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A Pilates exercise program with pelvic floor muscle contraction: Is it effective for pregnant women? A randomized controlled trial

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Aims: The aim of this study was to evaluate the effectiveness of a Pilates exercise program with pelvic floor muscle (PFM) contraction compared to a conventional intervention in pregnant women.

Methods: Fifty primiparous women, without gestational alterations, were randomized to the Pilates group ($n = 25$) and control group ($n = 25$). Interventions for both groups consisted of twice-weekly sessions of 1 h each during the period between the 14-16th and 32-34th gestational weeks. The Pilates group performed a Pilates exercises program with the addition of voluntary PFM contraction. Mat-based Pilates exercises were performed involving movement of the upper limbs, lower limbs and trunk in all sessions. The Control group walked for 10 min and performed strengthening exercises of the lower limbs, upper limbs, and trunk with resistance from an elastic band and body weight. Each woman was evaluated by an unblinded physiotherapist before and after intervention for primary (PFM strength using a manometer) and secondary (PFM strength using Oxford Scale, endurance and repeatability) outcomes. Covariance analysis (ANCOVA) was used to compare the groups using the baseline values as a covariate.

Results: Thirty-six women were included in the analysis. There were no differences between the groups for manometry. An increase in the PFM strength, endurance, and repeatability was only observed in the Pilates group. In addition, the Pilates group showed greater adherence to the intervention.

Conclusion: Pilates exercise program with PFM contraction is not able to change the PFM strength assessed by manometer in pregnant women, but it improved adherence to the intervention.

KEYWORDS
pelvic floor muscle, physiotherapy, Pilates exercise, pregnancy

The study was conducted in Kinesio-Functional Pelvic Performance and Women's Health Laboratory of the Federal University of Uberlândia, in the Faculty of Physical Education and Physical Therapy FAEFI. Rua Benjamin Constant, 1286 - Bairro Aparecida. Uberlândia-MG, Brazil.

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1 | INTRODUCTION

Exercise offers potential benefits to both maternal and fetal health. According to the American College of Obstetricians and Gynecologists (ACOG), despite the anatomic and physiologic changes in the maternal body, physical exercise should be encouraged during pregnancy. Exercise has been associated with better outcomes for mothers and their children in addition to protection against the development of chronic disease.[1]

Among exercises programs, the Pilates method has become more popular worldwide.[2] Proposed by Joseph Pilates, this method combines strength training and global stretching through low-impact exercises. Studies have demonstrated the Pilates method benefits for healthy and non-healthy adults, such as muscular strength gain, flexibility, coordination, proprioception, trunk, and pelvic stability and postural improvement.[3,4]

Modern Pilates exercise programs incorporate exercises that involve breathing and pelvic floor muscle (PFM) contraction.[5] PFM contractions are performed in coordination with breathing and concomitant recruitment of the trunk muscles in various positions.[6] Because the Pilates exercises are performed in conjunction with a PFM contraction, the hypothesis was raised that this method could strengthen these muscles. However, little is known about the effects of the Pilates method on the functionality of PFM.[7]

Culligan et al[4] demonstrated the feasibility of a Pilates exercise program for strengthening PFM. They observed that the Pilates exercise program and a PFM training program provided similar improvements in the pelvic muscle strength of continent women.[4] However, Ferla et al[7] concluded that the functionality of the PFM in younger women who practice the Pilates method is not different from that of sedentary women. Bø et al[8] also found a similar prevalence of urinary incontinence in a fitness instructors group as has been shown in the general female population, and yoga and Pilates instructors reported a prevalence equal to that of the other fitness instructors. In addition, Torelli et al[9] observed that the addition of voluntary PFM contraction was more effective than Pilates alone in improving the PFM strength of sedentary nulliparous women compared with Pilates exercises without this contraction.

Studies have shown that it it possible that pregnancy reduces PFM strength, which, together with hormonal changes, may result in pelvic floor dysfunction.[10,11] Preventive strategies for such disorders involve PFM training during pregnancy.[12] Therefore, it is possible that the Pilates method with voluntary PFM contraction is an approach to achieve two goals in the pregnancy period, maintain physical activity and perform PFM training. However, there is no consensus on the effects of the Pilates methods with voluntary PFM contractions in pregnant women. Therefore, the purpose of this study was to investigate the effects of the Pilates methods with voluntary PFM contractions in pregnant women.

