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Intervention Dose, Fidelity and the Full Outcome Spectrum of Peanut Ball Assisted Positioning in Epidural Labour: A Critical Integrative Review with Implications for Primiparous Women

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ABSTRACT:

Background: Peanut ball–assisted positioning is now widely offered to women who labour with an epidural, yet the trials behind it describe very different things under one name. A ball placed once and left alone, a ball used for 15 minutes in every hour and a ball moved through four positions every 30 minutes are not the same intervention, and pooled estimates that treat them as equivalent are hard to apply at the bedside.

Aim: To examine how the components, or "dose", of peanut ball positioning have been delivered in trials, and to appraise the evidence across the complete range of maternal, neonatal, experiential and economic outcomes, with particular attention to primiparous women with epidural analgesia.

Design: Critical integrative review following the Whittemore and Knafl framework.

Data sources: PubMed/MEDLINE, CINAHL, Scopus, the Cochrane Library, PEDro and ClinicalTrials.gov, searched from inception to October 2026, with backward and forward citation tracking.

Review methods: Randomized and quasi-experimental trials of the peanut ball, evidence syntheses and registered trials were included. Intervention components were extracted with a TIDieR-informed template and outcomes were mapped against a ten-domain outcome framework.

Results: Twelve trials reported in thirteen papers, six evidence syntheses, six registered trials and three published protocols formed the core evidence. Start points ranged from immediately after epidural insertion to 6 cm of dilatation, and repositioning intervals from 30 minutes to 2 hours; few trials documented whether the planned dose was delivered. The most consistent benefit was a shorter first stage of labour, with pooled reductions between about 53 and 87 minutes in epidural labour, but these figures rest on few trials and low-to-

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moderate certainty. Mode-of-birth effects remain uncertain. Perineal trauma, blood loss, cord blood gases, health-service use and cost were rarely or never reported. Women consistently rated their experience more favourably when a ball was used, although validated instruments were the exception.

Conclusion: Peanut ball positioning is low cost and appears safe, and the strongest signal is for first-stage duration. Whether a fixed, frequent schedule outperforms flexible use is untested. Future trials should report dose explicitly, measure fidelity, adopt estimand-based analysis plans and widen the outcome set to include perineal, haemorrhage, acid–base, experiential and economic end points.

1. INTRODUCTION

Roughly one birth in five worldwide is now by caesarean section, and global projections suggest that the proportion will keep rising through this decade [1]. Population-level rates above about 10% have not been linked with further falls in maternal or newborn mortality [2], which is why professional societies have directed attention to the first caesarean in nulliparous women at term, the point at which most later repeat operations originate [3]. Slow progress in the first or second stage of labour remains the single most common reason for that first operation [3,4].

Epidural analgesia occupies an awkward place in this story. It is the most effective form of labour pain relief available, and women who choose it are generally well served by it. Yet the Cochrane comparison of epidural with non-epidural methods found that it lengthens the second stage and increases instrumental vaginal birth, even though it does not raise the overall caesarean rate [5]. Cohort data from large maternity services suggest that the second-stage effect is larger than older diagnostic thresholds assumed, particularly in nulliparous women [6]. Part of this effect is pharmacological and depends on the dose and delivery mode of the local anaesthetic [7]. Part of it, very probably, is postural: a woman with a working epidural tends to stay in one or two reclining positions for long periods, and her pelvis loses the small, repeated changes in shape that would otherwise accompany labour [8].

International guidance favours mobility and freedom of position in labour [9,10], and obstetric bodies recommend limiting avoidable intervention in low-risk women [11]. For a woman whose legs are numb, however, "keeping mobile" has to be achieved by someone else. The peanut ball, an inflatable device pinched in the middle so that it can sit between the thighs or knees of a recumbent woman, was adopted for precisely this purpose [8,12]. It costs little, is reusable and involves no drug, which helps explain why it spread through labour wards largely ahead of the evidence.

That evidence has since grown into a dozen trials and several meta-analyses [13–17]. Their conclusions have shifted over time, from a non-significant reduction in total labour duration to a clearly shorter first stage among women with an epidural. Earlier reviews, including our own narrative review of the physiological rationale and trial design [18], have explained the disagreement mainly in terms of sample size, parity mix and risk of bias. A further explanation has received less attention. "Peanut ball use" is not a single, fixed treatment. It is a bundle of choices about when to start, how long each session lasts, how often the woman is turned, which positions are used, who carries out the changes and whether anyone checks that the plan was followed. An integrative review of peanut ball protocols published in 2023 found that only a minority of studies described these elements at all [19].

