Efficacy of birth ball exercises and structured antenatal counseling on labor pain, anxiety, and maternal satisfaction in primigravida women: a quasi-experimental study

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Abstract
Background: Labor pain and anxiety are closely connected experiences for many women giving birth for the first time. Primigravida women may have particular uncertainty about what labor will feel like, how contractions progress, when to request help, and how they will cope with increasing discomfort. Contemporary maternity care therefore increasingly values non-pharmacological comfort measures, informed preparation, mobility, respectful communication, and shared decision making. Birth ball exercise is a practical mobility-based intervention that can be taught before labor and used during labor, while structured antenatal counseling can provide information, rehearsal, coping skills, and realistic expectations. World Health Organization guidance emphasizes woman-centred antenatal and intrapartum care, and current professional guidance recognizes supportive, non-pharmacological measures as components of individualized labor care.
Objective: This review examines the evidence concerning birth ball exercises and structured antenatal counseling for labor pain, anxiety or fear related to childbirth, and maternal satisfaction in primigravida women, and then develops a practical framework for evaluating their combined effect through a quasi-experimental study design. The article also discusses mechanisms, intervention components, outcome measurement, bias control, safety, nursing and midwifery responsibilities, implementation issues, and research gaps.
Evidence synthesis: Randomized trials and systematic reviews have generally reported lower labor pain with birth ball use, although effects on labor duration and satisfaction vary across protocols and populations. Meta-analytic evidence has strengthened the case for birth ball exercise as a low-cost, non-pharmacological option during low-risk labor, while recent trials confirm reductions in pain at later cervical dilatations and in some studies improvements in satisfaction or related birth-experience measures. Evidence for antenatal education and counseling is similarly encouraging but heterogeneous. Reviews indicate reductions in childbirth fear and improvements in self-efficacy, while recent trials of structured education, telephone counseling, digital childbirth education, psychoeducation, and complementary preparation have demonstrated clinically relevant improvements in psychological preparedness. Conclusion: The literature supports evaluation of a combined birth ball and structured counseling package rather than assuming that either component alone explains all observed benefits. A quasi-experimental design with a clearly defined intervention group, comparable control group, repeated measurement of pain and anxiety, and a validated measure of maternal satisfaction can provide useful real-world evidence where randomization is not feasible. The resulting study should report actual participant data transparently and interpret changes in pain, anxiety, and satisfaction alongside obstetric factors, analgesia use, and implementation fidelity.

Keywords:
birth ball; birthing ball; primigravida; labor pain; childbirth anxiety; antenatal counseling; maternal satisfaction; non-pharmacological pain relief; quasi-experimental study; midwifery care.

1. Review Scope and Approach:

This manuscript is a focused narrative review with an integrated quasi-experimental study framework. Evidence was drawn from peer-reviewed trials, systematic reviews and meta-analyses, psychometric studies, and major maternity-care guidance identified through PubMed and official World Health Organization and American College of Obstetricians and Gynecologists resources. The emphasis is on studies relevant to primigravida or nulliparous women, although some broader labor studies are included when they directly inform pain management, supportive care, measurement, or implementation. The review is intentionally not presented as a formal systematic review because it does not claim an exhaustive database search, duplicate screening, formal risk-of-bias adjudication, or PRISMA reporting. The clinical question is framed using four linked elements: population, intervention, outcomes, and real-world design. The population is primigravida or nulliparous women with uncomplicated pregnancies who are preparing for vaginal birth. The intervention is a structured package combining antenatal counseling with planned instruction and use of a birth ball. The principal outcomes are labor pain, anxiety or childbirth-related fear, and maternal satisfaction. The study framework uses a non-equivalent comparison-group quasi-experimental design because this format is feasible in clinical settings where individual randomization may be restricted by staffing, scheduling, participant preference, or service organization. Recent evidence shows that quasi-experimental and randomized educational interventions can both be informative when the intervention is clearly defined and outcomes are measured consistently.

2. Background:

Labor is a dynamic physiological process involving progressive cervical change, uterine activity, fetal descent, positional adaptation, and substantial emotional and sensory demands. Pain during labor is influenced by contraction intensity, cervical dilation, tissue stretch, fetal position, fatigue, prior experiences, environmental conditions, perceived control, expectations, and psychological responses. The experience is therefore not adequately described by a single biological mechanism. Two women with similar cervical findings may report substantially different pain because attention, fear, support, coping confidence, communication, and the meaning attached to labor all influence perception and response. The World Health Organization places positive childbirth experience alongside clinical safety, highlighting respectful communication, woman-centred care, mobility, choice, and individualized support rather than a narrow focus on technical outcomes alone (World Health Organization, et al., 2018).

Primigravida women are especially relevant to interventions aimed at preparation because the first birth is an experience without a personal reference point. Expectations are built from family stories, social media, previous observation, antenatal teaching, cultural beliefs, and the way health professionals describe labor. Fear of childbirth can involve uncertainty about pain, concern about the baby, worries about loss of control, fear of complications, embarrassment, or concern about coping. In a multicentre study of more than one thousand nulliparous women, (Qiu et al.,2020) found that childbirth fear was measurable across a broad group of first-time mothers and was associated with several demographic and psychosocial factors. This supports an individualized approach rather than assuming that all primigravida women have the same level of fear or the same educational needs.

Current maternity care therefore increasingly treats antenatal education as an opportunity to build practical skills rather than merely deliver information. Preparation can include explanation of labor stages, breathing and relaxation, positions, mobility, communication with staff, analgesic options, warning signs, birth preferences, and realistic expectations about uncertainty. The World Health Organization recommends antenatal care that supports a positive pregnancy experience and explicitly recognizes information, communication, and respectful woman-centred interactions as components of quality care (World Health Organization, et al., 2016). More recent evidence also suggests that education is more useful when it is structured, interactive, and linked to coping and self-efficacy rather than delivered solely as passive information (Zaman et al., 2025; Merriel et al., 2024).

Birth ball exercise fits naturally into this model because it converts preparation into a physical skill that can be rehearsed before labor and applied during contractions. The ball provides a stable but movable support surface that can facilitate sitting upright, pelvic rocking, gentle circular movement, leaning forward, or supported positional changes. The potential value is not limited to a direct effect on pain. Mobility may improve comfort, give the woman an active task, change pressure distribution, and reinforce a sense of participation in the labor process. The intervention is also compatible with non-pharmacological pain management because it can be used alongside breathing, massage, relaxation, emotional support, and pharmacological analgesia when clinically indicated (Makvandi et al., 2015; Delgado et al., 2019).

