

Research Paper

Comparison of the Effect of Eight Weeks of Core Stability Training and Kegel on Diastasis Rectus Abdominis in Multiparous Women

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ABSTRACT

Objectives: Due to the importance of postpartum maternal health and the effect of pregnancy on the increase of recti diastasis rectus abdominis (DRA), this study aimed to compare the effect of eight weeks of core and Kegel exercise with emphasis on correcting the respiratory pattern on DRA in multiparous women.

Methods: This is a semi-experimental study that was conducted on 45 pregnant women who had given birth six weeks ago selected according to the inclusion criteria. Individuals were divided into three selected training groups, including central area, Kegel, and control. The covariance analysis was used for intergroup comparison and a correlated t-test was used for comparison within a group. The statistical analysis was done by SPSS software, version 27.

Results: The results of this study showed the effect of both training programs on reducing the distance between the recti-abdominal muscles ($P < 0.001$). No significant difference was reported between the two training groups in this regard. Also, there was a significant difference in terms of pain between the two training groups and the control group ($P < 0.05$), but there was no significant difference between the two training groups ($P > 0.045$).

Discussion: Due to the reduction of pain and DRA, it seems that using the two training programs can lead to desirable results for the people and represents the importance of using the exercises in the postpartum period.

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Highlights

- Core stability and Kegel exercises to achieve these goals are recommended to reduce pain and DRA
- Self-reported pain showed that the pain disappeared in the core stability exercise groups
- Importance of using the exercises in the postpartum period

Plain Language Summary

Weakness of the muscles after childbirth can lead to changes in body structure, instability of the trunk and pelvis, changes in breathing patterns, mobility increase in the lumbar-pelvic area, and trunk movements. Accordingly, with regard to the results of the present study, the use of core stability and Kegel exercises to achieve these goals is recommended.

1. Introduction

During pregnancy and after that, the distance between the recti abdominal muscle increases in many women due to the stretching and thinning of connective tissue [1].

This white connective tissue, also known as the white line or the Aba line, is made of collagen and is formed by the joining of the sheath of the external oblique, internal, and abdominal transverse muscles, and forms a line between the two right abdominal muscles under the skin. Although this line is not visible on the skin, it creates a visible groove in the middle area of the abdomen. Right diastasis rectus abdominis (DRA) occurs due to hormonal changes, mechanical stresses on the abdominal wall by the developing fetus, and displacement of the organs inside the abdomen [2]. DRA usually appears in the second trimester of pregnancy and peaks in the third trimester; however, it has various degrees and may resolve completely in the postpartum period [3]. This complication involves between 30 and 70% of pregnancies and occurs on average in 66% of women after childbirth [4]. The abdominal wall has a special function in posture, pelvic, and trunk stability, breathing, trunk movements, and support of abdominal organs. Nevertheless, increasing the distance between the recti abdominal muscles affects this function [5]. In this complication, the posture and mechanics of the trunk may be altered and the stability of the pelvis may be disturbed and impaired and as a result, the spine becomes more susceptible to injury [6, 7]. In a study in 1990, Kaufmann et al. showed that DRA can reduce abdominal integrity and functional strength and endurance of abdominal muscles, which can lead to postural instability, back pain, pelvic floor muscles dysfunction, and inability to daily performance [8, 9]. Also, if the interrec-

tus distance (IRD) worsens, the person will suffer from an abdominal hernia [10]. There are not enough studies on the risk factors for right abdominal diastasis, but in one of them, variables, such as age, ethnicity, body mass index, weight gain during pregnancy, pre-pregnancy weight, gestational age, fetal weight, number of deliveries, and type of delivery were analyzed and it was concluded that women with frequent deliveries have more and higher right DRA [11]. Although DRA is a potential and significant clinical problem, there are few studies on its prevention and management. However, regular exercise before and during pregnancy reduces the risk of developing this complication [12, 13]. In addition to abdominoplasty surgical treatment, electrotherapy, the use of bandages and kinesiotape and some exercises (central stabilizer and Kegel) that focus more on the oblique and transverse abdominal muscles help treatment of diastasis and reduce the distance between the right abdominal muscles. One of the most important muscles that play an important role in the stability of the abdomen and pelvis is the transverse abdominus muscle. Doing core stability exercises, the transverse muscle tone will be improved and the distance between the rectus muscles will be reduced and the stability of the lumbo pelvic will be increased.

Considering the importance of maternal health and its importance in the proper development of the child and the negative impact of increasing the distance between the recti-abdominal muscles, this study aimed to compare the effect of eight weeks of core and Kegel exercises with emphasis on correcting the respiratory pattern on recti DRA in multiparous women.

