Enhancing labor outcomes through non-pharmacologic interventions: a study on birthing ball and deep breathing relaxation in Indonesia

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ABSTRACT

Labor during the active phase of the first stage is often associated with significant pain and anxiety, which can prolong labor and negatively impact outcomes. Non-pharmacologic interventions such as birthing ball (BB) and deep breathing relaxation (DBR) have been introduced to address these challenges. However, comparative studies evaluating their effectiveness are limited. This study compares the effects of DBR and BB exercise on mothers' anxiety, pain threshold, and progress during the active phase of labor. This quasi-experimental study comprised 46 participants who were consecutive sampling to one of two groups using sequential sampling: DBR (n = 23) or BB (n = 23). The study had a pretest-posttest two-group comparison design. Interventions were carried out by midwifery led care in Pringsewu, Indonesia, from November 2024 to April 2025, during the active phase of labor. Data were collected using the State-Trait Anxiety Inventory (S-TAI) scale, partograph, Visual Analog Scale (VAS), and Labor and Delivery Satisfaction Questionnaire (LDSQ) mother satisfaction survey. The statistical analysis employed paired t-tests and Mann Whitney. Labor pain was considerably decreased by both therapies (DBR: mean reduction from 4.3 to 3.6; BB: mean reduction 4.5 to 3.8; p < 0.01). Following the therapies, anxiety levels also dropped, though not statistically significantly in DBR group 52.2 to 49.4; p < 0.05 and BB group 50.4 to 48.3; p< 0.00. In comparison to the DBR group (mean = 274.3 ± 29.3 minutes; p = 0.003), the BB group's active phase duration was significantly shorter (mean = 243.5 ± 31.1 minutes). In comparison to the DBR group (mean = 31.3 ± 3.1; p < 0.001), maternal satisfaction was significantly higher in the BB group (mean = 34.2 ± 3.7). Both DBR techniques and BB activities can help reduce pain and accelerate the labor process. However, BB exercises were more effective in shortening the duration of labor and increasing mother satisfaction. These findings support the use of non-pharmacological treatments in routine intrapartum care, especially in under resourced areas. These findings suggest that midwives and healthcare providers should consider incorporating BB exercises into standard intrapartum care protocols, especially in resource-limited settings.

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INTRODUCTION

A complicated physiological process, labor is frequently marked by great pain and elevated anxiety, particularly in the early stages of active labor when cervical dilatation happens quickly and fiercely.(1) According to WHO , over 80% of women report having labor pain in one form or another, with 85% reporting severe labor pain (VAS ≥7) and roughly 25–30% expressing significant anxiety levels that shorten the labor phase.(2) According to the report and other national studies, the average length of the first stage of active labor is still regarded as lengthy, particularly for primigravida women, and can exceed 4-8 hours or more.(3) It is frequently accompanied by complaints of excruciating pain and overwhelming anxiety, which raises the likelihood of referrals and medical procedures like cesarean sections.(4) Under the influence of uterine contractions, the fetus moves during labor, following the delivery canal.(5) The first and longest stage of this process is dilatation, which lasts 6–8 hours for multiparous women and 10–12 hours for primiparous women.(1) Compared to multiparous women, primiparous women typically have a lengthier initial stage. Pain and anxiety are not only distressing experiences during labor, but they also have a physiological impact that can interfere with uterine contractions and cervical dilation, ultimately prolonging the duration of the first stage of labor and increasing the risk of complications.(6)

The median first stage duration for primiparous women is 9.38 hours, while for multiparous women, it is roughly 5.08 hours, per a Chinese multicenter observational study.(7) A different study by found that the first stage lasts an average of 8.3 ± 3.8 hours for primiparous women and 5.0 ± 2.6 hours for multiparous women. This disparity is caused by physiological factors such uterine muscle tone, cervical flexibility, and the effectiveness of uterine contractions.(8) Regional anesthesia causes maternal hypotension, slows the second stage of labor, loses the urge reflex, and increases the risk of urinary retention.(9) Pharmacological management of labor pain and anxiety is not always available and can have negative side effects, such as the use of opiates, which cause nausea, vomiting, drowsiness in mothers, and respiratory depression in newborns.(10) Although pharmacological pain management is effective, its availability and potential side effects pose a dilemma for both mothers and providers, prompting the search for safe and accessible alternatives. Pharmacological pain management alternatives, notably epidural analgesia, are exceedingly scarce in Indonesia, particularly in primary and secondary healthcare settings where most labor and delivery services are provided. This lack of accessibility draws attention to a significant disparity in maternal care equity and emphasizes the significance of easily accessible, non-pharmacological therapies.(11)