2 | MATERIALS AND METHODS

This is a randomized controlled trial (RCT) with parallel randomization (1:1) divided into two arms, the control group and Pilates Group. It was accomplished between February 2015 and October 2016 in the Kinesio-Functional Pelvic Performance and Women's Health Laboratory of the Federal University of Uberlândia, Brazil. The study was approved by the Committee of Ethics in Research with Humans at this university (resolution n° 942.230). The women were recruited by advertisements in newspapers, radio, and electronic mail that provided the telephone contact to the interested parties. After contact, there were scheduled visits to check the inclusion criteria in the study.

The women included in this study met following the criteria: (1) primiparous, (2) older than 18 years, (3) medical permission for physical exercise during pregnancy, (4) the absence of gestational complications described in the medical follow-up, and (5) sedentary in the last 4 months. The exclusion criteria were (1) multiple pregnancy, (2) the presence of chronic low back pain and/or previous urinary incontinence, (3) inability to contract PFM, and (4) inability to perform physical exercises due to the presence of neurological or musculoskeletal disorders.

The sample size calculation was performed using G*Power software version 3.1.3 adopting a 95% confidence level and error of 4 cm H_2O ($\varepsilon = 4$) based on a Dias et al study[13]; a sample size of 24 per group was found. Pregnant women who met the inclusion criteria were allocated through a list of random numbers generated by computer into two groups, the control group and Pilates Group. A researcher not involved in the data collection assigned the groups, the Pilates group (PG) and Control group (CG), by the sealed envelope method. All women were informed about the study protocol and signed the Free and Informed Consent Form.

2.1 | Assessments

Only one unblinded, experienced physical therapist performed all evaluations of the two groups. Initially, all women underwent a complete physical examination and an interview of their thorough medical history. The women in the Pilates and Control groups were assessed between the 14th and 16th weeks and again between the 32nd and 34th weeks of gestation for primary (PFM strength using a manometer) and secondary outcomes (digital palpation variables—PFM strength using Oxford Scale, PFM endurance and PFM repeatability). The primary examiner performed an initial assessment of test-retest reproducibility. Eight nulliparous

women were tested in two different occasions, separated by 1 week, to determine the intra-class correlation coefficient (ICC) of all variables.

Initially, the assessment of the PFM function by digital palpation was performed using the PERFECT scheme.[14] The component strength, endurance, and repeatability were evaluated. The women were positioned supine with hip and knee flexion. In this position, the evaluator introduced index finger up to one third of the vagina. To assess the PFM strength, women were instructed to lift and squeeze the PFM as hard as possible. Strength was measured on the 6-point Modified Oxford Scale (ICC = 0.97). To measure the endurance component, the length of time was considered, up to 10 s, for which a maximal voluntary contraction can be sustained before the strength is reduced. The women were instructed to keep the PFM maximal voluntary contraction for as long as possible until interruption (ICC = 0.94). Finally, the number (up to 10) of 1-s PFM maximal voluntary contraction is assessed (repeatability). Subjects are instructed to "contract-relax" as quickly and strongly as possible, in their own time, until muscle fatigue (ICC = 0.80). A 2-min interval between assessments was respected.

After 5 min, women performed an evaluation of the PFM strength using Peritron equipment (Cardio Design Pty Ltd, Oakleigh, Victoria, Australia). This manometer has a graduation from 0 to 300 cm H_2O and is equipped with a vaginal probe (28 × 55 mm). The middle of the balloon was placed approximately 3.5 cm inside the vaginal introitus and calibrated. The women were asked to perform three 3-s maximum perceived effort contractions of PFM. The means of three maximal voluntary contractions were calculated (ICC = 0.94). The correct contractions were visually observed by the physical therapist through observation of the probe's movement and non-visible co-contractions of the accessory muscles.[15]

2.2 | Interventions

Interventions for both groups consisted of twice-weekly sessions of 1 h each during the period between the 14-16th and the 32-34th gestational weeks. The women were divided into groups of 6-8 people for sessions supervised by two trained physical therapists.

