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Peanut ball for decreasing length of labor: A systematic review and meta-analysis of randomized controlled trials

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ABSTRACT

Introduction: Prolonged length of labor is associated with increased maternal and neonatal complications. Therefore, great attention has been given to interventions aimed at reducing the length of labor. One such intervention is the peanut ball, a large elongated exercise ball placed between a woman's legs during labor.

Objective: The aim of this systematic review and meta-analysis of randomized controlled trials (RCTs) was to assess the effect of the use of peanut ball in reducing length of labor.

Study Design: Data sources: MEDLINE, EMBASE, Web of Sciences, Scopus, ClinicalTrial.gov, OVID and Cochrane Library were searched from inception until January 2019. *Selection criteria:* Selection criteria included RCTs of laboring women with singleton gestations in cephalic presentation at term (≥37weeks) who were randomized to either use of peanut ball or control group (no peanut ball). *Data Collection and Analysis:* Four trials with 648 nulliparous and multiparous women in spontaneous or induced labor were identified and included. 330 women were randomized to the intervention (peanut ball between the knees during labor) and 318 women to the control. Summary measures were reported as mean difference (MD) with 95% of confidence interval (CI) using the random effects model of DerSimonian and Laird. The primary outcome was total length of labor. *PROSPERO Registration Number:* CRD42018082438

Results: Total length of labor was 79 min shorter in the peanut ball group, but this was not significant (MD −79.1 min, 95% CI −204.9, 46.7). Peanut ball use showed trends toward higher incidence of spontaneous vaginal deliveries (RR 1.1, 95% CI 1.0, 1.2) and lower incidence of cesarean deliveries (RR 0.8, 95% CI 0.6, 1.0).

Conclusions: Peanut ball use was not associated with a significant decrease in total length of labor. Since there were trends toward reductions in length of labor, an increased incidence in spontaneous vaginal deliveries, and lower incidence of cesarean deliveries, more research is needed.

Introduction

Prolonged labor is associated with increased maternal complications such as chorioamnionitis, perineal lacerations, endometritis, postpartum hemorrhage, as well as perinatal complications such as neonatal sepsis, lower Apgar scores, and increased admission to the neonatal intensive care unit (NICU) [1,2].

Prolonged labor and failure to progress are common indications for cesarean delivery [3]. Cesarean delivery may subject the woman to a longer recovery time and increased risk of complications during the postpartum period and in future pregnancies. Therefore, great attention has been given to interventions aimed at reducing the length of labor [4–15].

Midwives and nurses commonly use traditional birthing balls (also known as Swiss balls) to increase maternal comfort, and widen the pelvic outlet [13–15]. An alternative to the traditional

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birthing ball is the peanut ball, a large elongated plastic ball shaped like a peanut shell that is placed between a woman's legs during labor while she is lying in the lateral recumbent position [16–19]. This position is thought to mimic the upright position and facilitate widening of the pelvis and fetal descent [17]. However, there is limited research available detailing its efficacy as a laboring tool and providing guidelines for its use.

Objective

Thus, the aim of this systematic review and meta-analysis of randomized controlled trials was to assess the effect of the use of peanut ball in reducing length of labor.

Methods

Search strategy

This meta-analysis was performed according to the Cochrane protocol recommended for systematic review [20]. The review protocol was designed a priori defining methods for collecting, extracting and analyzing data. The research was conducted using MEDLINE, EMBASE, Web of Sciences, Scopus, ClinicalTrial.gov, OVID and Cochrane Library as electronic databases. The trials were identified with the use of a combination of the following text words: "peanut ball," "peanutball", "peanut labor ball", "peanut shaped ball" from the inception of each database to January 2019. No restrictions for language or geographic location were applied. In addition, the reference lists of all identified articles were examined to identify studies not captured by electronic searches.

Study selection and risk of bias

Selection criteria included randomized controlled trials of laboring women with singleton gestations with cephalic presentations at term (> = 37weeks) who were randomized to either use of peanut ball or control group (i.e. no peanut ball). Multiple gestations and preterm births were excluded.

The risk of bias in each included study was assessed by using the criteria outlined in the *Cochrane Handbook for Systematic Reviews of Interventions* [20]. Seven domains related to risk of bias were assessed in each included trial, since there is evidence that these issues are associated with biased estimates of treatment effect: 1) random sequence generation; 2) allocation concealment; 3) blinding of participants and personnel; 4) blinding of outcome assessment; 5) incomplete outcome data; 6) selective reporting; and 7) other bias. Review authors' judgments were categorized as "low risk," "high risk" or "unclear risk" of bias.