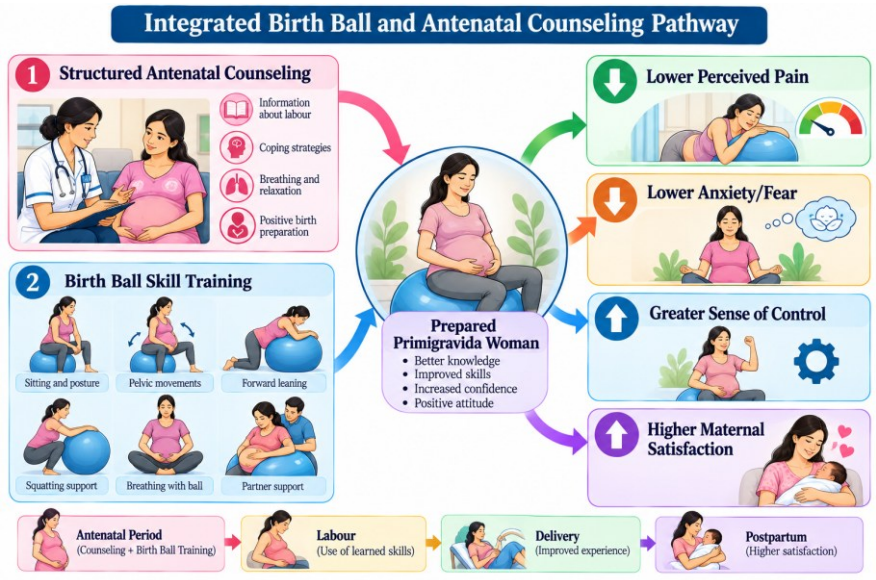


Figure. 1: Integrated Birth Ball and Antenatal Counseling Pathway

3. Birth Ball Exercises as a Non-Pharmacological Labor Intervention:

A birth ball is a large inflatable exercise ball used to facilitate supported upright or semi-upright positions and controlled pelvic movement. In maternity settings the intervention is sometimes described as birth ball, birthing ball, Swiss ball, fitness ball, or stability ball. Terminology varies, but the clinical concept is similar: the woman uses a resilient support surface to remain mobile while maintaining balance and comfort. The practical advantage is that the ball allows movement without requiring continuous ambulation. A woman can sit, rock, circle the pelvis, lean forward, kneel with support, or change positions while maintaining an accessible relationship with the bed, partner, nurse, or midwife. This combination of mobility and support is one reason the intervention is attractive in low-resource and routine maternity settings.

Evidence concerning pain has been relatively consistent compared with evidence for other outcomes. (Makvandi et al., 2015) reviewed randomized trials and found a statistically significant improvement in labor pain, although the number of included trials was small. (Delgado et al.,2019) broadened the evidence base to randomized and non-randomized clinical trials and concluded that birth ball use may benefit maternal outcomes, while also emphasizing variation among protocols and study quality. The updated meta-analysis by (Terres et al., 2025) included ten randomized controlled trials and 1,008 parturients and reported lower pain at 4 and 8 cm dilation and a reduction in first-stage duration, while some other labor outcomes did not differ significantly. These findings make pain relief the clearest outcome for which the intervention has a plausible and repeatedly observed signal, but they do not justify claiming that every woman will experience the same degree of benefit.

Individual trials illustrate the same pattern. (Taavoni et al., 2016) compared birth ball use, heat therapy, and standard care among primiparous women and reported lower pain scores in the birth-ball group than in controls at the assessed time points. In another randomized study, Aslantaş and Çankaya (2024) enrolled 120 primiparous women and found that pain measured later in labor was lower in the birth-ball group, while aspects of labor duration also improved; however, satisfaction scores were not significantly different between groups. This is an important reminder that pain relief and satisfaction are related but distinct outcomes. A woman may experience less pain yet remain dissatisfied if communication, expectations, autonomy, or perceived quality of care are poor. Conversely, a woman may report high satisfaction despite substantial pain when she feels informed, supported, and respected.

Other trials have found more favourable satisfaction effects, but their intervention protocols differ. Dunmez and Yilmaz (2024) compared birth-ball and squatting-position groups with controls and reported lower pain, shorter labor duration, and significant group differences in satisfaction, with the birth-ball group having the highest satisfaction in that study. (Erkal Aksoy et al., 2024) also found lower pain and a shorter active phase among women using a birth ball, with higher scores on the Birth Satisfaction Scale-Revised and its dimensions related to quality of care and personal attributes. The different findings across these trials do not necessarily contradict one another; they illustrate how satisfaction is influenced by the broader context in which an intervention is delivered, the timing of measurement, the comparator, the instrument used, and the woman's expectations.

The recent pragmatic trial by (Mylod et al., 2024) adds an especially useful perspective. Low-risk women were given access to a birth ball and an educational video for use during the latent phase at home. The trial did not demonstrate a significant difference in mean pain on admission, but most participants considered the birth ball helpful and said they would use it again. This suggests that acceptability and perceived usefulness may be important implementation outcomes even when a single pain measurement does not change. It also demonstrates why a comprehensive evaluation should not reduce the intervention to a single numeric pain score.

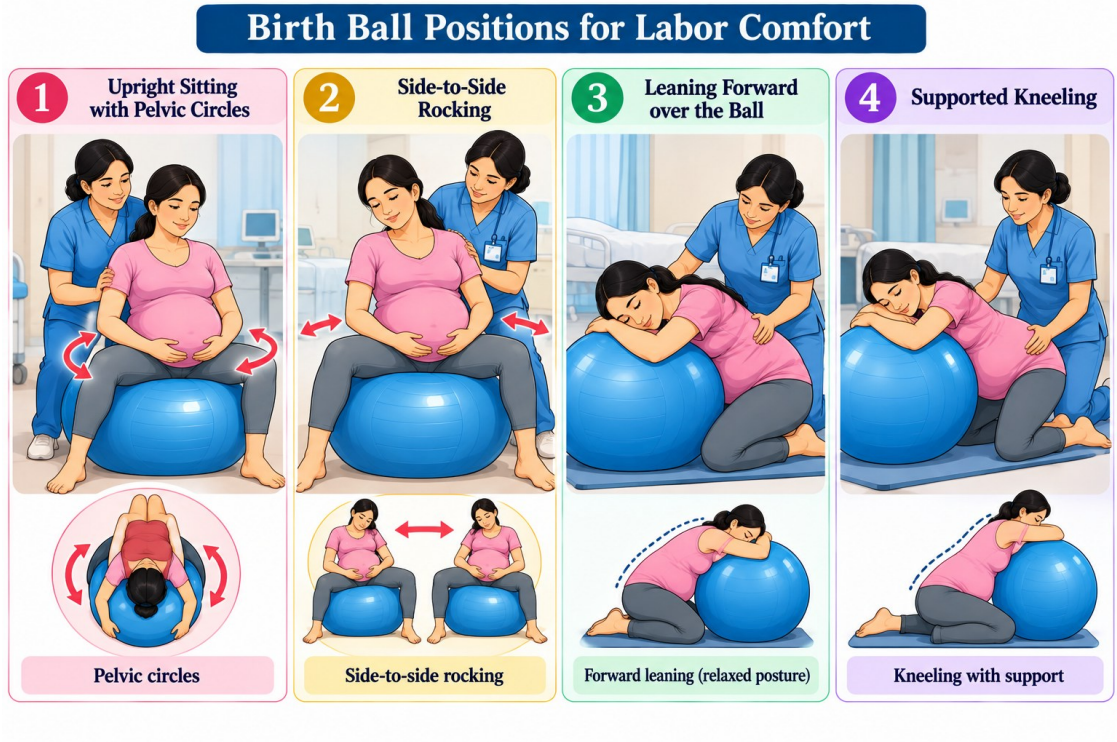


Figure. 2: Birth Ball Positions for Labor Comfort

4. How Birth Ball Exercise May Influence Labor Pain:

The most straightforward explanation for pain reduction is that movement changes how the woman experiences and responds to contractions. Sitting upright or moving the pelvis can reduce the sense of being physically restricted and may help the woman find a position in which pressure feels more tolerable. Gentle rhythmic movement also gives attention a purposeful target. Rather than waiting passively for each contraction, the woman can coordinate breathing, pelvic movement, and posture. This active coping process may reduce distress even when nociceptive input remains substantial. Non-pharmacological labor interventions are therefore better understood as pain-management strategies that can influence perception, coping, and distress, rather than as methods that abolish the physiological causes of labor pain (Mohammed et al., 2025).

