Q-Q plots or residual normality tests; and

homoscedasticity was evaluated by examining residual patterns.

Regression model assumptions were considered satisfied when no meaningful violations were identified. Regression findings were reported as coefficients (B), 95% CIs, p-values (exact values where $p \geq 0.001$), and coefficients of determination (R^2) as measures of model fit. All analyses used a 5% significance threshold and 95% CIs.

Research Ethics

Ethical approval was obtained before the study began from the Health Research Ethics Committee of Dr. R. Soedjati Regional General Hospital, Purwodadi, Grobogan (approval no. 41/Kom.etik/VI/2025). All participants received information about the study objectives, benefits, procedures, risks, and their right to withdraw at

any time without affecting the care they received. Written informed consent was obtained from every participant before enrollment. The ethical principles of respect for persons, beneficence, non-maleficence, justice, anonymity, and confidentiality were applied. Participant information was kept confidential and used solely for research purposes.

3. RESULTS AND DISCUSSION

Results

The study was conducted at the delivery unit of Grobogan Community Health Center between June and July 2025 and included 60 women in the active phase of the first stage of labor. Participants were divided into two groups: 30 in the birth ball exercise group and 30 in the left lateral position group.

Table 1. Baseline Characteristics of Participants in the Birth Ball Exercise and Left Lateral Position Groups

Characteristic	Birth ball exercise		Left lateral position		p-value
	n	%	n	%	p-value
Age (years)					
<20	4	13.3	4	13.3	0.003
20–35	22	73.3	22	73.3	
>35	4	13.3	4	13.3	
Education					
Elementary school	1	3.3	1	3.3	0.002
Junior high school	10	33.3	12	40	
Senior high school	19	63.3	17	56.7	
Higher education	0	0	0	0	
Parity					
1 birth	13	43.3	12	40	0.045
2 births	12	40	13	43.3	
3 births	4	13.3	4	13.3	
4 births	1	3.3	1	3.3	

Source: Primary data, 2025

Most participants in both groups were aged 20-35 years (73.3%). Senior high school was the most common educational level, reported by 63.3% of the birth ball exercise group and 56.7% of the left lateral position group. Regarding parity, first births were most common in the

birth ball exercise group (43.3%), whereas second births were most common in the left lateral position group (43.3%). The reported distributions differed significantly by age ($p = 0.003$), education ($p = 0.002$), and parity ($p = 0.045$).

Table 2. Normality Test Results

Variable	Statistic	df	p-value
Pretest dilation rate	0.323	30	0.065
Pretest labor duration	0.416	30	0.055
Posttest dilation rate	0.480	30	0.090
Posttest labor duration	0.254	30	0.066

According to the Shapiro-Wilk test, all reported variables had p-values above 0.05: pretest dilation rate ($p = 0.065$), pretest labor duration ($p = 0.055$), posttest dilation rate ($p =$

0.090), and posttest labor duration ($p = 0.066$). The data were therefore treated as normally distributed.

Table 3. Within-Group Pretest Posttest Comparisons for Birth Ball Exercise and the Left Lateral Position

Variable	Mean	SD	SE	95% CI	t	p-value
Pretest-posttest dilation rate (birth ball)	0.15533	0.27144	0.04956	0.05398-0.25669	3.134	0.004
Pretest-posttest duration (birth ball)	1.86667	2.17721	0.39750	1.05368-2.67965	4.696	<0.001
Pretest-posttest dilation rate (left lateral)	0.16333	1.15556	0.21099	-0.26819 to 0.59486	0.774	0.445
Pretest-posttest duration (left lateral)	0.50000	0.82000	0.14971	0.19380-0.80620	3.340	0.002

Paired-samples t-tests were used to compare pretest and posttest measurements within each group. In the birth ball exercise group, the pretest–posttest difference in cervical dilation rate was statistically significant, with a mean difference of 0.15533 (SD = 0.27144), 95% CI 0.05398–0.25669, $t = 3.134$, and $p = 0.004$.

For the duration of the first stage of labor, a significant pretest–posttest difference was also reported (mean difference = 1.86667, SD = 2.17721, 95% CI 1.05368–2.67965, $t = 4.696$, $p < 0.001$).