There is a second gap. Labour duration and caesarean birth dominate the published outcomes, while the outcomes that matter for a complete judgement of benefit and harm, such as perineal trauma, postpartum blood loss, neonatal acid–base status, childbirth experience and the cost of care, are scattered or missing. Trials now being designed, including a registered trial of scheduled peanut ball positioning in primiparous women with epidural analgesia in Qatar [20], have chosen to measure several of these outcomes, and they will need a clear picture of what is already known.

This review therefore had three objectives: (i) to describe how the components of peanut ball positioning have been delivered across trials, treating these components as dimensions of intervention dose; (ii) to appraise the evidence for each outcome domain, from labour duration through to cost, rather than for duration and mode of birth alone; and (iii) to identify which women appear to benefit most, and to translate the gaps into concrete recommendations for trial design and nursing practice.

2. REVIEW METHODS

2.1 Design

We used the integrative review method described by Whittemore and Knafl, which allows experimental, quasi-experimental and synthesis-level evidence to be combined within one interpretive framework through problem identification, literature search, data evaluation, data analysis and presentation [21]. The method suited our aims because the questions about dose and implementation could not be answered by randomized evidence alone. We did not attempt a new meta-analysis, since three meta-analyses had been published since 2022 and additional pooling of the same small set of trials would add little [15–17].

2.2 Search strategy

PubMed/MEDLINE, CINAHL, Scopus, the Cochrane Library and PEDro were searched from inception to October 2026. Trial registries (ClinicalTrials.gov) were searched to identify ongoing, completed-but-unpublished and terminated studies. The search combined three concept groups: the device ("peanut ball", "peanut-shaped ball", "birthing ball", "birth ball"), the labour context (labor, labour, parturition, childbirth, intrapartum) and positioning (maternal position, posture, positioning, mobility). Analgesia terms (epidural, neuraxial) were used to flag studies for subgroup consideration rather than as a restriction, so that trials in women without analgesia, which carry useful information about protocol design, would not be lost. Reference lists of all included papers were screened, and forward citation tracking was carried out for the key meta-analyses.

2.3 Eligibility

We included (a) randomized and quasi-experimental trials in which a peanut ball was used during labour and compared with any form of usual care or an alternative device; (b) systematic reviews, meta-analyses and integrative reviews of peanut ball use; and (c) registered trial records that described an intervention protocol, to capture design choices not yet visible in the published literature. For mechanistic and contextual questions we also drew on biomechanical imaging studies, large cohort studies of labour progress, guidelines and methodological standards. Case reports, opinion pieces without data and studies of the round birthing ball alone were excluded from the core evidence set, although the latter informed the discussion of mechanism.

2.4 Data extraction and appraisal

Intervention data were extracted using a template derived from the Template for Intervention Description and Replication (TIDieR) checklist [22], adapted to capture seven dose dimensions: point of initiation; session length; interval between position changes; positional repertoire; total exposure; who delivered the intervention; and whether adherence was recorded. Outcomes were mapped to ten domains: first-stage duration, second-stage duration, mode of birth, oxytocin augmentation, perineal outcome, blood loss and postpartum haemorrhage, neonatal condition, acid–base status, maternal experience, and resource use or cost. Where review authors had already judged risk of bias with the RoB 2 tool or graded certainty with GRADE, we report those judgements rather than repeating them [23,24].

2.5 Synthesis

Data were reduced, displayed and compared across studies in matrices organized by dose dimension and outcome domain. Patterns, contrasts and gaps were then drawn out and checked against the original reports. Because the trials varied so much in population, comparator and outcome definition, synthesis was narrative and interpretive. Statements about possible dose–response relationships are offered as hypotheses, not as estimates.

2.6 The evidence base

The core evidence comprised twelve trials published in thirteen reports [12,25–36], six evidence syntheses [13–17,19], two clinical summaries [37,38], six registered trials [20,39–43] and three published trial protocols [44–46]. Four trials were conducted in the United States, all among women with epidural analgesia, and the remainder in Brazil, Turkey, India and Honduras, mostly among women without neuraxial analgesia. Table 1 summarizes the trials by dose dimension.

