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Effect of Antenatal Exercises on Second Stage of Labor Outcomes in Nulliparous Women

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ABSTRACT The second stage of labor (SSL) has often been neglected, leading to birthing complications, perinatal morbidities, and higher rates of cesarean section (CS) in nulliparous women. In this paper, it was aimed to determine the effect of antenatal exercises on labor outcomes in nulliparous women. Two-group posttest-only randomized study. Overall, 60 nulliparous women at their 30th to 32nd weeks of gestation were allocated into two groups randomly. Group (A) received only routine antenatal care and educational instructions till the time of delivery (n=30), while group (B) received the same routine antenatal care and educational instructions in addition to antenatal exercises till the time of delivery (n=30). Comparing both groups revealed that group (B) had a significant increase in the number of spontaneous vaginal deliveries ($p<0.05$) and a significant decrease in duration of SSL ($p<0.05$), without any need to admit their neonates to the neonatal intensive care unit (NICU).

INTRODUCTION

Delivery is a complex event, especially in nulliparous women. A positive experience of labor is vital for the woman's health (Aral et al. 2014; Deliktas and Kukulu 2018). The process of natural childbirth is usually divided into three stages. These steps include the following:

The First Stage: This stage consists of three phases: latent, active, and transitional. Latent phase: It is the longest phase of labor, and its intensity is less than the others. In this phase, the number of contractions increases and helps to open the cervix. This phase is not very annoying, and during it, the cervix opens and becomes thin. If the uterine contractions are regular, the opening of the cervix is usually checked regularly. Active phase: The opening and thinning of the cervix proceed more rapidly, and the mother may feel severe pain or pressure in the lower back and abdomen with each contraction. She may also feel pressure in the anal area, which she has to push so hard, but her doctor will tell her to wait until the cervix is fully open. Transfer phase: The cervix opens completely and is 10 cm wide. Uterine contractions with intensity, pain, and more frequent turns; occur every three to four minutes for 60 to 90 seconds.

The Second Stage: This stage begins with the full opening of the cervix and ends with the exit of the fetus. At this stage, the mother's role has a great impact on the progress of labor, and her doctor will ask her you to push. The pressure of pushing and squeezing the uterus will push the baby down the birth canal. The softness and flexibility of the skull bones and the distances between these bones help the baby's head to pass through the birth canal, and finally,

the baby's head is seen and removed from the mother's genital area. As soon as the head comes out, the doctor removes the amniotic fluid, blood, and lining of the uterus from the baby's nose and mouth by suction or suction. After the head, the shoulders, and then other parts of the body come out of the vagina. In all these stages, the mother has to keep pushing. She should not forget that the pressure is more effective with concomitant uterine contractions, and also should remember to take deep breaths between labor pains to have more power to continue labor (Burke et al. 2017; Lavender et al. 2018).

The Third Stage: After the baby is born, the mother enters the final stage of labor. At this stage, the placenta, which was responsible for feeding and oxygenating the fetus, separates from the uterine wall and leaves the vagina. This step may take between five and 30 minutes.

Childbirth is one of the crises in a woman's life and the second stage of childbirth is extremely painful, which requires a lot of energy and causes pain, anxiety and fatigue in the mother. It is necessary to take the necessary measures to prevent these problems. The second stage of labor (SSL) is mainly characterized by fetal descending and expulsion from the maternal pelvis. This SSL consists of two phases; phase1 includes passive descent of the fetus through the maternal pelvis, while phase 2 includes the active phase of maternal pushing. Phase 2 is often characterized by frequent, regular uterine contractions, and an overwhelming maternal urge to bear down (Shen et al. 2017; Lavender et al. 2018).