Another proposed pathway involves pelvic mobility and fetal descent. Birth ball movement may facilitate repeated changes in pelvic orientation and maternal posture. However, evidence for shortened labor should be interpreted cautiously because findings differ between studies, and many factors influence labor duration, including parity, spontaneous versus induced labor, cervical status at intervention, maternal position, fetal position, oxytocin use, epidural analgesia, and institutional labor-management practices. The updated meta-analysis by Terres et al. (2025) reported a reduction in first-stage duration but not a significant difference in several other obstetric outcomes. A systematic review focused on non-pharmacological methods likewise found that birth-ball exercise can be associated with shorter labor in some studies, but intervention protocols and study quality vary (Terres et al., 2025).

Psychological effects are also plausible. Labor pain and anxiety can reinforce one another: fear heightens vigilance and muscle tension, increased discomfort confirms the expectation that labor is becoming unbearable, and that perception may further increase fear. A woman who has practiced a manageable coping response before labor may enter the process with a greater sense of predictability. The ball then acts not only as a physical aid but also as a familiar cue associated with previously learned skills. This is consistent with evidence linking childbirth preparation and self-efficacy to use of non-pharmacological coping strategies and with recent work suggesting that preparation is associated with greater use of such methods during labor (Zaman et al., 2025).

5. Structured Antenatal Counseling: From Information to Preparedness:

Structured antenatal counseling differs from routine health education because it follows a planned sequence with explicit learning objectives, opportunities for questions, rehearsal of coping strategies, and reinforcement over time. The content can be individualized according to gestational age, prior knowledge, childbirth expectations, cultural beliefs, and anxiety level. In a primigravida population, counseling is particularly valuable because many concerns are based on uncertainty rather than direct previous experience. Effective education therefore explains what is likely to happen without presenting labor as a rigid sequence in which every woman must progress identically. It should prepare women for normal variation while also explaining when additional monitoring or medical intervention may become necessary.

The evidence for antenatal education has evolved from traditional childbirth classes toward interventions that explicitly target fear, self-efficacy, coping, and decision making. (Alizadeh-Dibazari et al., 2023) reviewed randomized and quasi-experimental studies and found that prenatal education may reduce childbirth fear and pain intensity, but they also noted heterogeneity and limitations in evidence quality. (Zaman et al., 2025) reported in a meta-analysis of randomized trials that antenatal education improved childbirth self-efficacy and reduced fear of childbirth, supporting the idea that preparation affects both psychological readiness and the way women approach labor. These findings are clinically relevant because the desired outcome is not simply knowledge retention; it is the ability to apply knowledge under the stress of contractions.

Recent interventions provide useful examples of structure. Pardes and Guvenc (2025) found that antenatal education combined with telephone counseling between 28 and 34 weeks reduced childbirth fear and improved childbirth attitudes among nulliparous women. (Zafman et al., 2023) used an interactive digital childbirth education platform and observed lower third-trimester pregnancy-related anxiety together with higher satisfaction with childbirth education in a high-risk population. Although the populations and settings differ from a typical low-risk primigravida sample, both studies demonstrate that repeated contact and accessible communication can extend education beyond a single classroom session.

Psychoeducation can be equally relevant for women with more pronounced fear. (Boz et al., 2021) evaluated a psychoeducation intervention based on Human Caring Theory and reported that the program was feasible among nulliparous women with fear of childbirth. (Rouhe et al., 2013) showed that a targeted psychoeducational intervention for women with severe fear of childbirth was associated with more positive delivery experiences and differences in delivery mode. More recently, Golnazari et al. (2026) directly examined a quasi-experimental program of childbirth preparation classes and counseling among primiparous women and found reduced fear of childbirth after the intervention. These studies support the concept that structured preparation is more than an educational event; it can be an organized psychological and behavioural intervention.

The content of counseling should therefore address four practical questions: What is happening? What can I do? How can I decide? Whom can I ask for help? “What is happening?” covers the stages and expected sensations of labor. “What can I do?” covers breathing, relaxation, movement, birth ball use, position changes, partner support, and rest. “How can I decide?” covers pain-relief choices, consent, preferences, and adaptation when labor deviates from the original plan. “Whom can I ask for help?” emphasizes timely communication with nurses, midwives, obstetric clinicians, and support persons. (Merriel et al., 2024) found that a co-designed antenatal education session improved participants’ perceived preparedness and acceptability, reinforcing the importance of clear, relevant, stakeholder-informed educational content.

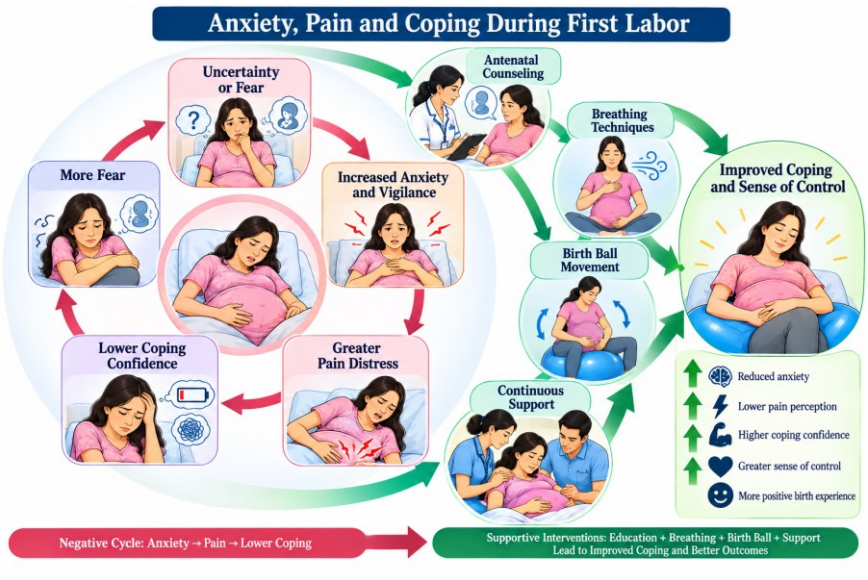


Figure. 3: Anxiety-Pain-Coping Cycle in Primigravida Labor

6. Why Combine Birth Ball Exercise With Structured Antenatal Counseling?

The strongest rationale for a combined intervention is that the two components target different but interconnected levels of the childbirth experience. Counseling primarily addresses knowledge, expectations, emotional preparation, self-efficacy, and decision making. Birth ball training primarily addresses movement, comfort, posture, and active coping during contractions. Teaching the woman about a birth ball without allowing her to practice it may reduce confidence when labor becomes intense. Conversely, providing a ball during labor without prior explanation may limit uptake because the woman may not understand why movement is being suggested or may perceive the equipment as unfamiliar. Combining the two creates continuity between antenatal learning and intrapartum action.

