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Effect of Different Birth Balls Used at the First Stage of Labor on Birth Outcomes and Maternal Satisfaction: A Randomized Controlled Trial

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ABSTRACT

Objective: This study aimed to determine the effectiveness of different birth balls used at the first stage of labor on fetal head descent, pain intensity, and maternal satisfaction.

Methods: This study used a single-blind, randomized controlled experimental design. It was conducted with 180 primipara women in a maternity hospital in Erzurum, Turkey between October 2018 and December 2019. Women were randomized into 3 groups: A=Control group (n=60), B=Spherical birth ball group (n=60), and C=Peanut ball group (n=60). Birth balls were initiated in the active phase in the first stage of labor when cervical dilatation was 4 cm. Data were collected using the Personal Information Form, the Visual Analogue Scale (VAS), the Verbal Rating Scale (VRS), Partograph, and the Scale for Measuring Maternal Satisfaction in Birth (SMMSB).

Results: In the active and transitional phases of labor, the VAS and VRS scores for labor pain perception of Group B were statistically significantly lower than the scores of Group A and C (p<.05). Compared to other groups, Group B had a faster rate of fetal head descent. Group B also had the highest maternal satisfaction rate (83.3%), and the difference between the groups was found to be significant (p<.05).

Conclusion: This study revealed that different birth balls reduced pain, accelerated the rate of fetal head descent, and increased maternal satisfaction at the active and transition phases of the first stage of labor.

Keywords: Labor pain, birth balls, satisfaction, non-pharmacological methods

1. INTRODUCTION

Women can experience some negative effects, particularly labor pain (slowdown of labor, anxiety, fear, increase in uterus contractions, etc.) due to the physiological and psychological factors experienced during labor (1). Expansion and strain of the cervix during labor cause uterus muscles to contract and push the fetus out, making the mother feel pain (2). Defined as acute pain during the labor process, labor pain is the most severe type of pain known (3).

Pharmacological or nonpharmacological methods can be utilized to relieve this pain during the labor process. When the potential adverse effect on the mother and the fetus is taken into consideration, the use of pharmacological methods may not be the first option. Therefore, trying effective nonpharmacological methods is often the primary option for the management of labor pain. Exercises done using birth balls may increase blood flow to the uterus and relax muscles and therefore decrease pain (2). Besides, focusing the pregnant woman's attention on the movements and positions during the exercise may also decrease the perception of pain (1,4). In addition, birth ball exercises can relax back muscles, increase comfort, and decrease pain (1). Birth ball exercises are reported to decrease pain in the pelvic region and back during labor (5-7), facilitate the progression of the fetus in the birth canal, shorten the latent phase, and decrease the need for epidural analgesia and cesarean section (5,6). Labor motivation can be increased by decreasing pregnant women's anxiety or bringing it under control (8,9). Birth balls can be utilized to increase maternal comfort and expand the pelvic outlet during labor (10,11).

Sitting and swinging on a ball helps the woman to feel comfortable and increases the endorphin release because the flexibility of the ball stimulates receptors responsible for endorphin release in the pelvis (10). Besides, the effect of gravity helps the progression of birth and expansion and relaxation of pelvic muscles and bones, which enhances fetal descent. The use of birth balls during labor also prevents the mother from staying in the supine position all the time during labor (2,12). Large, long peanut balls are an alternative to traditional round balls, which are used by placing them between legs in a side-lying position during labor (14-16). Vertical use of this position out of bed is known to enhance the expansion of the pelvis as well as fetal descent with the effect of gravity (12,13).

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The literature reports the use of peanut balls and spherical birth balls as nonpharmacological methods for providing relief (such as a decrease in labor pain and duration, increase in cervical dilatation, decrease in fear and stress, and distraction with ball exercises) to laboring women (14-16). Most studies have focused on spherical birth balls (6,8,14,17). Only a limited number of studies have investigated the use of peanut balls, indicating the need for more evidence-based, randomized controlled trials on this topic (14-16,18). In addition, there is limited evidence on the comparative effectiveness of birth balls. Therefore, this study aimed to provide a valuable contribution to the literature by investigating both birth balls.

This study aimed to determine the effectiveness of different birth balls used at the first stage of labor on fetal head descent, pain intensity, and maternal satisfaction. Birth balls could offer an alternative midwifery practice for the management of labor.