Negligence in the management of SSL often leads to birthing complications and perinatal morbidities (Singh et al. 2018). The SSL may get extended due to cephalopelvic disproportion, abnormal fetal position and poor expulsive efforts resulting from maternal exhaustion, leading to higher rates of emergency cesarean section (CS) (Hobbs et al. 2016; Burke et al. 2017). CS may result in several maternal and neonatal complications such as intra partum or post-partum hemorrhage, infection, increased mortality rate, preterm delivery, and neonatal respiratory complications. Moreover, mothers' inabilities after CS lead to unsuccessful breastfeeding and impose financial burdens on families (Aral et al. 2014; Hobbs et al. 2016; Ghanbari-Homayi et al. 2019).

Exercise is an integral part of normal life (Kader and Naim-Shuchana 2014). Exercise is recommended for pregnant women to promote comfort, maintain muscle tone, promote a positive body image, increase awareness of good body mechanics, prepare them for childbirth and enable speedy recovery after delivery (Moyer et al. 2016). It has been suggested that prenatal training, which is specifically targeted at SSL position training, affects the risk of vaginal delivery. A Cochrane review has revealed that assuming upright positions during the SSL in women without epidural had reduced instrumental vaginal delivery rate (Gupta et al. 2017).

Antenatal education for nulliparous and their families can overcome this limitation. Childbirth educators, especially women's health physiotherapist and nurse, can help to facilitate the comprehensive knowledge of potential obstetric complications. Antenatal exercise sessions help in providing training on the best way of performing antenatal exercises, as well as giving advice on positions of ease during the different stages of labor together with teaching breathing awareness and relaxation to prevent maternal nervous fatigue (Dilaxshan et al. 2017). Thus, this study aimed to raise the awareness about the effect of antenatal exercises on SSL outcomes in nulliparous women.

Research Objective

As mentioned earlier, the SSL has often been neglected leading to birthing complications, perinatal morbidities and higher rates of CS in nulliparous women. Exercise during pregnancy can prevent and limit the side effects of mother and fetus during childbirth. For this reason, in this paper, it is tried to determine the impact of antenatal exercises on labor outcomes in nulliparous women.

MATERIAL AND METHODS

The Design of Study

The present paper is designed as a randomized trial with only two-group post-test. Ethical approval was obtained from the Ethics Committee at Beni Suef University Hospital and by the Board of Institutional Review in the Schools of

Physiotherapy and Nursing, Beni-Suef University [BSU.PT.09/13/4/2019]. It should be noted that this article follows the guidelines of the Declaration of Helsinki (GDH) on Human Research. This was done from the beginning of December 2018 until the end of May 2019.

Participants

Sixty nulliparous women (no previous birth $\geq$ 24 weeks of gestation) were employed from the maternity unit of Beni-Suef University Hospital to be included in the study. All participants were healthy women at their 30th to 32nd weeks of gestation, had a singleton healthy fetus in cephalic presentation, and intended to give a spontaneous vaginal birth. Their age ranged from 18-35 years and also their body mass index (BMI) did not exceed 30 kg/m^2. Participants were excluded if they had heart diseases, lung diseases, incompetent cervix or cervical cerclage, intrauterine fetal growth retardation, hypertension, diabetes mellitus, severe anemia, thyroid disease, underweight, abnormalities of placentation (for example, low-lying placenta or abruption placentae), uterine structural abnormalities, or any medical or obstetrical complication that may affect second stage management.

Interventions

Group (A) included 30 nulliparous women who received only routine antenatal care and educational instructions till the time of delivery, while group (B) included 30 nulliparous women who received the same routine antenatal care and educational instructions in addition to antenatal exercises till the time of delivery. All participants in both groups were instructed to contact the fourth researcher (nurse) at the onset of labor to attend with her and to arrange with the obstetrician to observe and register all data needed for the analysis.

Routine Antenatal Care

All nulliparous women in both groups received their routine antenatal care, by their obstetrician, till the time of delivery. They attended scheduled clinic visits biweekly until the 36th week of gestation, then weekly until delivery. The care included several screening tests, diagnostic measures and prophylactic managements. Some of which were customarily done while others were provided to women according to the identified problems (Ngxongo 2018).