Table 1. Peanut ball trials summarized by dose dimension

Study, country	Population	Start point	Schedule and positions	Labour-duration finding
Tussey et al., 2015, USA [12]	About 200 women with epidural; mixed parity	After epidural placement	Ball for at least 15 min each hour with position changes; controls repositioned every 1–2 h	First stage 269 vs 356 min and second stage 21 vs 44 min (raw); attenuated after parity adjustment
Roth et al., 2016, USA [25]	Elective induction at ≥39 weeks with planned epidural	Within 30 min of epidural	Side-to-side turns every 30 min	First stage shorter in nulliparous women only; pushing time unchanged
Mercier and Kwan, 2018, USA [26]	86 nulliparous women with epidural	≥6 cm	Ball versus usual care	No difference in dilatation rate or active-labour length
Hickey and Savage, 2019, USA [27]	Women with epidural; quasi-experimental	After epidural	Ball combined with nurse-led position changes	Women repositioned more often had shorter first and second stages
Sönmez and Ejder Apay, 2023, Turkey [36]	180 primiparous women; three arms	4 cm	Sitting, forward-leaning and rocking movements on the ball	Round ball outperformed peanut ball for pain and fetal descent
Fraga et al., 2024, Brazil [28]	100 women without analgesia	Active phase	Positions matched to fetal station, plus pelvic mobility	Active phase about 82 min and total labour about 89 min shorter
Alan Dikmen et al., 2025, Turkey [29]	90 women	First stage	Peanut ball positions	Duration unchanged; less pain and fatigue
Çankaya et al., 2025, Turkey [30]	Primiparous women	5 cm	Movements with the ball	First stage 209 vs 250 min; second stage 27 vs 32 min
Kamath et al., 2024 and 2026, India [31,32]	768 low-risk primigravidae without epidural	3–4 cm	Several peanut ball positions	Shorter active first stage; less pain and stress
Hoyladı and Yıldırım Varışoğlu, 2026, Turkey [33]	102 women	4 cm	Researcher guide; position change every 30–45 min	Duration unchanged; lower pain; greater comfort
Özkeçeci and Güvenç, 2026, Turkey [34]	Women with BMI >30 kg/m²	5 cm	At least 30 min each hour; six positions	Duration unchanged; lower pain; higher satisfaction
Osorto Zelaya et al., 2026, Honduras [35]	163 nulliparous women	Admission in active labour (≥4 cm)	30-min sessions every 2 h; lateral, semi-sitting, Taylor	Active phase about 90 min shorter; oxytocin use higher
Hamad Medical Corporation, Qatar (registered) [20]	110 primiparous women with epidural	Active labour after epidural	Left and right lateral, semi-sitting and Taylor positions every 30–60 min	Ongoing

BMI, body mass index. Values are as reported in the original papers or in clinical summaries of them; most non-US trials enrolled women without neuraxial analgesia.

3. INTERVENTION COMPONENTS AS DIMENSIONS OF DOSE

The language of dose is borrowed from pharmacology, but it fits positioning interventions well. The UK Medical Research Council framework for complex interventions asks investigators to specify the active components of an intervention, how much of each is delivered and through what mechanism it is expected to act [47]. For peanut ball positioning the plausible mechanism is mechanical: sustained hip flexion, abduction and asymmetry, which free the sacrum and widen the relevant pelvic plane, combined with periodic change, which gives the fetal head the chance to use different diameters as it descends and rotates. Imaging studies support the first element. Magnetic resonance pelvimetry has shown that the bony pelvic diameters change with posture [48], that the changes occur in pregnant and non-pregnant women alike and amount to several millimetres [49], and that postures that bend, open and outwardly turn the hips create the most space [50]. A simpler bedside test of external pelvic diameters has shown similar position-dependent gains in late pregnancy [51]. If both sustained opening and periodic change matter, then each dose dimension below is, at least in theory, a lever on effectiveness.

3.1 Point of initiation

Two broad strategies are evident. In the epidural trials from the United States, the ball was introduced in relation to the epidural itself: immediately after insertion or within 30 minutes of it [12,25,39]. In the trials among women without analgesia, initiation was tied to cervical dilatation, at 3–4 cm [31], 4 cm [33,36], 5 cm [30,34] or at admission in active labour [35]. One epidural trial deliberately waited until 6 cm [26], and a registered trial was designed with the same threshold [43]. It is perhaps telling that the 6 cm epidural trial was the clearest null result among the North American studies: it found no difference in the rate of cervical change or the length of active labour [26]. A late start leaves less time for any positional effect to accumulate, and it also coincides with the phase in which labour normally accelerates on its own [4]. This comparison is indirect and confounded by other differences, but it supports starting early in epidural labour, as the Qatar protocol does by beginning once the epidural is established in active labour [20].

3.2 Session length and interval between changes

The interval between position changes varied fourfold. The Californian trial turned women from side to side every 30 minutes [25]; a Turkish trial asked women to change position every 30–45 minutes [33]; trials in women with obesity prescribed at least 30 minutes on the ball in every hour [34,40]; the Arizona trial asked for at least 15 minutes of ball use in every hour [12,38]; and the Honduran trial used 30-minute sessions every 2 hours [35]. The Qatar protocol specifies changes every 30–60 minutes according to tolerance [20]. None of these intervals was chosen on empirical grounds, and no trial has compared two intervals directly.