Outcomes

All analyses were done using an intention-to-treat approach, evaluating women according to the treatment group to which they were randomly allocated in the original trials.

The primary outcome of this meta-analysis was the total length of labor. Secondary outcomes were length of the first stage and second stage of labor, mode of delivery, and neonatal outcomes, including birth weight and Apgar score. Outcomes were assessed in subgroup analyses by parity.

Data analysis

The data analysis was completed using Review Manager 5.3 (Copenhagen: The Nordic Cochrane Centre, Cochrane Collaboration, 2014). Between-study heterogeneity was explored using the I^2 statistic, which represents the percentage of between-study variation that is due to heterogeneity rather than chance. A value of 0% indicates no observed heterogeneity, whereas I^2 values of $\geq$ 50% indicate a substantial level of heterogeneity.

The summary measures were reported as summary relative risk (RR) or as summary mean difference (MD) with 95% of confidence interval (CI) using the random effects model of DerSimonian and Laird.

All review stages were conducted independently by two reviewers (JG, ER). The two authors independently assessed electronic search, eligibility of the studies, inclusion criteria, risk of bias, data extraction and data analysis. Disagreements were resolved by discussion with a third reviewer (VB).

The meta-analysis was reported following the Preferred Reporting Item for Systematic Reviews and Meta-analyses (PRISMA) statement [21]. Fig. 1 shows the flow diagram (PRISMA template) of information through the different phases of review. The meta-analysis was registered with the PROSPERO

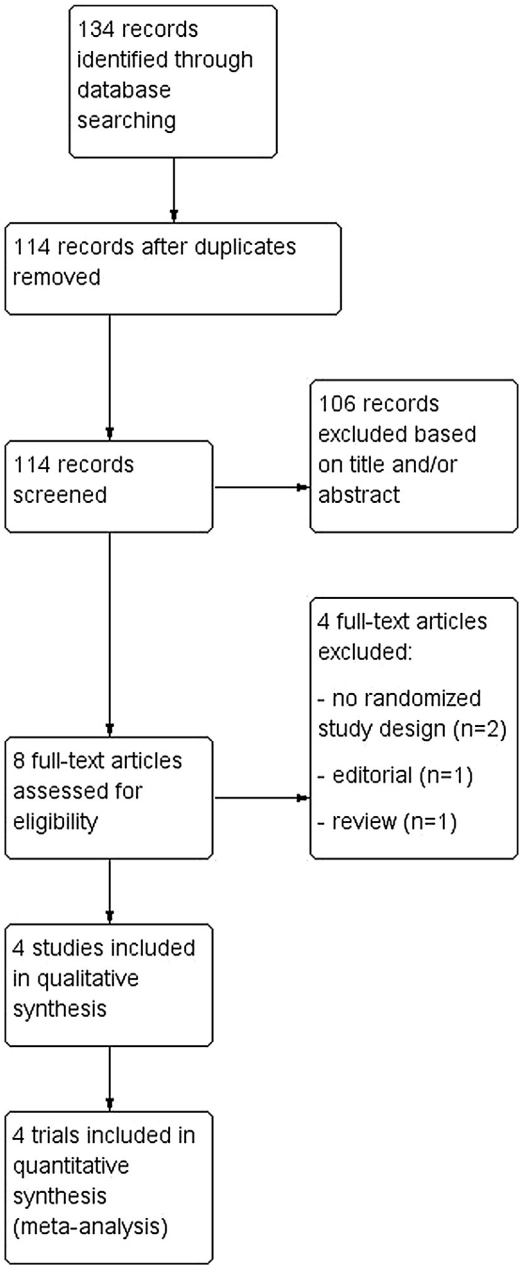

Fig. 1. Flow diagram of studies identified in the systematic review.

International Prospective Register of Systematic Reviews. The registration number is CRD42018082438.

Results

Study selection and study characteristics

Four trials were included in the meta-analysis [16–19]. All trials included only women with singleton gestations with cephalic presentation at or after 37 weeks gestation who chose an epidural for their labor pain management. A total of 648 nulliparous and multiparous women in spontaneous or induced labor were included. Of the 648 women included, 330 (50.93%) were randomized to the intervention group (peanut ball) and 318 (49.1%) were randomized to the control group (no peanut ball) (Table 1).

The intervention group (peanut ball) involved the use of a peanut shaped exercise ball placed between the knees usually soon after the epidural and until 10 cm dilation. The control group received standard care with no use of the peanut ball (Table 2).