2. Materials and Methods

This is a semi-experimental study. Subjects included women in Tehran province who had a history of second childbirth. To determine the sample size, G-Power software (covariance) was used, considering a statistical power of 0.8 and an alpha value of 0.05, and 10% missing data, a maximum of 45 people were selected. The inclusion criteria included having only a history of two cesarean section deliveries, a 3-5 cm distance between the inner part of the recti abdominis, no pain score greater than four in the VAS index, and body mass index in the range of 21-25kg/m². Exclusion criteria included pain during the training period, being absent for two consecutive sessions in training sessions, and three non-consecutive sessions. Subjects were randomly assigned to the core stability exercises group, the Kegel exercise group, and the control group. To collect the data, the subjects were referred to a midwife. A digital caliper with an accuracy of 0.01 mm (model E325, Iran) was used by the examiner to evaluate the distance between the recti abdominal muscle. Before starting the pre-test stage, the personal information form and consent form was completed by the subjects. The intervention groups (core stability exercises and Kegel exercises) performed exercises for eight weeks, three times a week and the duration of each training session was 40-60 minutes. In addition to these variables, the chronic pain rate of back reported by the individual was recorded in the pre-test and post-test stages. All assessments were re-evaluated in the pre-test and after eight weeks of training.

Evaluation of DRA

The width of the Linea Alba (distance between the two blocks of the recti abdominal muscle) was assessed us-

ing a tool called a digital caliper (accuracy: 0.01 mm; Made in Iran; Model E325) (Figure 1). In this measurement test, the participant is lying with an open arch, bending her knees (45 degrees), and putting her hands next to her body [6]. The desired measurement location was 3cm above the point of the umbilicus; the examiner asked the subjects to slowly lift their heads and shoulders off the examination bed and move in half crunch mode toward the knee to lift the shoulder off the floor, and then hold this position for about 10 seconds so that the examiner could touch the recti abdominal muscle with the two forefingers and the middle finger, and place the caliper's internal measuring arms between the two muscle blocks; Then, the registered number on the digital display was recorded by another tester. Three tests were performed for each evaluation and then the mean value was registered. Also, the validity of this test was 0.84 [14].

Core exercise protocol

During the research, the training group started the Core exercises from 20 minutes to 60 minutes in the last week for eight weeks and three times a week. Core muscle exercises consisted of two parts: flexibility exercises and strength exercises. The rest time between movements depended on the size of the change of position and getting into a new position. Also, about how to increase the training load, increasing the training load was applied in two ways: 1- Increasing the number of repetitions in each round and increasing the movement maintenance time; for example, in the first weeks, the movement maintenance time was 5 seconds and six repetitions, which in the last weeks, reached 8 seconds and ten repetitions. 2- Adding limb movement to the previous movement was weekly (Table 1) [15].



Figure 1. Evaluation of diastasis rectus abdominis (DRA)

Table 1. Core stability exercise protocol

Exercise Protocol	
Stretching Exercises	Hip Flexor Stretching
	Hip Abdominal contraction Stretching
	Hamstring Stretching
	Dynamic Hamstring Stretching
Strength Exercises	Abdominal contraction while lying on your back
	Abdominal contraction and bending one knee toward the chest
	Abdominal contraction while lying on your back and column heel
	Abdominal contraction with two knees towards the chest
	Swing to the sides while lying on your back
	Raise the upper torso with the hands on the side
	Cobra movement in the prone position
	Winging the opposite arm and leg while lying on the abdomen
	Raise one arm and leg in a four-legged position
	Pelvic rotation movement up and down in a four-legged position
	Four-legged movement
	Bridging movement
	Throw backward foot
	Raise the hands and feet while lying on your back Bending back movement in a standing position
	Abdominal contraction in the bridging position
Abdominal contraction with Rolled legs in the abdomen	
Bending sideways while lying on back	
Raise the upper torso with the hands on the side	

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Kegel exercise protocol

The kegel exercise program was based on Agarwal et al. The subjects in the Kegel exercise group, after knowing the anatomical location of the pelvic floor muscles in the standing and sitting position and the ability to control it voluntarily and its conscious contractions, did their exercises for eight weeks and three 45-minute sessions each week, of which the first 10 minutes planned to warm up the body with preparation movements and slowly running and quickly walking and doing stretching exercises and the last five minutes of the session were also programmed to cool down. In the first week, ten repetitions of all described movements were performed in each session. All exercises were performed ten times in the first two weeks and a three-minute break was considered between each movement with the next one. All movements were repeated 15 times in the second two weeks and there was a three-minute break between movements [16].