The usage of Birthing Ball (BB) and Deep Birthing Relaxation (DBR) techniques are two methods that are being used increasingly. While DBR has been shown to lower anxiety and enhance the mother's self-control during contractions, BB have been shown in recent research to speed up cervical dilatation, lessen pain, and shorten the active phase by more than two hours.(12) The autonomic nervous system, oxygen circulation, hormone balance, and the mother's psychological state all have a significant impact on the labor process, particularly the active portion of the first stage.(13) The sympathetic nervous system is triggered when a mother suffers extreme pain and anxiety during the active period, which results in the release of stress hormones such cortisol, noradrenaline, and adrenaline.(14) The primary hormone that triggers uterine contractions, oxytocin, can be inhibited by these vasoconstrictors.(15) Consequently, the mother suffers from physical tiredness and ongoing emotional stress, labor lasts longer, and contractions lose their effectiveness.(16)

Even though each works well on its own, there is currently no study comparing the two when examined combined in terms of pain, anxiety, and the length of the first stage of active labor. This study is crucial because it offers solid scientific proof of how well a mix of non-pharmacological therapy supports a painless and successful delivery process and strengthen the mother's ability to manage herself during contractions. Despite their

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individual effectiveness, there is currently little study on how the two work together when examined concurrently in regard to pain, anxiety, and the length of the first stage of active labor. Despite their individual effectiveness, there is currently a lack of comparative studies evaluating BB and DBR side by side in terms of their effects on pain, anxiety, and the duration of the active first stage of labor. Deep breathing helps mothers feel less anxious and more pain, while the birthing ball promotes the best possible fetal positioning and pelvic mobility.

To date, no studies have directly compared BB and DBR in an integrative approach addressing multiple labor outcomes simultaneously. This gap persists partly due to limitations in previous research that focused on either BB or DBR in isolation, used small samples, or lacked standardized outcome measures It is essential to investigate these two approaches simultaneously since they are both noninvasive, economical, and useful strategies that can empower women, enhance the quality of births, and lessen the need for pharmaceutical interventions especially in environments with limited resources. To support a comfortable and productive work process, it is crucial that this research offers solid scientific proof of the efficacy of the combination of non-pharmacological therapies. Therefore, the objective of this study is to compare the effects of BB exercises and DBR on maternal pain, anxiety, duration of the active first stage of labor, and maternal satisfaction in order to provide evidence based recommendations for midwifery care, particularly in low resource settings and another objective of this research is to evaluate the effectiveness of a combined intervention using BB and DBR techniques in reducing pain, alleviating anxiety, and shortening the duration of the first stage of labor among Indonesian parturient. We hypothesize that this combination of interventions will significantly reduce labor pain, anxiety levels, and shorten the duration of the active first stage compared to only BB therapy.

METHOD

This quasi-experimental study employed a pretest–posttest control group design to evaluate the effectiveness of birthing ball (BB) and deep breathing relaxation (DBR) techniques on labor pain, anxiety, and the duration of the first stage of active labor. The study was conducted from August 2024 to April 2025 at an independent midwifery practice in the Pringsewu region, Indonesia, following ethical approval from the Health Research Ethics Committee of Aisyah Pringsewu University (Approval No. 272/UAP/OT/KEP/EC/2024). A total of 46 laboring women were recruited through consecutive sampling and equally assigned to two intervention groups: the BB group (n = 23) and the DBR group (n = 23). Eligible participants were identified upon admission by attending midwives or trained research assistants using specific inclusion and exclusion criteria to ensure sample homogeneity and participant safety.