Oxytocin use was only reported in two of the four studies [17,19]. In the studies that reported oxytocin use, 115 of 150 women (76.7%) in the peanut ball group received oxytocin and 108 of 137 women (78.8%) in the control group received oxytocin. Three of four studies reported induction of labor [16,17,19]. In one study, all women in both groups were induced [16]. In the other two studies, 54 of 150 women (36%) in the peanut ball group were induced and 52 of 137 women (38.0%) in the control group were induced (Table 3).

Risk of bias of included studies

The quality of the RCTs included in our meta-analysis was assessed by using the criteria outlined in the Cochrane Handbook for Systematic Reviews of Interventions. All the included studies had low risk of bias in "random sequence generation" Adequate methods for allocation of women were used in all the included studies (Fig. 2). Tests for funnel plot asymmetry were carried out only with an exploratory aim because the total number of publications included for each outcome was less than ten.

Synthesis of results

The primary outcome, total length of labor, was only reported in one out of the four trials [16]. In this trial, total length of labor was 79 min shorter in the peanut ball group compared to the control group; however, this difference is not significant (MD −79.1 min, 95% CI −204.9, 46.7; 1 study; 170 participants; Fig. 3). When analyzed by parity, there was also no significant difference in total length of labor between peanut ball versus no peanut ball groups in nulliparous women only (MD −94.6 min, 95% CI −298.5, 109.3; 1 study; 62 participants; Table 6) or multiparous women only (MD −89.7 min, 95% CI −238.4, 59.0; 1 study; 108 participants; Table 7).

Length of the first stage of labor was 53 min shorter in the peanut ball group versus the control group, and this difference approached significance (MD −53.2 min, 95% CI −110.8, 4.3; 4 studies; 648 participants; I^2 = 60%; Table 4). This data was further analyzed based on parity. In nulliparous women, length of the first stage of labor was 48 min shorter in the peanut ball versus no peanut ball group; however, this difference was not significant (MD −48.4 min, 95% CI −110.7, 13.7; 4 studies; 429 participants; I^2 = 49%; Table 6). Similarly, for multiparous women, the length of the first stage of labor was 65 min shorter in the peanut ball group, but the difference was not significant (MD −64.6 min, 95% CI −132.2, 2.9]; 2 studies; 198 participants; I^2 = 0%; Table 7).

There was also no significant difference in the length of the second stage of labor in the peanut ball group versus no peanut ball

Table 1
Study Characteristics.

	Location	Intervention group (n)	Control group (n)	Parity	Exclusion criteria
Roth 2016[16]	USA	89	81	Nulliparous and multiparous	Initially, there were no exclusion criteria other than those implied by inclusion criteria. Researchers later decided to exclude from analysis all women who required C-section because most did not reach 10 cm dilation.
Tussey 2015[17]	USA	107	94	Nulliparous and multiparous	Preeclampsia requiring magnesium sulfate; intrauterine infection; Category 3 fetal heart tracing
Evans 2016[18]	USA	91	100	Nulliparous	High risk pregnancies; musculoskeletal disorders; preterm or post-term gestation; diabetes; use of magnesium sulfate; planned cesarean delivery
Mercier 2018[19]	USA	43	43	Nulliparous	Multiparous, multiple gestation, under 18 years old, non-English speakers, major fetal congenital anomalies

Table 2
Intervention and control groups.

	How peanut ball was used	When enrolled in labor	When in labor started	When in labor ended	Control group
Roth 2016[16]	Peanut ball placed between knees. Additional lateral rotation of body position every 30 minutes.	Upon presenting for induction of labor	Within 30 minutes of epidural.	At 10 cm dilation	No peanut ball, maximum one pillow between knees.
Tussey 2015[17]	Peanut ball placed between knees. Additional changing of body position every 1-2 hours after epidural administration.	After receiving epidural	Immediately after epidural.	At 10 cm dilation and after passive decent of fetus.	No peanut ball
Evans 2016[18]	Peanut ball placed between knees.	Not reported	Within 30 minutes of epidural.	At 10 cm dilation	No peanut ball, receiving standard care using pillows and wedges
Mercier 2018[19]	Peanut ball placed between knees for at least 15 minutes per hour of labor.	Upon presenting to Labor and Delivery for labor or labor induction	Upon reaching 6 cm or greater dilation	At 10 cm dilation	No peanut ball, maximum 2 pillows between knees.

Table 3
Labor management.