The most suggestive evidence on frequency comes from a nurse-led quasi-experimental study in which women with an epidural used the ball with position changes. In that study it was how often women were repositioned, rather than ball use as such, that tracked with a shorter first and second stage [27]. The finding is observational and open to reverse causation (women whose labours progress well may simply be easier to turn), yet it is consistent with the biomechanical argument and with a much older body of nursing literature on positioning [8]. It is the main reason to treat frequency as a candidate active ingredient.

3.3 Positional repertoire and sequence

Trials described between two and seven positions. The epidural trials relied chiefly on alternating side-lying positions with the ball between the knees or ankles [12,25]. Other protocols added a semi-recumbent "tuck" or pushing position, a Taylor (modified sitting) position, forward-leaning positions or a semi-sitting lunge [20,34,35]. The Brazilian physiotherapy trial was unusual in choosing each posture to match how far the fetal head had descended, so that positions thought to open the inlet were used early and those thought to open the outlet were used late [28]. That trial reported one of the largest reductions in labour duration, about 82 minutes in the active phase and 89 minutes overall [28]. Whether the gain came from the station-matched sequence, the added pelvic mobility exercises or simply the intensity of physiotherapist attention cannot be separated, but the trial shows that a physiologically reasoned sequence is feasible.

Intrapartum ultrasound offers a way to make station- and position-guided protocols more objective than digital examination [52]. Occiput posterior position is more frequent among women with epidurals [53] and is associated with longer labour and

more operative birth [54]. A protocol that adjusts the side-lying direction to the fetal spine, for example, could be tested only if fetal position were documented reliably at baseline, which no published peanut ball trial has done.

3.4 Who delivers the intervention, and how adherence is recorded

Nurses delivered the intervention in the North American epidural trials, physiotherapists did so in Brazil [28], and in several of the newer trials it was not always clear whether ward midwives or members of the research team carried out the position changes. These differences matter. A dedicated physiotherapist or researcher at the bedside can maintain a schedule that a busy midwife caring for several women may not. The Australian pilot work was designed partly to measure exactly this, recording why ball use stopped [44]. Only a minority of trials documented adherence, typically by noting time on the ball in the chart [40]. Without such data, a null result cannot distinguish an ineffective intervention from an intervention that was not delivered. Implementation science treats adherence, exposure, quality of delivery and participant responsiveness as distinct elements of fidelity, each of which can be measured [55].

3.5 The comparator

The control condition also varied. In the Arizona trial, control women were repositioned every 1–2 hours without a ball [12,38]; in the Ohio registered trial, they received the usual wedges and pillows [39]; in most other trials, "usual care" was not described in enough detail to know whether women were turned at all. A comparison of a ball-plus-schedule package against an unstructured control tests the whole package, whereas a comparison against regular turning without a ball tests the device. The Qatar protocol, which compares scheduled peanut ball positioning with standard care without structured positioning, falls in the first category [20], and its results should be interpreted as the effect of the package.

4. THE OUTCOME SPECTRUM

Table 2 summarizes, for each of the ten outcome domains, the direction and certainty of the evidence and the number of trials reporting the outcome.

Table 2. State of the evidence across ten outcome domains

Outcome domain	Extent of reporting	Direction of effect	Certainty and comment
First-stage duration	Most trials; five syntheses	Shorter; pooled 53–87 min in epidural labour	Low to moderate; inconsistent and sensitive to definition of active phase [15–17]
Second-stage duration	Several trials	Possibly shorter by about 11 min	Low; heterogeneous [17]
Mode of birth	Most US trials; few others	Trend to fewer caesareans and more vaginal births	Low; no trial adequately powered [15,16]
Oxytocin augmentation	Few trials	Inconsistent; higher in one trial	Very low; possible performance bias [35]
Perineal trauma	One study	Possibly fewer lacerations	Very low [19]
Blood loss and haemorrhage	None identified	Unknown	Not studied
Apgar score and neonatal admission	Most trials	No difference; one trial reported higher Apgar scores	Low; events rare [30]
Cord blood gases	None identified	Unknown	Not studied

Outcome domain	Extent of reporting	Direction of effect	Certainty and comment
Experience, comfort and satisfaction	Most recent trials	Favourable; pain findings mixed	Low; unblinded, varied instruments [16]
Resource use and cost	None identified	Unknown	Not studied

Certainty judgements are drawn from published GRADE assessments where available and otherwise from the authors' appraisal.