The inclusion criteria consisted of women aged 18–35 years, either primigravida or multigravida, with a singleton pregnancy at term gestation (37–41 weeks), spontaneous onset of labor with cervical dilation between 4–10 cm (active phase of the first stage), cephalic fetal presentation, no obstetric or medical complications, and willingness to participate by providing written informed consent. Women were excluded if they had a history of multiple pregnancies, fetal malpresentation, chronic illnesses or pregnancy complications (e.g., preeclampsia, gestational diabetes, antepartum hemorrhage), labor induction or planned cesarean section, pelvic injury, contraindications to physical movement, or prior participation in other relaxation or labor interventions. Prior to enrollment, researchers explained the study objectives, procedures, potential risks, and benefits. Participation was entirely voluntary, and women were informed that withdrawal at any time would not affect their clinical care. Baseline demographic and obstetric data, including age, gestational age, parity, educational status, occupation, and exercise habits, were collected through a structured questionnaire prior to intervention.

Four parameters were measured in this study. Labor pain was assessed using the Visual Analog Scale (VAS), ranging from 0 (no pain) to 10 (worst imaginable pain), recorded before and after the intervention. The Indonesian version of the VAS has been validated with a Cronbach's α > 0.80. Maternal anxiety was measured using the State-Trait Anxiety Inventory (STAI), with scores ranging from 20 to 80, where higher scores indicate greater anxiety. The Indonesian version demonstrated good reliability (Cronbach's α = 0.87). Anxiety scores were collected before and after the intervention. The duration of the active first stage was recorded in minutes, from 4 cm to full 10 cm cervical dilatation, following standard WHO intrapartum observation guidelines. Maternal satisfaction was assessed post-delivery using the Labor and Delivery Satisfaction Questionnaire (LDSQ), which evaluates dimensions of comfort, support, pain management, and sense of control during labor. All measurement instruments had been previously validated for use in the Indonesian context or underwent a rigorous translation and validation process prior to data collection.

For the BB intervention, participants sat astride a 65-cm birthing ball in an upright position with feet firmly on the floor. The exercises included gentle pelvic tilts, circular rotations, and rhythmic bouncing movements. Each session lasted approximately 20 minutes and was repeated every 1–2 hours until full cervical dilatation (10 cm). A trained midwife supervised each session to ensure proper posture and technique while providing verbal encouragement. In the DBR intervention, participants practiced slow diaphragmatic breathing (inhaled through the nose for a count of four, hold for two counts, and exhale slowly through the mouth for a count of six) performed in a semi-reclined or side-lying position. Each session also lasted about 20 minutes and was repeated every 1–2 hours until 10 cm dilation. Breathing patterns and relaxation responses were closely monitored by a trained midwife. Both intervention protocols followed standardized written guidelines to ensure procedural consistency across participants. The research flow chart was illustrated in Figure 1.

Descriptive statistics were used to summarize participants' baseline demographic and obstetric characteristics, expressed as frequencies and percentages for categorical variables and as mean ± standard deviation (SD) or median for continuous variables. Within-group comparisons (pretest versus posttest) were analyzed using the paired t-test for normally distributed data, while between-group comparisons (BB versus DBR) were performed using the Mann–Whitney test for non-normally distributed data.
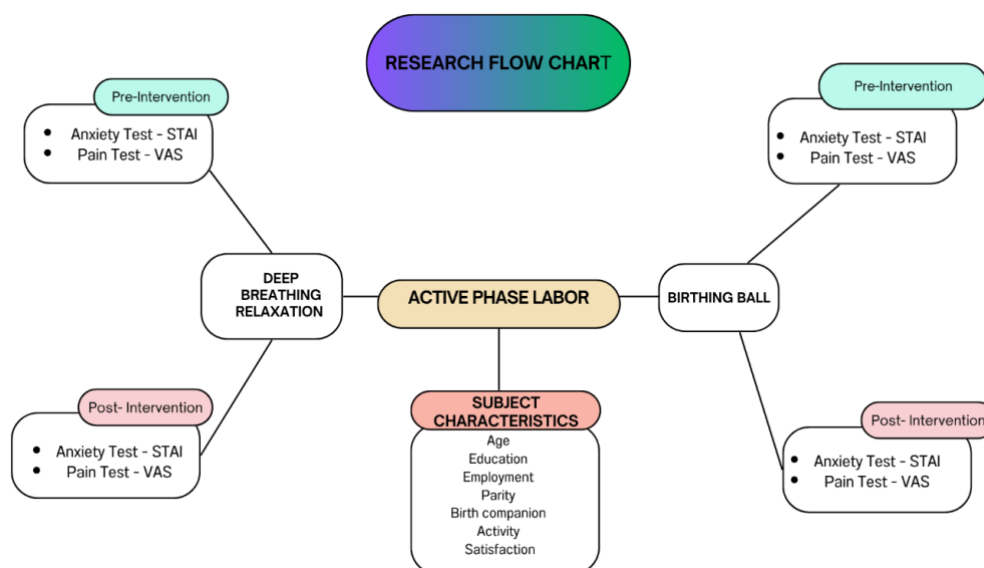

