

Effectiveness of Birthing Ball Exercises Therapy in Improving Labor Pain and Labor Outcomes: A Systematic Review

Uma Phalswal; M.Sc.¹, Sujata Jha; M.Sc.², Priyanshi Dixit; M.Sc.³, Raksha Yadav; M.Sc.¹

1 College of Nursing, All India Institute of Medical Sciences, Rishikesh, Uttarakhand, India

2 Department of Nursing, All India Institute of Medical Sciences, Bhopal, Madhya Pradesh, India

3 College of Nursing, Vardhman Mahavir Medical College, New Delhi, India

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Abstract

Objective: We must treat every woman with respect and compassion during her childbirth, allowing her to choose how she wants to remember the experience. Midwives and nurses use birthing balls to reduce labor pain and enhance maternal comfort without an epidural. The aim of this systematic review was to critically evaluate the available evidences on the effect of birthing balls on labor pain and labour outcomes.

Materials and methods: Studies identified through PubMed, Semantic Scholar, and Mendeley electronic databases to gather evidences with selected keywords. This review incorporated randomised controlled trials and quasi-experimental research studies that met specific, predefined inclusion criteria. The search generated 441 titles and abstracts, which were further filtered down to 29 publications that were possibly relevant. Out of those, eight studies met the inclusion criteria. Performed a quality assessment of the articles using the JBI quality assessment tool.

Results: All of the included studies show labor pain on a 10-cm Visual Analogue Scale (VAS), and interventional groups reported significantly less labor pain in delivery compared to the control group without birth ball exercise. On labour outcome findings, the intervention group had a higher mean score of cervical dilation in 2 studies, quicker head descent in 3 studies, lower labor time in 4 studies, mother satisfaction throughout labor in 2 studies, and a preference for vaginal delivery in 2 studies.

Conclusion: Clinical implementation of a birthing ball exercise during the process of labor is an effective intervention to reduce labor pain and improve labor outcomes.

Keywords: Birthing Ball; Labor Pain; Labor Outcomes; Parturient Mothers

Introduction

While most women experience great joy soon after childbirth, but the process is typically painful and

exhausting (1). A woman's life is impacted by her pregnancy and delivery. Females are physiologically ready to conceive, carry, and give birth to a child, and both pregnancy and delivery are physiological phenomena. Even though labor pain is normal, women may find it extremely difficult to handle due to extreme level of pain. Every woman deserves

Correspondence:

Sujata Jha

Email: sujatajha1996@gmail.com



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compassionate, considerate care during labour that addresses pain management and gives her the freedom to create a special memory (2, 3).

There are four steps in the entire labor process. The first stage of labor, sometimes referred to as the cervical stage, begins when actual labor pains begin. This is the longest stage of labor, lasting up to 12 hours for primigravidae. As labor progresses, the frequency and intensity of the women's labor pains rise until they reach an excruciating level (4).

A number of studies have found that maternal anxiety over labor pains leads mothers to request a caesarean delivery (C/S), which leads to an upward trend in the number of C/S (5). The percentage of caesarean section deliveries in India has gone through a significant surge, climbing from 3% in 1992–93 to 17% in 2015–16 (6). While it has been documented that the mortality rate for C/S is five times greater than that of normal vaginal delivery, feeling of severe pain may influence woman's decision regarding the method of childbirth in subsequent pregnancies (7).

Effective management of labor pain is an important aspect of obstetric care and the primary goal of intrapartum care. Various techniques for pain management and coping mechanisms have been proposed to reduce the amount and severity of pain during birthing. These methods include a variety of approaches, including medical procedures like epidural analgesia, and non-medical measures like breathing exercises (8).

The birthing ball was first created in 1963 and is now utilized as a physical therapy for the treatment of neurodevelopment (9). Perez and Simkin created the birthing ball as a delivery aid in 1980. According to Perez (2001), using a birthing ball during pregnancy and labor can be physiologically advantageous as it promotes appropriate placement, reduces pain during contractions, and encourages non-habitual movement (10).