	Oxytocin	Induction
Roth 2016[16]	Not reported	All women were induced PB: 78/78 (100%) No PB: 71/71 (100%)
Tussey 2015[17]	PB: Oxytocin used in 85/107 (79.3%) No PB: Oxytocin used in 74/94 (79.8%)	PB: 30/107 (28.0%) were induced No PB: 29/94 (31.5%) were induced
Evans 2016[18]	Not reported	Not reported
Mercier 2018[19]	PB: Oxytocin used in 30/43 (70%) No PB: Oxytocin used in 34/43 (79%)	PB: 24/43 (55%) No PB: 23/43 (53%)

PB, peanut ball.

group (MD −11.7 min, 95% CI 33.6 to 10.2; 2 studies; 371 participants; I^2 = 81%; Table 4). When analyzed based on parity, there was no significant difference between groups in nulliparous women (MD −19.7, 95% CI −45.7 to 6.4; 2 studies; 152 participants; I^2 = 46%; Table 6) or in multiparous women (MD −5.5 min, 95% CI −11.6, 0.7; 2 studies; 198 participants; I^2 = 0%; Table 7).

Use of the peanut ball versus no peanut ball resulted in trends for higher incidence of spontaneous vaginal delivery (RR 1.1, 95% CI 1.0, 1.2; 4 studies; 648 participants; I^2 = 0%; Table 4) and lower incidence of cesarean delivery (RR 0.8, 95% CI 0.6, 1.0; 4 studies; 648 participants; I^2 = 0%; Table 4). Subgroup analyses of these outcomes in nulliparous (Table 6) and multiparous women (Table 7) concurred with the overall analysis (Figs. 4 and 5).

There was not a significant difference in rate of operative vaginal delivery in peanut ball versus no peanut ball group (Table 4) overall, or in subgroup analyses of nulliparous (Table 6) and multiparous women (Table 7). There was also no significant difference found in neonatal outcomes such as Apgar score and birth weight (Table 5).

Discussion

Main findings

This meta-analysis included four trials with 648 participants and aimed to evaluate length of labor, and potential harms and benefits of peanuts ball in singleton gestations with cephalic presentation at term with epidural anesthesia. This study demonstrated that use of the peanut ball during labor results in a non-significant reduction in total length of labor by over one hour. Similarly, a trend toward reduction of first and second stage of labor was also found in the peanut ball group versus the control group, though this trend was not significant. There was also a slight increased incidence of spontaneous vaginal delivery and decreased incidence of cesarean delivery, and these data approached but did not reach statistical significance. These findings suggest that while there is no significant benefit associated with use of the peanut ball, there may be possible reduction in the length of labor and possible increased incidence of spontaneous vaginal delivery, with more research and data needed.

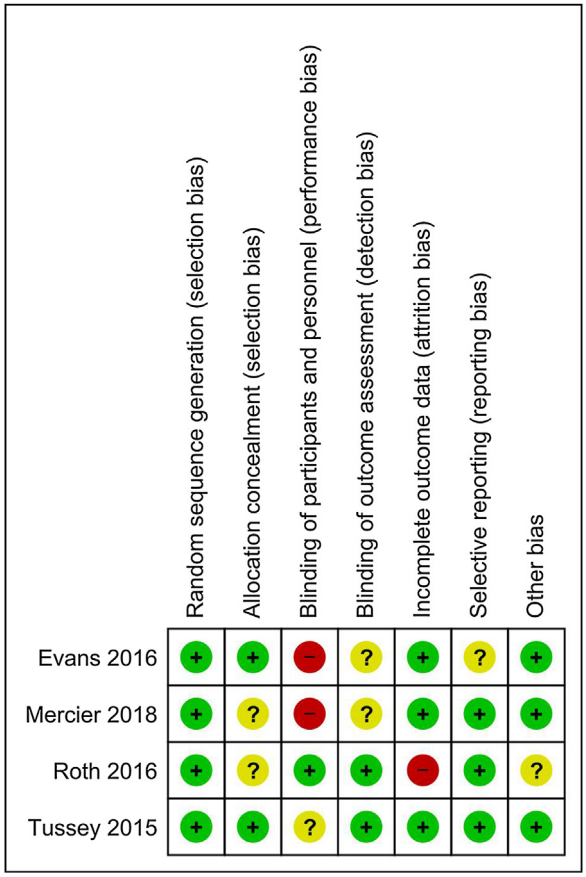

Fig. 2. Assessment of risk of bias. (A) Summary of risk of bias for each trial; Plus sign: low risk of bias; minus sign: high risk of bias; question mark: unclear risk of bias. (B) Risk of bias graph about each risk of bias item presented as percentages across all included studies.

