

Birth ball use for women in labor: A systematic review and meta-analysis

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ABSTRACT

Objective: To evaluate, with the best level of evidence, the possible benefits of using birth balls during labor in maternal and neonatal outcomes.

Methods: This research was made using MEDLINE/PubMed, LILCAS, CINAHL, CENTRAL, and SCOPUS databases, with no period or language restrictions. The terms "labor" and "birth ball" were used. Clinical trials (randomized and non-randomized) were included when compared a group with parturients using birth ball with control group under usual care. The following primary outcomes were: maternal outcomes: pain intensity; length of first and second stage; perineal trauma and episiotomy. Neonatal outcomes: APGAR score, admission to neonatal intensive care unit and delivery room resuscitation. The quality of evidence was evaluated by the GRADE system. Quantitative analysis through meta-analysis was also applies whenever possible.

Results: Seven studies were included. The pain outcome showed differences in the subgroups of 20/30 min on the birth ball (mean difference) $-1,46$; 95% Confidence Interval: 2,15 to $-0,76$, $p < 0.0001$), 60 min (mean difference $-1,95$; 95% Confidence Interval: 2,68 to $-1,22$; $p < 0.00001$) and 90 min (mean difference $-1,72$; 95% Confidence Interval: 2,44 to $-1,00$; $p < 0.0001$), based in a moderated quality of evidence. Other outcomes did not showed differences between groups after the interventions, with a low and very low level of evidence.

Conclusions: Use the birth ball reduced pain after 20–90 min of use and there was no difference in the other outcomes. The low quality of the studies included in this meta-analysis suggests that new trials with better methodology quality are necessary.

1. Introduction

Using the birth ball during labor is a common practice in hospitals that recognize the importance of humanized birth and women empowerment, as it is a cheap, reusable, non-pharmacological and non-invasive resource [1,2]. Birth balls were introduced into birth rooms from the 1980s onwards, and new research are increasingly being undertaken to prove its efficacy during labor [3,4].

There are several shapes and sizes of birth balls (Swiss ball, bean shape, peanut shape), aiming to fit different sizes of patients. The exercises are made in various positions [2,3,5]. The parturient can sit during the first and second stages of labor or sit and move the hips back and forth during contractions [1,6].

Physical Therapists assisting the mother during labor can use this resource to facilitate the fetal decent and relieve labor strain through pelvic biomechanical control [7]. Depending on the movements made

by the pelvic girdle on the ball, the positioning of all the bones, muscles and ligament structures of the girdle are changed. Thus, the knowledge about the pelvic girdle anatomy, development and biomechanics is indispensable to physiotherapy practice [7,8].

A meta analytic systematic review of four randomized clinical trials with 220 pregnant women in labor found a significant reduction in pain using the birth ball during the first stage of labor ($-0.921[-1.28$ to $-0.56]$, $P = 0.0000005$) [3]. However, despite reducing pain during labor, there are still questions about its efficacy related to important outcomes as the length of the first and second stages of labor, delivery type, use of oxytocin or analgesia, perineal lacerations, APGAR score at the fifth minute of life, resuscitation and admission at the neonatal intensive care unit.

The aim of this systematic review was to evaluate the possible benefits and disadvantages of using birth balls during labor on the maternal and neonatal outcomes using the best level of evidence.

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Table 1
Research strategies for each research database.

DATABASE	SEARCH STRATEGY
MEDLINE (PUBMED) COCHRANE (CENTRAL)	"labour"[All Fields] OR "labor"[All Fields] OR "labor, obstetric"[MeSH Terms] OR "Nulliparous"[All Fields] OR "Primiparous"[All Fields] OR "Multiparous"[All Fields] OR "labor stage, first"[MeSH Terms] OR "first labor stage"[All Fields] OR "labor stage, second"[MeSH Terms] OR "second labor stage"[All Fields] AND "birth ball"[All Fields] OR "Swiss ball"[All Fields] OR "Fitness ball"[All Fields] OR "Gym ball"[All Fields]"Peanut ball"[All Fields]
LILACS	(Delivery, Obstetric) OR (Labor, Obstetric) OR (Labor Stage, First) OR (Labor Stage, Second) OR (Humanizing Delivery) OR (Parturition) OR Nulliparous OR Primiparous OR Multiparous AND "birth ball" OR "Swiss ball" OR "Fitness ball" OR "Gym ball" OR "Peanut ball"
CINAHL	("Labor") OR ("Delivery, Obstetric") OR "Nulliparous" OR "Primiparous" OR "Multiparous" AND "birth ball" OR "Swiss ball" OR "Fitness ball" OR "Gym ball" OR "Peanut ball"
SCOPUS	TITLE-ABS-KEY (Labor) OR TITLE-ABS-KEY (Obstetric) TITLE-ABS-KEY (Nulliparous) OR TITLE-ABS-KEY (Primiparous) OR TITLE-ABS-KEY (Multiparous) AND TITLE-ABS-KEY (birth ball) OR TITLE-ABS-KEY (Swiss ball) OR TITLE-ABS-KEY (Fitness ball) OR TITLE-ABS-KEY (Gym ball) OR TITLE-ABS-KEY (Peanut ball)

2. Methods

This review followed a previous protocol register in the PROPEPO (2016: CRD42016043179) and reported according to PRISMA.

2.1. Data sources and searches

Two independent reviewers conducted searches and selected eligible studies in MEDLINE/PubMed (1966–April/2018), Cochrane Central Register of Controlled Trials (CENTRAL) (1993–April/2018), Lilacs (1982–April/2018), CINAHL (1981–April/2018) and Scopus (1950–April/2018). There was no temporal or language restrictions and the search strategies used for each database were done considering their specific descriptors (Table 1).

2.2. Study selection

2.2.1. Types of studies

All randomized clinical trials (RCTs) or quasi-randomized were eligible for this systematic review.

2.2.2. Population studies

Studies involving pregnant women independent of parity, between 37 and 42 weeks' gestation, with vertex or breech presentation, alive fetus and singleton pregnancy were included.

2.2.3. Types of interventions

Studies that used the birth ball during the first and/or second stage of labor as an intervention compared to a control group or usual care that did not included the birth ball use. Types of Birth Balls: Swiss Ball and Peanut Ball. Studies that compared the birth ball to pharmacological methods of pain control were excluded.