The Pilates group performed a Pilates exercises program based on the principles of the method proposed by Joseph Pilates[16] with voluntary PFM contraction. Initially, the women received instructions about the Pilates technique, breathing, transversus abdominis, PFM, muscle contraction, and all basic principles. Mat-based Pilates exercises were performed involving the movement of upper limbs, lower limbs, and trunk in all sessions, with eight repetitions each. The intervention was started with light exercise intensity, and the intensity was increased after an adaptation period of 4 weeks. Mats, therapeutic balls and elastic bands were used during the exercises. The women were instructed to perform a transversus abdominis muscle contraction and PFM submaximal contraction during exhalation in all exercises.

The Control group underwent walking for 10 min and strengthening exercises of the lower limbs, upper limbs, and trunk with elastic band and body weight resistance. The exercise intensity was increased as in the Pilates group. At the end of each session, the women performed stretching and relaxation exercises. No type of instruction or verbal command was given regarding the PFM and abdominal muscle contraction.

Both groups had their vital parameters monitored during sessions, such as their heart rate, blood pressure, oxygen saturation, and subjective intensity of effort by the Borg scale, as recommended by ACOG[1]. To control the intensity of effort, a limit of 13-14 reported by the Borg Scale was adopted. Only volunteers who participated in more than 50% of the sessions were included.

2.3 | Statistical analysis

The statistical analysis was performed using SPSS Statistics 17.0 software. The data normality was tested using the Shapiro-Wilk test. The Mann-Whitney test was used to verify the homogeneity of the groups. Covariance analysis (ANCOVA) was used to compare the groups before and after the intervention with the baseline values as covariate. The significance level was 5%. Data are presented as the mean ± standard deviation. To estimate the clinical significance of the data, the effect size and confidence interval (CI) for the primary outcomes were calculated. The size of effect was considered mild for values lower than 0.20; moderate for values between 0.25 and 0.75; and large for values above 0.80.[17]

3 | RESULTS

Fifty primiparous women were randomly divided between the Pilates and Control groups, consisting of 25 pregnant women each. However, one woman in the Pilates group and 13 women in the control group discontinued the interventions due to the lack of time. Therefore, 36 pregnant women completed the interventions and were included in the analysis (Fig. 1). No significant differences were observed between groups for demographic information. The Pilates group showed higher adherence with the intervention, which was considered as the number of sessions attended, compared to the control group (Table 1).

When comparing data between groups, with baseline values as a covariable, no significant differences were