Figure 1. Research Flow Influence of non-pharmacological methods on duration of labor

RESULTS

A total of 46 laboring women met the inclusion criteria and were allocated equally to the two intervention groups: the deep breathing relaxation (DBR) group (n = 23) and the birthing ball (BB) group (n = 23). Table 1 presents the participants' demographic and obstetric characteristics. The mean age of participants in the DBR group was 29.20 ± 4.91 years, while that of the BB group was 31.87 ± 3.81 years. Most participants in both groups had completed secondary or higher education (56.53% in DBR and 65.22% in BB). Most participants were not employed outside the home (60.87% in DBR; 69.57% in BB). In terms of parity, primiparas predominated in the DBR group (56.53%), while multiparas were more common in the BB group (69.67%). Most mothers were accompanied by their husbands during childbirth (82.60% in DBR; 65.22% in BB). Regular antenatal exercise (≥3 times per week) was slightly more common among the DBR group (56.63%) than in the BB group (47.82%). No statistically significant differences were found in baseline characteristics between the two groups (p > 0.05), indicating that both groups were comparable prior to the intervention.

Table 1. Baseline Characteristics of Participants (N = 46)

Variable	DBR (n = 23)	BB (n = 23)
Age (years), Mean ± SD (Range)	29.20 ± 4.91 (22–38)	31.87 ± 3.81 (25–39)
Education, n (%)		
Middle	10 (43.47)	8 (34.49)
High	13 (56.53)	15 (65.22)
Occupation, n (%)		
Working	9 (39.14)	7 (30.43)
Not working	14 (60.87)	16 (69.57)
Parity, n (%)		
Primipara	13 (56.53)	7 (30.43)
Multipara	10 (43.47)	16 (69.57)
Childbirth Companion, n (%)		
Husband	19 (82.60)	15 (65.22)
Other	4 (17.40)	8 (34.78)
Physical Activity, n (%)		
Exercise ≥3 times/week	13 (56.63)	11 (47.82)
None	10 (43.37)	9 (39.13)

Note. No significant differences were found between groups in baseline demographic or obstetric characteristics (p > 0.05).
Abbreviations: DBR = Deep Breathing Relaxation; BB = Birthing Ball.

The Shapiro–Wilk test indicated that the data for some outcome variables were not normally distributed (p < 0.05); therefore, non-parametric tests (Mann–Whitney) were applied for between-group comparisons, while paired t-tests were used for within-group pre–post analyses.

Table 2. Comparison of DBR and BB Based on Mann–Whitney U Test Results

Intervention	Mean Rank	Sum of Ranks	p-value
Deep Breathing Relaxation	36.58	2,430	0.000
Birthing Ball	87.45	5,743	

Table 2 shows the deep breathing relaxation group and the birthing ball group differed significantly in the measured variable, according to the results of the Mann Whitney U test. With total rank scores of 5,743 and 2,430 respectively, the birthing ball group had a mean rank of 87.45, which was greater than the deep breathing relaxation group's 36.58. The test findings revealed a significant difference between the two intervention groups, with a p-value of 0.000 (p < 0.05). This indicates that the birthing ball is more effective than deep

breathing relaxation in shortening the duration of the first stage of active labor (or reducing pain/anxiety, depending on the variable you mean with this data).