2.3. Evaluated outcomes

The following primary outcomes were considered: maternal outcomes: pain intensity (as defined by trialists); length of first and second stage (min); perineal trauma (perineal lacerations of third or fourth degree) and episiotomy. Neonatal outcomes: APGAR score (less than five at 7 min), admission to neonatal intensive care unit and delivery room resuscitation. Secondary outcomes: maternal outcomes: spontaneous vaginal delivery; instrumental delivery; cesarean delivery; oxytocin use (after randomization); epidural analgesia use (after randomization); maternal fatigue (as defined by trialists); maternal anxiety (as defined by trialists) and maternal satisfaction with the childbirth experience (as defined by trialists). Neonatal outcomes: low umbilical cord blood pH (arterial less than 7.2 and venous less than 7.3) and fetal Heart Rate variability (as defined by trialists).

2.4. Data collection and analysis

2.4.1. Selection of studies

The two reviewers screened the studies by title and abstract, performing a pre-selection through eligibility criteria on the computer screen. Then, they read the full text of potentially eligible studies to confirm their inclusion. It was pre-defined that a third reviewer would decide disagreements between two reviewers. Furthermore, the reference list of the included studies was also assessed to ensure that all potential eligible trial that could not be found in the databases were included.

2.5. Data extraction and management

A form was design to extract data. For eligible studies, at least two review authors extracted the data using the agreed form. The differences and discrepancies were resolved by discussion and, when necessary, by consulting a third reviewer. The data was inserted into the Review Manager software [9] and checked for accuracy. When information was unclear, the authors attempted to contact the responsible for the original reports to provide further details.

2.6. Risk of bias (quality) assessment

The risk of bias in each study was assessed using a recently developed revision of the Cochrane risk of bias tool (RoB 2.0: a revised tool to assess risk of bias in randomized trials) [10]. This new risk of bias tool presents five domains of bias: (1) the randomization process, (2) deviations from intended interventions, (3) missing outcome data, (4) measurement of the outcome, and (5) selection of the reported results. For each domain there was signaling questions with the following options of answer: Yes, probably yes, probably no, no and "no information" and the risk of bias judgment is classified in "Low Risk," "Some Concerns", or "High Risk" of bias. The risk of bias was assessed for each outcome. Two reviewers assessed the risk of bias for each outcome, the discrepancies between them were resolved by discussion to reach consensus, and if necessary, a third reviewer was consulted to achieve a decision.

2.7. Quality of evidence assessment

Quality of evidence assessment was undertaken by two independent reviewers through the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) system, where five factors can decrease the quality of evidence for randomized trials: study limitation, inconsistency, indirectness, imprecision and publication bias, according to the following classification: high, moderate, low and very low [11,12].

The quality of evidence for the outcomes pain, length of first and second stage (min), spontaneous vaginal delivery, perineal trauma (perineal lacerations of third or fourth degree), APGAR score (less than

five at 7 min) and admission to neonatal intensive care unit was assessed using the GRADE system. A review of the evidence for each factor followed the following classification: (no reduction in points), serious (reduction of 1 point) and very serious (reduction of 2 points) [12], being punctuated by reviewers according to the interference biases detected in these items.

2.8. Strategy for data synthesis

Data analysis was performed with RevMan 5.3 software. The homogeneity of studies was assessed through the test for heterogeneity, being considered homogeneous when p take value greater than 0.05, and the index of heterogeneity (I-squared), being classified as low heterogeneity values up to 30%. In the first statistical analysis, a fixed effect meta-analysis was conducted, but when the heterogeneity index was positive, we carried out a random effects meta-analysis. Data was synthesized using inverse variance for continuous data and Mantel Haenszel for categorical data. When a meta-analysis could not be performed, the results was shown through a qualitative analysis.

3. Results

977 studies were identified in the pre-established databases, according to the revision of search strategies. After the initial screening, duplicated articles were excluded and the remaining articles were submitted to title and summary analysis. Seven articles were considered

eligible to full review. One study was excluded from the meta-analysis since the data was displayed in Geometric Mean (Fig. 1).

Two studies were made in North America [13,14], two in South America [15,16], two in Asia [17,18] and one in Europe [19]. Regarding the intervention protocols, five studies used Swiss Balls soon after the admission, when the mothers were in active labor stage (3–10 cm of uterine dilation) [15–19], and two studies used Peanut Shaped Balls between the participant legs soon after the application of epidural anesthesia and kept the ball until they have full dilation (10 cm of uterine dilation) [13,14].

The seven studies [13–19] included 629 women in labor. All the subjects had a similar mean age (18–35 years), in a low risk gestation, at term, in cephalic presentation and with a single fetus. All the participants who used the Swiss Ball were nulliparous [15–19], and the participants who used the Peanut Ball were primiparous or multiparous [13,14].

Regarding exercises on Birth Balls, one study used the Swiss Ball during Prenatal in women with 30–32 weeks of gestation [18]. Participants performed ball exercises at home, guided by a videotape and a booklet with 26 pages for 20 min, three times per week, during 6 weeks. Women only used the ball during the labor stage in all the other studies.

Relative to the beginning and permanence with the birth ball, all the studies started the exercises at early active labor (3–4 cm of uterine dilation). Permanence varied between studies. Two studies kept the parturients through a minimum period of 20–30 min on the ball, not informing the total time [17,19]. In one study, the parturients stayed on