Educational Instructions

All nulliparous women in both groups received educational instructions till the date of delivery, about the onset of labor, different stages of labor, importance of positioning during the SSL, as well as effects of different pushing techniques with great attention to thoroughly explain benefits and hazards of both pushing techniques (Simpson 2006). Also, they were advised on ideal posture for lifting objects, traveling, sexual intercourse and showering in the last trimester of pregnancy (Khot and Polmear 2011; Hezelgrave et al. 2011; Waters et al. 2014).

Antenatal Exercises

Group (B) participants were trained on antenatal exercises till the time of delivery. The exercise program parameters were in accordance with the American College of Obstetrics and Gynecology (ACOG) guidelines, which includes 3 times a week, relatively hard endurance intensity, time of 60 minutes a day and type of low impact aerobic, strengthening and stretching exercises (Perales et al. 2017). Each session included 10 minutes of aerobic training in the form of walking on a treadmill at intensity of 60–80 percent of maximal aerobic capacity (VO_{2max}), which was preceded by a 5-minute warm-up and followed by a 5-minute cool-down (Davies et al. 2018). Then, women performed calf stretch using rolled towel, hip adductor stretch on stability ball, hip flexor stretch on stability ball and hamstring stretch with strap (each stretch was held for 10-30 secs and repeated 3-5 sets) (Di Paolo et al. 2019), as well as pelvic floor exercises (including exercises for both pubovaginalis and puborectalis muscles) to be maintained for 5 secs and then the woman relaxed for 10 secs for 10 repetitions. Also, women received positional education on upright birth positions such as squatting, standing, kneeling and quadruped positions to be performed with bearing down during the SSL (each position was maintained for 5 min), and were

trained on deep breathing to be applied during first and second stages of labor in addition to panting breathing to be applied at crowning of fetal head. Finally, women were trained on general relaxation, teaching muscle sense (for 10 min), as well as Diversion drill (for 3 min) (Lawrence et al. 2013; Kader and Naim-Shuchana 2014; Gupta et al. 2017). The procedures of antenatal training sessions for group (B) participants were approved by their obstetrician before starting the antenatal classes.

Outcome Measures

Mode of Delivery (Primary Outcome Measure)

All women in both groups were assessed for mode of delivery, whether it was a spontaneous vaginal birth, instrumental vaginal birth or CS.

Duration of SSL (Secondary Outcome Measure)

The duration of SSL was measured, using labor partograph, for all women who gave birth vaginally in both groups. It included duration of latent and active phases. The starting of the second stage was defined by the occurrence of full cervical dilatation, and the active phase of the SSL was defined when active pushing began.

Admission to Neonatal Intensive Care Unit (Secondary Outcome Measure)

The number of neonates needed to be referred to NICU was detected by using neonatal Apgar scoring chart for offspring of all women in both groups.

Data Analysis

It should be noted that sample size was determined a priori using G*Power. Calculation was based on independent t-test, the type I error rate was set at 5 percent (alpha-level 0.05), and the effect size 1.03 of the main outcome variable (Latent Duration of SSL) obtained from pilot study performed on 5 participants at each group, and type II error rate was at 95 percent power. The appropriate minimum sample size for this study was 52 participants. The authors add 15 percent (8 participants) to avoid drop out. Preliminary assumption checking revealed that duration of SSL was normally distributed, as assessed by a normal Q-Q plot. While for nominal variables non parametric analysis was used. Statistical analysis involved the calculation of the means and standard deviations for duration of SSL and frequency distribution (percent) for mode of delivery and admission to NICU. Parametric analysis in form of independent sample t-test was used to compare duration of SSL between the two groups. Non-parametric analysis in form of Chi square and also the Fisher's exact tests are applied to compare mode of delivery and admission to NICU between both groups respectively. The level of significance was set at p value of less than 0.05.