The birthing ball is a sizable rubber ball filled with air that can sustain the mother's weight. It facilitates the widening and flexing of the pelvic bone and joints, which makes it easier for the baby to descend into the birth canal. It also helps to strengthen the pelvic floor muscles, which are in charge of the pushing stage of labour (11, 12).

The standard birthing ball size that is appropriate for women who are in labour is 65 cm. Depending on the mother's height, the size varied slightly (13). A woman can sit on it and can rock and slightly bounce to reduce the perineal pressure. The mother can also

lean over the ball, allowing the baby to hang down, in order to decrease any back pain or back labour (14).

The use of a birthing ball during labor enables an upright position, allowing the foetus descend with the help of gravity and also increases the size of the pelvic region (15). Engaging in birthing ball exercises empower women mentally, allowing them to actively participate in their own care during labor. This involvement promotes their ability to maintain body posture and effectively manage labor pain (16).

The present systematic review aimed to critically evaluate and summarise the available evidences from randomised clinical trials (RCTs) and quasi-experimental studies on the use of the birth ball as a supportive method for pain relief during labor and improved labor outcomes.

Materials and methods

We presented this review using the preferred reporting items for systematic reviews and meta-analyses (PRISMA) (17) (Figure 1). Reviewers 1 and 2 conducted the initial screening. For the initial screening, the title and abstract of all the articles were reviewed. Duplications of articles and other articles that were not related to relevant topics were excluded. We produced all the potentially relevant articles in full text after initial screening. Articles were included for final review only if they specifically measured the effect of birthing ball exercise on labor pain and labor outcomes. The selected articles were reviewed by three experts in clinical nursing practice.

Information Sources and Search Strategy: An electronic search was conducted through four e-databases, including PubMed, Semantic Scholar, and Mendeley. Two authors designed the search strategy, which encompassed three concepts related to the study's objective: (1) use of birthing ball exercise; (2) labor pain; (3) labor outcome. It is also limited to the English-language articles published in the last 15 years. The following search words were used: "birthing ball" OR "birth ball" OR "swiss ball" OR "balance ball" OR "exercise ball" AND "labour" OR labour." Only open-access, free full-text articles were searched during the searching process.

Eligibility Criteria: For the review, the researcher focused on the following criteria to include the studies in the review: (1) English-language papers, original research articles, RCTs, quasi-experimental studies, and peer-reviewed publications; (2) The papers were freely available in full text; (3) Articles in which proper methodology was used (4).