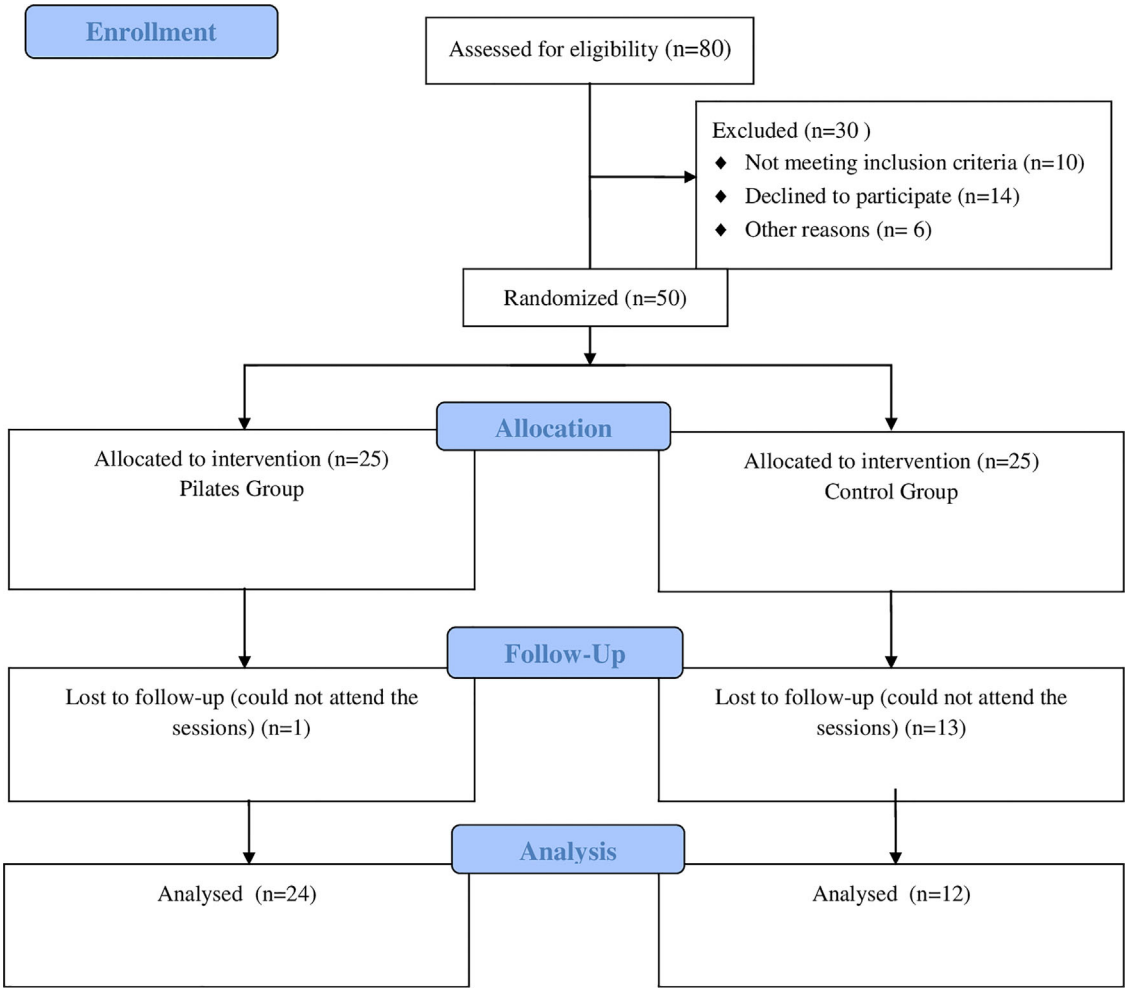

FIGURE 1 Flow diagram

observed between groups for the PFM strength assessed by manometer ($P = 0.95$). For the digital palpation variables, a significant difference was observed between groups regarding the PFM strength ($P = 0.01$, effect size: 2.07, 95%CI: 1.18-2.85), endurance ($P = 0.05$, effect size: 1.02, 95%CI: 0.27-1.73) and repeatability ($P = 0.04$, effect size: 1.31, 95% CI 0.53-2.04—Table 2).

4 | DISCUSSION

In the present study, contrary to our initial hypothesis, there were no significant differences between groups for the PFM strength assessed by manometer. Only significant differences were observed for the variables evaluated by digital palpation. Contrary to our study, Culligan et al[4] observed an increase in the PFM strength assessed by manometer in healthy, non-pregnant women after 12 weeks of individual intervention using the Pilates method. Torelli et al[9] also observed that non-pregnant women who performed Pilates exercises with verbal instruction for PFM contraction increased their PFM strength assessed by vaginal palpation and manometer.

In this study, women in the Pilates group were constantly instructed by physical therapists to perform PFM voluntary contraction during all exercises. Despite this, no increase in the PFM strength assessed by manometer was observed. Unlike Torelli et al,[9] pregnant women were evaluated in the present study. It is known that physiologic changes during pregnancy may increase all levator hiatus dimensions.[18] Therefore, an increase in the elevator hiatus area during gestation is observed, and this may have resulted in difficulty recording minimal PFM changes, as demonstrated in the present study.

Several studies reported that pregnant women who had performed PFM training increased their PFM strength assessed by manometer.[19] In the present study, with PFM contractions performed in conjunction with Pilates exercises, this increase in strength was not observed. Therefore, it is possible that pregnant women require specific PFM training for a significant strength gain that can modify PFM strength assessed by manometer, including full concentration during PFM contraction.