RESULTS

Sixty women were eligible for the inclusion criteria and assigned into two groups, randomly. All women in both groups completed the trial (see Fig. 1). Also, the demographic characteristics of nulliparous women are showed in Table 1.

The mode of delivery revealed a statistically significant difference between both groups ($p<0.05$) with a significantly higher prevalence of vaginal delivery either spontaneous or instrumental among subjects of group (B) (90%) compared to group (A) (63.4%), while prevalence of cesarean delivery was significantly higher in group (A) (36.7%) compared to group (B) (10%) (Table 2).

Table 1: Demographic characteristics of nulliparous women in both groups

	Group (A)(n = 30)	*Group (B)(n = 30)*	*P value*
Age (years)	26.27±4.27	25.33±4.32	0.404 ^{NS}
BMI (kg/m^2)	29.26±0.79	28.89±0.97	0.116 ^{NS}
Gestational age (weeks)	31.33±0.80	31.53±0.73	0.317 ^{NS}

Data were expressed as mean ± standard deviation
^{NS} P > 0.05 = Non-significant, P = Probability

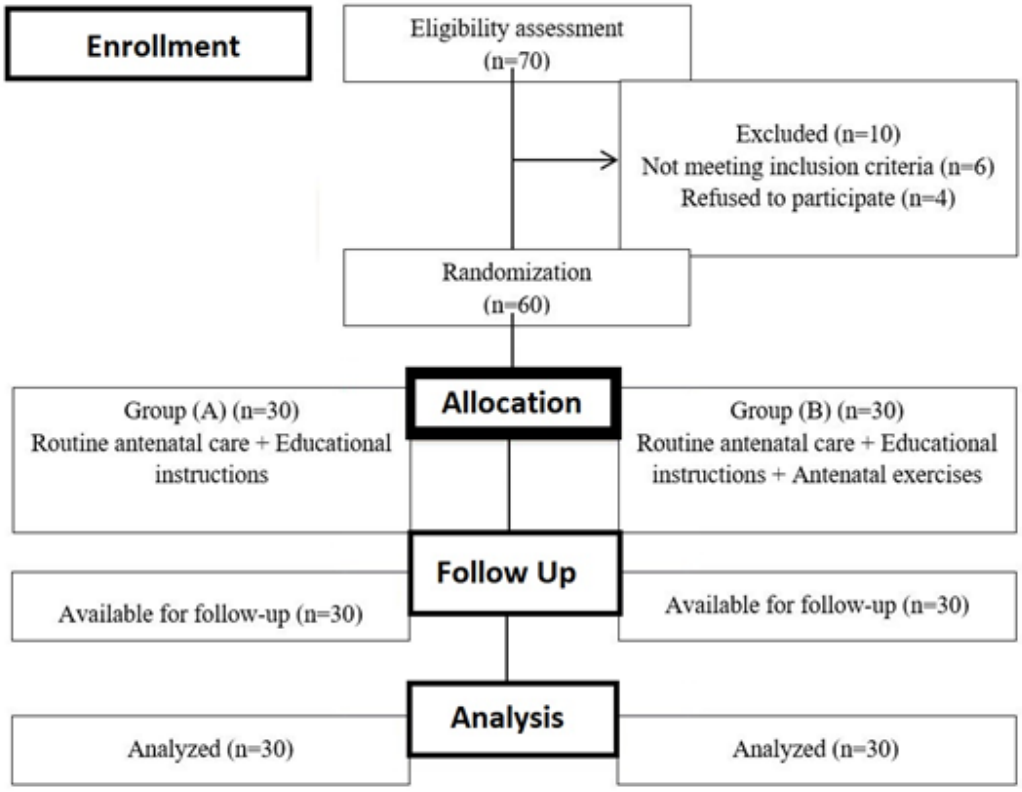

Fig. 1. The flow chart of the study participants
Source: Authors

Table 2: Mode of delivery for both groups

	Group (A)(n = 30)	*Group (B)(n = 30)*	*Chi-square*	*P value*
Spontaneous vaginal	11 (36.7%)	25 (83.3%)	13.616	0.001 [S]
Instrumental vaginal	8 (26.6%)	2 (6.7%)		
C.S	11 (36.7%)	3 (10%)		