2. METHODS

2.1. Design

This randomized controlled single-blind experimental study was conducted in the only public maternity hospital that provided secondary care services in a city located in eastern Anatolia between October 2018 and December 2019. The delivery room in the hospital includes five beds separated with curtains between them.

2.2. Participants

Approximately 8583 deliveries take place in a year in the hospital where the study was conducted, and the number of natural deliveries was 450 in the month the data were collected. The target population of the study consists of primipara pregnant women who applied to the maternity hospital for labor between October 2018 and December 2019. Those who were admitted to the delivery room and met the study inclusion criteria were included in the research.

2.3. Sample

A G*power (3.1.9.6) analysis was conducted to calculate the number of participants to be taken into groups (19,20). The sample size in this study was similar to that of Taavoni et al. (2016) taking the pain scores in their study as reference, effect size (0.64), 5% margin of error (α=0.05) and 99% power (1-β=0.99) were calculated as 54 participants for each group (21). Considering possible data losses, the number of samples was increased by 10% and it was aimed to include 60 participants for each group.

2.3. Inclusion Criteria

Inclusion criteria for the study were as follows: being aged 18 and above, having term pregnancy (38-40 weeks), having an estimated fetal weight of less than 4000 g based on ultrasound and clinical examinations, having a normal pelvic diameter based on vaginal examinations, being primiparous, having a singleton pregnancy, carrying a live fetus, having 4 cm of cervical dilation, having no risks regarding the pregnancy and the fetus, and having a head presentation.

2.4. Exclusion Criteria

Reluctance to participate in the study and undergoing an emergency cesarean section were the exclusion criteria.

2.5. Randomization

The single-blind randomized play-the-winner (PW rule) was applied for randomization (22). According to this rule, the same type of paper on which A, B, C were written were placed in a box (inside of the box could not be seen). The box had 60 A, 60 B, and 60 C papers, a total of 180 papers inside. Each pregnant woman chose a random paper from the box and was assigned according to the group written on the paper. The paper randomly chosen by the pregnant woman was put back after the procedure was completed. This process was continued until the target number of samples for each group was reached. When the number of samples in a group was reached, the papers belonging to that group were removed from the box. Each group included 60 primipara pregnant women. The CONSORT 2010 (23) flow diagram was created with a sample of 180 primipara pregnant women (Fig.1). As a result of the Post hoc power analysis made with the data obtained from the study, the power of the study was found to be 81%, sufficient in the number of 180 samples.

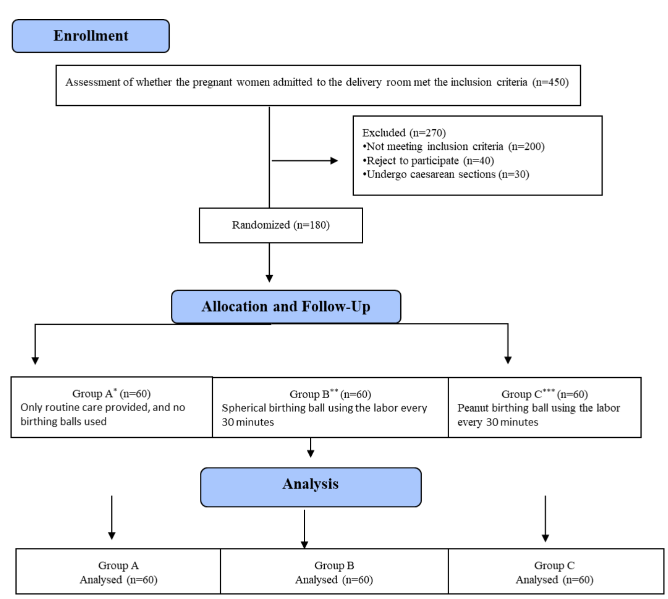


Figure 1. *Study diagram*
**Control Group*
*** Spherical Ball Group*
****Peanut Ball Group*

2.6. Data collection tools

Data were collected using the "Personal Information Form", the "Visual Analogue Scale (VAS)", the "Verbal Rating Scale (VRS)" (Since pain is a subjective phenomenon, a verbal rating scale (VRS) was added to allow pregnant women to express them verbally, considering the possibility that they could not evaluate it visually (VAS), "Partograph", and the "Scale for Measuring Maternal Satisfaction in Birth (SMMSB)".