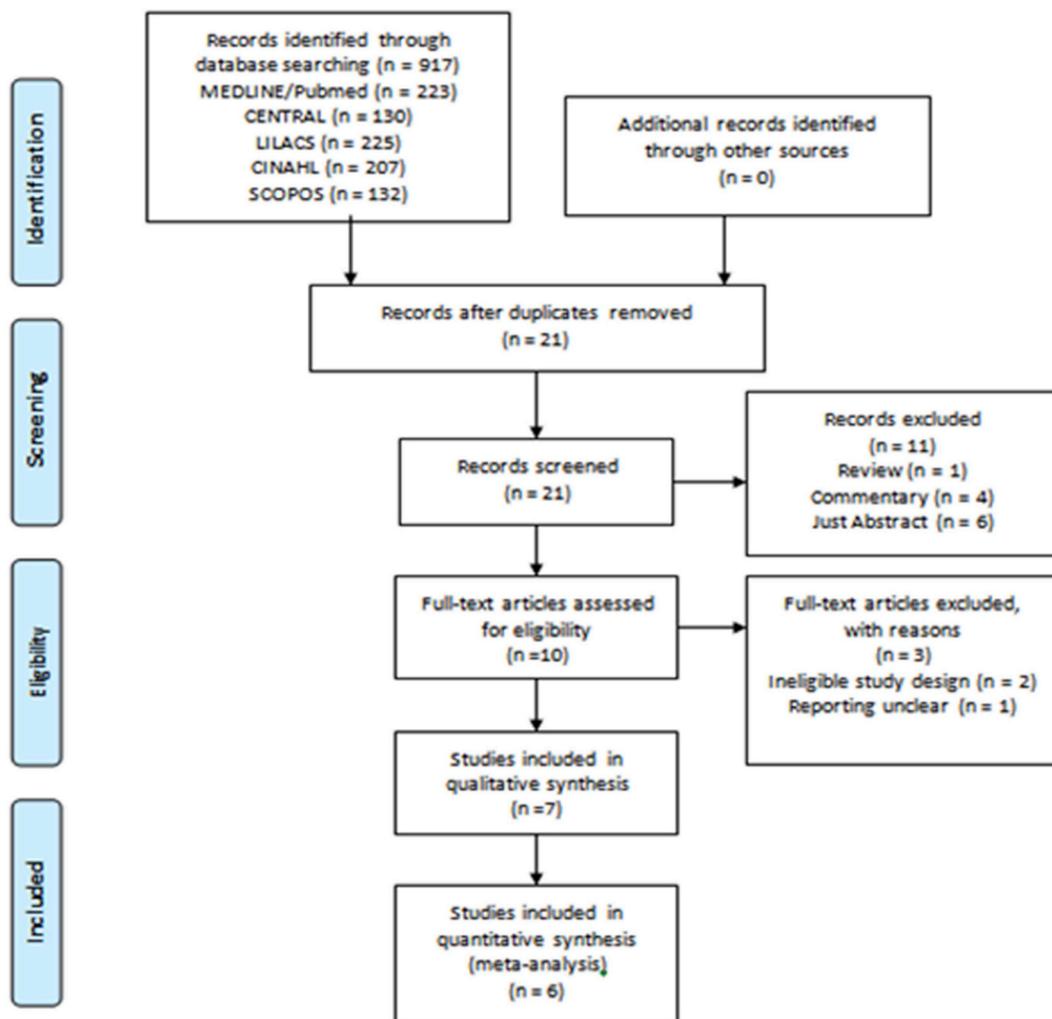


Fig. 1. Flow diagram of the selection steps of the identified articles according to the PRISMA.

Table 2
Characteristics of interventions of each study.

Author, year (Country)	Sample	Participants	Type of birth ball used	Use of epidural anesthesia	Protocol intervention
Lopes [15], 2003 (Brazil)	EG: 16 CG: 18	Parity: nulliparous Low risk, single fetus, cephalic presentation Term pregnancy Age: 18–35 years	Swiss Ball	No	EG: Parturients had the ball available in the room and received instructions about its benefits and use. The Parturients also were stimulated to stay in the ball, but were free to change the position to a more comfortable one CG: Parturients had the ball available in the room, but were encouraged to follow the hospital protocol
Taavoni [17], 2011 (Iran)	EG: 29 CG: 31	Parity: nulliparous Cephalic presentation Gestational week: 38–40 weeks Age: 18–35 years	Swiss Ball	No	EG: sat on birth ball and moved hips back and forth or around in a circle for a minimum of 30mins CG: routine care with no intervention
Delgado-Garcia [19], 2011 (Spain)	EG: 34 CG: 24	Parity: nulliparous Low risk, single fetus, cephalic presentation Term gestation Age: 18–35 years	Swiss Ball	No	EG: the pregnant woman sits on the ball and performs movements in vertical position of swing and rotation of the pelvis during labor for a minimum of 20 min. CG: freedom of movement, rest of care similar to experimental group, except offered use of the birth ball.
Gau [18], 2011 (Taiwan)	EG: 48 CG: 39	Parity: primiparous or multiparous Singleton, cephalic presentation Term pregnancy Age: 18–35 years	Swiss Ball	No	EG: received a 26-page booklet and a 19 min video tape of the birth ball exercise program during prenatal; practiced exercises and positions at home for at least 20mins, 3 times a week for 6–8weeks; choose the most comfortable positions, movements, and exercises with birth ball during labor. CG: standard nursing and midwifery care.
Gallo [16], 2014 (Brazil)	EG: 20 CG: 20	Parity: nulliparous Low risk, single fetus, cephalic presentation Term gestation Age: 18–35 years	Swiss Ball	No	EG: pelvic mobility exercises for 30 min during active labor; Active exercises of pelvic anteversion and retroversion, lateralization, circumduction and propulsion. CG: subjected to the hospital procedures and freedom to change positions.
Tussey [13], 2015 (United States)	EG: 107 CG: 94	Parity: primiparous or multiparous Fetus in the cephalic presentation Term pregnancy Age: 18–35 years	Peanut Ball	Yes	EG: The peanut ball was placed between the legs of a woman in the intervention group immediately after she received her epidural and consented to participate in the study. The ball was removed when the cervix of the woman became completely effaced and dilated, passive descent had occurred, and she was ready to actively push. CG: standard care was given to control groups
Roth [14], 2016 (United States)	EG: 78 CG: 71	Parity: primiparous or multiparous Gestation week: 39 weeks gestation	Peanut Ball	Yes	EG: Women assigned to the EG had the peanut ball placed between their knees within 30 min after epidural placement, with rotation of lateral positions every 30 min or as indicated by patient/fetal status. CG: women in the CG did not use the peanut ball and nurses were instructed to use a maximum of one pillow between the knees.

Table 3

Risk of Bias of the following outcomes: pain, length of first stage, length of second stage, perineal lacerations, episiotomy, Apgar score, spontaneous vaginal delivery, instrumental delivery, caesarean delivery, oxytocin, epidural analgesia. The authors evaluated a different number of different outcomes (described at the footnotes of this table), and the risk of bias was variable between outcomes and between authors.