There is also a behavioural rehearsal component. Skills that are practiced in low-stress conditions can become easier to retrieve during stressful events. Antenatal counseling can therefore introduce a short sequence: recognize tension, exhale slowly, release unnecessary muscle effort, assume a supported posture, perform gentle pelvic movement, reassess comfort, and communicate with the caregiver. When the same sequence is used during labor, the woman is not attempting to learn a new behaviour while experiencing contractions. This is consistent with the broader concept of childbirth preparation as physical, informational, and emotional readiness rather than education alone (Zaman et al., 2025).

The combination may also support maternal satisfaction indirectly. Satisfaction is not equivalent to absence of pain. A recent global systematic review found that childbirth satisfaction is associated with respectful care, support, expectations, and other contextual factors, while substantial heterogeneity remains across settings (Hollins Martin and Martin, 2014). A 2026 systematic review similarly identified emotional support, communication, companionship, perceived control, and autonomy-supportive care as recurring features of positive childbirth experiences (Bohren et al., 2017). Thus, an intervention intended to improve satisfaction should not merely reduce a pain score; it should create conditions in which women feel informed, listened to, supported, and able to participate in care.

Table. 1: Summary of Key Evidence Relevant to the Combined Intervention

Evidence source	Population / design	Main outcome relevant to topic	Interpretation for proposed study
Makvandi et al., 2015	4 RCTs; 220 women	Birth ball associated with lower labor pain	Supports pain as a primary endpoint
Delgado et al., 2019	Systematic review/meta-analysis of clinical trials	Maternal outcomes including pain assessed; evidence graded for quality	Supports birth-ball intervention with protocol standardization
Terres et al., 2025	10 RCTs; 1,008 low-risk parturients	Lower pain at 4 and 8 cm and shorter first stage in pooled analysis	Supports objective, stage-specific pain measurement

Alizadeh-Dibazari et al., 2023	18 RCT/quasi-experimental studies	Prenatal education may reduce fear and pain, but evidence heterogeneous	Supports structured counseling while emphasizing methodological rigor
Zaman et al., 2025	40 studies; 31 meta-analysed	Improved self-efficacy and reduced childbirth fear	Supports anxiety/self-efficacy as meaningful outcomes
Xu et al., 2026	18 RCTs; 7,462 women	Lower anxiety/fear and greater satisfaction/self-efficacy with midwifery-led programs	Supports integrated, nurse/midwife-delivered education
Golnazari et al., 2026	Quasi-experimental; 90 primiparous women	Childbirth preparation/counseling reduced fear of childbirth	Directly informs quasi-experimental feasibility
Erkal Aksoy et al., 2024	RCT; birth-ball vs standard care	Lower pain and higher BSS-R dimensions in intervention group	Supports inclusion of satisfaction as a distinct outcome

7. Why Focus Specifically on Primigravida Women?

Primigravida women represent a clinically meaningful target group because first birth often involves the greatest uncertainty regarding labor progression and coping. The absence of prior labor experience means that women may have difficulty interpreting the difference between expected discomfort and signs that require clinical assessment. This uncertainty can amplify worry, especially when personal stories or online information present childbirth as either uniformly traumatic or unrealistically predictable. (Qiu et al., 2020) documented measurable childbirth fear across a large sample of nulliparous women, while research on severe fear shows that targeted psychoeducation can alter childbirth experience and obstetric outcomes (Rouhe et al., 2013). These findings provide a strong rationale for delivering preparation before the onset of labor rather than waiting until anxiety becomes overwhelming.

At the same time, primigravida status should not be treated as a synonym for high anxiety. Some first-time mothers approach labor with confidence, strong social support, and good understanding of pain-management options, while others require more intensive counseling. A proposed study should therefore measure baseline anxiety or childbirth fear rather than assume it. Screening can also identify women whose needs exceed the scope of routine antenatal counseling and who may require mental-health or obstetric referral. Instruments such as the State-Trait Anxiety Inventory and childbirth-specific fear measures provide options for distinguishing general anxiety from childbirth-focused concerns, although validated language versions and locally accepted tools should be selected for each setting (Delgado et al., 2016).

Focusing on primigravida women can also reduce one source of heterogeneity: previous birth experience. Previous labor may influence expectations, learned coping strategies, and satisfaction. Restricting eligibility to women with no previous birth allows a more direct examination of whether structured preparation changes the experience of a first labor. However, this increases the importance of carefully recording age, gestational age, educational level, marital or partner support, employment, antenatal attendance, induction status, cervical dilation at admission, and analgesia exposure because these factors can still differ between groups and act as confounders.

8. Proposed Intervention Protocol:

For a practical quasi-experimental evaluation, the intervention should be described with enough detail that another maternity unit could reproduce it. The counseling component can begin during the late second or early third trimester and continue over a short series of structured sessions. A three-session model is one reasonable framework: an initial education session on labor physiology, expectations, anxiety, and pain-coping; a second session focused on practical rehearsal of birth ball positions, breathing, relaxation, and partner support; and a final session devoted to individualized questions, birth preferences, warning signs, when to seek care, and rehearsal of the complete coping sequence. The exact number and duration of sessions should be adapted to local antenatal scheduling and documented in the protocol. Evidence from structured education trials supports repeated and interactive contact rather than a single unstructured lecture (Pardes et al., 2025; Merriel et al., 2024).

Birth ball training should include demonstration followed by supervised return-demonstration. The participant should learn how to sit with stable foot placement, how to perform gentle pelvic rocking and circular

movement, how to lean forward for support, how to stop and reposition when discomfort increases, and how to use the ball with a partner or caregiver nearby. The teaching should explicitly distinguish comfortable movement from vigorous exercise. During labor, the ball should be used after clinical assessment and according to facility safety procedures. The woman should be observed for dizziness, excessive fatigue, loss of balance, fetal or maternal concerns, or any indication that upright movement is no longer appropriate. The purpose is comfort and active coping, not forced exercise.

The intervention should also preserve choice. A woman may prefer walking, side-lying, supported standing, heat, massage, pharmacological analgesia, neuraxial analgesia, or another strategy. A birth ball should be presented as an option within a broader pain-management plan rather than as a replacement for clinical analgesia. Current ACOG guidance emphasizes individualized management and notes that non-pharmacological support measures can complement standard labor care, while neuraxial analgesia should remain available when desired and clinically appropriate (American College of Obstetricians and Gynecologists, 2024). This distinction is important for maternal autonomy and for ethical interpretation of satisfaction.