The Personal Information Form: The form consisted of 7 questions about participating women's sociodemographic (age, education level, employment, and income level) and obstetric characteristics (number of pregnancies, miscarriages, abortions).

The Visual Analogue Scale (VAS): The scale was utilized to determine the intensity of labor pain (24). It was developed by Hayes and Patterson in 1921 (25,26). It has a 10cm long vertical line, with 0 at the bottom end (no pain) and 10 at the top end (very severe pain) (1). VAS is a very easy, efficient, cost-effective, and repeatable pain severity measurement method that determines the perceptions of women regarding pain experiences. Participating women were asked to mark the number corresponding to their pain intensity on the line. Cronbach's alpha value of the scale is .92 (27). Labor pain data were collected by VAS during labor.

The Verbal Rating Scale (VRS): The scale developed by Melzack and Targerson is intended to determine the severity of the participants' pain. Participants are asked to describe the severity of pain as mild (1), discomforting (2), distressing (3), horrible (4), and excruciating (5). Respondents are asked to select the option that best describes their pain (28).

Partograph*:* Partograph is used for routine monitoring of labor, helps in identifying slow progress in labor, and also initiates appropriate interventions to prevent prolonged and obstructed labor. It is a single sheet of paper which includes information about the fetal heart rate, uterine contraction, state of membranes and colour of fluid, cervical dilatation, and fetal head descent. Partograph was utilized to determine the fetal head descent in the first stage of labor (active and transition phases). Partograph is started when the cervical dilatation is 4 cm, and data are recorded on the form until delivery (29).

The Scale for Measuring Maternal Satisfaction in Birth (SMMSB): The scale is utilized to assess maternal satisfaction in normal delivery. The scale consists of 43 items responded on a 5-point Likert scale with options including "1-Disagree, 2-Partly agree, 3-Undecided, 4-Agree and 5-Strongly agree". Cronbach's alpha reliability coefficient of the scale was found 0.91. Higher total scores on the scale indicate higher maternal satisfaction with the hospital care provided during normal delivery (≥150.5 high satisfaction rate, <150.5 low satisfaction rate) (27). Cronbach's alpha reliability coefficients of the scale according to the groups were found as 0.85 for the control group, 0.89 for the spherical ball group, and 0.85 for the peanut ball group.

2.7. Interventions

In Groups B and C

While the women in Group B were given spherical birth ball, the women in Group C were given peanut ball; in each group, pregnant women's height was taken into consideration for the size of the balls to be given. Pregnant women used delivery balls (spherical or peanut balls) during the active period in the first stage of labor (cervical dilatation was started when it was 4 cm and continued until it reached 9 cm).

The researcher participated in a course for the training of trainers for Pilates during pregnancy and received a certificate. Positions and movements to be performed with birth balls were designed based on the information obtained during the literature review (1,2,6,8,12,16,30-32). Before the implementations started, the positions and movements to be performed by women were introduced and demonstrated by the researcher according to the groups the participants were included. Round birth ball exercises were composed of 4 different positions (sitting on a round birth ball leaning in front, kneeling on the floor and leaning on the birth ball, sitting on the ball, and side-lying position in bed) and movements to be performed with these positions (swing hips right-left, front-back, round the circle, jumping on the ball) (Group B). Peanut ball exercises included five different positions (half-sitting position, tucked side-lying position, hands and knee fire hydrant position, straddling position, forward-leaning position) and movements suitable to these positions (jumping, right-left, front-back on the ball) (Group C). It is clearly stated in the literature which positions and movements to be made with birth balls during labor. Changes were made between positions and movements according to the baby's position and the mother's comfort. These positions and movements done using birth balls realize pelvic rotation, increase pelvic mobility, and relax pelvic muscles and joints, which decreases labor pain and helps the baby to descend to the birth canal more easily (1,2,6,8,12,16,30-32). Positions and movements were performed every 30 minutes. The pregnant women were allowed to rest when they were tired or wanted to take a break. Partograph was started when the cervical dilatation was 4 cm. Fetal head descent level was evaluated and recorded on the partograph every hour until delivery. Evaluation of the cervical dilation and partograph record of the fetal head descent level was performed by the midwife. The VAS and VRS were assessed at the end of each phase of labor by the researcher.