Autor/desfechos	Bias arising from the randomization process	Bias due to deviations from intended interventions	Bias due to missing outcome data	Bias in measurement of the outcome	Bias in selection of the reported result	Overall bias
Delgado-Garcia [19]*	Some concerns	Some concerns	Low	Pain, partos = High Others: low	Low	Pain = High partos = High Others: low
Gau [18]**	Low	Some concerns	Low	Pain: High Other: low	High	High
Tavonni [17]***	Low	Some concerns	Low	Pain: High Other: low	Low	Pain = High Others = Some concerns
Tussey [13]****	Low	Some concerns	Low	Low	Low	Some concerns
Lopes [15]*****	Some concerns	Some concerns	Low	Low	Low	Some concerns
Galo [16]*****	High concerns	Some concerns	Low	Low	Low	High

*Pain, length of first stage, length of second stage, perineal lacerations, episiotomy, Apgar score, spontaneous vaginal delivery (SVD), instrumental delivery (ID), caesarean delivery (CD), epidural analgesia use.

** Pain, Length of first stage, length of second stage, apgar score, spontaneous vaginal delivery, instrumental delivery, oxytocin user.***Pain, length of first stage.

**** APGAR score, spontaneous vaginal delivery, instrumental delivery, caesarean delivery, oxytocin user.

***** Length of first stage, length of second stage, perineal lacerations, caesarean delivery, oxytocin user.

***** Length of first stage, APGAR score, spontaneous vaginal delivery, caesarean delivery.

the ball until they reach 8 cm of dilation [18], and in four other studies the participants remained on the ball until the end of the first stage (10 cm dilation) [13–16] (Table 2).

Table 3 synthesizes the risk of bias for all the outcomes (pain, length of first stage, length of second stage, perineal lacerations, episiotomy, APGAR score, spontaneous vaginal delivery, instrumental delivery, cesarean delivery, oxytocin, epidural analgesia), for all the six articles included in the meta analytic systematic review. The number of outcomes and the risk of bias varied between authors.

3.1. Primary outcomes

3.1.1. Maternal outcomes

3.1.1.1. Pain. Two clinical trials [17,19] measured pain using a Visual Analogic Scale (VAS), obtaining the following results according to the subgroups for 20/30 min (mean difference (MD) -1.46; 95% confidence interval (CI) -2.15 to -0.76; two studies, 104 women, random-effects: I² = 0%; T² = 0.18; p < 0.0001), for the 60 min subgroups (MD -1.95; 95% CI -2.68 to -1.22; one studies, 60 women, random-effects: p < 0.00001), and for the 90 min subgroup (MD -1.72; 95% CI -2.44 to -1.00; one studies, 60 women, random-effects: p < 0.0001), (Fig. 2), based in a moderate level of evidence (Table 4).

Two other studies [16,18] also evaluated pain, but were not included in the metanalysis because they based the pain evaluation interval by uterine dilation [16,18]. One of those studies had a difference of 2 (CI: 1.29 to 2.79) on pain when the uterus had 4 cm of dilation, and 1.7 (CI: 1.18 to 2.22) with 8 cm of uterine dilation [18]. This study [18] also assessed pain by two other scales: Verbal Response Scale [MD 10.4; CI: 7.5 to 13.2 (4 cm)]; [MD 7; CI: 2.6 to 11.3 (8 cm)]; Present Pain Intensity Scale [MD 1.4; CI: 1.05 to 1.75 (4 cm)]; [MD 0.7; CI: 0.5 to 1.1 (8 cm)]. The second study [16] did not included a mean difference, thus it was not possible to evaluate the mean difference.

3.1.1.2. Length of first stage (min). Five clinical trials [15–19] showed no differences between the use birth balls and usual care in the length of the first stage of labor ((MD) 5.48 min, 95% (CI) - 46.60 to 35.24, five studies, 265 women, random-effects: I² = 27%; T² = 640.77; P < 0.79)) (Fig. 3), based in a very low level of evidence (Table 4).

3.1.1.3. Length of second stage (min). The length of second stage showed no difference in three trials [15,18,19], with a low level of evidence (Table 4), (MD 1,56 min; 95%CI) - 10,24 to 7,12, three studies, 165 women, random-effects: I² = 0%; T² = 0,00; p < 0,72), (Fig. 3).

3.1.1.4. Perineal trauma (perineal lacerations of third or fourth degrees). Two clinical trials [15,19] showed no difference between the use of birth balls and the usual care in the risk of perineal trauma, based in a very low level of evidence (Table 4) (risk ratio (RR) 0,94; 95% CI 0,42 to 2.11), (Fig. 3).

3.1.1.5. Episiotomy. The results of a single study [19] with 32 women showed no difference between the use of birth balls and the usual car in the risk of episiotomy (RR 1.40; 95% CI 0.95 to 2.07), (Fig. 3).

3.1.2. Neonatal outcomes

3.1.2.1. APGAR score (less than five at 7 min). The results of four clinical trials [13,16,18,19] showed no differences in the APGAR Score less than 7 points at the fifth minute of life when comparing usual care with birth ball intervention, based in a very low level of evidence (Table 4) (RR 1.02; 95% CI 0.47 to 2.21) (Fig. 4).

3.1.2.2. Admission to neonatal intensive care unit and delivery room resuscitation. None of the included articles reported this outcome.

3.2. Secondary outcomes

3.2.1. Maternal outcomes

3.2.1.1. Spontaneous vaginal delivery. The results of four clinical trials [13,16,18,19] involving 380 women showed no increase in normal births in the group using birth balls when compared with the usual care group, based in a low-level quality of evidence (Table 4), (RR 1.11; 95% CI 0.98 to 1.25), (Fig. 4).

3.2.1.2. Instrumental delivery. Three studies [13,18,19] evaluated this outcome in 340 women. No difference was found regarding the risk of instrumental delivery between groups (RR 0.66; 95% CI 0.38 to 1.17) (Fig. 4).