Table. 2: Proposed Structure of the Combined Intervention

Phase	Core content	Teaching method	Fidelity check
Antenatal session 1	Labor stages, expected sensations, pain physiology, anxiety, coping choices, respectful communication	Interactive teaching, discussion, question-answer	Checklist completed by educator
Antenatal session 2	Birth ball positions, pelvic movement, breathing, relaxation, partner support	Demonstration + supervised return-demonstration	Skill checklist and participant practice record
Antenatal session 3	Birth plan preferences, warning signs, when to contact maternity unit, coping rehearsal	Scenario rehearsal and individualized counseling	Session completion form
Intrapartum use	Supported birth ball movement according to clinical status and preference	Nurse/midwife guidance with reassessment	Time of use, positions, tolerance, interruptions recorded

9. Comparison Group and Usual Care:

The comparison group should receive the institution's existing standard antenatal and intrapartum care without the structured combined intervention. Usual care should be defined clearly rather than left as a vague label. It may include routine antenatal advice, standard health education, ordinary nursing or midwifery support, clinician-directed pain relief, mobility as permitted, and any services routinely available to all women. The study protocol should record major differences in exposure because "usual care" can change during the recruitment period. Documentation is particularly important when staff are trained in birth-ball use as part of a quality-improvement program, because spill-over can reduce the contrast between groups.

Where allocation is non-random, comparability should be addressed at baseline. Women in the intervention and comparison groups should be assessed using the same eligibility criteria, recruitment period, and outcome measures. Researchers should collect baseline measures of anxiety or fear and, when feasible, an antenatal expectation measure before the counseling begins. Matching or statistical adjustment can be considered for important characteristics such as age, gestational age, education, induction status, cervical dilation at baseline labor assessment, and planned analgesia preference. The goal is not to manufacture equivalence after recruitment but to identify plausible differences that might otherwise be mistaken for treatment effects.

10. Outcome Measures:

The primary outcome set should retain the three patient-centred domains named in the research question: labor pain, anxiety, and maternal satisfaction. Each domain should be measured with a defined instrument and timing schedule. A simple 0-10 or 0-100 visual analogue or numeric rating approach can capture pain intensity repeatedly during labor, but repeated measures should be tied to clinically meaningful milestones such as early

active labor, later active labor, and the immediate postpartum period. The specific instrument should be stated in the protocol and used identically in both groups. Birth-ball trials have commonly used visual analogue pain measures, which makes stage-specific comparisons possible across studies (Taavoni et al., 2016; Aslantaş et al., 2024; Dunmez and Yilmaz, et al., 2024).

Anxiety requires slightly different consideration because general state anxiety and childbirth-specific fear are not identical constructs. If a state anxiety scale is used during labor, researchers should document the language version and psychometric support for the target population. (Delgado et al., 2016) evaluated the construct validity and internal consistency of the State-Trait Anxiety Inventory state-anxiety scale in women during labor, supporting its use as a research measure when properly adapted and administered. A childbirth-specific fear measure can be added in the antenatal phase to capture worries before labor begins. Researchers should avoid changing instruments between time points merely because labor intensity changes, because this prevents direct interpretation of change.

Maternal satisfaction should be measured separately from pain. The Birth Satisfaction Scale-Revised (BSS-R) was developed as a concise multidimensional measure addressing quality of care provision, women's personal attributes, and stress experienced during labor (Hollins Martin and Martin, et al., 2014). Later work has shown that the tool can be adapted and validated across cultural settings, reinforcing the need to use a validated version suitable for the local population. Satisfaction can also be influenced by communication, involvement in decisions, expectations, and perceived support. Consequently, a total score can be complemented by a small set of service variables such as perceived helpfulness of the intervention, whether the woman would use the ball again, and whether she felt adequately informed.

Table. 3: Suggested Outcome Measurement Schedule

Outcome	Measure	Time point	Purpose
Baseline anxiety/fear	Validated anxiety or childbirth-fear scale	Before counseling / before group exposure	Establish baseline psychological status
Labor pain	VAS or numeric rating scale	Repeated during active labor at predefined cervical dilatations	Primary intrapartum pain outcome
Intrapartum anxiety	State anxiety measure if feasible	Predefined labor time point(s)	Examine psychological change during labor
Maternal satisfaction	BSS-R or validated local satisfaction instrument	Within 24-72 h postpartum or according to tool guidance	Patient-centred outcome
Secondary outcomes	Analgesia use, labor duration, mode of birth, adverse events	During labor and at discharge	Clinical context and safety

11. Proposed Quasi-Experimental Study Design:

A non-equivalent control-group pretest-posttest design is suitable when random assignment is not practical. Eligible primigravida women can be recruited consecutively and allocated according to predefined clinical or service arrangements, such as intervention and comparison periods, antenatal clinic sessions, or separate participating units. The allocation mechanism must be disclosed because a predictable assignment process can introduce selection bias. If a facility can randomize without disrupting care, a randomized controlled design would provide stronger causal inference; however, the quasi-experimental design remains useful for implementation-focused research because it can reflect routine clinical practice more closely. Eligibility criteria should be explicit. A practical target population may include primigravida women with singleton, cephalic, low-risk pregnancies at term who plan vaginal birth and can understand the study language. Exclusion criteria should address conditions for which birth-ball use or routine vaginal labor preparation would not be appropriate according to local obstetric policy. Examples may include conditions requiring planned cesarean birth, significant medical or obstetric complications that preclude the intervention, or inability to safely participate in the birth-ball exercises. The protocol should not use broad exclusions that unnecessarily remove women who could safely benefit from individualized movement and counseling.

Recruitment and consent should occur before labor. Baseline demographic and obstetric data should include age, education, gestational age, antenatal attendance, employment or occupation as locally relevant, family or partner support, and baseline anxiety or childbirth fear. The researcher should then provide the intervention according to the standardized schedule. During labor, the research team should avoid interfering with necessary

clinical decisions. Pain and anxiety measurements should be timed around routine care rather than forcing assessments at clinically inappropriate moments.

Blinding is challenging because participants and educators will know whether a birth-ball program was provided. However, outcome measurement can be improved by using standardized forms and, when practical, having postnatal satisfaction data collected by staff who were not responsible for delivering the educational sessions. Statistical analysis should be performed using a prespecified plan that includes both unadjusted and adjusted analyses. These measures reduce the influence of expectancy effects and selective reporting even when full blinding is impossible.

12. Statistical Analysis Framework:

The analysis should begin with a descriptive comparison of the intervention and comparison groups. Continuous variables can be summarized using mean and standard deviation when approximately normally distributed or median and interquartile range when distributions are skewed. Categorical variables can be reported as frequencies and percentages. Baseline imbalance should be described transparently rather than concealed. For the primary pain outcome, repeated measurements can be analysed using an approach that accounts for within-person correlation, such as repeated-measures analysis or a mixed-effects model, depending on the sample size and data structure. A simple post-intervention comparison alone is less informative because it ignores baseline differences and repeated observations.

