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RESEARCH ARTICLE

WAIST CIRCUMFERENCE IN RESPONSE TO KINESIOTAPING ON RECTUS ABDOMINIS DIASTASIS AMONG POSTNATAL FEMALES

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ABSTRACT

Background: During and after pregnancy, many women experience an increase in the inter-recti abdominal muscle distance due to increased uterine volume as well as stretching and thinning of the linea alba. This condition, on average, affects 66% of women and is associated with spinal pain and instability, pelvic floor muscle weakness, abdominal muscle weakness and increase Waist circumference. ***Objective:*** To assess the effect of Kinesiotaping (KT) on the Waist circumference in postnatal women. Methods: Forty-eight post-partum women .They were divided randomly into two equal groups. The first group A received KT in addition to abdominal exercises; group B received only abdominal exercises .The intervention in both groups for two sessions /week for 8 weeks. The outcome measures were evaluating pre and post treatment via assessing the Waist circumference by using tape measurement. ***Results:*** Within group comparison, there was a significant decrease in the waist circumference post treatment compared to pre-treatment in the study and control groups ($p < 0.001$). Between groups comparison, there was no significant difference between groups pre-treatment ($p > 0.05$). Comparison between groups post treatment revealed a significant decrease in the waist circumference of the study group compared with that of the control group ($p > 0.01$). ***Conclusion:*** Kinesiotaping (KT) reduce waist circumference; if combined with abdominal exercises, it can augment the effects.

INTRODUCTION

After delivery, women's appearance and form undergo physiological and structural changes that may necessitate restoration in order to restore their physical and psychological well-being. One of these changes is an increase in abdominal girth during pregnancy, which causes straining and weakening of the midline abdominal fascia, exacerbating preexisting rectus muscle diastasis, which can lead to herniation or protrusion of abdominal contents (1). It has been stated that RD has several long-term effects on women's health. It may affect posture by increasing abdominal circumferences and increasing back strain owing to decreased strength and function, resulting in low back ache as well as dissatisfaction with body form, changed self-esteem, and disadvantage in interpersonal relationships (2). Increased hormone levels such as relaxin, progesterone, and estrogen soften connective tissue during pregnancy, thus weakening the lineaalba (LA). In conjunction with the expanding uterus, mechanical tension on the anterior abdominal wall strains abdominal muscle, thus decreasing the force vector and strength of abdominal muscles (3).

Diastasis recti (DR) are a clinical condition described by a change in the linea Alba that leads in an abnormal separation of the rectus muscles' two medial rims. It is caused by a reduction in the strength of the fibers that make up the structure (4). DRA is the most common postpartum complication. DRA can occur in varying degrees during pregnancy and may not resolve spontaneously in the postpartum period (5).And it affects a large number of women during the prenatal and postnatal periods, with a prevalence rate of 32.6 % at 12 months after delivery (6).While the reported incidence during and after pregnancy varies, it ranges from 100 %to 53 % post-delivery (within 24 hours) and up to 36 % post-natal time (up to 12 months) (7-8). The abdominal muscles are divided into four layers that go from the ribcage to the pelvis. The abdominal muscles are referred to as the "Core." It is important for abdominal wall support, breathing, trunk stability, posture maintenance, rotation, side bending, trunk flexion, and stabilizing the lower back throughout all activities. Flexion of the trunk on a fixed pelvis or flexion of the pelvis on a fixed trunk is an essential identified function of the rectus abdominis (5).

The palpation technique – often known as the 'finger width' technique – is mostly utilized to identify DRA during IRD testing. Despite its widespread use in evaluation, palpation is considered an inaccurate and unreliable technique for determining the width of the gap (9).Ultrasound imaging (USI) has been broadly studied and is considered as an accurate method to locate and determine the size of the IRD. On the other hand, USI machinery is pricey and requires sufficient proficiency from the person doing the examination (10).Calipers, tape measures, computed tomography (CT), and magnetic resonance imaging (MRI). Are there alternative methods for determining the IRD. There are still no clear criteria for the measurement method, measurement site, or body position when measuring (11). Conservative treatment was chosen over surgical procedure since it consists of a combination of exercises including aerobic, upper and lower limb strength training, and the use of electrotherapy such as hot and cold modalities (12-13). Physiotherapy is usually the primary step in the treatment of DRA. Physiotherapy for DRA should begin 6-8 weeks after delivery, and should include therapeutic and/or aerobic movement, patient education on posture and back, and the use of an abdominal brace (14). KT has been evolving as a unique treatment tool since it's developed by Dr. KenzoKase in Japan in the 1970s. His goal was to develop a therapeutic tape and taping technique that could support joints and muscles without limiting range of motion. His technique generated attention throughout the global health care community once he developed and refined it (15).