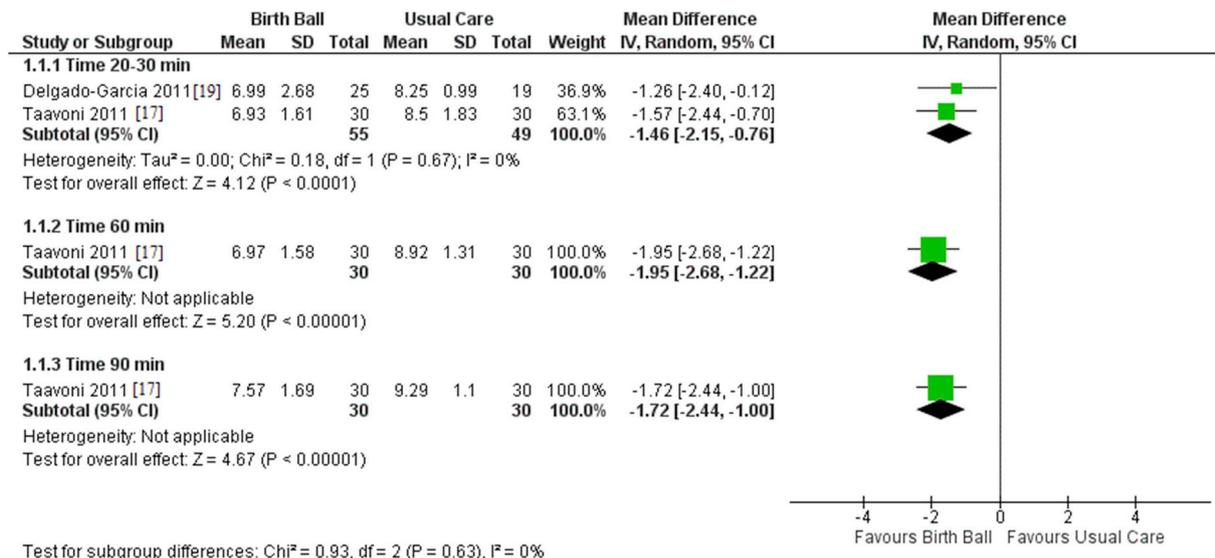


Fig. 2. Forest plot from the use of Birth Ball versus Usual Care for woman in labor for the outcome pain.

Table 4

Assessment of quality of evidence using the GRADE for maternal and neonatal outcomes (pain, length of first and second stages of labor, normal birth, perineal lacerations, Apgar at the 5th minute of life and admission at neonatal intensive care unit) in women using birth balls during labor.

Birth ball compared to usual care for women in labor						
Patient or population: Women in Labor						
Setting: Obstetric Center						
Intervention: Birth Ball						
Comparison: Usual Care						
Outcome № of participants (studies)	Relative effect (95% CI)	Anticipated absolute effects (95% CI)			Quality	What happens
		Without birth ball	With birth ball	Difference		
Pain - Time 20–30 min № of participants: 104 (2 RCTs)	–	The mean pain - Time 20–30 min was 0	–	MD 1.46 lower (2.15 lower to 0.76 lower)	⊕⊕⊕○ MODERATE ^a	One study measured 60min (MD 1,95lower (2,68 lower to 1,22 lower) and 90 min (MD 1,72 lower (2,44 lower to 1,00 lower).
Length of First Stage (min) № of participants: 265 (5 RCTs)	–	The mean length of First Stage (min) was 0	–	MD 5.48 lower (46.2 lower to 35.24 higher)	⊕○○○ VERY LOW ^{a,b,c}	
Length of Second Stage (min) № of participants: 165 (3 RCTs)	–	The mean length of Second Stage (min) was 0	–	MD 1.56 lower (10.24 lower to 7.12 higher)	⊕⊕○○ LOW ^{c,d}	
Apgar Score (less than five at 7 min) № of participants: 380 (4 RCTs)	RR 1.02 (0.47–2.21)	6.1%	6.2% (2.9–13.4)	0.1% more (3,2 fewer to 7,4 more)	⊕○○○ VERY LOW ^{a,b,c}	
perineal lacerations of third or fourth degree № of participants: 73 (2 RCTs)	RR 0.94 (0.42–2.11)	68.6%	64.5% (28.8–100.0)	4.1% fewer (39,8 fewerto 76,1 more)	⊕○○○ VERY LOW ^{b,c,d}	
Spontaneous vaginal delivery № of participants: 380 (4 RCTs)	RR 1.11 (0.98–1.25)	72.9%	80.9% (71.4–91.1)	8.0% more (1,5 fewerto 18,2 more)	⊕⊕○○ LOW ^{a,c}	
admission at neonatal intensive care unit- not reported	–	–	–	–	–	

*The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the relative effect of the intervention (and its 95% CI). CI:Confidence interval; MD:Mean difference; RR:Risk ratio.

GRADE Working Group grades of evidence. High quality: We are very confident that the true effect lies close to that of the estimate of the effect. Moderate quality: We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different. Low quality: Our confidence in the effect estimate is limited: The true effect may be substantially different from the estimate of the effect. Very low quality: We have very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect.

- a. Not informed the randomization of some studies and the studies did not made masking – less one point.
- b. There is a variation in the effect size between studies. The high heterogeneity index and high p-value < 0.05- less two points.
- c. CI was null – less one point.
- d. One study did selective description of outcomes – less one point.