The SMMSB was administered to the mothers within 1-4 hours in the postpartum period. All data were collected by the researcher. Midwives provided support to both pregnant women and the researcher in this process.

In Control Group (A)

Only routine midwifery care including cervical dilatation and effacement, contraction, fetal heart rate and vital signs monitoring was applied to the control group during labor. No other non-pharmacological method was applied to the control group. All data were collected by the researcher.

2.8. Data Analysis

The data were analyzed using the SPSS (IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.) software program. The statistician who analyzed the data was blinded to the groups (single-blind). The data were assessed using numbers, percentages, means, chi-square, One-Way ANOVA, and Repeated Measures. The Bonferroni test was utilized to determine the source of significant differences. Statistical significance was taken p-value of <.05.

2.9. Ethical Considerations

Before the study was conducted, ethics committee approval was obtained from the Atatürk University Faculty of Medicine Clinical Research Ethics Committee (B.30.2.ATA.0.01.00/237 numbered and 04.10.2018 dated) and the Erzurum Provincial Health Directorate of Nenehatun Maternity Hospital, where the study was conducted (44827528-604.02 numbered and 11.16.2018 dated). Written and verbal consent was received from all participating women. All the procedures were carried out in accordance with the principles of the Helsinki Declaration. In addition, this study was registered to the ClinicalTrials.gov with the ID number of NCT04827797.

Table 1. *Comparison of sociodemographic and obstetric characteristics according to groups.*

		Group A*		Group B**		Group C***		Test and p value
		n	%	n	%	n	%	
Socio demographic Characteristics	**Age** 18-24 25 and older	39 21	65.0 35.0	42 18	70.0 30.0	37 23	61.7 38.3	X^{2a}=0.93 p=0.62
	Education Level Elementary Secondary Higher	21 31 8	35.0 51.7 13.3	26 19 15	43.3 31.7 25.0	25 20 15	41.7 33.3 25.0	X^2=6.962 p=0.13
	Employment Status Employed Unemployed	5 55	8.3 91.7	7 53	88.3 11.7	6 54	10.0 90.0	X^2=0.37 p=0.83
	Income Status More income than ex. Income equal to ex. Lower income than expenses	16 41 3	26.7 68.3 5.0	10 42 8	16.7 70.0 13.3	21 31 8	35.0 51.7 13.3	X^2=8.45 p=0.076
		n %		n %		n %		Test and p value
Obstetric Characteristics	**Number of Pregnancies** 1 2	55 5	91.7 8.3	54 6	90.0 10.0	57 3	95.0 5.0	X^2=1.08 p=0.581
	Number of Miscarriages 0 1	55 5	91.7 8.3	54 6	90.0 10.0	59 1	98.3 1.7	X^2=3.75 p=0.15
	Number of Abortions 0 1	60 -	100.0 -	60 -	100.0 -	58 2	96.7 3.3	X^2=4.04 p=0.13

a: Chi square test
**: Control Group*
***: Spherical ball group*
****: Peanut ball group*

3. RESULTS

The groups were found to be homogenous as they had similar sociodemographic and obstetric characteristics. As shown in Table 1, there is no statistically significant difference between the groups (p>.05).

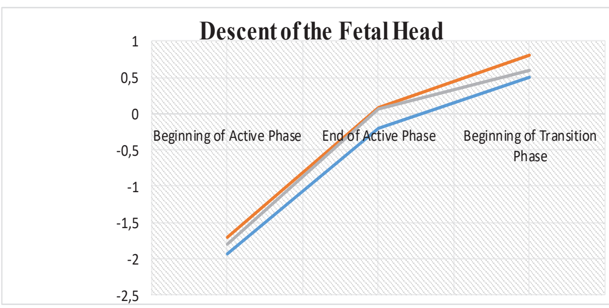
When the VAS and VRS mean scores were analyzed, a statistically significant difference was found in the VAS and VRS mean scores of the groups in the active and transition phases (p<.05). Further analysis showed that Group A was the source of the difference between VAS and VRS mean scores (Bonferroni test) (Table 2). Paired comparisons were also performed in the analyses. VAS and VRS analyses performed in the active and transition phases found that the control group's mean score was higher in comparison to other groups, and the difference was significant (e>f, e>g, f>g, h>ı, h>j, p<.05). However, the mean scores were found to be similar in the comparison of the peanut and round ball, but the difference was not significant (e≈f, ı≈j, p>.05) (Table 2).