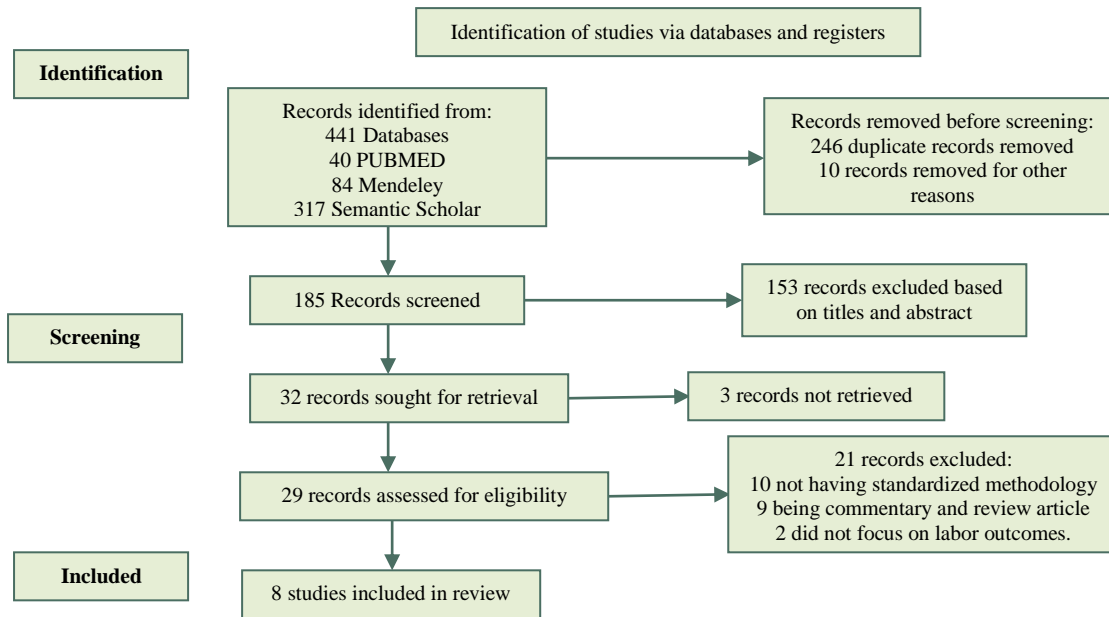


Figure 1: PRISMA flow chart for the selection of articles for systematic review

The study sample included the primary labouring mother who engaged in birthing ball exercise and reported the severity of labor pain and labor outcome after use of birth ball exercise. We excluded the articles that does not meet the single criteria of inclusion. PICOT criteria of included studies are summarized in table 1.

Table 1: PICOT criteria of included studies

Criterion	Definition
Population	Laboring mothers in active phase of labor
Intervention	Birthing ball exercise
Comparators	No birthing ball exercise, only routine care during labor
Outcome	Labor pain and labor outcomes
Time	Published in last 15 year
Study design	Randomised controlled Trial and quasi-experimental studies

Outcome Measures: The primary outcome was labor pain on a 10 cm VAS scale, and the secondary outcomes were labor outcome including cervical dilation, foetal head decent, maternal satisfaction, mode of delivery, duration of labor, etc.

Assessment of Study Risk of Bias: The quality of the articles included in this study was assessed using the quality assessment tool released by JBI for randomised control trials and quasi-experimental studies (18).

Two authors separately assessed the quality of the work. There are 13 items in this tool for RCT studies and 09 items for quasi-experimental studies, each of which can be marked as Yes, No, or Not Cleared.

Yes, it receives a score of 1, whereas all other responses received a score of 0. The total score, in other words, is the number of affirmative responses.

In terms of qualitative evaluation of the final scores of RCT studies, those above score 11 are considered good, those below 9 are considered poor, and those between 9 and 11 are considered fair. For quasi-experimental studies, scores above 7 are considered good, scores above 5 are considered fair, and scores below 5 are considered poor quality of the study. Most of the studies included in this review were of good or moderate quality.

Data Extraction: To include important data, a data extraction table was used: (1) the name of the lead author and country; (2) the type of study; (3) the population and sample size; (3) the measurement tool; (4) the intervention; and (5) the result (Table 2).

Results

In total, 441 publications were identified. Of those, 185 articles were included in the initial screening after duplication removal. Further, 153 articles were excluded based on the screening of titles and abstracts, and 3 articles were not retrieved. The eligibility of the 29-remaining full-text articles was determined. There were 12 articles excluded for not having appropriate measures and methodologies, and 9 articles were excluded for being commentary or review reports. Following the full-text screening, eight studies met the inclusion criteria and were included in this review.

Birth Ball and Labor Outcomes

Table 2: Characteristics of included studies (n=8)