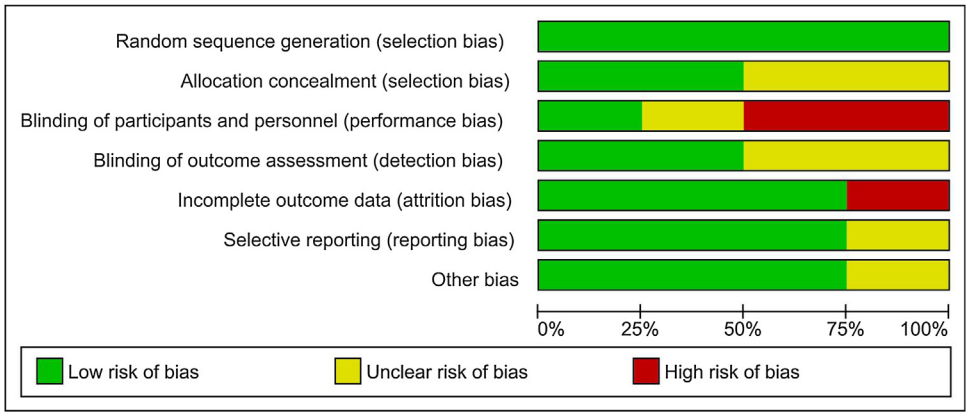

Fig. 2. (Continued)

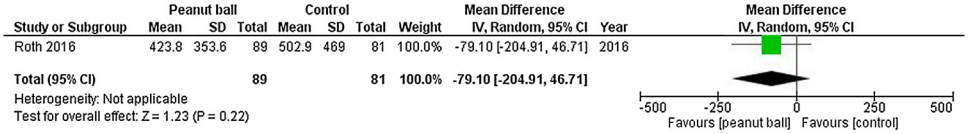

Fig. 3. Forest plot for total length of labor.

Table 4
Obstetric outcomes.

	Total length of labor (min)	1st stage (min)	2nd stage (min)	SVD	OVD	CD
Roth 2016[16]	423.8 (353.6) vs 502.9 (469.0)	370.1 (341.5) vs 449.3 (456.1)	53.7 (47.6) vs 53.6 (54.0)	73/86 (84.9%) vs 70/84 (83.3%)	4/86 (4.7%) vs 4/84 (4.8%)	9/86 (10.5%) vs 10/84 (11.9%)
Tussey 2015[17]	Not reported	250.9 (185.9) vs 343.0 (214.3)	21.5 (25.0) vs 43.8 (52.1)	87/107 (81.3%) vs 64/94 (68.1%)	9/107 (8.4%) vs 11/94 (11.7%)	11/107 (10.3%) vs 19/94 (21.1%)
Evans 2016[18]	Not reported	331.3 (187.1) vs 322.7 (174)	Not reported	70/91 (76.9%) vs 69/100 (69.0%)	0/91 vs 0/100	21/91 (23.1%) vs 31/100 (31.0%)
Mercier 2018[19]	Not reported	315 (176) vs 387 (227)	Not reported	29/43 (67.4%) vs 28/43 (65.1%)	0/43 vs 0/43	14/43 (32.6%) vs 15/43 (34.9%)
Total	424 vs 503	317 vs 376	38 vs 49	259/327 (79.2%) vs 231/321 (72.0%)	13/327 (4.0%) vs 15/321 (4.7%)	55/327 (16.8%) vs 75/321 (23.4%)
I^2	N/A	60%	81%	0%	0%	0%
RR or MD (95% CI)	−79.1 [−204.9 to 46.7]	−53.2 [−110.8 to 4.3]	−11.7 [−33.6 to 10.2]	1.1 [1.0 to 1.2]	0.8 [0.4 to 1.6]	0.8 [0.6 to 1.0]

Data presented as numbers (percentage) or as mean (standard deviation) in the intervention (peanut ball) vs control (no peanut ball) group.
RR, relative risk; MD, mean difference; CI, confidence interval; SVD, spontaneous vaginal delivery; OVD, operative vaginal delivery; CD, cesarean delivery.