Table 2. *Comparison of mean scores on the VAS and VRS according to groups.*

Pain perception intensity				
VAS Application Time	**Group A* (n=60)** $\bar{X}$ ± SD	**Group B** (n=60)** $\bar{X}$ ± SD	**Group C*** (n=60)** $\bar{X}$ ± SD	**Test and p value**
Active phase	7.40±1.59[e]	5.64±1.60[f]	5.11±1.70[g]	F=32.11 **p=.000**
Transition phase	9.53±0.63[h]	8.31±1.30[ı]	8.74±1.06[j]	F=21.39 **p=.000**
Test* and p value	F=387.48, **p=.00**	F=249.31, **p=.00**	F=304.12, **p=.00**	
VRS Application Time	**Group A (n=60)** $\bar{X}$ ± SD	**Group B (n=60)** $\bar{X}$ ± SD	**Group C (n=60)** $\bar{X}$ ± SD	**Test and p* value**
Active phase	3.51±0.77[e]	2.83±0.82[f]	2.85±0.65[g]	F[c]=15.98 **p=.001**
Transition phase	4.75±0.59[h]	3.78±0.80[ı]	4.03±0.55[j]	F[c]=37.46 **p=.001**
Test[b] and p[d] value	F=225.09, **p=.001**	F=175.63, **p=.001**	F=181.44, **p=.001**	

**: Control Group*
***: Spherical ball group*
****: Peanut ball group*
[b]*Bonferroni test*
[c] *One-Way ANOVA*
[d]*p<0.05*
[e]*(Active phase-Group A)*
[f]*(Active phase-Group B)*
[g]*(Active phase-Group C)*
[h]*(Transition phase – Group A)*
[ı]*(Transition phase-Group B)*
[j]*(Transition phase-Group C)*

The rate of fetal head descent was compared by the groups, and it was found to be faster in Group B in comparison to other groups (0.8). The rate of fetal head descent was statistically significant at the end of the active phase (p<.05). Further analysis showed that Group A was the source of the difference between the level of fetal head descent scores (Bonferroni test) (Fig. 2).



	Beginning of Active Phase	End of Active Phase	Beginning of Transition Phase
Control Group (A)	-1.93	-0.2	0.5
Spherical Ball Group (B)	-1.7	0.08	0.8
Peanut Ball Group (C)	-1.8	0.06	0.6
Significance	0.38	0.04	0.08

Figure. 2. *Comparison of descent of the fetal head for the pregnant women*

When the level of satisfaction was compared by the groups, the women in Group B were found to have the highest satisfaction levels (83.3%), and the women in Group A had the lowest satisfaction levels (58.3%); the difference between the groups was found to be significant (p<.05) (Table 3). The level of satisfaction was also compared and the results showed that while the participants in Group B had the highest satisfaction levels (83.3%), the participants in Group A had the lowest satisfaction levels (58.3%); the difference between the groups was found to be significant (p<.05) (Table 3).

Table 3. *Comparison of the pregnant women's total mean scores and cut-off point percentages for the SMMSB k*

	Group A* (n=60) $\bar{X} \pm$ SD		Group B** (n=60) $\bar{X} \pm$ SD		Group C*** (n=60) $\bar{X} \pm$ SD		Test and p value
Total scale point	145.66±18.30		171.20±19.44		157.90±15.09		F=31.18 **p=.001**
Scale Cut-Off Point	**Group A**		**Group B**		**Group C**		**Test and p value**
	n	**%**	**n**	**%**	**n**	**%**	
Satisfaction level Low (<150.5)	35	58.3	10	16.7	19	31.7	X^2=23.32 **p=.001**
High (≥150.5)	25	41.7	50	83.3	41	68.3	

**: Control Group*
***: Spherical ball group*
****: Peanut ball group*
[k]SMMSB: Scale for Measuring Maternal Satisfaction in Birth

4. DISCUSSION

Both birth balls utilized in this study were found to affect the pain perception levels, but the spherical birth balls were found to have the highest effect. Several studies that investigated the effect of the use of birth balls on pain have shown that the use of the balls reduced labor pain significantly (7,9,17,30,32-39). A randomized study indicating that nonpharmacological methods reduced the severity of labor pain reported that the use of a peanut ball in 4-5 cm cervical dilatation, massage application in 5-6 cm cervical dilatation, and a hot shower after 7 cm cervical dilatation reduced labor pain significantly (40).