Kinesiotaping (KT) is a frequently used adhesive elastic tape. Reduced pain, facilitated or inhibited muscle strength, and increased range of motion are just a few of the advantages of KT that have been proposed. According to the manufacturer, KT may stimulate muscular contractions when applied from the muscle's origin to its insertion site and can inhibit muscular contractions when applied from the muscle's insertion point to its origin (16). When KT tape is applied to the targeted location, convolutions form on the skin, which pulls the skin away from the soft tissue, increasing blood supply to the affected and/or desired muscle .The purpose of Kinesiotaping is to restore muscle length and strength by stimulating the tissues beneath, adjacent to, and associated with the tape location (17). Kinesiotaping can be beneficial in enhancing muscle firing and contraction patterns. This can result in better muscle tone and sports performance (18). Although the mechanism of action of KT is unknown, it has been suggested that it may modulate muscle and fascia tension. One theory of muscular action is the stimulation of mechanoreceptors by skin application. Afferent fibers transmit nerve impulses to the central nervous system when skin mechanoreceptors are activated (19). In the postpartum period, exercise is also suggested to counteract the effects of pregnancy on a woman's anterior abdominal wall and posture. Strengthening training programs are based on the assumption that the contraction of all abdominal muscles will lower the abdominal horizontal diameter so that a horizontal force will be created, resulting in the approximation of both rectus abdominis muscles, particularly at the umbilical level (20). The effectiveness of exercise in preventing or correcting diastasis recti is controversial, with mixed results Walking and strengthening the abdominal core are both preventive exercise routines. Corrective exercise programs include core strength, aerobic activity, and neuromuscular reeducation (21).

Because of the prevalence of abdominal muscular weakness and an increase in waist circumference caused by DRA after delivery, as well as the lack of a coordinated and effective program for treating DRA, this study was done to resolve this concern using newer methods like as kinesiotaping.

MATERIALS AND METHODS

This study was a randomized control study, approved by the Institutional Ethical Committee of the Faculty of Physical Therapy, Cairo University, granted the authors the approval to conduct the trial under the agreement code of P.T.REC/012/003222. This trial was documented in clinical trials.gov with an identifier number (NCT04932772). Before consenting to the participation in this trial, the right to withdraw from the study at any time was confirmed and explained to every participant. The rules of Helsinki's declaration were taken into consideration during the application of this trial. The evaluation and treatment protocol was explained to each patient. A detailed evaluation sheet was made for each patient. A brief explanation was given to the patient of the assessment procedures for each patient. Each patient signed a consent form prior to conducting the study. The subjects were recruited for eligibility from the gynecologic outpatient clinic at College of Physiotherapy, October 6 University. Their ages ranged from 25 to 35 years, and all gave birth by normal vaginal delivery. Inclusion criteria were diastasis recti more than 2.5 cm at any point of assessment along the linea alba; Body mass index (BMI) was less than 30 kg/m^2; All the participants' were after the end of the postpartum period, i.e. eight weeks after birth.. Exclusion criteria were Women with skin over sensitivity to tape; abdominal skin diseases; abdominal hernia; previous or current cesarean section; multiple pregnancies more than 3 times; other abdominal or back operation. Pregnancy related complications such as polyhydramnios, fetal macrostomia, diabetes, and hypertension; Spinal disorders and body deformities that might hinder the abdominal exercises. Forty-eight post-partum women were divided randomly into two groups by a simple randomization method. Sample size calculation was performed prior to the study using G*POWER statistical software (version 3.1.9.2; Franz Faul, Universitat Kiel, Germany) and revealed that the required sample size for this study was 24 subjects per group to taking into account the 20% of drop out. Calculations were made using α=0.05, β=0.2 and effect size = 0.91 and allocation ratio N2/N1 =1.The first group (Group A) was given KT and abdominal muscle exercises for two sessions /week, and the second group (Group B) was given abdominal muscle exercise for two sessions/week, and the entire program for both groups was applied for eight weeks.