Effect on Maternal Anxiety

Both interventions effectively reduced maternal anxiety during the first stage of labor. As illustrated in Figure 2, the mean State Anxiety Inventory score decreased from 52.6 (SD = 5.4) before intervention to 49.2 (SD = 4.9) after intervention. Paired t-test results confirmed a statistically significant reduction in anxiety ($p < 0.001$). When compared between groups, the BB group demonstrated a greater reduction in anxiety levels than the DBR group, although the difference was not statistically significant ($p > 0.05$).
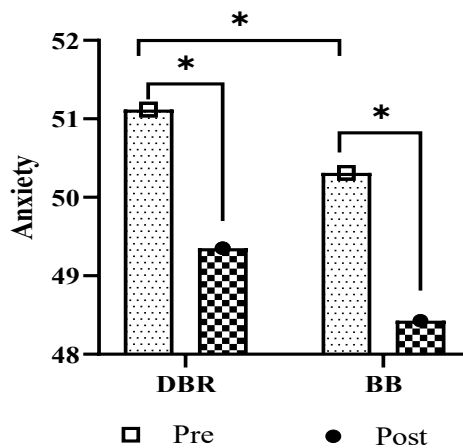

Figure 2. Comparison of DBR and BB against anxiety

Effect on Labor Pain

A significant decline in pain intensity was observed following both interventions. The mean Visual Analog Scale (VAS) score decreased from 4.3 (SD = 0.9) before to 3.6 (SD = 1.2) after intervention ($p < 0.001$). Comparative analysis showed that the BB group achieved a greater reduction in pain scores compared to the DBR group, supporting the superior analgesic effect of the birthing ball exercise during the active phase of labor ($p < 0.05$) (Figure 3).
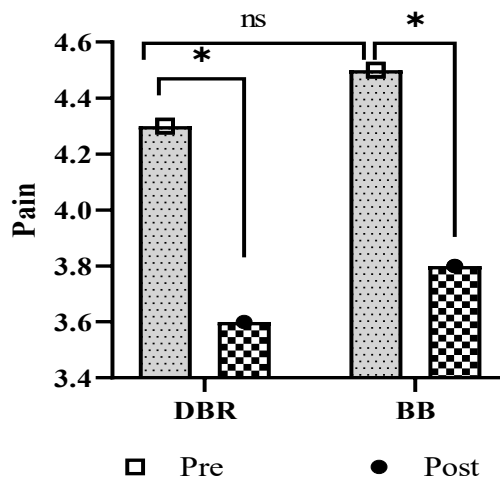

Figure 3. Comparison of DBR and BB on labor pain

Effect on Duration of the Active First Stage of Labor

As shown in Table 3, the mean duration of the active first stage of labor was significantly shorter in the BB group (243.5 ± 31.1 minutes; range 149–291) compared to the DBR group (274.3 ± 29.3 minutes; range 196–332), with a p-value of 0.003. This finding suggests that pelvic mobility and positional changes facilitated by the birthing ball may enhance uterine efficiency, promote cervical dilation, and expedite fetal descent.

Table 3. Comparison of Deep Breathing Relaxation and Birthing Ball on the Duration of Active First Stage of Labor

Intervention Group	n	Mean Duration (minutes)	SD	Min	Max	p-value
Deep Breathing Relaxation	23	274.3	29.3	196	332	0.003
Birthing Ball	23	243.5	31.1	149	291	

Maternal Satisfaction

Maternal satisfaction scores, assessed using the Labor and Delivery Satisfaction Questionnaire, revealed that mothers in the BB group reported significantly higher satisfaction levels (mean = 34.2 ± 3.7; range 29–34) than those in the DBR group (mean = 31.3 ± 3.1; range 29–33) (p < 0.001) (Table 4). The increased satisfaction among BB users may be attributed to the combined benefits of comfort, physical engagement, pain relief, and enhanced maternal control during labor.