For anxiety and maternal satisfaction, the preferred analysis should match the scale properties and timing of measurement. Change scores can be examined, but adjusted models are generally more informative when baseline values differ. Potential covariates may include age, education, baseline anxiety or fear, induction of labor, cervical dilation at the first pain assessment, and analgesia exposure. The exact model should be selected before data analysis, and assumptions should be checked. Effect estimates with confidence intervals should accompany p values so that readers can judge the magnitude and precision of the observed differences.

Sample size should be calculated from the prespecified primary outcome using an evidence-based effect estimate from a previous study or pilot sample, with the chosen significance level, statistical power, expected attrition, and design characteristics clearly stated. It would be methodologically unsound to insert a convenient sample size simply because it resembles another article. Birth-ball research has used varied sample sizes, while recent antenatal-education trials and meta-analyses also demonstrate the importance of adequate power for psychological outcomes (Zafman et al., 2023; Terres et al., 2025; Xu et al., 2026). A future protocol should therefore report the exact calculation rather than presenting an unsupported number.

13. Expected Influence on Labor Pain:

The literature provides the most direct support for an association between birth-ball use and lower reported labor pain. In the 2015 meta-analysis, the pooled difference favoured birth-ball use, and later reviews and trials have repeated the observation in different settings. (Terres et al., 2025) found lower pain scores at specified cervical dilatations across ten randomized trials, while Aslantaş and Çankaya (2024) found the clearest difference at later cervical dilatation rather than at the earliest measurement. This stage-specific pattern suggests that the timing of assessment matters. A study that takes one pain score after the intervention may underestimate or miss differences that become more visible as labor intensifies.

The mechanism should nevertheless be described cautiously. Birth ball use may alter posture, pressure distribution, pelvic movement, attention, and coping behaviour, but it cannot be assumed to directly block nociceptive transmission. The intervention should therefore be framed as a comfort and coping technique within multimodal pain management. The 2025 systematic review of non-pharmacological interventions found overall reductions in labor pain across many techniques, but heterogeneity was high, underscoring the need to avoid treating all non-pharmacological methods as interchangeable (Mohammed et al., 2025). A well-designed birth-ball study should isolate the intervention as much as possible while documenting co-interventions such as massage, heat, breathing exercises, oxytocin, and pharmacological analgesia. Pain measurement should also recognize the subjective nature of the outcome. A lower score does not necessarily mean a woman experienced an objectively easier labor in every dimension. The score may reflect coping confidence, emotional support, expectation, or the timing of the measurement. For this reason, pain should be analysed alongside anxiety and satisfaction rather than as a single end point. The combination of outcomes allows the researcher to determine whether a lower pain score occurs together with lower distress and greater satisfaction, which would provide a more coherent patient-centred interpretation.

14. Expected Influence on Anxiety and Childbirth Fear:

Antenatal counseling is especially relevant to anxiety because it can intervene before labor begins. Education can reduce uncertainty by explaining what women may experience, how long common stages may last, why pain changes, which responses are normal, and what choices are available. Rehearsal adds a behavioural component so that women can practice coping responses instead of only hearing about them. Recent meta-analytic evidence indicates that antenatal and midwifery-led educational interventions can reduce anxiety, fear of childbirth, and related psychological distress while improving self-efficacy and satisfaction (Zaman et al., 2025; Xu et al., 2026).

The benefit may be greatest when counseling is individualized. A woman with mild uncertainty may need clear information and skills practice, whereas a woman with severe childbirth fear may require more intensive psychoeducation, cognitive-behavioural support, or referral. The study should therefore record baseline fear or anxiety so that results can be interpreted according to initial severity. The recent quasi-experimental study by (Golnazari et al., 2026) demonstrates that structured childbirth preparation can reduce fear in primiparous women and provides direct support for using a quasi-experimental approach when studying educational interventions in real-world services.

Anxiety should also be considered a time-varying experience. A woman can enter labor calm and become anxious during a particularly intense phase, or she may become calmer after receiving reassurance and understanding what is happening. Repeated assessment can capture these changes, but measurement itself should not disrupt clinical care. Where repeated intrapartum assessment is impractical, the researcher can use one antenatal measure and a second postpartum or early intrapartum assessment, combined with a brief retrospective item on perceived control. The design should always prioritize clinical safety over research scheduling.

15. Expected Influence on Maternal Satisfaction:

Maternal satisfaction is a multidimensional outcome that reflects the woman's evaluation of care, personal coping, expectations, stress, communication, support, and the actual course of birth. The BSS-R captures several of these dimensions and is therefore more informative than a single question such as "Were you satisfied?" (Hollins Martin and Martin, et al., 2014). Recent evidence continues to show that satisfaction varies with respectful care, autonomy, support, and contextual factors rather than with pain alone (Hollins Martin et al., 2014; Bohren et al., 2017).

Birth ball interventions may contribute to satisfaction by increasing a sense of active participation. A woman who can choose a comfortable position and move during a contraction may feel less passive than a woman who remains continuously in bed. However, this effect should never be assumed. Aslantaş and Çankaya (2024) reported lower pain and shorter labor in the birth-ball group but no significant group difference in satisfaction, illustrating that satisfaction may depend more strongly on the broader care experience. By contrast, (Erkal Aksoy et al., 2024) observed improvement in BSS-R domains among women using the ball. The appropriate conclusion is that birth ball use may influence satisfaction, but satisfaction is context-dependent and should be measured directly. Structured counseling may also affect satisfaction by aligning expectations with reality. A woman who understands that labor can change direction, that analgesia remains available, and that clinicians may recommend interventions when indicated may be less distressed if the birth plan changes. This does not mean education should be used to persuade women toward a preferred mode of birth. Instead, counseling should support informed, flexible decision making. Research evaluating satisfaction should therefore report whether women perceived the intervention as helpful, whether they felt involved in decisions, and whether they felt their questions were taken seriously.

16. Safety and Clinical Considerations:

Birth ball use should be incorporated only within appropriate clinical assessment and facility policy. The ball is an active mobility aid and therefore requires attention to balance, environment, footwear or foot stability, floor safety, equipment integrity, and the presence of a trained supporter when needed. Women should be instructed to stop if they feel dizzy, unstable, excessively fatigued, or otherwise unwell. The intervention should be adapted or discontinued when obstetric or fetal conditions make the chosen position inappropriate. Evidence from birth-ball trials has generally not identified major safety concerns in appropriately selected low-risk participants, but a low-risk trial population cannot be used to claim universal safety for all pregnancies (Makvandi et al., 2015; Delgado et al., 2019; Mylod et al., 2024).