S.NO	Author, Year and Country	Type of study and no. of participants	Tools used	Intervention	Result
1	Gau ML et al (19) (2011), Taiwan	RCT N-87 (control group-39, experiment group- 48)	Demographic and obstetrics characteristics Short Form McGill Pain Questionnaire (SF-MPQ) Childbirth Self-Efficacy Inventory (CBSEI)	Exercise consists of 26-page booklet and a 19-minute videotape, with periodic follow-ups during pre- natal checks. Exercise at home: 20 minutes, 3 times a week for 6-8 weeks	The birth ball exercise decreased labour pain and increased childbirth self-efficacy. Birth ball exercises provided statistically significant improvements in childbirth self-efficacy and pain. Specifically, self-efficacy had a 30–40% mediating effect on relationships between birth ball exercises and childbirth pain. Mothers in the experimental group had shorter first-stage labour duration, less epidural analgesia, and fewer caesarean deliveries than the control group
2	Taavoni S, Abdollahian, Haghani H et al. (20) (2011), Iran	RCT N-60 (control group-30, experiment group- 30)	Demographic characteristics. Visual Analogue Scale (VAS) Score.	Active phase of labor when cervical dilation between 4-8cm instructed 30 minutes birthing ball exercise.	The mean score of pain severity in the birth ball group was significantly less than that of control group. No significant difference in the duration of uterine contraction between 2 groups. No significant difference in the duration of active phase of labor between the groups.
3	Farrag R and Omar A (21) (2018), Egypt	Quasi experimental. N:120 (Control-60, experimental-60)	Socio demographic data Labor progress and outcome: partograph Visual analogue pain severity scale (VAS) State trait anxiety inventory (STAI) Satisfaction visual analogue scale (SVAS)	First phase of labour: 15 minutes video teaching with live demonstration by researcher Active phase of labour: birthing ball exercise every hourly for 10 to 20 minutes up to 10 cm dilation of cervix.	Intervention group had higher mean score of cervical dilatation and foetal head descent. Intervention group had less mean score of pain and anxiety with significant p value. Length of first and second stage of labour is reduced in intervention group after birth ball exercise. Augmentation of labour during second stage of labour is reduced in study group as compare to control group. Experimental group showed 70 % of higher satisfaction regarding care as compare to control group which is 25% higher satisfaction.
4	Shirazi M, Kohan S, Firoozehchian F and Ebrahimi E. (22) (2019), Iran	RCT N-178 (Control group-89, experimental group-89)	Demographic and obstetric information. Visual analogue scale (VAS). Childbirth self- efficacy inventory (CBSEI)	The women in the intervention group were asked to join a planned exercise with the birthing ball including 20 min well defined exercise three times a week for 6-8 weeks at home.	The means of VAS scores ($\beta=1.85$) were found to be significantly lower in the intervention group ($p<0.001$) compared to the control group. Labor pain is lower in the intervention group compared to control group ($p<0.001$ in both cervical dilatations). The score of self-efficacy of interventional group is higher than that of the control group ($p<0.001$).
5	Aktas D, Kolsuz S, Ertugrul M et al. (23) (2021), Turkey	RCT N-60 (Control group-30, experiment group-30)	Socio-demographic and obstetric data. Visual Analogue Scale (VAS) Score.	Birthing ball exercise program includes tutorial booklet and an educational videocassette. 35 th week onward performed exercise 3 times in a week for 20-25 min for each session for 6-8 weeks.	VAS score in experiment group were significantly lower than the control group when cervical dilation was 4-8cm.

Table 2: Characteristics of included studies (n=8) (continue)

S.NO	Author, Year and Country	Type of study and no. of participants	Tools used	Intervention	Result
6	Sonmez T and Apay S. (24) (2023), Turkey	RCT N-180 (A=Control group-60, B=Spherical birth ball group-60, C=Peanut ball group-60)	Socio demographic data and obstetric characteristics. The Visual Analogue Scale (VAS). The Verbal Rating Scale (VRS). Partograph. The Scale for Measuring maternal Satisfaction in Birth (SMMSB).	Active phase of labor: delivery balls exercises (spherical birth ball or peanut balls) were initiated when cervical dilatation is 4cm and continued until it reached 9cm of 1 st stage of labor.	<ul style="list-style-type: none"> Mothers who use different birth ball during active and transition phase of labor had low pain level, faster fetal head descent (0.8) and Higher mother satisfaction (83%) Round birth ball reduced pain more than the peanut ball and higher maternal satisfaction compared to peanut ball group and control group.
7	Aslantas B and Cankaya S (25) (2023), Turkey	RCT N-120 (Control group-60, experimental group-60)	Socio-demographic and obstetric characteristics. Childbirth Comfort Questionnaire (CCQ). Visual Analogue Scale (VAS) Birth and Postpartum Follow-up Form-partograph and Apgar score. Mackey Childbirth Satisfaction Rating Scale (MCSRS).	During labor:- birthing ball exercises every hourly. Birthing ball exercises were in 3 positions including sitting, kneeling and squatting. Women were encouraged to choose most comfortable positions and movements every hourly.	Length of duration from active phase of labor to full dilatation is shorter in intervention group ((200.67 ± 85.09 min) compared to control group (332.00 ± 95.81 min) The mean time of fetal head descent is shorter in intervention group. VAS score when cervical dilatation is 4cm had no statistically significant difference between both groups. VAS score when cervical dilatation is 9cm were significantly lower in experiment group(p<0.001) There is no statistically significant difference in the total score of CCQ and MCSRS. (p>0.05)
8	Jha S, Vyas H, Nebhinani M. et al. (26) (2023), India	Quasi-experimental design. N-60 (control group-30, experiment group-30)	Socio-demographic data. Visual Analogue Scale (VAS). Labour outcome included maternal outcome and fetal outcome- Partograph and APGAR SCORE respectively	Active phase of labor- two sessions of 20 minutes birthing ball exercise at subsequent gap of 1 hour.	The mean VAS score in experiment group is 8.36±0.97 whereas in control group 9.4±1.13 were found to be significantly lower in experiment group. The mean duration of labor is significantly lower in experiment group as compared to control group. The majority of mothers in experiment group underwent vaginal delivery as compared to control group. A significant difference is observed in cervical dilatation, augmentation/induction of labor, use of analgesics, and mode of delivery in experiment group as compared to control group.