Table 4. Maternal Satisfaction Scores in DBR and BB Groups

Intervention Group	n	Mean Score	SD	Min	Max	p-value
Deep Breathing Relaxation	23	31.3	3.1	29	33	
Birthing Ball	23	34.2	3.7	29	34	0.000

Overall, both birthing ball exercises and deep breathing relaxation proved effective in reducing labor pain and anxiety, while improving maternal comfort. However, the birthing ball intervention demonstrated superior outcomes in shortening the duration of the active phase and enhancing maternal satisfaction. These findings highlight the potential of integrating non-pharmacologic, midwife-led interventions into intrapartum care to promote positive childbirth experiences.

DISCUSSION

This study demonstrates that birthing ball (BB) exercises had a greater overall positive impact on maternal labor outcomes compared to deep breathing relaxation (DBR). The BB intervention resulted in significantly shorter duration of the active first stage of labor, greater reductions in pain and anxiety levels, and higher maternal satisfaction scores. These findings are particularly significant in the context of midwifery practice in Indonesia, where access to pharmacologic interventions such as epidural analgesia remains limited, especially in primary and secondary healthcare settings. Therefore, effective and affordable non pharmacologic strategies like BB offer a practical and evidence-based solution to improve maternal care. Our study found that both birthing ball and deep breathing relaxation significantly reduced labor pain and anxiety. In the DBR group, the mean pain score decreased from 4.3 to 3.6 (a reduction of 0.7, p = 0.03), and in the BB group, the score decreased from 4.5 to 3.8 (also a reduction of 0.7, but with stronger statistical significance, p < 0.01). For anxiety, the DBR group showed a decrease from 52.2 to 49.4 (−2.8), though not statistically significant (p > 0.05), while the BB group showed a significant reduction from 50.4 to 48.3 (−2.1, p < 0.001).Additionally, the mean duration of the active first stage of labor was significantly shorter in the BB group (243.5 ± 31.1 minutes) compared to the DBR group (274.3 ± 29.3 minutes), with a p-value of 0.003. In terms of maternal satisfaction, the BB group had a higher mean score (34.2 ± 3.7) than the DBR group (31.3 ± 3.1), with this

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difference being highly significant (p = 0.000). These findings suggest that the BB intervention offers superior benefits in enhancing both physiological labor progress and maternal emotional experience during childbirth.

The present study demonstrated that both DBR and BB interventions significantly reduced labor pain during the active first stage. DBR showed a reduction in mean pain scores from 4.3 to 3.6 (p = 0.03), while BB demonstrated a reduction from 4.5 to 3.8 (p < 0.01). Although the numerical reduction was equal in both groups (0.7 points), the greater statistical significance in the BB group suggests a more consistent analgesic effect. These findings are supported by the Gate Control Theory of pain proposed by Melzack and Wall, which explains that non painful input (e.g., movement, pressure, or controlled breathing) can close the "gates" to painful input, thereby reducing the perception of pain.(17) DBR may alleviate pain by stimulating the parasympathetic nervous system and promoting relaxation, which reduces muscle tension and modulates pain signals.(18) However, BB potentially activates multiple sensory inputs simultaneously touch, proprioception, and pressure offering stronger gate closing effects.(19) Compared to DBR, the BB technique also provides mechanical advantages by improving maternal posture, encouraging pelvic mobility, and reducing pressure on the sacral nerves and perineum. These biomechanical effects help distribute uterine contractions more evenly, minimize discomfort, and support optimal fetal positioning.(20)

Following both treatments, the anxiety scores dramatically dropped on average going from 52.6 to 49.2 (p = 0.000). This supports the idea that the sympathetic nervous system is activated by labor anxiety, which results in increased cortisol, adrenaline, and noradrenaline secretion.(21) This, in turn, suppresses oxytocin, a hormone that is essential for successful uterine contractions.(22) In order to assist settle mother emotions, deep breathing enhances oxygenation and triggers the parasympathetic nervous system.(18) The BB, on the other hand, reduced anxiety more, probably because it stimulated many senses by combining movement, posture modification, and tactile feedback, who found that women who used BBs experienced significantly less anxiety than those who used breathing techniques alone, corroborate these findings.(13)