Procedures: Evaluative procedures Evaluations were done before and after the interventions in both groups.

Waist circumference: It was used to assess the recovery of the abdominal muscles using a tape measure according to the standard established by the World Health Organization when a woman is in a standing position at the end of a normal exhalation without pressure on the skin (22). Measuring technique: To measure waist circumference correctly, you should use a flexible tape measure that is not elastic (i.e., the tape measure should not stretch when you are taking the measurement). You should also remove any bulky clothing that can add padding around your abdomen.

Follow these steps to measure your waist: Stand up to get an accurate waist measurement; Wrap the tape measure around the widest part of your stomach, across your belly button. The tape measure should rest gently on your skin; once the tape measure is positioned correctly, breathe out naturally and take your measurement. Take the measurement three times to make sure you get a consistent result. Holding the tape too tight so that it digs into your flesh or holding it too loosely so that it droops will cause you to get an incorrect result.

Fig .1.Waist circumference

Treatment procedures: The two groups received their treatments for two sessions /week for 8 weeks.

Kinesiotaping: Women in group A received kinesiotaping for 2 sessions/ week for eight weeks i.e. the Kinesiotaping was changed every 3 days.

Technique: Include Rectus Abdominals Muscles (RAM), Oblique Abdominal Muscles (OAM). Tape was placed to RAM utilizing the muscles facilitation technique from muscle origin to muscle insertion with a tension of 15-35 %. The band began with no tension on the symphysis pubis, and then the women stretched the abdominal region with deep abdominal inspiration, ending at the xiphoid process. Tape was applied to the right and left external oblique muscles. The procedure began without tension from the bottom and of 6-12 ribs, and then the hip was positioned in flexion and rotation to the opposite direction, and the tape was attached to the pubic bone with tension ranging from 15% to 35%. Finally, the right and left internal oblique muscles were started to work on. The procedure began with the woman in a crock lying position without tension from the anterior superior iliac spine, followed by the hip being placed in an extension position and the tape being attached to the lower 4 ribs and linea alba with tension ranging from 15 to 35 % (15).

Abdominal muscles exercise: Women in group B received abdominal muscles exercise (2 sessions/ week) for eight weeks. The women repeated the same exercise program on other days as home routine. This program is proposed by Kamel and Yousif, 2017 (23). There is no gold standard exercise program for DRAM. The exercises were illustrated so that the women might perform the same exercise program as a home routine on subsequent days. All of the exercises were done while the participant wrapped a scarf around her abdomen.

Fig.2. Kinesiotaping application (A) the facilitation technique is applied to the rectus abdominis muscle (RAM). (B) The facilitation technique is used on the right internal oblique abdominal muscles (OAM). (C) The facilitation technique is used on the left external oblique abdominal muscles (OAM). (F) The final form of the facilitation technique on the abdominal muscles

Sit-ups, reverse sit-ups, U-seat exercises, and reverse trunk twists were among the exercises advised Fig 3 (A-D). Throughout the interventions, each exercise was repeated 20 times and increased by four repetitions every week. Furthermore, a respiratory rehabilitation technique involving the abdominal muscles, particularly the transverse abdominis, was conducted as a diaphragmatic stretching and thoracic blocking maneuver by visual awareness of the mainly abdominal breathing pattern, which was deep inspiration followed by deep expiration accompanied by isometric abdominal muscle contraction (23).The respiratory rehabilitation procedure was started with five repetitions and subsequently increased by one repetition per week until the end of the eight-week intervention.

Fig. 3. illustrates the abdominal exercises that were completed by both groups. Sit-up exercise (A), reverse sit-up exercise (B), U-seat exercise (C), and reverse trunk twist exercise (D)

Statistical analysis: Normal distribution of data was checked using the Shapiro-Wilk test. Levene's test for homogeneity of variances was conducted to test the homogeneity between groups. Unpaired t-test was conducted for comparison of subject characteristics between groups. Mann Whitney U test was conducted for comparison of number of deliveries and months since delivery between groups. Unpaired t-test was conducted to compare the mean values of the waist circumference between the study and control groups. Paired t-test was conducted for comparison between pre and post treatment in each group. The level of significance for all statistical tests was set at $p < 0.05$. All statistical analysis was conducted through the statistical package for social studies (SPSS) version 25 for windows (IBM SPSS, Chicago, IL, USA).