In the left lateral position group, the pretest–posttest difference in cervical dilation rate was not statistically significant (mean difference =

0.16333, SD = 1.15564, 95% CI -0.26819 to 0.59486, $t = 0.774$, $p = 0.445$). For the duration of the first stage, a significant pretest–posttest

difference was reported (mean difference = 0.50000, SD = 0.82001, 95% CI 0.19380–0.80620, $t = 3.340$, $p = 0.002$).

Table 4. Between-Group Comparisons of Birth Ball Exercise and the Left Lateral Position

Variable	Mean	SD	SE	95% CI	t	p-value
Pretest dilation rate (birth ball)	1.3000	0.75783	0.13836	-0.35253 to 0.67919	0.634	0.229
Pretest dilation rate (left lateral)	1.1367	1.19084	0.21742	-0.35450 to 0.68117	0.634	0.229
Posttest dilation rate (birth ball)	1.3000	0.75783	0.13836	-0.35253 to 0.67919	0.821	0.015
Posttest dilation rate (left lateral)	1.1367	1.19084	0.21742	-0.35450 to 0.68117	0.821	0.015
Pretest duration (birth ball)	4.8333	2.52003	0.46009	-0.71936 to 1.71936	0.634	0.529
Pretest duration (left lateral)	4.3333	2.18669	0.39923	-0.71988 to 1.71988	0.634	0.529
Posttest duration (birth ball)	4.8333	2.52003	0.46009	-0.71936 to 1.71936	0.821	0.415
Posttest duration (left lateral)	4.3333	2.18669	0.39923	-0.71988 to 1.71988	0.821	0.415

Pretest and posttest comparisons between the birth ball exercise group and the left lateral position group are presented below.

At pretest, the mean cervical dilation rate was 1.30 ± 0.76 in the birth ball exercise group and 1.14 ± 1.19 in the left lateral position group. The reported p-value was 0.229 ($p > 0.05$), indicating no statistically significant between-group difference before the intervention.

At posttest, the reported mean cervical dilation rate remained 1.30 ± 0.76 in the birth ball exercise group and 1.14 ± 1.19 in the left lateral position group. The reported p-value was 0.015 ($p < 0.05$), indicating a statistically significant between-group difference after the intervention.

At pretest, the mean duration of the first stage of labor was 4.83 ± 2.52 hours in the birth ball exercise group and 4.33 ± 2.19 hours in the left lateral position group. The p-value of 0.529 ($p > 0.05$) indicated no statistically significant between-group difference before the intervention.

At posttest, the reported mean duration of the first stage remained 4.83 ± 2.52 hours in the birth ball exercise group and 4.33 ± 2.19 hours in the left lateral position group. The p-value of 0.415 ($p > 0.05$) indicated no statistically significant between-group difference after the intervention.

Table 5. Multiple Linear Regression Analysis Of Cervical Dilation Rate (Cm/Hour)

Variable	Coefficient (B)	p-value	95% CI
Intercept	1.245	0.044	0.037 – 2.454
Group (birth ball vs left lateral)	0.607	<0.001	0.308 – 0.905
Maternal age	0.008	0.600	-0.022 – 0.037
Parity	0.055	0.610	-0.158 – 0.267
Baseline cervical dilation	-0.175	0.070	-0.364 – 0.014

After adjustment for maternal age, parity, and initial cervical dilation, birth ball exercise was significantly associated with a 0.607 cm/hour higher cervical dilation rate than the

left lateral position ($p < 0.001$). Maternal age, parity, and initial cervical dilation were not significantly associated with cervical dilation rate (all $p > 0.05$).