4.1 First-stage duration

Shortening of the first stage is the most consistent finding, but the size of the effect depends heavily on which trials are pooled. The 2019 meta-analysis of four randomized trials (648 women) found a 79-minute reduction in total labour that did not reach significance [13]. The 2021 review of six trials found no significant difference in the first stage [14]. The 2022 review restricted to women with epidural analgesia reported a reduction of 87 minutes with high certainty [15], but this estimate came from only two randomized trials with 272 women [37]. The 2025 update, which included eight studies and 1,352 women, found that women with an epidural who used the ball had a first stage about 53 minutes shorter [16]. The most recent pooled analysis, from 2026, found a moderate standardized reduction in first-stage duration and judged the evidence to be of low quality [17].

The newer trials, although mostly in women without analgesia, point the same way more often than not. Active labour was shorter by about 90 minutes in the Honduran trial [35], first-stage duration was shorter in primiparous Turkish women [30] and the active first stage was shorter in the large Indian trial of 768 primigravidae [32]. Two Turkish trials, however, found no effect on duration [29,33], nor did a trial in women with obesity [34]. Most of this inconsistency is probably real. Some of it is likely to be measurement artefact, because duration outcomes are sensitive to how the active phase is defined and how often vaginal examinations are performed. Contemporary data show that cervical change before about 5–6 cm is slow and highly variable [4,56], so trials that start the clock at 3 or 4 cm will inevitably record longer and noisier first stages than those starting at 6 cm.

There is also an analytic problem. Labour duration cannot be observed for women who have a caesarean before full dilatation, and these women are rarely random: they tend to be those whose labours were slowest. Excluding them biases the comparison; imputing a value distorts it. Time-to-event methods that treat caesarean as a competing event avoid both errors and have long been recommended for studies of labour progress [57].

4.2 Second-stage duration

Evidence for the second stage is thinner. The Arizona trial reported a second stage 23 minutes shorter in raw data, which became an 11-minute difference after adjustment for parity [12,38]. The Californian trial found no change in pushing time [25]. The 2026 meta-analysis found a mean reduction of roughly 11 minutes in three trials, with substantial heterogeneity [17]. A Taiwanese study registered a three-way comparison of lithotomy, lateral and lateral-with-ball positions for the second stage, but allocation was not randomized [41]. Because the strongest second-stage evidence in epidural labour, the BUMPES trial, showed more spontaneous births with lying down than with upright positions [58], and the corresponding Cochrane review found no advantage for upright positions [59], lateral positions supported by a peanut ball are a reasonable default for the passive second stage. A meta-analysis of mobility in low-dose epidural labour reached a cautious version of the same conclusion: movement appeared safe, but effects on duration and mode of birth were uncertain [60].

4.3 Mode of birth

The question that matters most to women and services remains open. Pooled estimates for caesarean birth have pointed towards benefit in most syntheses, with relative risks around 0.74 to 0.82, but confidence intervals have often crossed or approached the line of no effect, and certainty has been rated low [13–16]. The 2022 epidural-specific review found an 11% relative increase in vaginal birth with moderate certainty [15]. At the service level, a bundle that increased peanut ball use from 16% to 45% of nulliparous labours was accompanied by a fall in the caesarean rate, but the bundle changed several practices at once [61]. No trial has been powered for caesarean birth. The Honduran trial, for instance, observed 10.8% versus 15.0% and acknowledged that it was underpowered for binary outcomes [35]. For a reduction from 20% to 15% to be detected with conventional power, several hundred women per arm would be needed, which is beyond any single-centre trial so far.

4.4 Oxytocin augmentation and other co-interventions

Oxytocin use is both an outcome and a co-intervention, and it deserves closer attention than it has received. Oxytocin shortens slow labour [62], so any between-group difference in augmentation can mask or mimic an effect of positioning. In the Honduran trial, oxytocin use was unexpectedly higher in the peanut ball group (67.5% versus 38.8%) [35]. Several explanations are possible: more frequent bedside attention may have led to earlier recognition of slow progress, or clinicians aware of group allocation may have behaved differently. In either case the result shows how performance bias can enter an unblinded positioning trial. In the Californian trial, the effect of the ball on first-stage duration differed by parity among women given oxytocin [25]. Trials should therefore either standardize augmentation criteria or record its timing and dose so that it can be modelled. The same applies to the epidural regimen, since programmed intermittent bolus delivery, compared with continuous infusion, tends to reduce motor block and local anaesthetic consumption [7]; a denser block plausibly limits what positioning can achieve.