Data were expressed as number (n) and percent (%)
[S] P > 0.05 = Significant, P = Probability

Table 3: The duration of SSL (total duration, latent phase and active phase) for women who delivered vaginally in both groups

	Group (A)(n = 30)	*Group (B)(n = 30)*	*P value*
Total duration (minutes)	58.62±2.21	39.51±5.08	0.000 [S]
Latent phase (minutes)	23.88±1.69	27.92±5.28	0.001 [S]
Active phase (minutes)	34.24±2.30	11.02±2.42	0.000 [S]

Data were expressed as mean ± standard deviation[S] P > 0.05 = Significant, P = Probability

The duration of SSL revealed a statistically significant difference between both groups with a significantly shorter total duration of SSL and duration of active phase of SSL among subjects of group (B) ($p < 0.05$), while the duration of latent phase of SSL was significantly longer in group (B) compared to group (A) ($p < 0.05$) for women who delivered vaginally (Table 3).

The admission to NICU revealed a statistically significant difference between both groups with a significant increase in number of neonates admitted to NICU in group (A) ($p < 0.05$) (see Table 4).

DISCUSSION

The current study revealed three statistically significant findings concerning mode of delivery, duration of SSL and admission to NICU. First, prevalence of spontaneous vaginal delivery was significantly higher among group (B), while cesarean delivery was significantly higher among group (A). Second, the average duration of SSL was significantly shorter in participants of group (B) who gave birth vaginally due to a shorter active phase. Third, neonatal admission to NICU appeared only among neonates of subjects in group (A).

Regarding mode of delivery, the results of this study were in agreement with Chan et al. (2019) who found that CS rate was lower in women who performed regular exercises. In the same manner, Mathew et al. (2012) showed a significant relationship between performing antenatal exercise and mode of delivery with a higher rate of spontaneous vaginal delivery in the intervention group (95%) than that in the control group (65%). In addition, Ferreir et al. (2019) found an increased rate of spontaneous vaginal delivery in exercising women. Moreover, Lavender et al. (2018) reported in their study a strong positive effect for antenatal training and education on health behaviors and a vaginal low-risk birth in nulliparous women. The positive effect of antenatal exercises on increasing vaginal delivery rates could be clarified by many explanations. First, exercise induces some hormonal and metabolic alterations that can influence the uterine contractions and increase the chance to have spontaneous onset of delivery (Ferreira et al. 2019). Second, exercise improves cardiovascular function and aerobic fitness of women, as well as limits their weight gain during pregnancy (Lavender et al. 2018). The improved maternal aerobic fitness during pregnancy enables women to maintain effective pushing efforts during the SSL. Third, regular exercise has an advantageous effect on the placenta, so it decreases the rates of emergency CS resulting from a non-reassuring fetal heart rate tracing (Poyatos-León et al. 2015). Fourth, relaxation training during gestation reduces CS rates through regulating emotional states and physiology, minimizing stress, anxiety and fear from childbirth, and reducing maternal physiological and endocrine measures (Fink et al. 2012). Finally, previous studies reported that maintaining upright positions during the SSL is associated with a reduction in the incidence of assisted and instrumental deliveries compared with supine positions (Deliktas and Kukulu 2018).