Table 6. Multiple Linear Regression Analysis of Active-Phase Duration (hours)

Variable	Coefficient (B)	p-value	95% CI
Intercept	10.633	0.002	4.108 – 17.159
Group (birth ball vs left lateral)	-3.786	<0.001	-5.397 – -2.174
Maternal age	-0.003	0.969	-0.163 – 0.157
Parity	-0.124	0.829	-1.274 – 1.026
Baseline cervical dilation	-0.352	0.492	-1.373 – 0.669

After adjustment for maternal age, parity, and initial cervical dilation, birth ball exercise was significantly associated with a 3.786-hour shorter active phase of the first stage of labor than the comparison intervention ($p < 0.001$). Maternal age, parity, and initial dilation were not statistically significant predictors (all $p > 0.05$). The R^2 values for the two regression models ranged from 28.8% to 29.1%, suggesting that

approximately 70% of the variation in cervical dilation rate and active-phase duration remained unexplained by the four variables included in the models. Other potentially relevant factors include maternal psychological state, fetal position and station, maternal pelvic dimensions, and the strength and pattern of uterine contractions.

Discussion

Participant Characteristics

The univariate analyses indicated that the comparison group (left lateral position) and intervention group (birth ball exercise) had relatively similar baseline characteristics in terms of age, parity, and cervical dilation at study

entry. Baseline comparability is methodologically important because it suggests that the two groups entered the intervention period under broadly comparable conditions. However, given the nonrandomized design, unmeasured factors may also have contributed to differences in subsequent outcomes.

Maternal age is associated with reproductive physiological readiness, the strength of uterine contractions, the elasticity of birth canal tissues, and the capacity to adapt during labor. Women of typical reproductive age (20-35 years) may experience a more physiological labor course than those at higher-risk ages, while very young and older maternal age have been associated with prolonged labor, postpartum hemorrhage, and operative delivery (16). In addition to age, parity may influence labor progression. Primiparous women generally experience a longer labor than multiparous women because the cervix has not previously undergone labor-related dilation and tissue distensibility may differ. Multiparous women may therefore experience faster cervical dilation because of anatomical and physiological changes associated with previous deliveries (17). Most women in both study groups had a parity of one or two, representing a relatively narrow parity distribution; nevertheless, parity was treated as a potential confounder and included in the multivariable models.

Cervical Dilation Rate in the Birth Ball Exercise and Left Lateral Position Groups

The study reported a higher cervical dilation rate in the birth ball exercise group than in the left lateral position group. The bivariate analysis using a t-test was described as showing faster cervical dilation and a shorter first stage of labor with birth ball exercise ($t = 4.696$). These findings

were interpreted as indicating more rapid cervical dilation among women who performed birth ball exercises than among those who received the left lateral position intervention alone.

Theoretically, this difference may be related to the dynamic pelvic movements enabled by birth ball exercise, including pelvic rocking, pelvic rotation, and gentle bouncing. These movements may increase pelvic mobility and facilitate optimal fetal positioning and descent of the fetal head into the pelvis (18–20). More favorable fetal head descent could increase pressure on the cervix and stimulate cervical ripening and dilation during labor. Thus, birth ball exercise may provide benefits beyond simply changing maternal position by enabling more active pelvic movement during the first stage of labor. These mechanisms remain theoretical and were not directly measured in this study.

The multivariable findings were also reported to support the observed association. After adjustment for age, parity, and baseline cervical dilation, the birth ball exercise group had a cervical dilation rate 0.607 cm/hour higher than that of the left lateral position group ($p < 0.001$). The authors interpreted the consistency of the bivariate and multivariable findings as suggesting that the association between birth ball exercise and increased cervical dilation rate persisted after accounting for several potentially confounding maternal characteristics. Thus, the

reported group difference could not be attributed solely to age, parity, or initial cervical dilation, although residual confounding by unmeasured factors remains possible.

Parity is a physiological determinant of labor progression because multiparous women generally differ from primiparous women in cervical tissue characteristics and previous childbirth experience. Maternal age and initial cervical dilation may likewise be related to labor progression. Adjustment for these three variables in the multivariable model suggested that the association between birth ball exercise and cervical dilation rate persisted, without establishing causality. Physiologically, birth ball exercise allows women to perform active pelvic movements, particularly pelvic rocking, while supported in an upright position. Upright posture and rhythmic movement may facilitate labor through several mechanisms. Gravity may promote descent of the presenting fetal part into the pelvis, increasing cervical pressure and potentially stimulating the Ferguson reflex, with endogenous oxytocin release and stronger uterine contractions (5). Rhythmic movement may also facilitate fetal positioning and increase functional pelvic dimensions, particularly the transverse diameter of the pelvic inlet, thereby assisting fetal descent and cervical dilation (21).