4.5 Perineal trauma and blood loss

These outcomes are almost absent from the peanut ball literature. The 2023 integrative review found only one study linking peanut ball use to fewer perineal lacerations [19]. Indirect evidence suggests why the question is worth asking. In a population cohort of more than 113,000 spontaneous births, lateral birth position was associated with a slightly lower risk of obstetric anal sphincter injury in nulliparous women, while lithotomy carried a higher risk [63]. Prolonged second stage, occiput posterior position and oxytocin augmentation are recognized risk factors for severe perineal tears [63,64]. If peanut ball positioning shortens labour, encourages anterior rotation and reduces operative birth, a perineal benefit is plausible; if it simply delays birth in a lateral position, it might have no effect. Similarly, a longer second stage in nulliparous women is associated with more postpartum haemorrhage and chorioamnionitis [65,66], so blood loss is a reasonable secondary outcome. Trials should use standardized definitions: grade of tear by a recognized classification, and quantified rather than estimated blood loss where possible.

4.6 Neonatal condition and acid–base status

No trial has reported serious neonatal harm, and most found no difference in Apgar scores or neonatal unit admission [13,15]. One Turkish trial reported higher 1- and 5-minute Apgar scores with the ball [30], but the absolute differences were small and all values were within the normal range, so the finding is of uncertain clinical meaning. The Apgar score has well-known limitations as a measure of intrapartum condition [67]. Umbilical cord arterial pH is a more objective marker; low cord pH is strongly associated with neonatal morbidity, mortality and later neurological outcomes [68], and paired arterial and venous sampling is the accepted method [69]. None of the published peanut ball trials reported cord gases. In low-risk populations, serious neonatal events are rare, and trials of a few hundred women can only rule out large harms. A practical compromise is to report cord pH and base deficit as continuous measures, which are more statistically efficient than rare binary events, alongside a composite of neonatal morbidity.

4.7 Childbirth experience, comfort and satisfaction

This is the domain in which the newer trials agree most. Women using the ball reported less fatigue and a more positive perception of birth [29], better recall of labour and higher birth satisfaction [30], greater physical and psychospiritual comfort [33], higher satisfaction in women with obesity [34], and a better birth experience with lower maternal stress in India [31,32]. The 2025 meta-analysis found significantly higher satisfaction with the ball [16]. Pain findings are more mixed: some trials showed lower pain scores [29,33], whereas the Honduran trial found no difference in pain or anxiety [35], and a three-arm Turkish trial found the round birthing ball more effective than the peanut ball for pain and fetal descent [36].

Two cautions apply. First, outcomes reported by women who know which group they were in are susceptible to expectation effects, especially when the intervention brings more staff contact. Second, the instruments varied widely and were often study-specific. Validated measures exist: the Childbirth Experience Questionnaire, developed in primiparous women, covers own capacity, professional support, perceived safety and participation [70], and the Birth Satisfaction Scale–Revised offers a brief, psychometrically tested alternative [71]. Satisfaction depends less on pain relief as such than on involvement in decisions, support from caregivers and the quality of the relationship with them [72,73]. The experiential gains seen with the peanut ball may therefore partly reflect the attention that comes with it, which is not a weakness if attention is part of the intervention, but which should be acknowledged when results are interpreted.

4.8 Health-service use and cost

No published trial has costed peanut ball positioning. The device is cheap and reusable, so the main costs are staff time for repositioning, training and cleaning. The potential savings lie in shorter labour-ward stays, fewer operative births and fewer complications. Caesarean sections that are not medically needed impose a considerable global cost on health systems [74]. A simple within-trial analysis comparing length of stay, operative birth and hospitalization cost between groups, as planned in the Qatar trial [20], would fill a real gap. Ideally, such analyses should also capture midwifery time per woman, because that is the resource most likely to limit adoption.

5. WHO BENEFITS? EFFECT MODIFIERS

5.1 Parity

Parity is the most consistently implicated modifier. In the Californian trial, the reduction in first-stage duration was significant among nulliparous but not multiparous women [25]; the clinical-inquiry summary for family physicians graded the evidence for a greater effect in primiparous women as level B, from a single trial [38]. The biological argument is straightforward: the nulliparous pelvis and pelvic floor have not previously accommodated a term fetus, nulliparous labours are longer [4], and the epidural effect on second-stage length is greatest in this group [6]. Restricting enrolment to primiparous women, as several recent trials have done [20,30,32,35], produces a more homogeneous sample and avoids diluting a parity-specific effect.

5.2 Body mass index

Higher maternal body mass index is associated with a slower first stage of labour [75], greater difficulty with repositioning and a higher risk of caesarean birth. These features suggest both a larger potential benefit and a harder implementation challenge. The only completed trial in women with obesity found no effect on active or second-stage duration, although pain and satisfaction favoured the ball [34], and a registered trial in this population has used caesarean birth as its primary outcome [40]. Ball size, usually chosen by maternal height, may need adjustment for body habitus in this group.