Respiratory pattern

Both intervention groups performed two movements related to the correction of respiratory pattern, including 1- The person sleeps in a supine position, the knee is bent 90 degrees, and the soles of the feet are on the ground. The practitioner pulls her abdomen inwards and simultaneously prevents pelvic tilt and lumbar lordosis. Then, the person crosses her hands on her abdominal muscles pulling the muscles towards the Lina Alba line, bringing the muscles together, and while doing this, performs the act of exhaling. While exhaling, she brings the chin close to the chest and waits for a little at the end of the exhaling, and this action will be repeated up to five times. Shoulders should not be off the ground during the exercise. If the person feels uncomfortable in this position, a cushion can be used to put under the shoulders and position the head higher. 2- The person was asked to lean completely against the wall while sitting and without any movement in the pelvic area, pull her abdomen inwards and exhale slowly. Gradually, with practice, the depth of exhalation will increase. Exhalation is initially

performed in 30 seconds and gradually increases to 90 seconds. Respiratory exercises after obtaining the necessary training were performed by individuals twice during the night [17].

Statistical analysis

The statistical process was analyzed using SPSS software, version 27. Descriptive statistics were used to analyze demographic information. Normality was checked using the Shapiro-Wilk test. Also, with the value of covariance in the Loon test to analyze the research hypotheses, analysis of covariance was used for intergroup comparison and a correlated t-test was used for within-group comparison. De Cohen's effect was also used to determine the effect of exercises. To determine the effect of exercises, the size of Cohen's d effect was used.

3. Results

The results of Table 2 represent that the groups were homogeneous in all respects and no difference was found between them ($P < 0.001$).

Normal variables were analyzed via a Shapiro-Wilk test and parametric tests. The results related to self-reported pain showed that the pain disappeared in the core stability exercise groups of four people (six people reported pain at first). Also, in the Kegel group, the num-

ber of people who complained of pain increased from five to three people, and in the control group from five to three people.

The results of paired t-test showed that both central stability and Kegel exercises caused an improvement in reducing the distance between the inner parts of the recti abdominal muscle after eight weeks (Table 3).

The results of the analysis of covariance showed a significant difference between the two groups of core and Kegel and the control group in the post-test and to examine the difference, the Sidak post hoc test was used (Table 4).

The results showed that there was no significant difference between the two groups in DRA; thus, eight weeks of core stability and Kegel exercises with emphasis on correcting the respiratory pattern ($P > 0.80$), had a significant effect on the distance between the inner recti abdomens ($P < 0.001$).

4. Discussion

The amount of participation of each of these exercises in quantifying the stability of the abdomen and the extent of their differences was not known and the purpose of this study was to determine the degree of this participation. The results obtained in determining the effect of core and Kegel stability exercises showed the effect of both training programs on reducing diastasis of

Table 2. Descriptive characteristics (age, height, weight, and body mass index) related to the experimental groups

Variable	Mean±SD			P
	Kegel Exercises	Core Exercises	Control	
Age (y)	30.0±2.34	28.60±3.20	29.90±3.95	0.58
Height (cm)	169±2.34	173±2.98	169±2.16	0.501
Weight (kg)	65.0±2.36	68.80±3.58	66.70±2.16	0.302
Body mass index(kg/m ²)	22.66±0.41	23.03±1.18	23.35±0.73	0.23

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Table 3. Diastasis rectus abdominis (DRA) in the exercise and control groups

Groups	Mean±SD		P
	Pre-test	Post-test	
Control	4.78±0.48	4.65±0.46	0.38
Core	4.74±0.71	2.56±0.65	0.001
Kegel	4.83±0.45	2.77±0.43	0.001

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Table 4. Results of covariance test on diastasis rectus abdominis (DRA) in groups

Average Square	F	df	P	Eta
13.02	48.08	2	0.001	0.025

Groups	Cohen's Effect Size
Control	0.27
Core	3.20
Kegel	4.68

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the rectus abdominal muscle (DRAM). Our results are in line with those of Yalfani et al. who assessed the effect of isometric-isotonic exercises on core stability in women with postpartum rectal diastasis and its secondary complications [18], Laframboise et al. who assessed the effect of postpartum exercises on reducing DRAM [19], Thabet et al. who pointed out to the effect of core stability training program in postpartum women on reducing DRAM [20], and Walton et al. who pointed out to the effect of six weeks of the plank of stability of the core area and traditional strength-stability exercises on DRAM [21].