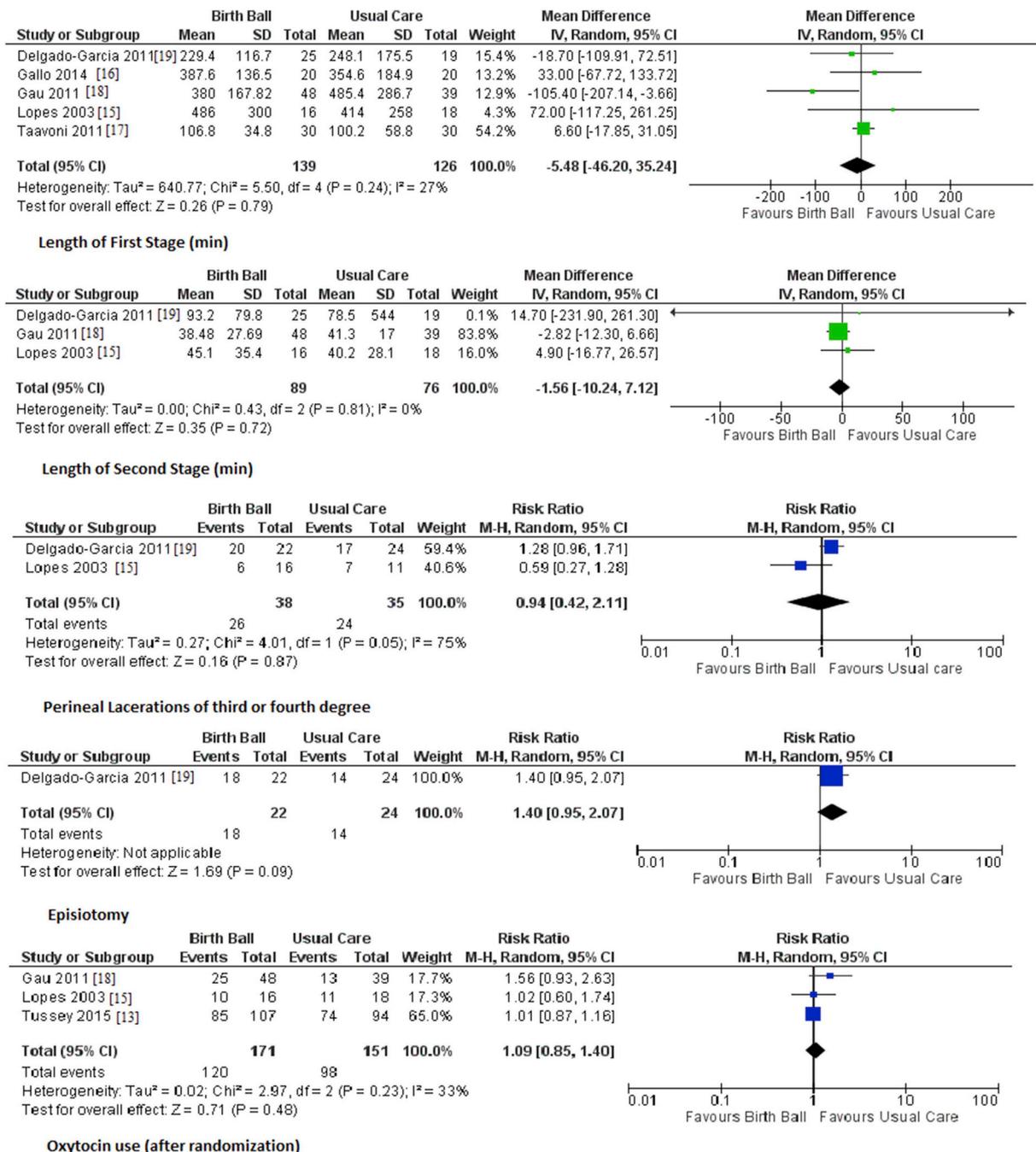


Fig. 3. Forest plot of Birth Ball use versus Usual Care for woman in labor for the outcomes: Length of First and Second Stage, Oxytocin and Epidural analgesia, APGAR Score.

3.2.1.3. *Caesarean delivery.* Four studies [13,15,16,19] with 307 women showed no increase in cesarean delivery between groups (RR 0.62; 95% CI 0.18 to 1.01) (Fig. 4).

3.2.1.4. *Use of oxytocin (after randomization).* Three clinical trials [13,15,18] with 322 women showed no difference between the use of birth ball and usual care in the risk of oxytocin use (RR 1.09; 95% CI 0.85 to 1.40) (Fig. 3).

3.2.1.5. *Epidural analgesia (after randomization).* Only one study [19] evaluated this outcome and found no differences between groups (RR 0.95; 95% CI 0.66 to 1.42) (Fig. 4).

3.2.1.6. *Fatigue, anxiety and maternal satisfaction with the childbirth experience (as defined by trialists).* None of the included studies reported this outcome.

3.2.1.7. *Low umbilical cord blood pH (arterial less than 7.2 and venous less than 7.3) and fetal heart rate variability (as defined by trialists).* None of the included studies reported on this outcome.

4. Discussion

Results shows that the use of birth balls compared with usual hospital care during labor can reduce pain after 20–90 min by 1.46 and