TABLE 1 Demographic data: age, initial body mass index, initial gestational age, end gestational age, and adherence

Variables	Pilates group	Control group	*P*-value
Age (years)	29 ± 3.96	29.83 ± 3.09	0.533
Initial BMI (kg/cm^2)	23.07 ± 2.78	23.87 ± 3.20	0.591
Initial GA (weeks)	15.87 ± 2.59	18.5 ± 2.35	0.101
End GA (weeks)	33.79 ± 1.81	32.75 ± 2.34	0.113
Adherence (number of clinical visits)	34.37 ± 7.82	25.83 ± 3.63	0.001*

Initial BMI, initial body mass index; Initial GA, initial gestational age; End GA, end gestational age.
*$P < 0,05$ with Mann-Whitney test.

Despite the benefits of physical exercise during pregnancy, studies show that few pregnant women are involved in physical activity programs during this period of life. Nascimento et al,[20] in a systematic review, demonstrated that the percentage of pregnant women who engaged in some type of physical exercise during pregnancy was 15.8% in the United States, 21.5% in Ireland and only 12.9% in Brazil (of which only 4.7% remained active throughout pregnancy). The highest dropout rate occurs in the third trimester during which women find it difficult to move because of their increased body mass.[21]

In the present study, the highest dropout was observed in the control group. Although the justification of pregnant women for dropout was difficulties with the schedule or transportation, the protocol of the control group involved walking and other standing activities, which may have caused greater discomfort among pregnant women with increased body mass. Furthermore, it is possible that the great popularity of Pilates Method throughout the world over the last decade justifies the greater adherence of Pilates group. In Brazil, obstetricians recommend the Pilates method in prenatal consultation, which may have resulted in a greater motivation of women to the interventions.

Despite the trend of a low participation of pregnant women in physical activity groups, the Pilates group had a low dropout rate and higher compliance with the intervention. The present study demonstrated that the combination of PFM with abdominal muscles during body movement is sufficient to improve palpation digital variables during gestation. As both physical activity and PFM training are indicated during pregnancy,[1,19] it is possible that the Pilates method is an approach to achieve good compliance with the exercises. Further studies should be performed to validate this hypothesis.

It is important to emphasize that, for the purposes of the study, all pregnant women underwent PFM assessment before Pilates intervention. It is known that this is not a practice in clinics and studios that work with the Pilates method. Studies show that approximately 30% of young women are not able to perform PFM contraction.[22] Therefore, it would be important to assess the muscles of pregnant women before the Pilates intervention to ensure proper implementation of contraction during exercise.

The main limitation of the present study was that the physical therapist who performed the assessment and treatment was not blinded and therefore could consciously or unconsciously influence the results. In addition, the sample loss of the present study may limit the conclusions because it is possible that a larger sample size may alter some of the results. Despite the sample loss, the significant variables had a large effect size, which shows that the treatment had a significant effect over the clinical variables. Given the great popularity of the Pilates method, new studies must be performed to investigate the effects of adding PFM contraction to a Pilates exercise program in pregnant women.

TABLE 2 Pelvic floor muscle (PFM) strength using a manometer and Oxford Scale, PFM endurance, and PFM repeatability in both groups before and after the intervention

Variable	Group	Pre	Post	Change mean (95%IC)	*P*-value
PFM strength (cm H_2O)	Pilates group	35.1 ± 12.78	31.95 ± 15.69	−3.32 (−9.2 to 2.6)	0.95
	Control group	24.86 ± 18.87	26.67 ± 19.52	1.8 (−2.52 to 6.12)	
Oxford	Pilates group	3.0 ± 0.83	4.0 ± 0.76	0.5 (0.15-0.84)	0.01*
Scale	Control group	2.33 ± 0.88	2.41 ± 0.79	0,08 (−0.09 to 0.25)	
PFM endurance	Pilates group	3.0 ± 2.25	7.5 ± 2.46	2.5 (1.3-3.6)	0.005*
	Control group	4.0 ± 2.13	5.8 ± 2.15	1.08 (−0.59 to 2.75)	
PFM repeatability	Pilates group	6.0 ± 2.63	10 ± 1.07	2.5 (1.5-3.5)	0.04*
	Control group	6.58 ± 2.27	8.25 ± 1.76	1.66 (−0.35 to 3.67)	

PFM = pelvic floor muscle.

5 | CONCLUSION

Our findings suggest that a Pilates exercise program with PFM contraction is not able to change the PFM strength assessed by manometer in pregnant women, but it improved compliance with the intervention.

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