General characteristics of the subjects

Study group: Twenty-four women with postnatal diastasis recti were included in this group. Their mean ± SD age, weight, height and BMI were 29.71 ± 2.34 years, 73.6 ± 6.76 kg, 165.12 ± 7.51 cm and 31.05 ± 2.37 kg/m²respectively. (Table1).

Control group: Twenty-four women with postnatal diastasis recti were included in this group. Their mean ± SD age, weight, height and BMI were 29.75 ± 2.04 years, 74.75 ± 5.44 kg, 167. 41± 6.42cm and 30.5 ± 2.54 kg/m²respectively. (Table 1). Comparing the general characteristics of the subjects of both groups revealed that there was no significance difference between groups in age, weight, height and BMI ($p > 0.05$).

Comparison of of number of deliveries and monthes since delivery between the study and control groups:

Number of deliveries: The median (IQR) of number of deliveries of the study group was 2 (2-1) and that of the control group was 2 (2-2). There was no significant difference in the number of deliveries between the study and control groups ($p = 0.45$). (Table 2).

Monthes Since Delivery: The median (IQR) of months since delivery of the study group was 4 (5-4) and that of the control group was 4 (5-4). There was no significant difference in the months since delivery between the study and control groups ($p = 0.3$) (Table 2).

Effect of treatment on waist circumference:

Within group comparison

Study group: The mean ± SD waist circumference pre treatment of the study group was 95.25 ± 2.69cm while post treatment was 91.16 ± 2.49cm. The mean difference was 4.09 cm and the percent of change was 4.29%. There was a significant decrease in the waist circumference of the study group post treatment compared with that pre treatment ($p = 0.001$). (table 3, figure 4).

Control group: The mean ± SD waist circumference pre treatment of the control group was 95.87 ± 2.51 cm while post treatment was 93.37 ± 2.24 cm. The mean difference was 2.5 cm and the percent of change was 2.61%. There was a significant decrease in the waist circumference of the control group post treatment compared with that pre treatment ($p = 0.001$). (table 3, figure 4).

Between group comparison

Pre treatment: The mean difference in waist circumference between groups pre treatment was -0.62 cm.
There was no significant difference in the waist circumference between groups pre treatment ($p = 0.41$). (table 3, figure 4).

Post treatment: The mean difference in waist circumference between groups post treatment was -2.21 cm.There was a significant decrease in the waist circumference of the study group compared with that of the control group post treatment ($p = 0.002$). (table 3, figure 4).

DISCUSSION

Postpartum, abdominal muscle strength declines and the waist-to-hip ratio rise. Kinesio taping (KT) is a simple technique for stimulating muscle activity.The purpose of this study was to evaluate the benefits of KT paired with exercise on the Waist circumference in postnatal women versus the effects of exercise alone. Waist circumference was assessed by tape measurement before and after treatment for both groups A and B. The present study showed a significant decrease waist circumference in group (A) more than group (B) that treated by kinesotaping in combination with abdominal muscles exercises. Group B, which simply got abdominal workouts twice a week for eight weeks, exhibited considerable improvement in the assessed parameters within the group. This is attributed to a large reduction in the size of fat cells in the abdominal, subscapular, and gluteal regions after progressed abdominal exercises (24-25). Furthermore, abdominal exercise can help to maintain a slim waistline by lowering total abdominal, abdominal subcutaneous and visceral fat (26-27).
The length of the rectus abdominis muscle had risen by 115 percent of its normal length at 38 weeks of pregnancy to accommodate the developing fetus, while the rectus abdominis and internal oblique muscles were thinner soon after childbirth in postpartum females; the reforepostnatal abdominal exercises aid in the rehabilitation of abdominal muscular function and prevent abdominal muscle weakening symptoms (28).

(29) Reported that an improvement in IRD was positively correlated with improvement in the strength of the trunk flexors. Abdominal exercise, particularly isometric contraction, initiates and activates myogenic satellite cells, which merge with existing muscle fiber to produce new myofibres, which explains the resolution of IRD. These cells were discovered to be responsible for postnatal abdominal muscle toning and regeneration (30). Adaptive changes in the muscles generated by training when the metabolic capacities of the muscles are increasingly overwhelmed might explain the current study's findings of improved muscular strength. Muscle fiber development and higher motor unit activation make muscle, which is a contractile tissue, stronger. It also has a big influence on the metabolic cost of producing a specific amount of muscle force, resulting in more muscular endurance and power (31). Group (A) who received the KT additionally to abdominal exercises, showed both intra group and intergroup significant decrease waist circumference. This is explained by the stretching force applied by the tape on the skin, which produces more space by raising the fascia and soft tissue, which improves communication with mechanoreceptors and recruits more motor units, facilitating muscular contraction and eventually improving muscle strength (32-33).