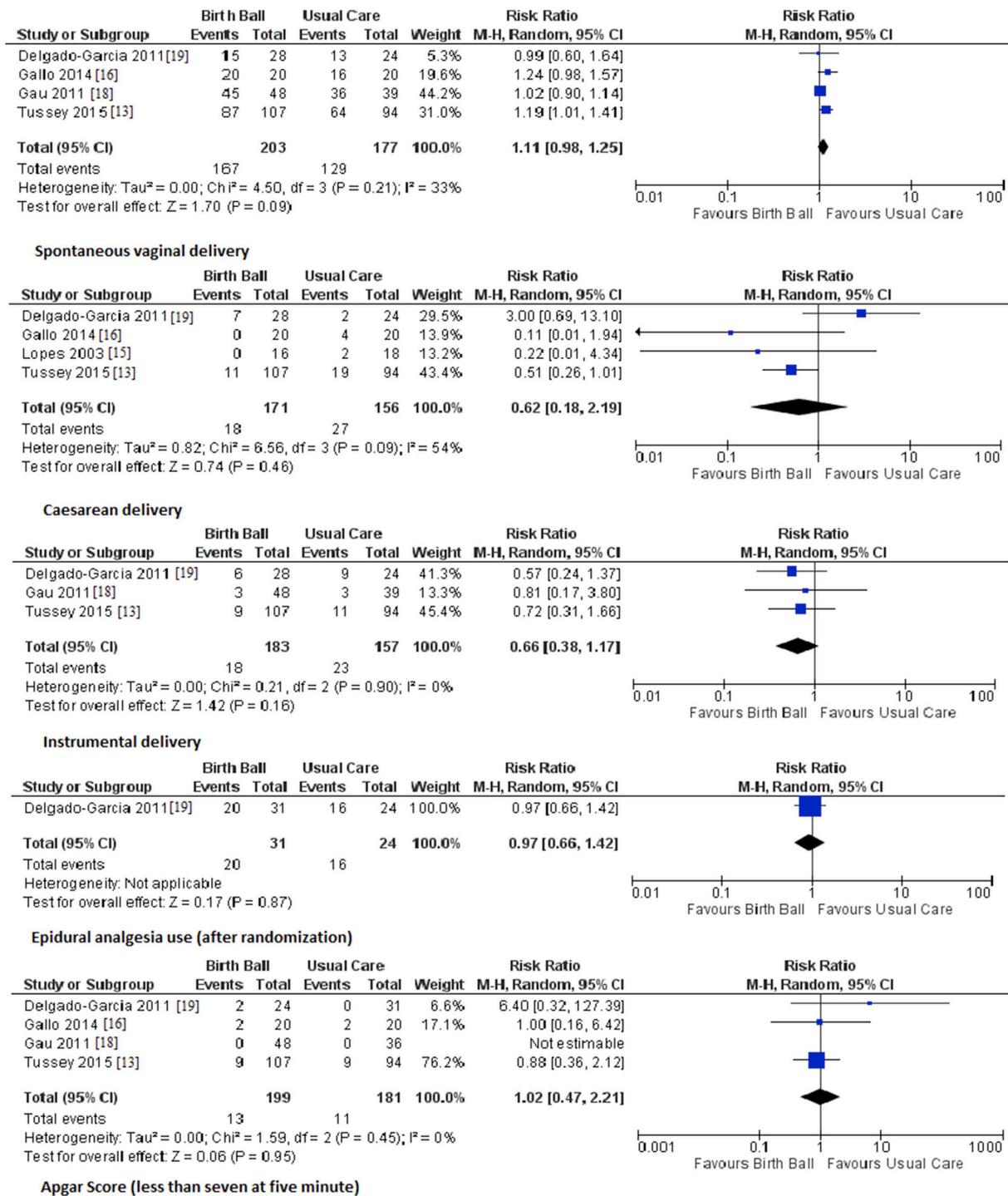


Fig. 4. Forest plot of Birth Ball use versus Usual Care for woman in labor for the outcomes: Perineal lacerations, episiotomy, spontaneous vaginal, caesarean and instrumental delivery.

1.95 points in Visual Analogic Scales, based in a moderated quality of evidence. However, others maternal and neonatal outcomes showed no differences between the uses of birth balls and the usual care, with a low and very low level of evidence.

Although two studies were not included in the meta-analysis [16,18], since they evaluated pain through the time of uterine dilation and not by length of birth ball use, their results also showed an improvement in pain symptoms, supporting the findings of this revision. Birth balls are non-pharmacological methods of treatment used by healthcare professional to assist women during labor to reduce pain [7]. Several mechanisms could explain the pain reduction. One of them is

the gate control theory of pain that consists of using non-painful stimulus to inhibit pain sensation. This mechanism works mainly through the sensitive component of pain, blocking the nociceptive signal [20]. This physiological response can occur when the pelvis moves on the ball during labor. Furthermore, the sitting position reduces pressure in nervous fibers in the sacroiliac articulation, causing relieve of pain in the lumbar region [17].

A previous review found similar results regarding pain symptoms. This review only evaluated pain, but the bibliographical compilation method differed from the adopted by our review, for they included three studies in the meta-analysis. Pain symptoms were evaluated by

the standardized mean difference between groups [3]. We emphasize that the evaluation method of systematic reviews should be as homogeneous as possible. Even though GAU's study [18] evaluated pain through three different instruments (Visual Analog Scale; Verbal Response Scale; Present Pain Intensity Scale) they all show improvement in the pain intensity.

Regarding the results related to the length of first and second stages of labor, as well the natural birth incidence, no difference between groups using birth balls or usual care was found, based in a low and very low level of evidence. Evidence points that vertical position and freedom of movement during labor can improve the quality and effectiveness of contractions [21].

As consequence, labor length is reduced, and the number of natural births is increased, with a smaller probability of cesarean birth [21]. It was expected that the birth ball could positively interfere these outcomes, since the ball provides a vertical positioning to the mothers, but this result was not shown in this review. This result could be attributed to the dosimetry used. Generally, the exercises began when the mother reached 4 cm of uterine dilation, and kept in the ball for a brief time. Maybe the results could be improved with a longer time in the ball.

None of the studies prescribed the exercises according to the obstetrics conditions as the fetal presentation, dilation or fetal positioning in line with pelvic biomechanics. The absence of this orientation can also be the reason for these results in labor length and type of delivery. It is important to highlight that this evidence has a low reliability, and thus these results can change in future researches [21].

No differences were found between groups using birth balls or usual care related to the use of oxytocin or epidural analgesia. However, caution is needed to interpret these results, as the evidence for these findings are base in only one study [19], with a small sample and serious limitations, making the evaluation of birth balls efficacy in these outcomes inconclusive. The rate of epidural use is an important outcome once it could interfere in the maternal and neonatal outcomes and futures studies with the birth ball should measure it.

Regarding the outcomes related to the pelvic floor (episiotomy and perineal trauma), it is suggested that the pelvic movements performed in the birth ball massage the pelvic floor and stimulate proprioception, and this could improve the muscle activity during labor, reducing the need for episiotomy and the risk of lacerations [22]. However, the evidence of this revision shows no difference between groups, based in a very low quality of evidence.

About the neonatal outcomes, no differences were found between groups, but this should be interpreted with caution, since the level of evidence for this outcome is low. There is evidences that babies of mothers in vertical positions during the first stage of labor had less chance to be admitted at neonatal intensive care unit, but this result is based in only one study (RR 0.20, CI 95% 0.04 to 0.89) [21].

Included studies did not evaluated fatigue, anxiety and mother's satisfaction with treatments. These outcomes are considered important during labor and to improve the empowerment and autonomy of women [23]. Studies show that anxiety and fatigue can negatively influence labor [23–25]. The use of birth balls as a therapeutic and playful tool during contractions could help distracting the mother, reducing anxiety and fatigue [26].

The elaboration of this manuscript followed the most recent Cochrane recommendations for systematic reviews and interventions [27], aiming to minimize bias during the review. Although the main healthcare databases were searched, the EMBASE platform was not available to the authors, and this could be considered a limitation for this review. However, it is important to emphasize that the CENTRAL database recover its manuscripts from EMBASE. Furthermore, some eligible studies maybe were not included in this review, considering that they may have been published in difficult to access journals.

5. Conclusion

There is moderated evidence that using the birth ball in the first stage of labor can reduce pain after 20–90 min of use. However, no difference was shown between the birth ball or the usual care in the length of labor, the type of delivery (natural, cesarean or instrumental), use of oxytocin and analgesia, perineal laceration, episiotomy and APGAR score after 5 min, based in a low and very low level of evidence. Considering the high heterogeneity and bias in the studies, new clinical trials with better quality are recommended to confirm the risks and benefits of using the birth ball compared to the usual care during labor.

The next clinical trials should control bias and increase the length of stay in the birth ball, guiding the exercises based in the pelvic biomechanics. Maternal outcomes as anxiety, fatigue and satisfactions must be investigated, as well the admission in neonatal intensive care unit, blood pH in the umbilical cord, and neonatal heart rate variability.