With regards to duration of SSL, the shorter duration of SSL in group (B) could be mainly related to the combined effects of pelvic floor, breathing and relaxation training, as well as receiving positional education on upright birth positions during pregnancy to maintain them during labor. Concerning the effect of pelvic floor training on SSL, a systematic review with meta-analysis by Du et al. (2015) revealed the effectiveness of practicing antenatal pelvic floor muscle exercise in shortening the duration of SSL. Regular pelvic floor muscle training improves control, strength and flexibility of the pelvic floor muscles that contribute to the fetal head descent and rotation, leading to shortening of the first

Table 4: Admission to NICU in both groups

	Group (A)(n = 30)	*Group (B)(n = 30)*	*Fisher's Exact Test*	*P value*
No	21 (70%)	30 (100%)	10.588	0.002 [S]
Yes	9 (30%)	0 (0%)		

Data were expressed as number (n) and percent (%)[S] P > 0.05 = Significant, P = Probability

and second stages of labor. About the influence of breathing exercises on SSL, Yuksel et al. (2017) concluded that performing breathing exercises during the SSL was effective in minimizing labor pain and hence decreasing duration of SSL. Regarding the effect of relaxation training on duration of SSL, Asl et al. (2018) found a significant correlation between women's behaviors during labor (verbal expressions, voice tone, facial expressions, body movement, degree of relaxation and functioning of respiratory system during childbirth) and both severity of labor pain and duration of first and second stages of labor, indicating the importance of behavioral coping strategies like relaxation for reducing pain severity and labor duration. With regard to the effect of positional education on SSL, Gupta et al. (2017) reported the effectiveness of upright postures in reducing the duration of the SSL compared with lying postures. The beneficial effect of upright postures could be attributed to the gravity effect, increased strength and efficiency of uterine contractions, and easy fetal passage through the pelvis due to improved fetal alignment, as well as increased antero-posterior and transverse diameters of the pelvic outlet. Finally, Hoeger and Hoeger (2003) reported that moderate exercise during pregnancy has a positive impact on increasing muscle strength and preparing the body for childbirth challenges.

Regarding admission to NICU, the increased neonatal admission to NICU among neonates of women in group (A) could be explained by Hobbs et al. (2016) who found that delivery by CS was a significant risk factor for admission to NICU. So, the increased NICU admission, reported in group (A), may be related to the increased rate of CS in this group. There are several suggestions that may clarify the absence of neonatal admission to NICU among neonates of women in group (B). First, it could be related to the positive effect of maternal relaxation training during pregnancy on reducing the basal fetal heart rate through decreasing maternal anxiety, reducing levels of stress hormones, increasing placental perfusion and modulating fetal sympathetic activity. The second explanation is that assuming upright positions during delivery is effective in reducing compression on aorta and inferior vena cava, as well as improving neonatal acid-base outcomes.

On the other hand, the results of this study were not in line with those of some studies which found no effect of maternal activity during gestation on mode of delivery, duration of SSL, neonatal Apgar score or need to ICU (Salvesen et al. 2014; Barakat et al. 2014; Garnæs et al. 2017). The controversy between the results of the current study and the previous studies may be due to the differences in the study design and duration, the participants' age and parity number, as well as the type and parameters of the applied exercise.

CONCLUSION

Maintaining a physically active lifestyle in the last trimester of pregnancy protects nulliparous women against SSL complications and shifts the mode of delivery towards normal, complication-free delivery in nulliparous women and their offspring. The results of the current study raise the awareness about the positive effect of performing antenatal exercises on promoting normal vaginal delivery without maternal or fetal complications and limiting the need for CS in nulliparous women especially in resource limited countries. However, it has some limitations which include the lack of measuring other maternal outcomes (for example, need for analgesia or anesthesia, birth canal trauma, labor pain, rates of episiotomy and hemorrhage) and other fetal outcomes (for example, gestational age, birth weight, heart rate). Therefore, further studies are needed to evaluate the effect on antenatal exercising on these maternal and fetal outcomes. Another limitation is that the study population included only healthy women that didn't have any obstetric complications, and therefore our results can't be generalized to women having risk pregnancy.

RECOMMENDATIONS

In this paper, it was aimed to determine the effect of antenatal exercises on labor outcomes in nulliparous women. It is suggested to determine some specific exercises and investigate the performance of each of them to determine which is more effective.

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