Study characteristics and primary study findings are summarized in Table 2. The sample size of the eight studies ranged from 60 to 180 participants, for a total of 865 participants, including 467 participants in the interventional group and the remaining 398 participants in the control group. This review includes six RCTs and two quasi-experimental studies. The eight studies were conducted in four different countries, including Egypt (n = 1) (21), Taiwan (n=1) (19), Iran (n = 2) (20, 22), Turkey (n = 3) (23- 25), and India (n=1) (26).

A variety of scales were used in the studies (n = 8) for assessing labor pain and labor outcomes. To assess labor pain, the Visual Analogue Scale (VAS) was used in all the included studies. Scales used to assess labor outcome were the state trait anxiety inventory (STAI), satisfaction visual analogue scale (SVAS), childbirth self-efficacy inventory (CBSEI), verbal rating scale (VRS), partograph, scale for measuring maternal satisfaction in birth (SMMSB), childbirth comfort questionnaire (CCQ), Mackey childbirth satisfaction rating scale (MCSRS), and short form McGill pain questionnaire (SF-MPQ).

JI Quality Assessment Score for Randomized control trails and Quasi experimental studies are depicted in Table 3.

The result of birthing ball exercise effectiveness during labor is detailed in the following sections:

Labor Pain: All the included studies reported the mean of labour pain on a 10-cm Visual Analogue Scale (VAS), and interventional groups reported significantly less labor pain in delivery compared to the control group without birth ball exercise. One study (22) showed that when cervical dilation is 4 cm, there is no significant difference in the VAS pain score of both groups, but when cervical dilation reaches 9 cm, the VAS score is significantly lower in the experimental group. Out of eight studies,

maximum seven studies mentioned the mean VAS score of labor pain except one (25). Figure 2 depicted the mean VAS score at 8 cm of cervical dilation of all the included studies.

Labour Outcomes: Cervical dilation and foetal head decent: Out of 8 included studies, only 2 studies (19, 23) found that intervention groups had a higher mean score of cervical dilation, whereas only 3 included studies (11, 19, 21) showed a faster foetal head decent in the experimental group, and one study (21) found it 0.8.

Length of labour duration, including first stage and second stage, is reduced in interventional groups after birthing ball exercise, as reported by 4 included studies (19, 22, 23, 26), along with augmentation of labour during the second stage of labour, which was also found to be reduced in the interventional group by 2 studies (19, 23).

Only 2 included studies (19, 21) explained maternal satisfaction during labour. According to Farrag et al. (19), maternal satisfaction is higher in the birth ball exercise group (70%) as compared to the control group (25%), and Sonmez T et al. (21) found that maternal satisfaction is 83% higher in the interventional group. On the other hand, two studies (20, 26) showed the score of self-efficacy in the interventional group was higher than that in the control group.