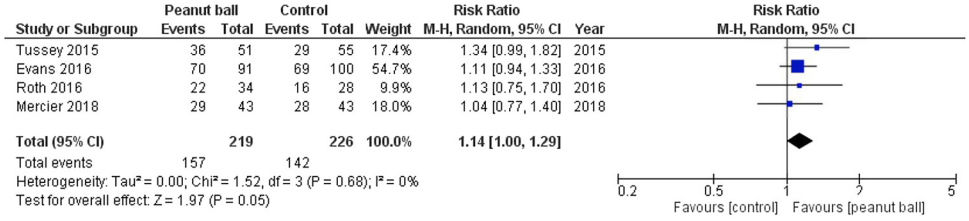

Fig. 4. Forest plot for spontaneous vaginal delivery in nulliparous women.

Strengths, limitations, and comparison with existing literature

This meta-analysis has several strengths. All randomized controlled trials published on this topic were included in this analysis. To our knowledge, this is the first meta-analysis examining whether use of the peanut ball reduces the length of labor.

Limitations of this analysis are inherent to the limitations of the included RCTs. Only four trials were included, and only one study reported data on the primary outcome. Defining length of labor is challenging since it often depends on when a woman initially presents for labor if labor is spontaneous. If labor is induced, it is still challenging because techniques used for cervical ripening can vary between patients and providers. However, the fact that all studies in this analysis are randomized should mitigate some of this variability. Additionally, subgroup analyses in RCTs are considered to be provisional; therefore, any subgroup analysis in

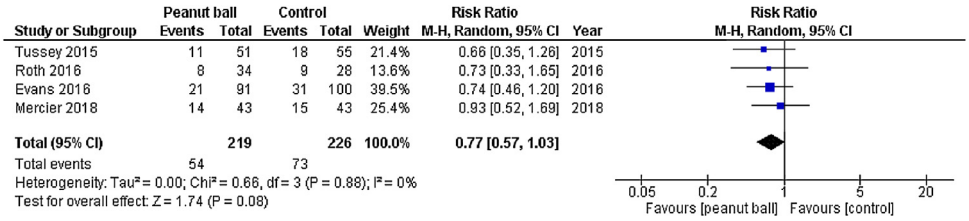

Fig. 5. Forest plot for cesarean delivery in nulliparous women.

Table 5
Neonatal outcomes.

	Birth weight (grams)	Apgar score at 1 min	Apgar score at 10 min
Roth 2016[16]	Not reported	Not reported	Not reported
Tussey 2015[17]	3,456 (452) vs 3393 (609)	8.2 (1.2) vs 8.2 (1.5)	8.8 (1.2) vs 8.8 (1.0)
Evans 2016[18]	Not reported	Not reported	Not reported
Mercier 2018[19]	3,254 (466) vs 3281 (509)	Not reported	Not reported
Total	3,355 vs 3,337	8.2 vs 8.2	8.8 vs 8.8
I^2	0%	Not applicable	Not applicable
MD (95% CI)	28.8 [−98.4 to 156.0]	0.0 [−0.4 to 0.4]	0.0 [−0.3 to 0.3]

Data presented as numbers (percentage) or as mean (standard deviation) in the intervention (peanut ball) vs control (no peanut ball) group.
MD, mean difference; CI, confidence interval.

Table 6
Obstetrics outcomes in subgroup analyses of nulliparous women.

	Total length of labor (min)	1st stage (min)	2nd stage (min)	SVD	OVD	CD
Roth 2016[16]	605.6 (403.9) vs 700.2 (410.6)	502.9 (412.7) vs 596.7 (408.5)	102.8 (49.9) vs 103.5 (69.7)	22/34 (64.7%) vs 16/28 (57.1%)	4/34 (11.8%) vs 3/28 (10.7%)	8/34 (23.5%) vs 9/28 (10.7%)
Tussey 2015[17]	Not reported	303.8 (230.7) vs 401.1 (197.1)	33.7 (27.5) vs 62.7 (60.1)	36/51 (70.6%) vs 29/55 (44.6%)	4/51 (7.8%) vs 8/55 (14.5%)	11/51 (21.6%) vs 18/55 (32.7%)
Evans 2016[18]	Not reported	331.3 (187.1) vs 322.7 (174)	Not reported	70/91 (76.9%) vs 69/100 (69.0%)	0/91 vs 0/100	21/91 (23.1%) vs 31/100 (31.0%)
Mercier 2018[19]	Not reported	315 (176) vs 387 (227)	Not reported	29/43 (67.4%) vs 28/43 (65.1%)	0/43 vs 0/43	14/43 (32.6%) vs 15/43 (34.9%)
Total	606 vs 700	363 vs 376	68 vs 83	157/219 (71.7%) vs 142/226 (62.8%)	8/219 (3.7%) vs 11/226 (4.9%)	54/219 (24.7%) vs 73/226 (32.3%)
I^2	Not applicable	49%	46%	0%	0%	0%
RR or MD (95% CI)	−94.6 [−298.5 to 109.3]	−48.5 [−110.7 to 13.7]	−19.7 [−45.7 to 6.4]	1.1 [1.0 to 1.3]	0.7 [0.3 to 1.7]	0.8 [0.6 to 1.0]