Rectal diastasis is a complication that can lead to an abdominal hernia if left untreated and usually the cost of surgery to repair connective tissue (abdominal surgery) is 10,000 \$-5,000 \$, which is a significant cost. This complication changes the angle of connection of the abdominal muscles at the sagittal and frontal levels, and as a result, the recti abdominal muscles are moved outwards in the middle of the trunk [22]. This displacement gradually changes the connection of the bone, fascia, and joint line, and likely the ability to produce torque, leading to transverse tension of the linea alba (LA) tissue, which is made of connective tissue and muscle tendons [23]. Strengthening the control muscles of the middle of the trunk in the abdomen is very important in the postpartum period because it helps to create muscular support for the spine and lumbar region; therefore, it is important to strengthen these muscles regularly after childbirth to regain the strength and form before pregnancy [22]. In this study, the main focus of exercises was on the muscles of the core and abdominal area and many studies have come to the conclusion that strengthening the internal and transverse oblique muscles of the abdomen can significantly reduce the distance of ARAM and as well as the strength of the recti abdominal muscles can be achieved. Contraction of the rectus abdominal muscles reduces the horizontal diameter of the abdomen so that a horizontal

force is produced approximately in both rectus abdominis muscles, especially at the umbilical surface [24]. Kamel et al. assessed the two groups of exercise therapy and the combination of exercise and electrical stimulation and showed that adding electrical stimulation to rehabilitation exercises is more effective because electrical stimulation recalls deep muscular fibers in low-intensity exercise; type II fibers are usually activated only during high-intensity contractions. Kamal et al. also reported that the most appropriate time to start exercise interventions is about two to three months after delivery, because the ability of the abdomen to stabilize the pelvis against resistance decreases during pregnancy and at least eight weeks after birth. Abdominal muscle exercises should be carefully selected and also the most recovery from rectal diastasis occurs between one day and eight weeks after delivery and since then progress remains constant [25]. El-Mekawy et al. also noted in their study that strengthening the core muscles in the first months after delivery is so important because it helps create muscular support in the spine and reduces DRA. This study also emphasizes that the strength of the abdominal muscles is due to adaptive changes in the muscles arising from exercise as the metabolic abilities of the muscles are constantly overloaded [23]. In most of these studies, we observed a decrease in IRD due to abdominal muscle-strengthening exercises. In general, the reduction in width and faster recovery of DRAM, which is seen in exercise may be related to the type of the selected exercise.

The transverse abdominal muscle is the deepest abdominal muscle and has a strong fascia bond with the recti abdominal muscle and LA [26]. Activation and training of the transverse abdominal muscle close the bulge of both recti abdominal muscles together, increases LA integration, increases fascia tension, and causes load transmission and production of torque [26]. Walton et al. showed that Planck's modified dynamic exercises along with Kegel exercises are effective in reducing diastasis of recti

abdominal muscle and pelvic disability index and this exercise activates sensational inputs, deep sense, and neural receptors mechanisms [21]. More activation of the abdominal muscles by exercises, such as pulling the abdomen inward can strengthen the transverse abdominal muscle and empower it or Kegel exercise, in which by contracting the pelvic floor muscle, these muscles are strengthened and better function of the trunk muscles and the organs inside the abdomen, like the uterus and bladder is observed. Plank exercises also not only strengthen the abdominal and back muscles but also correct posture. This movement activates the central muscles of the body, which is the middle part of the body, and it can be said that by combining such exercises on the central muscles of the body, pregnant women can be helped to return sooner to ideal physical condition after giving birth. Nevertheless, high-quality studies in the future are essential to assess this need. These abdominal exercises help in the facilitation, contraction, and stability of the abdomen, and because muscle is a contractile tissue, as a result of hypertrophy of muscle fibers and increasing use of motion units, we will observe an increase in muscle endurance and strength [27]. These exercises activate both fast and slow contraction fibers and increase the rapid contraction force in the abdominal area [28]. Bilateral activity of the transverse muscle activity can stabilize the ribs, LA, and thoracolumbar (thoracic-lumbar) fascia [23]. The contraction of the mentioned muscle is accompanied by the simultaneous contraction of the recti abdominal muscle, and leads to a decrease in the pressure in the lumbar vertebrae, causing a large amount of air to escape from the lungs and the diaphragm, which has been lowered due to weakness of the abdominal muscles while returning to its original position [29]. When the transverse abdominal muscle is involved, the recti abdominal muscle is narrowed and the LA cleft becomes more closed. Correction of the diastasis of the recti abdominal muscle after the first delivery by strengthening the transverse abdominal muscle is very important for prevention as well, as it helps prevent further separation of the right abdominal muscle in future pregnancies [30]. Accordingly, using core stability and Kegel exercises to achieve these goals is recommended. Due to the COVID-19 conditions and related considerations in mothers, it was not possible to control other intervention factors, but in subsequent studies, the duration and follow-up of individuals should be considered.

5. Conclusion

In general, the results of the present study indicated the effect of both the Kegel exercise program and core stability on reducing DRAM. It seems that the use of these

two exercise programs in this community can lead to desirable results and shows the importance of using them in the postpartum period.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Ethics Committee of the Hamadan University of Medical Sciences (Code: IR.UMSHA.REC.1400.608).

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Authors' contributions

All authors equally contributed to preparing this article.

Conflict of interest

All authors declared that they have no conflict of interest.

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