In addition, movement may reduce pain perception through the gate control mechanism, supporting relaxation and potentially more

effective uterine contractions (22). Although the left lateral position can improve uteroplacental blood flow, it involves less gravitational assistance and pelvic mobility than active birth ball exercise, which may be consistent with the lower cervical dilation rate reported in that group.

These findings are consistent with those of Aslantaş and Çankaya, who reported that birth ball exercise significantly shortened the interval from the active phase to full dilation among primiparous women compared with controls (6). They also accord with Jha et al., who reported faster cervical dilation and shorter labor in the birth ball group than in the nonintervention group (7). Delgado et al. found that active pelvic movements on a Swiss ball improved labor progression and reduced the duration of the first stage, as well as pain, fatigue, and anxiety (19,22). The present findings are also consistent with those of Nurhasanah et al., who reported faster fetal head descent following birth ball techniques (13), and Ermasari and Winarno, who described the role of birth ball–assisted pelvic rocking in improving pelvic mobility during pregnancy (11). Arfah and Tridiyawati likewise reported beneficial effects of birth ball–assisted pelvic rocking on labor progression (19).

Nevertheless, comparisons with previous research require caution. Most earlier studies compared birth ball exercise with no intervention or standard care rather than with

the left lateral position, so effect magnitudes are not directly comparable. Furthermore, prior findings have not been entirely consistent: the meta-analysis by Terres et al. found no significant difference in second-stage duration (4), and a randomized trial involving 60 primiparous women reported pain reduction but no significant difference in active-phase duration. Differences in study populations, exercise protocols, and designs may account for this variability. A study cited as Yasar also suggested that pelvic rocking, pelvic rotation, and bouncing promote pelvic movement, changes in maternal position, and descent of the presenting fetal part (23).

Duration of the Active Phase of the First Stage of Labor in Both Groups

Consistent with the findings on cervical dilation rate, the active phase of the first stage of labor was reported to be significantly shorter in the birth ball exercise group (median 4.0 hours) than in the left lateral position group (median 8.5 hours; $p < 0.001$). Multiple linear regression further indicated that, after adjustment for age, parity, and initial cervical dilation, birth ball exercise remained associated with a 3.786-hour reduction in active-phase duration relative to the comparison group ($p < 0.001$), with the entire 95% confidence interval below zero.

A shorter active phase is mathematically and physiologically linked to faster cervical dilation:

the faster the cervix dilates per unit of time, the less time is needed to reach full dilation. Shortening of the first stage may be clinically relevant to labor progression. However, this study did not assess maternal or neonatal complications, maternal fatigue, or maternal satisfaction, and any benefits for these outcomes cannot be inferred from the available data.

The findings are consistent with the meta-analysis by Terres et al., which reported that birth ball use shortened the first stage of labor by more than two hours, potentially through greater pelvic mobility and more favorable fetal positioning (4). Padlilah et al. also found a shorter mean first-stage duration among women using a gymball than among controls (12), while Sari and Suhertusi reported that birth ball exercises were effective in shortening the first and second stages of labor (18). These observations align with the concept of active birth, which encourages movement and upright positioning during labor (17). Fatimah and Miskiyah similarly reported an association between birth ball–assisted pelvic rocking and shorter labor duration (24). Although maternal mobilization during labor has been associated with more effective uterine contractions and improved fetal positioning, neither factor was measured in the present study.

Contribution of Potential Confounders (Age, Parity, and Baseline Dilation)

In both regression models, maternal age, parity, and cervical dilation at baseline were not significantly associated with cervical dilation rate or active-phase duration (all p-values > 0.05). Two implications were noted. First, methodologically, the association between birth ball exercise and the study outcomes remained statistically significant after adjustment for these covariates. Second, clinically, the findings suggest potential benefits of birth ball exercise in the population studied. However, confirmation in larger multicenter studies is necessary before extending these findings to broader populations.