5.3 Maternal age, gestational age and induction

Labour tends to be longer in older women [76], and induction of labour has a slower latent and early active phase than spontaneous labour. One trial was conducted entirely among women undergoing elective induction [25]. Gestational age, which the Qatar trial records as a covariate [20], influences fetal size and engagement. None of these factors has been examined as a modifier in a peanut ball trial.

5.4 Fetal position and epidural regimen

Occiput posterior position at the start of the intervention is a plausible modifier because rotation is one of the proposed mechanisms [53,54], and the density of motor block is another because it determines how passive the woman is [7]. Neither has been recorded systematically.

5.5 Sociodemographic factors

Education, nationality and employment status, which the Qatar trial will examine [20], are unlikely to modify the mechanical effect of positioning, but they may well influence acceptability, expectations and reported experience. In multinational maternity units such as those in the Gulf, where women of many nationalities give birth in the same service, these factors also bear on communication, consent and adherence.

5.6 Analysing heterogeneity responsibly

Subgroup findings from single trials are a common source of false leads. The PATH statement recommends that heterogeneity of treatment effect be explored through a small number of prespecified, biologically justified modifiers, ideally using risk-based or effect-modelling approaches, with formal interaction tests rather than separate subgroup p values [77]. For the peanut ball, parity (where both parities are enrolled), body mass index, baseline fetal position and induction status are the strongest candidates.

6. SAFETY AND PRACTICAL RISK MANAGEMENT

No randomized trial or meta-analysis has reported serious harm attributable to the peanut ball [15,37,38]. The risks are mostly practical and foreseeable: hip or pelvic girdle discomfort if the ball is too large, pressure on the skin, interruption of fetal heart

rate monitoring during turns, and the possibility of a fall if a woman with leg weakness tries to move unaided. Ball size is usually selected by maternal height, with 40, 50 and 60 cm balls covering most women [44]. Single-use covers or cleaning between women address infection control, and at least one trial used a fresh sheath for each participant [34]. Turning a woman with a dense block is a two-person task in many units. The Qatar protocol provides for one-to-one midwifery care during position changes, documented stopping rules and continuous fetal monitoring [20], which is a model worth replicating. Continuous labour support, which itself improves outcomes [78], should be maintained alongside positioning, not replaced by it.

7. A METHODOLOGICAL AGENDA

The weaknesses identified above are typical of trials of nursing and midwifery interventions. They are also correctable. Table 3 lists the main gaps and suggests a response for each, with reference to current reporting standards.

Table 3. Gaps in the evidence and recommended responses for future trials

Gap	Recommended response	Relevant standard
Intervention dose poorly described	Report start point, session length, interval between changes, positions, sequence and total exposure	TIDieR; CONSORT-NPT; SPIRIT 2025 [22,79,80]
Fidelity not measured	Bedside positioning log; proportion of planned changes completed; prespecified adherence analyses	Implementation fidelity framework [55]
Comparator undefined	Describe positioning in usual care; consider a turned-without-ball arm to isolate the device	CONSORT 2025 [81]
Mixed parity dilutes effects	Enrol primiparous women only or stratify randomization by parity	PATH statement [77]
Caesarean censors duration outcomes	Define the estimand; use time-to-event models with caesarean as a competing event	ICH E9(R1) [57,82]
Uncontrolled co-interventions	Standardize or record oxytocin, epidural regimen and timing of pushing	[7,62]
Unblinded outcome assessment	Protocolize timing of vaginal examinations; blinded record extraction; objective end points	RoB 2 [23]
Narrow outcome set	Add tear grade, quantified blood loss, cord gases, validated experience measures and cost	[69–71]
Underpowered for mode of birth	Multicentre designs; plan for individual participant data meta-analysis	[16]
Unpublished or terminated trials	Register prospectively, publish protocols, share data	SPIRIT 2025 [80]

CONSORT-NPT, CONSORT extension for non-pharmacological treatments; PATH, Predictive Approaches to Treatment heterogeneity; TIDieR, Template for Intervention Description and Replication.

Several of these points warrant elaboration. First, protocols and reports should describe the intervention at the level of detail set out in TIDieR [22] and in the CONSORT extension for non-pharmacological treatments [79], and should follow the updated SPIRIT 2025 and CONSORT 2025 statements, which give new emphasis to intervention and comparator description, harms, and data sharing [80,81].

Second, the analysis plan should define the estimand. The ICH E9(R1) addendum asks trialists to state in advance how intercurrent events will be handled [82]. In a labour trial, caesarean before full dilatation, discontinuation of the protocol and

the start of oxytocin are all intercurrent events. A treatment-policy estimand that compares groups as randomized, regardless of adherence, answers the pragmatic question; a hypothetical or principal-stratum estimand answers the question about efficacy among women who received the planned schedule. Both may be useful, but they are not interchangeable.