One more interesting finding regarding mode of delivery was also assessed by only 2 included studies (23, 26), which found that the majority of women in the experimental group undergo vaginal delivery as compared to a caesarean section.

Sonmez et al. (21) compared the labour pain in 3 groups, including the round birth ball, peanut birth ball, and control group, and found that the round birth ball reduced pain more than the peanut ball group and control group (Figure 3).

Table 3: JBI Quality Assessment Score: Randomized control trail studies (RCT) (Part I)

S.N	Authors name	1	2	3	4	5	6	7	8	9	10	11	12	13	Total score
1	Gau ML et al. (19)	1	1	1	0	0	0	1	1	1	1	1	1	1	10/13
2	Taavoni S et al. (20)	1	1	1	1	0	0	1	1	1	1	1	1	1	11/13
3	Shirazi M G et al. (22)	1	1	1	1	0	0	1	1	1	1	1	1	1	11/13
4	Aktas D et al. (23)	1	1	1	0	0	0	1	1	1	1	1	1	1	10/13
5	Sonmez T et al. (24)	1	1	1	1	0	0	1	1	1	1	1	1	1	11/13
6	Aslantas B et al. (25)	1	1	1	0	0	0	1	1	1	1	1	1	1	10/13

Table 3: Quasi experimental studies (Part II)

S.N	Authors name	1	2	3	4	5	6	7	8	9	Total score
1	Farrag R E (21)	1	1	1	1	1	1	1	1	1	9/9
2	Jha S et. al. (26)	1	1	1	1	0	0	1	1	1	7/9

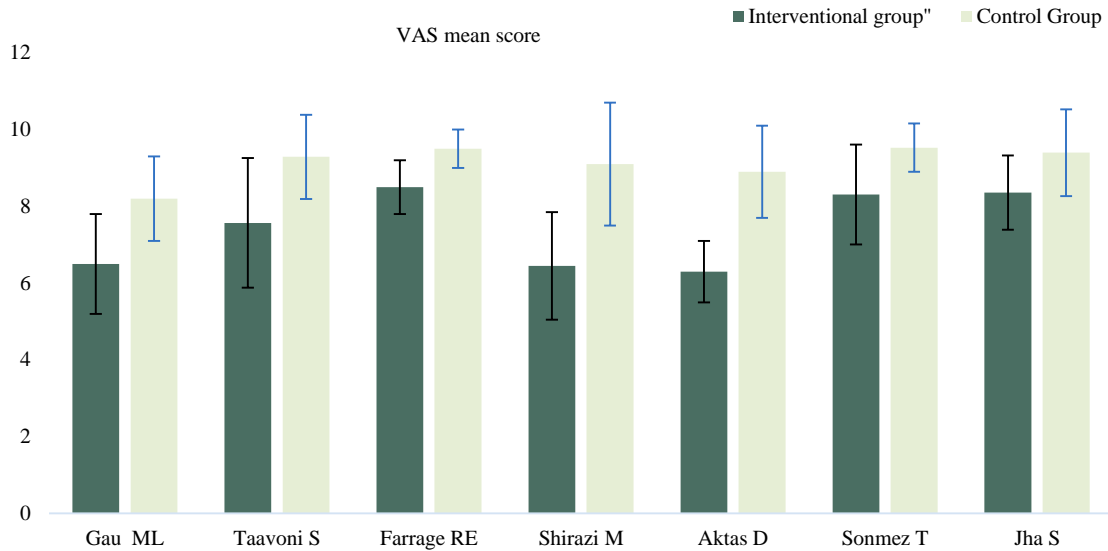


Figure 2: Mean visual analog scale (VAS) score and standard deviation in the birth ball intervention and control groups (VAS score ranges from 0= no pain to 10= severe pain)