Data presented as numbers (percentage) or as mean (standard deviation) in the intervention (peanut ball) vs control (no peanut ball) group.
RR, relative risk; MD, mean difference; CI, confidence interval; SVD, spontaneous vaginal delivery; OVD, operative vaginal delivery; CD, cesarean delivery.

Table 7
Obstetrics outcomes in subgroup analyses of multiparous women.

	Total length of labor (min)	1st stage (min)	2nd stage (min)	SVD	OVD	CD
Roth 2016[16]	336.6 (292.8) vs 426.3 (471.5)	306.4 (284.7) vs 392.1 (464.7)	30.2 (21.4) vs 34.2 (29.7)	51/52 (98.1%) vs 54/56 (96.4%)	0/52 vs 1/56 (1.8%)	1/52 (1.9%) vs 1/56 (1.8%)
Tussey 2015[17]	Not reported	208.0 (126.3) vs 267.1 (214.8)	11.6 (17.5) vs 18.0 (20.0)	56/56 (100.0%) vs 31/38 (81.6%)	0/56 (0.0%) vs 3/38 (7.9%)	0/56 (0.0%) vs 4/38 (10.5%)
Evans 2016[18]*	–	–	–	–	–	–
Mercier 2018[19]*	–	–	–	–	–	–
Total	336 vs 426	257 vs 330	21 vs 26	107/108 (99.1%) vs 85/94 (90.4%)	0/108 vs 4/94 (4.3%)	1/108 (0.9%) vs 5/94 (5.3%)
I^2	N/A	0%	0%	88%	0%	44%
RR or MD (95% CI)	−89.7 [−238.4 to 59.0]	−64.6 [−132.2 to 2.9]	−5.5 [−11.6 to 0.7]	1.1 [0.9 to 1.4]	0.2 [0.0 to 1.5]	0.3 [0.0 to 4.3]

Data presented as numbers (percentage) or as mean (standard deviation) in the intervention (peanut ball) vs control (no peanut ball) group.
RR, relative risk; MD, mean difference; CI, confidence interval; SVD, spontaneous vaginal delivery; OVD, operative vaginal delivery; CD, cesarean delivery.
* Evans 2016 and Mercier 2018 included only nulliparous women.

this meta-analysis cannot be considered as definitive as analysis of the randomized group.

Conclusions and implications

Maternal positioning during labor can be modified to facilitate fetal descent and progression of labor. In the United States, women most commonly labor in a horizontal position likely due to the popularity of epidural anesthesia for pain management [11]. Women remain in bed after placement of epidural anesthesia due to risk of postural hypotension and decreased lower extremity mobility [11]. However, this horizontal position may be detrimental to the progression of labor. The pressure of the bed causes the sacrum and coccyx to be pushed anteriorly, hindering the natural widening of the pelvic outlet and interfering with fetal descent [13]. Therefore, laboring in an upright position is favored in order to widen the pelvic outlet and facilitate fetal descent. Upright positioning has also been associated with decreased operative vaginal delivery, decreased length of first and second stage of labor, and decreased incidence of perineal lacerations [13]. Some upright positions commonly used include standing, squatting or sitting, including sitting on a birthing ball [11].

While our results are not statistically significant, use of the peanut ball during labor may result in a reduction in total length of labor, first stage of labor, and second stage of labor, as well as trends for higher rate of vaginal delivery and lower rate for cesarean delivery. More data from additional RCTs are needed to determine if these trends are valid.

Disclosure

The authors report no conflict of interest.

Financial support

No financial support was received for this study.

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: None

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] Laughon SK, Berghella V, Reddy UM, Sundaram R, Lu Z, Hoffman MK. Neonatal and maternal outcomes with prolonged second stage of labor. Obstet Gynecol 2014;124(July 1):57–67.

[2] Cheng YW, Shaffer BL, Bryant AS, Caughey AB. Length of the first stage of labor and associated perinatal outcomes in nulliparous women. Obstet Gynecol 2010;116(November 5):1127–35.