The duration of active labor was substantially shorter in the BB group (243.5 ± 31.1 minutes) than in the DBR group (274.3 ± 29.3 minutes), with a p-value of 0.003. According to, the mechanism may be explained by gravity assisted fetal descent, better pelvic alignment, and more efficient uterine contractions brought on by upright posture and rhythmic activity discovered comparable trends to those Kember et al. (2024), who observed median active phase durations of 5.08 hours for multiparas and 9.38 hours for primiparas in a multicenter research conducted. (23) Our findings are consistent with those of a study that revealed that, on average, the use of a BB reduced the labor duration by 40 to 60 minutes in comparison to standard treatment. (24,25) With p = 0.000, the BB group's maternal satisfaction levels were substantially higher (mean = 34.2, SD = 3.7) than those of the DBR group (mean = 31.3, SD = 3.1). This might be a result of the BB increased comfort, involvement, and sensation of control.(26) According to, three important factors that affect how satisfied women are with childbirth are autonomy, emotional support, and pain management.(27) Our findings are in line with a study by which discovered that women who used BB and upright positions during delivery had greater satisfaction scores than those who laid supine.(28)

Few research have directly compared the advantages of DBR and BB, despite the fact that other investigations have independently verified these benefits. Our results provide fresh proof that, notwithstanding the effectiveness of both approaches, BB exercises had a higher overall positive impact on maternal outcomes. This could be because of its integrative approach, which influences the psychological (control, relaxation) and physiological (fetal descent, uterine contraction) aspects of labor. Therefore, our study closes a large research gap in the comparative analysis of various methods.

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Both DBR and BB should be advised as part of standard intrapartum treatment due to their cost effectiveness, safety, and accessibility, especially in places with limited resources where pharmaceutical interventions might not be available or pose concerns. Educating midwives to carry out these actions could enhance women's delivery experiences, decrease the need for medical interventions, and improve maternal outcomes.(29)

Important research questions are brought up by this work. Although the results are encouraging, more extensive research using randomized controlled designs is required to validate them and lower the possibility of performance and selection bias. Future studies should also examine the long-term effects of BB and DBR on mothers and newborns, as well as evaluate the effectiveness of these therapies in a range of demographics and medical environments. Qualitative research may shed more light on women's subjective experiences with these methods by identifying variables that affect cultural preferences, comfort, and acceptance. Additionally, multicenter trials or pooled data may improve generalizability and help guide national policy recommendations. Several limitations must be acknowledged. The relatively small sample size and limited geographic scope restrict the external validity of the findings. The non randomized design may have introduced selection bias, and the impossibility of blinding participants or observers might have led to performance or observer bias. Self-reported outcomes, while valuable for capturing maternal perceptions, are also prone to response bias. Future studies should address these methodological challenges through improved study design, standardized protocols, and the inclusion of objective outcome measures where possible.

CONCLUSION
This study shows that deep breathing relaxation (DBR) and birthing balls (BB) are both useful non pharmacologic methods to improve labor outcomes for mothers, especially in terms of lowering pain and anxiety. However, the overall advantages of BB exercises were stronger, as seen by higher levels of maternal satisfaction, a shorter duration of the active first stage of labor, and a more noticeable decrease in maternal anxiety. These results have significant therapeutic ramifications, particularly in low resource environments like Indonesia where women need noninvasive, affordable methods to help them during childbirth. A happier delivery experience, less dependence on medical interventions, and better intrapartum care can all result from BB and DBR being included into routine midwifery practice. To strengthen the evidence base and guide policy development, future studies should employ rigorous designs such as randomized controlled trials with larger and more diverse populations. Qualitative research is also needed to explore women lived experiences with these techniques, providing a deeper understanding of their acceptability and cultural relevance. Ultimately, expanding access to and training in non-pharmacologic labor support interventions may serve as a vital step toward more respectful, person-centered maternity care.

AUTHOR CREDIT STATEMENT
FF: Conceptualization, Methodology, Data Collection, Formal Analysis, Writing – Original Draft, Writing – Review & Editing, Visualization, Supervision, Validation.

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