Third, the statistical model should reflect the design. When randomization is stratified or blocked, the analysis should adjust for the stratification variables, since ignoring them produces confidence intervals that are too wide and tests that are conservative [83]. Duration outcomes are skewed and censored by caesarean birth, so medians, quantile regression or time-to-event models with competing risks are more appropriate than simple comparisons of means [57].

Fourth, sample size should be based on the primary outcome in the target population. Effect sizes borrowed from trials that measured different outcomes, used a different device or enrolled women without analgesia may overstate the expected effect and leave a trial underpowered. Variance estimates for first-stage duration in epidural labour are available from the trials pooled in the recent meta-analyses [16,17].

Fifth, fidelity should be measured, not assumed. A bedside chart recording the time of each planned and completed position change, the position adopted and any reason for missing a change allows adherence to be summarized as a proportion and analysed against outcomes [55]. Feasibility and pilot work of the kind undertaken in Australia [44] and planned before the Qatar main trial [20] is the right place to test whether a schedule can be kept on a busy labour ward.

Finally, registration and publication of all trials matters. Of the registered peanut ball trials we identified, at least one was terminated [42] and several had no linked publication [39,41,43]. Selective publication of positive findings would inflate pooled estimates. Brazilian investigators have published a protocol for a fatigue-focused peanut ball trial, a practice others should follow [46].

8. IMPLICATIONS FOR NURSING AND MIDWIFERY PRACTICE

The evidence is incomplete, but it supports practice that is both reasonable and safe. The peanut ball is inexpensive, appears free of serious harm, probably shortens the first stage of labour in women with an epidural and is consistently appreciated by women [15,16,38]. Practice can reasonably be organized around five principles.

First, start early. In epidural labour, introduce the ball once the block is established rather than waiting for a cervical threshold. Second, change position deliberately. A rhythm of roughly every 30–60 minutes, alternating sides and adding semi-recumbent or Taylor positions, matches the trials that showed benefit and is achievable alongside routine observations [20,25]. Third, fit the position to the labour where possible. Station and fetal position, ideally confirmed by ultrasound where available, can guide whether inlet- or outlet-opening positions are used [28,52]. Fourth, keep a record. A simple positioning chart serves clinical handover, audit and research equally well. Fifth, keep women at the centre. Women should understand why the ball is offered, be free to decline or pause it, and receive continuous support throughout [9,78].

These principles have particular relevance in South Asia and the Middle East. In India, caesarean rates have risen sharply, with wide gaps between public and private facilities [84], and epidural services are expanding in urban centres. In high-volume Gulf maternity units, such as the Qatar trial site, which manages more than 1,300 births each month [20], epidural use is common and the workforce is multinational. In both settings, a low-cost, nurse-led positioning protocol could support efforts to reduce primary caesarean birth, provided it is introduced with training and staffing that make the schedule realistic. Training should cover ball sizing, safe turning of women with motor block, coordination with fetal monitoring and documentation.

9. STRENGTHS AND LIMITATIONS

This review is, to our knowledge, the first to analyse peanut ball trials explicitly by dose dimension and to map the evidence across a complete outcome framework rather than duration and mode of birth alone. It includes the trials published in 2025 and 2026 and draws on registry records to capture designs not yet in print. Several limitations should be noted. The integrative method allows broad synthesis but does not produce pooled effect estimates, and our conclusions about dose are inferential. Most trials outside North America enrolled women without epidural analgesia, so their relevance to epidural labour is indirect. We relied on risk-of-bias and certainty judgements made by previous review authors and did not re-appraise each trial ourselves. Finally, although no language restriction was applied at screening, the synthesis drew mainly on English-language reports, and relevant trials published in other languages may have been missed.

10. CONCLUSIONS

The peanut ball rests on a sound mechanical idea: a woman who cannot move because of an epidural can still have her pelvis held open and changed in shape as labour proceeds. The best current evidence suggests that this shortens the first stage of labour, probably by somewhere between half an hour and an hour and a half, without evident harm, and that women value it. Beyond that, the evidence thins quickly. Effects on mode of birth are uncertain, and perineal, haemorrhage, acid–base and economic outcomes are largely unstudied. The likeliest reason for inconsistent trial results is that the intervention has been delivered in very different doses, with little record of whether the planned dose was received. The next generation of trials, particularly those enrolling primiparous women with epidural analgesia, should treat timing, frequency, positional sequence and fidelity as explicit design variables, adopt estimand-based analysis plans and measure the full range of outcomes that matter to women and services. Only then will it be possible to say not just whether the peanut ball works, but how it should be used.

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