Declaration of interest

The authors declare no conflicts of interest.

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Appendix A. Supplementary data

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References

- [1] A.M.L. Lago, L. Mosquera, E.T. Bouza, La pelota de parto redescubriendo un recurso no farmacológico de gran importancia en el proceso del parto, *Rev ROL Enferm* 37 (2014) 188–194.
- [2] R.J. Mercier, M. Kwan, Impact of peanut ball device on the duration of active labor: a randomized control trial, *Am. J. Perinatol.* 35 (2018) 1006–1011.
- [3] S. Makvandi, R. LatifnejadRoudsari, R. Sadeghi, L. Karimi, Effect of birth ball on labor pain relief: a systematic review and meta-analysis, *J. Obstet. Gynaecol. Res.* 41 (2015) 1679–1686.
- [4] E. Zwelling, Overcoming the challenges: maternal movement and positioning to facilitate labor progress, *MCN Am. J. Matern./Child Nurs.* 35 (2010) 72–80.
- [5] L. Pérez, Manejo del dolor del trabajo de parto con métodos alternativos y complementarios al uso de fármacos, *Matronas Prof* 7 (2006) 14–22.
- [6] G. Tulley, Spinning babies, <http://spinningbabies.com/learn-more/techniques/other-techniques/birth-balls/>, (2015).
- [7] R.W.C. Leung, et al., Efficacy of birth ball exercises on labour pain management, *Hong Kong Med. J.* 19 (2013) 393–399.
- [8] A. Lemos, *Fisioterapia Obstétrica Baseada Em Evidências*, MedBook, 2014.
- [9] Review Manager (RevMan), [Computer program]. Version [insert version number], The Nordic Cochrane Centre, The Cochrane Collaboration, Copenhagen, 2014.
- [10] J.P.T. Higgins, J.A.C. Sterne, J. Savović, M.J. Page, A. Hróbjartsson, I. Boutron, B. Reeves, S. Eldridge, A revised tool for assessing risk of bias in randomized trials, in: J. Chandler, J. McKenzie, I. Boutron, V. Welch (Eds.), *Cochrane Methods. Cochrane Database of Systematic Reviews*, vol. 10, 2016, pp. 29–31.
- [11] H. Balsem, M. Helfand, H.J. Schunemann, et al., GRADE guidelines: 3. Rating the quality of evidence, *J. Clin. Epidemiol.* 64 (2011) 401–406.
- [12] G.H. Guyatt, A.D. Oxman, R. Kunz, et al., GRADE guidelines: 2. Framing the question and deciding on important outcomes, *J. Clin. Epidemiol.* 64 (2011) 395–400.
- [13] C.M. Tussey, E. Botsios, R.D. Gerkin, L.A. Kelly, J. Gamez, J. Mensik, Reducing length of labor and cesarean surgery rate using a peanut ball for women laboring with an epidural, *J. Perinat. Educ.* 24 (2015) 16–24.
- [14] C. Roth, S.A. Dent, S.E. Parfitt, S.L. Hering, R.C. Bay, Randomized controlled trial of use of the peanut ball during labor, *Am J MaternChildNurs* 41 (2016) 140–146.
- [15] T.C. Lopes, L.M. Madeira, S. Coelho, O uso da bola do nascimento na promoção da posição vertical em primíparas durante o trabalho de parto, *Rev. Min. Enf.* 7 (2003) 134–139.

- [16] R.B.S. Gallo, L.S. Santana, A.C. Marcolin, S.M. Quintana, Swiss ball to relieve pain of primiparous in active labor, *Rev Dor* 15 (2014) 253–255.
- [17] S. Taavoni, S. Abdollahian, H. Haghani, L. Neysani, Effect of birth ball usage on pain in the active phase of labor: a randomized controlled trial, *J. Midwifery Wom. Health* 56 (2011) 137–140.
- [18] M.L. Gau, C.Y. Chang, S.H. Tian, K.C. Lin, Effects of birth ball exercise on pain and self-efficacy during childbirth: a randomised controlled trial in Taiwan, *Midwifery* 27 (2011) 293–300.
- [19] B. Delgado-García, M. Orts-Cortés, A. Poveda-Bernabeu, P. Caballero-Pérez, Randomised controlled clinical trial to determine the effects of the use of birth balls during labour, *EnfermClin* 22 (2011) 35–40.
- [20] R. Melzack, P.D. Wall, Pain mechanisms: a new theory, *Surv. Anesthesiol.* 11 (1967) 89–90.
- [21] A. Lawrence, L. Lewis, G.J. Hofmeyr, C. Styles, Maternal positions and mobility during first stage labour, *Cochrane Database Syst. Rev.* (10) (2013), <https://doi.org/10.1002/14651858.CD003934.pub4> CD003934.
- [22] M. Barbieri, A.J. Henrique, F.M. Chors, N.L. Maia, M.C. Gabrielloni, Warm shower aspersion, perineal exercises with Swiss ball and pain in labor, *Acta Paul. Enferm.* 26 (2013) 478–484.
- [23] A.M. Delgado, A.B. Freire, E.L.S. Wanderley, A. Lemos, Analysis of the construct validity and internal consistency of the state-trait anxiety inventory (STAI) state-anxiety (S-anxiety) scale for pregnant women during labor, *Rev. Bras. Ginecol. Obstet.* 38 (2016) 531–537.
- [24] S. Ebrahimzadeh, N. Golmakani, M. Kabirian, M.T. Shakeri, Study of correlation between maternal fatigue and uterine contraction pattern in the active phase of labour, *J. Clin. Nurs.* 21 (2012) 1563–1569.
- [25] Y.L. Tzeng, Y.M.Y. Chao, S.Y. Kuo, Y.K. Teng, Childbirth related fatigue trajectories during labour, *J. Adv. Nurs.* 63 (2008) 240–249.
- [26] E.D. Adams, A.L. Bianchi, A practical approach to labor support, *J. Obstet. Gynecol. Neonatal Nurs.* 37 (2008) 106–115.
- [27] J.P.T. Higgins, S. Green, *Cochrane Handbook for Systematic Reviews of Interventions* Version 5.1.0, [updated March 2018] The Cochrane Collaboration, 2018 Available from: <http://handbook.cochrane.org/>.