[3] Gifford DS, Morton SC, Fiske M, Keesey J, Keeler E, Kahn KL. Lack of progress in labor as a reason for cesarean. Obstet Gynecol 2000;95(April 4):589–95.

[4] Aquino CI, Guida M, Saccone G, Cruz Y, Vitagliano A, Zullo F, et al. Perineal massage during labor: a systematic review and meta-analysis of randomized controlled trials. J Matern Fetal Neonatal Med 2018;19:1–13, doi:http://dx.doi.org/10.1080/14767058.2018.1512574 Sep.

[5] Riegel M, Quist-Nelson J, Saccone G, Locci M, Shrivastava VK, Salim R, et al. Dextrose intravenous fluid therapy in labor reduces the length of the first stage of labor. Eur J Obstet Gynecol Reprod Biol 2018;228:284–94, doi:http://dx.doi.org/10.1016/j.ejogrb.2018.07.019 Sep Epub 2018 Jul 17. Review..

[6] Aquino CI, Saccone G, Troisi J, Zullo F, Guida M, Berghella V. Use of lubricant gel to shorten the second stage of labor during vaginal delivery. J Matern Fetal Neonatal Med 2018;27:1–8, doi:http://dx.doi.org/10.1080/14767058.2018.1482271 Jun.

[7] Schoen CN, Saccone G, Backley S, Sandberg EM, Gu N, Delaney S, et al. Increased single-balloon Foley catheter volume for induction of labor and time to delivery: a systematic review and meta-analysis. Acta Obstet Gynecol Scand 2018;97(September 9)1051–60, doi:http://dx.doi.org/10.1111/aogs.13353 Epub 2018 Apr 25.

[8] Saccone G, Ciardulli A, Baxter JK, Quiñones JN, Diven LC, Pinar B, et al. Discontinuing oxytocin infusion in the active phase of labor: a systematic review and meta-analysis. Obstet Gynecol 2017;130(November 5):1090–6, doi:http://dx.doi.org/10.1097/AOG.0000000000000232.

[9] Ehsanipoor RM, Saccone G, Seligman NS, Pierce-Williams RAM, Ciardulli A, Berghella V. Intravenous fluid rate for reduction of cesarean delivery rate in nulliparous women: a systematic review and meta-analysis. Acta Obstet Gynecol Scand 2017;96(July 7):804–11, doi:http://dx.doi.org/10.1111/aogs.13121.

[10] Ciardulli A, Saccone G, Anastasio H, Berghella V. Less-restrictive food intake during labor in low-risk singleton pregnancies: a systematic review and meta-analysis. Obstet Gynecol 2017;129(March 3):473–80, doi:http://dx.doi.org/10.1097/AOG.0000000000001898.

[11] Shermer RH, Raines DA. Positioning during the second stage of labor: moving back to basics. J Obstet Gynecol Neonatal Nurs 1997;26(November-December 6):727–34.

[12] Commentary Paciornik M. Arguments against episiotomy and in favor of squatting for birth. Birth 1990;17(June 2):104–5.

[13] Zwelling E. Overcoming the challenges: maternal movement and positioning to facilitate labor progress. MCN Am J Matern Child Nurs 2010;35(March-April 2):72–80.

[14] Zwelling E, Johnson K, Allen J. How to implement complementary therapies for laboring women. MCN Am J Matern Child Nurs 2006;31(November-December 6)364 70.

[15] Johnson J. Birth balls. Midwifery Today 1997;43:59–67.

[16] Roth C, Dent SA, Parfitt SE, Hering SL, Bay RC. Randomized controlled trial of use of the peanut ball during labor. MCN Am J Matern Child Nurs 2016;41(May-June 3):140–6.

[17] Tussey CM, Botsios E, Gerkin RD, Kelly LA, Gamez J, Mensik J. Reducing length of labor and cesarean surgery rate using a peanut ball for women laboring with an epidural. J Perinat Educ 2015;24(1):16–24.

[18] Evans SJ, Cremering M. Use of peanut labor ball for pelvic positioning for nulliparous women following epidural anesthesia. JOGNN: Journal of Obstetric, Gynecologic & Neonatal Nursing 2016;45(Suppl S3):S47.

[19] Mercier RJ, Kwan M. Impact of peanut ball device on the duration of active labor: a randomized control trial. Am J Perinatol 2018;35(10):1006–11.

[20] Higgins JPT, Green S, editors. Cochrane handbook for systematic reviews of interventions, version 5.1.0. The Cochrane Collaboration; 2011 (update March 2011).

[21] Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. J Clin Epidemiol 2009;62:1006–12.