Implications for Midwifery Practice

Birth ball exercise is a relatively simple nonpharmacological intervention that does not require complex equipment and could be implemented in primary healthcare settings, as reflected in training programs for independent midwives (15). However, safety and cost were not evaluated in this study. If these findings are confirmed by more rigorous research, birth ball exercise could be considered as an adjunct for supporting labor progression, although its effects on prolonged labor and referral rates remain unknown. Previous research has suggested that birth ball exercise enables active maternal movement and may reduce labor pain (4,5), but pain and comfort were not assessed

here. Other nonpharmacological interventions, including hydrotherapy and music therapy (1), have also been reported to reduce labor pain (25). Direct comparisons of these approaches with birth ball exercises regarding labor progression remain limited and warrant further study. Birth ball exercise may therefore be considered as a potential nonpharmacological option in the delivery unit, subject to the limitations of the current evidence and further confirmation.

Study Limitations

This study has several limitations. First, the sample was small (30 women per group) and recruitment was limited to one community health center, restricting generalizability. Second, convenience sampling may have left residual confounding that could not be fully controlled. Third, the quasi-experimental design was susceptible to selection bias and unmeasured confounding related to maternal body mass index, fetal weight, occiput position, uterine contraction strength, maternal anxiety, and the use of analgesia during labor. Fourth, the absence of random allocation increased the possibility of selection bias and baseline differences between groups; regression adjustment addressed only the measured covariates (age, parity, and baseline cervical dilation), and residual confounding remains possible. Fifth, blinding participants and intervention providers was not feasible. Cervical

examinations were performed by healthcare professionals according to routine practice, and inter-examiner variation cannot be ruled out. Sixth, the study assessed only cervical dilation rate and active-phase duration; no conclusions can be drawn regarding safety, complications, maternal comfort, or other maternal and neonatal outcomes. Future studies should use randomized controlled designs, larger samples, and multiple healthcare facilities to improve external validity.

Unlike epidural analgesia, which requires anesthesia personnel, resources, and close monitoring and may therefore be difficult to provide widely in primary care settings (26–28),

4. CONCLUSION

In this study, women performing birth ball exercises had a higher cervical dilation rate and a shorter active phase of the first stage of labor than women adopting the left lateral position. These differences persisted after adjustment for maternal age, parity, and cervical dilation at the start of observation. The findings are consistent with previous evidence supporting maternal mobilization during labor. However, the nonrandomized quasi-experimental design and single-center setting limit causal interpretation and generalizability. Birth ball exercise is a simple intervention that may be a feasible nonpharmacological option in primary maternity care. Its incorporation into routine clinical

birth ball exercise may represent a less resource-intensive nonpharmacological approach that midwives can implement. However, cost and ease of implementation were not directly evaluated in this study. This approach is compatible with respectful maternity care and midwife-led care models for low-risk pregnancies (27). Mylod et al. also reported benefits of birth ball use during the latent phase of labor (20). Nevertheless, care during the first and third stages of labor should continue to follow comprehensive evidence-based practice (29–31), with maternal and neonatal safety as the primary priority.

practice should, however, be supported by further randomized controlled trials with larger samples, multicenter recruitment, and assessment of safety and maternal and neonatal outcomes.

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Conflict of Interest

The authors declare no conflict of interest related to the conduct of the study, the interpretation of the results, or the publication of this manuscript.

Ethics Approval

This study received ethical approval from the Health Research Ethics Committee of Dr. R. Soedjati Regional General Hospital, Purwodadi, Grobogan, Indonesia (Approval No. 41/Kom.etik/VI/2025). Written informed consent was obtained from all participants prior to data collection. Participation was voluntary, and participants were informed of their right to withdraw from the study at any time. The confidentiality and anonymity of participants

were maintained throughout the research process.

Author Contributions

Sri Untari: Conceptualization, Data curation, Formal analysis, Resources, Investigation, Validation, and Writing-original draft. Dhiyan Nany Wigati: Conceptualization, Data curation, Supervision, Validation, and Writing-reviewing draft. Rizki Sahara: Data curation, Validation, and Supervision.

Artificial Intelligence (AI) Use Disclosure

The authors declare that no artificial intelligence (AI) tools were used in the preparation, writing, editing, or analysis of this manuscript.

Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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