Counseling also has a safety dimension. Education must not create false reassurance or encourage women to interpret all labor symptoms as normal. Participants should be told when to contact the maternity service and should understand that clinical assessment remains necessary if there are concerns about fetal movement,

bleeding, rupture of membranes, fever, severe unusual pain, or other locally defined warning signs. The specific warning-sign list should follow current local obstetric policy rather than being improvised by the researcher. Pain management should remain individualized. Birth ball exercise does not replace pharmacological analgesia, neuraxial analgesia, or urgent obstetric intervention. Current ACOG guidance recognizes the availability of neuraxial analgesia and supports individualized decision making, while also describing supportive non-pharmacological measures as potentially useful adjuncts (American College of Obstetricians and Gynecologists, 2024). A study is ethically stronger when the intervention is offered without restricting women from receiving appropriate analgesia. Researchers should document analgesia exposure so that differences in pain scores are interpreted in context.

17. Role of the Nurse and Midwife:

Nurses and midwives are central to implementation because they often provide repeated antenatal contact and continuous or near-continuous intrapartum support. Their role begins with assessment: identifying knowledge gaps, clarifying expectations, screening for significant anxiety or childbirth fear, and determining whether the woman is physically able to participate in the planned exercises. Education then becomes a coaching process. The nurse or midwife can demonstrate the birth-ball movement, observe return-demonstration, correct unsafe posture, and reinforce the woman's ability to choose the technique that feels comfortable. During labor, the nurse or midwife can help the woman connect the antenatal skills with real-time coping. This may involve reminding her of slow breathing, helping her change position, maintaining privacy, explaining what is happening, and communicating with the obstetric team. The caregiver should avoid turning the intervention into a rigid schedule. A birth ball used mechanically despite fatigue or discomfort is not patient-centred care. The woman's preference should remain central, and the caregiver should help her move between methods according to clinical circumstances.

Documentation is another key nursing responsibility. For research and quality improvement, the record should capture when education occurred, which skills were demonstrated, whether the woman practiced them, when the birth ball was used in labor, which positions were comfortable, why it was stopped, and what other pain-relief measures were used. Implementation fidelity is important because an intervention that is described as "birth ball plus counseling" but delivered inconsistently cannot be interpreted reliably. The evidence on midwifery-led care suggests that educational and psychosocial interventions can be beneficial, but the content, intensity, and delivery mode vary substantially across studies (Xu et al., 2026).

18. Feasibility in Routine Maternity Services:

A combined intervention is attractive for routine services because it uses relatively simple equipment and can be integrated into antenatal education rather than requiring a separate specialist program. The cost profile is potentially modest: a durable birth ball, cleaning procedures, printed or digital educational material, staff training, and time for structured counseling. The major implementation challenge is not the ball itself but ensuring that staff have a consistent teaching protocol and that the intervention remains available during busy labor periods.

Staff training should cover both educational content and practical risk management. A short competency package can include the evidence rationale, inclusion criteria, birth-ball positions, infection control, safe environment, contraindications according to local policy, documentation, and communication skills. (Merriel et al., 2024) showed the value of stakeholder-informed antenatal education and refinement of training resources. That finding is relevant to implementation because local adaptation should not change the core intervention beyond recognition; it should preserve essential components while making the program culturally and logistically usable. The intervention should also be culturally responsive. Language, family participation, privacy, beliefs about movement during labor, and expectations about pain expression vary between communities. Counseling should therefore use simple, respectful language and invite women to describe what they already believe about childbirth. Family or partner participation may be beneficial when the woman wants it. The intervention should never assume that a woman's partner or family member is available. Professional support must remain accessible independent of family structure, and choice of support person should be respected in accordance with facility policy and safety requirements.

19. Sources of Bias and How to Reduce Them:

The main threat to causal interpretation in a quasi-experimental study is selection bias. Women who choose an educational intervention may differ from women who do not in motivation, health literacy, social support, or confidence. A standardized recruitment process, consistent eligibility criteria, baseline measurement, and statistical adjustment can reduce but cannot completely remove this risk. The limitation should be

acknowledged explicitly. Where possible, researchers can use consecutive recruitment and a comparison group drawn from the same clinical environment and period.

Performance bias is also likely because participants know whether they received the intervention. The intervention may increase attention from staff, and this attention itself can influence anxiety or satisfaction. A protocol should therefore define how many contacts are part of the intervention and encourage comparable respectful care in the comparison group. Outcome-assessor bias can be reduced through standardized questionnaires, predefined measurement times, and, when practical, postnatal data collection by staff not involved in the intervention.

Contamination is another important issue. A woman in the control group may independently use a birth ball, watch online childbirth education, or receive similar counseling from another provider. These exposures should be recorded when feasible. Likewise, staff working across groups may inadvertently deliver elements of the intervention to controls. The study report should describe such contamination rather than simply classifying all women according to their original group. This is especially important when the intervention is skill-based and easy to reproduce outside the research sessions.

Attrition and missing data should be anticipated. Women may withdraw before delivery, deliver at another facility, or miss postpartum satisfaction assessment. The protocol should identify primary and secondary outcomes before data collection, specify how missing values will be handled, and report the number of women at each stage. Modern reporting should also distinguish between participants allocated to an intervention and participants who actually completed each session. Evidence from recent educational trials shows that intervention uptake can be incomplete even when the program is well accepted (Zafman et al., 2023; Fleet et al., 2024).

20. Research Gaps:

The literature has several persistent limitations. First, birth-ball protocols are not standardized. Studies vary in the time of initiation, duration, positions, frequency of movement, cervical dilatation at first use, staff assistance, and whether the intervention is combined with other techniques. This makes it difficult to compare effects directly. Second, many trials focus on pain or labor duration and provide less detailed information about anxiety, self-efficacy, or satisfaction. Third, primigravida-specific analyses are sometimes mixed with multiparous samples, even though parity can materially influence labor experience and expectations. Updated meta-analyses have improved the evidence base, but protocol heterogeneity remains a major issue (Terres et al., 2025; Mohammed et al., 2025).

A second gap concerns the integration of antenatal and intrapartum components. Education studies and birth-ball studies are often evaluated separately, yet the theoretical rationale for combining them is strong. Few studies are designed to determine whether teaching a physical coping technique before labor adds benefit beyond education alone, or whether counseling enhances the uptake and effect of birth-ball use during active labor. A well-designed quasi-experimental study can therefore contribute useful implementation evidence by examining a combined package and documenting both exposure and fidelity.

A third gap concerns patient-centred outcomes. Pain scores are important, but women also value confidence, control, communication, involvement, and the emotional meaning of birth. Recent studies of satisfaction reinforce the need to treat these domains as legitimate endpoints rather than secondary “soft” outcomes. Future work should therefore include validated satisfaction tools, self-efficacy measures, and qualitative feedback. The relationship between lower pain, lower anxiety, and higher satisfaction should be examined rather than assumed. This is particularly important because some birth-ball trials report pain benefits without significant satisfaction differences (Aslantaş et al., 2024).

A fourth gap involves equity and accessibility. Digital education can improve access for women who cannot attend traditional classes, as demonstrated in the trial by (Zafman et al., 2023), but digital approaches also depend on connectivity, language, literacy, and device access. In many settings, in-person counseling may remain the most practical approach. Research should compare delivery modes without assuming that one method is universally preferable. The design should also consider whether the intervention is acceptable to women from different cultural, socioeconomic, and educational backgrounds.