A clinical study showed that free positioning with birth balls could directly reduce women's labor pain by enlarging the dimensions and mobility of pelvic and fetal positions (38). Another study reported that the use of birth balls in midwifery and nursing could relieve pain and enhance smooth delivery (41). There are several mechanisms to explain the labor pain process. The first one is the endogenous mechanism gate-control theory, which is composed of the transmission of pain-free messages to the painful area. This mechanism has a key role in the sensory distinguishing components of pain by blocking some of the nociceptive messages in the spine. The soft surface of birth balls can support and massage the perineum and the back, relieving some pressure. When women rock the pelvis on the ball, they stimulate normal somatosensory input to the projector neurons, which may relieve the pain perception (5). According to this theory, a birth ball supports the perineum and decreases pressure. Besides, some studies indicate that compared to the supine position, movement freedom and upright positions assisting gravity like sitting on a swinging chair during labor, sitting on a birth ball or toilet enhance the fetus descent, decrease contractions and labor pain, and increase the quality and efficiency of the labor (5,6,12,17,42,43). In this way, women's being in comfortable positions helps them to cope with uterus contractions during the labor process.

The present study found that the participants in spherical birth ball had a faster rate of fetal head descent and was statistically significant at the end of the active phase. This faster rate of fetal head descent could be attributed to the increase of dilatation thanks to the birth balls and the downward movement of the fetal head due to gravity. Studies show that due to the use of gravity, even with the patient in semi-flexed postures and the lateral decubitus position, there is a favor in the descent of the fetal pole into the pelvic cavity, helping to dilate and efface the cervix (44-46). Studies that investigated the effects of the use of birth balls indicate a statistically significant correlation between the groups regarding the level of fetal head descent (9,30,33,47). Mercier and Kwan (14) conducted one of the first studies that investigated the effects of peanut balls on the active phase of labor and specifically examined these effects in terms of descent and rotation of the fetus. The results of the study indicated that although the intended aim of the peanut ball was to facilitate better descent and rotation of the fetus, there was no difference between the groups. Movements such as swinging and jumping with a birth ball by stimulating the pelvic floor increase pelvic outlet by 30%; relax connectives, sacroiliac joints, and muscles in the pelvic region; decrease pressure on the bladder, back, and coccyx; increase the blood flow to the uterus; optimize the fetal blood circulation; and enable the descent of the fetus easily and rapidly with the effect of gravity (2,35,45). Therefore, the birth balls used in this study are believed to accelerate the duration of fetal head descent.

In our study we found that the control group had lower levels of satisfaction and the spherical ball group had high levels of satisfaction. According to the results of the studies examined in the literature, the use of birth balls significantly increased maternal satisfaction levels (37,48). A study done at Bellarmine University (17) and examined how participants felt about the use of the peanut ball in the first and second stages of labor found that the feedback was positive in the participants who used a peanut ball for labor. Tussey et al. (13) reported that the peanut ball was well received by the patients who expressed satisfaction during labor and did not cause discomfort. By focusing the attention on moving with a ball, the use of birth balls decreases stress and tension during labor and increases satisfaction. Besides, movements done on the ball enable endorphin release because the flexibility and slope of the ball stimulate receptors responsible for endorphin release in the pelvis, which increases the mother's feelings of relaxation (2,47). It could be concluded that mothers' satisfaction levels increased as a result of the movements of the sitting position on the ball.

5. CONCLUSION

This study found that in comparison to usual care, the pain level was lower, fetal descent was faster, and mother satisfaction was higher in the groups that utilized different birth balls in the active and transition phases of labor. Round birth ball reduced pain more than the peanut ball. Pregnant women in the round birth ball group had higher satisfaction compared to other groups. Midwives can utilize birth balls in care practices in the labor process.

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Author Contribution:

Research idea: TS

Design of the study: TS, SEA

Acquisition of data for the study: TS

Analysis of data for the study: TS, SEA

The statistician Interpretation of data for the study: TS, SEA

Drafting the manuscript: TS, SEA

Revising it critically for important intellectual content: TS, SEA

Final approval of the version to be published: TS,SEA

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