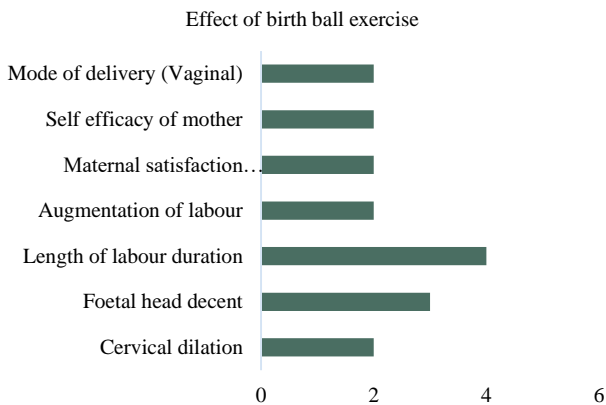


Figure 3: Secondary outcomes observed in the included studies (X axis: Number of studies)

Discussion

While most women experience pleasure and delight during childbirth, pain and stress often accompany the experience. However, some non-pharmacological methods, such as using a birth ball during labor, may reduce these unpleasant and stressful experiences to some extent. The present systematic review included eight studies, including randomised control trials and quasi-experimental studies, to investigate the effect of birthing ball exercises on labor pain and labor outcomes.

This systematic review extracts the finding that use of birthing ball exercises reduces labor pain during the active stage of labor on a 0–10 rating of

the VAS scale. Furthermore, using a birth ball helps to improve labor outcomes such as cervical dilation, faster descent of the fetal head, decreased labour duration, increased maternal satisfaction, and so on.

Potential mechanisms suggest that utilising a birth ball may lessen labour discomfort. The first endogenous mechanism is gate control theory, which involves delivering non-painful massages to painful locations. This method focuses on pain sensory discrimination by suppressing a portion of the nociceptive information in the spine (27). A decrease in lumbar discomfort during sitting postures may be due to less pressure on the nerve filaments connecting the iliosacral joint and its immediate surrounding areas (20). Furthermore, the reduction in labour pain due to birth ball activities may be linked to pain distraction. Distraction means offering certain activities to laboring women in order to reduce conscious thoughts and fears (28).

Furthermore, certain studies have suggested that being able to move freely and maintain an upright position, such as sitting in a rocking chair, on a birth ball, or on the toilet during labour, can help the natural force of gravity promote and improve the descent of the foetus. This can improve the quality and effectiveness of labor contractions, as well as reduce labor pain (29, 30).

We made every effort in the current study to minimise bias in the database searches, paper reviews, and criticisms. Two reviewers independently

carried out every phase of the investigation, including searching databases, selecting studies, evaluating quality, and extracting data. JBI released a quality assessment tool for RCT and quasi-experimental studies, which we used to assess the quality of the included trials.

A systematic review by M. Somayeh et al. (8) also reported consistent results, concluding that if used in a medical setting, a birth ball exercise may help women in labor feel less pain. It's an easy-to-do measure that doesn't cost a lot and could be useful in places with few resources. A different review by Grenvik JM et al. (31) found that the birthing ball group had significantly less labor pain than the control group (-1.7 points; 95% CI -2.20 to -1.20). However, there was no difference in the number of spontaneous vaginal births, operative vaginal births, caesarean births, or perineal lacerations between the groups that used and didn't use birthing balls. D. Alexander (32) conducted another systematic review in 2019 and found that the birth ball decreased discomfort after 20 to 90 minutes of use, and the other labor outcomes remained unchanged but in our research, labor outcomes were also improved after birthing ball exercise. Still, it is important to conduct well-powered randomised RCTs and quasi-experimental research in order to establish a solid conclusion.

Blinding of participants and healthcare providers to group allocation is not possible in this type of intervention, making it difficult to reduce bias risk. It is challenging to standardise interventions. Another limitation is that this review included a small number of studies and some studies included limited number of variables related to labor outcomes.

Conclusion

Based on the reviewed studies of this research, it inferred that pregnant women experience a reduction in labor pain and improved labor outcomes by utilising a birthing ball exercise in a clinical environment. This approach is cost-effective and does not need substantial training to make it beneficial in circumstances when resources are limited.

Conflict of Interests

Authors declare no conflict of interests.

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