21. Interpretation of the Combined Evidence:

Taken together, the literature suggests a coherent but not definitive chain of evidence. Birth ball exercise has a repeated association with lower labor pain in randomized trials and meta-analyses. Antenatal education and counseling have repeated associations with reduced fear or anxiety and improved self-efficacy. Supportive care and respectful communication are associated with more positive childbirth experiences and satisfaction.

These findings make it reasonable to evaluate a combined intervention, but they do not permit the claim that the combination will necessarily produce a specific magnitude of improvement in every population.

The strength of the rationale lies in complementarity. The birth ball gives the woman a concrete physical tool, while counseling provides the knowledge and confidence needed to use that tool effectively. The intervention is low technology, teachable, and compatible with routine nursing care. However, its effect is likely to depend on implementation fidelity, participant preference, clinical circumstances, parity-specific expectations, and co-interventions. The study should therefore be designed to capture not only the outcome scores but also how much of the intervention was actually received. The current evidence also argues for a broader definition of efficacy. If a woman reports lower pain but no change in satisfaction, the intervention may still be clinically useful but incomplete as a patient-experience strategy. If satisfaction improves without a statistically significant change in pain, the program may still have achieved a meaningful improvement through confidence, communication, or control. A multidimensional analysis is therefore more informative than a single composite outcome. The evidence on childbirth experience and satisfaction reinforces that supportive care, communication, autonomy, and contextual factors matter alongside pain intensity (Bohren et al., 2017; Hollins Martin et al., 2014).

22. Proposed Study Questions and Hypotheses:

The proposed study can be organized around one primary question: among primigravida women with uncomplicated pregnancies, does participation in a structured antenatal counseling and birth-ball exercise program produce better labor pain, anxiety, and maternal satisfaction outcomes than usual maternity care? Secondary questions can examine whether the intervention is associated with shorter labor, lower rescue analgesic use, greater use of non-pharmacological coping, or differences in mode of birth, while recognizing that these secondary outcomes may be influenced strongly by clinical factors beyond the intervention.

The primary hypothesis can be stated as follows: primigravida women who receive the combined intervention will demonstrate lower labor pain and anxiety scores and higher maternal satisfaction scores than women receiving usual care, after accounting for important baseline and intrapartum covariates. Secondary hypotheses may address greater self-efficacy, greater use of non-pharmacological coping, and better perceived control. These hypotheses should be registered or written into the protocol before outcome data are examined so that post hoc findings are not presented as confirmatory evidence.

23. Ethical Considerations:

Ethical conduct in this study requires informed consent before labor, privacy during counseling, confidentiality of data, and unrestricted access to necessary obstetric care. Participants should understand that joining the study is voluntary and that declining the intervention will not alter routine maternity care. Because labor can progress unpredictably, the research schedule should remain subordinate to clinical judgment. The intervention should be stopped whenever the treating team determines that continued use is inappropriate. The control group should not be denied accepted pain relief or supportive care. The study tests the addition of a structured program, not the withholding of usual treatment. Data collection forms should minimize burden, especially during painful contractions. Postpartum satisfaction questionnaires should be timed to permit adequate recovery and should not imply that women are expected to describe a positive experience. Negative or mixed experiences are valid study outcomes and should be recorded without judgment.

24. Strengths and Limitations of the Evidence Base:

The evidence base has several strengths. It includes randomized controlled trials, systematic reviews, meta-analyses, psychometric studies, implementation research, and current professional guidance. Several studies focus directly on primigravida or nulliparous women, which improves the relevance of the intervention to the proposed target population. More recent evidence also includes practical, digital, and quasi-experimental approaches, expanding beyond traditional childbirth classes.

The limitations are equally important. Birth-ball studies use different protocols and timing, and some have small samples. Satisfaction is measured with different tools and is influenced by setting and expectations. Antenatal education varies in length, content, individualization, and delivery mode. Studies with positive findings may not all have the same methodological strength, and heterogeneity limits direct comparison. Consequently, the proposed study should standardize its intervention and measurement while acknowledging that causal inference remains weaker than in a well-conducted randomized trial.

25. Implications for Nursing, Midwifery, and Maternity Practice:

For nursing and midwifery practice, the central implication is that preparation should begin before labor and continue into labor through consistent coaching. A structured program can make non-pharmacological coping skills visible, teachable, and repeatable. It can also reduce the dependence on spontaneous uptake, because women know in advance what the birth ball is for and how it can be used. The intervention should be incorporated within broader shared decision making, with analgesia and obstetric care available according to clinical need. For service leaders, the intervention offers a potential quality-improvement strategy when implemented with staff training, equipment maintenance, standard operating procedures, and outcome monitoring. The cost of a birth ball is relatively low compared with many clinical technologies, but sustainability depends on staff engagement and time for education. Programs should therefore track not only patient outcomes but also staff workload, equipment availability, infection-control procedures, and intervention fidelity. Evidence from recent co-designed antenatal education supports the importance of feasibility and acceptability alongside effectiveness (Merriel et al., 2024).

For educators, the key lesson is to move from information delivery toward skill development. Women should leave the session knowing what to do, not just what to know. Demonstration, practice, return-demonstration, scenario rehearsal, and individualized discussion can make antenatal counseling more memorable and relevant. For researchers, the recommendation is to report interventions in enough detail to allow replication and to include patient-centred outcomes in addition to obstetric endpoints.

26. Conclusion:

Birth ball exercises and structured antenatal counseling represent two complementary, low-technology approaches to improving preparation for first labor. Current evidence supports birth-ball use as a potentially effective non-pharmacological strategy for reducing labor pain in low-risk women, with some studies also reporting shorter labor and greater satisfaction. Evidence for structured antenatal education and counseling supports reductions in childbirth fear or anxiety and improvements in self-efficacy, preparedness, and attitudes toward childbirth. These effects are clinically plausible because physical movement and psychological preparation address different components of the labor experience.

The combined intervention should nevertheless be evaluated carefully rather than described as universally effective. A quasi-experimental design can provide valuable real-world evidence when randomization is not feasible, particularly if it uses comparable groups, baseline assessment, standardized counseling, supervised birth-ball training, repeated pain and anxiety measurements, validated satisfaction measures, adjustment for major confounders, and transparent reporting of adherence and adverse events. The proposed framework offers a practical foundation for such a study, while actual efficacy estimates should come only from prospectively collected participant data.

Overall, the most evidence-consistent view is that labor pain, anxiety, and satisfaction are interconnected but distinct outcomes. A woman-centred intervention should therefore seek not merely to reduce pain but to increase understanding, coping ability, participation, and perceived support while preserving access to all clinically appropriate forms of pain relief and obstetric care. Future studies should test the combined program in diverse maternity settings, standardize intervention dose and timing, and explore which elements matter most for primigravida women.

27. Declarations:

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Ethical statement: The manuscript does not report new participant-level research data. Any future quasi-experimental implementation should obtain approval from the appropriate institutional ethics committee and written informed consent from participants before enrollment.

Data availability: No original dataset was supplied or generated for this manuscript.

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