Table 1. Comparison of the mean age, weight, height and BMI between the study and control groups

	Study group $\bar{X}$ ±SD	Control group $\bar{X}$ ±SD	MD	t- value	p-value	Sig
Age (years)	29.71 ± 2.34	29.75 ± 2.04	-0.04	-0.06	0.94	NS
Weight (kg)	73.6 ± 6.76	74.75 ± 5.44	-1.15	-0.64	0.52	NS
Height (cm)	165.12 ± 7.51	167.41± 6.42	-2.29	-0.84	0.26	NS
BMI (kg/m²)	31.05 ± 2.37	30.5 ± 2.54	0.55	0.71	0.48	NS

$\bar{x}$: meanSD: Standard deviationMD: mean difference; t value: Unpaired t valuep value: Probability value
NS: Non significant

Table 2. Comparison of median values of number of deliveries and monthes since delivery between the study and control groups

	Study group Median (IQR)	**Control group Median (IQR)**	**U-value**	**P value**	**Sig.**
Number of deliveries	2 (2-1)	2 (2-2)	256.5	0.45	**NS**
Months since delivery	4 (5-4)	4 (5-4)	241.5	0.3	**NS**

U: Mann–Whitney U test valueIQR: Inter quartile rangep value: Probability valueNS: Non significant

Table 3. Mean waist circumference pre and post treatment of the study and control groups

Waist circumference (cm)	Study group $\bar{X}$ ±SD	Control group $\bar{X}$ ±SD	MD	t- value	p-value	Sig
Pre treatment	95.25 ± 2.69	95.87 ± 2.51	-0.62	-0.83	0.41	NS
Post treatment	91.16 ± 2.49	93.37 ± 2.24	-2.21	-3.22	0.002	S
MD	4.09	2.5				
% of change	4.29	2.61				
t- value	18.87	20.76				
p-value	0.001	0.001				
Sig	S	S				

$\bar{X}$: Mean SD: Standard deviation MD: Mean difference
p value: Probability value S: Significant NS: Non significant

Weak abdominal muscles have a crucial part in the etiology of waist pain during the prenatal and postnatal periods **(**34). The results of the present study was agreed with (35)whom conducted the study of Effect of Kinesiotaping on Diastasis Recti, concluded that Kinesiotaping was effective in reducing diastasis recti in postpartum women as Kinesiotaping can increase the effect of exercise by stimulating muscle facilitation. kinesotaping should be planned for patients as part of a rehabilitation program or in combination with exercise programs.

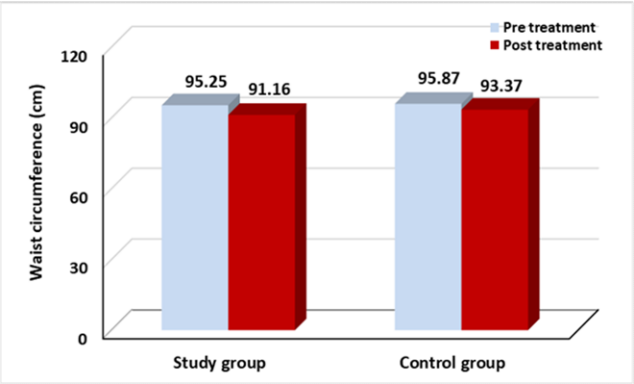

Figure (4). Mean waist circumference pre and post treatment of the study and control groups

As a result, waist circumferences reduce as DRA decreases. The present study goes with **(**36) (who evaluated the effects of exercise and Kinesiotaping on abdominal recovery in women with cesarean section, reported an increase in abdominal muscle strength and endurance, and decrease in intensity of pain, an improvement in waist and umbilical circumferences and a decrease in disability in postnatal women who obtained KT with exercise.

However, (37) claimed that muscular strength development was unrelated to any electrical changes in the KT applying muscle. Additionally (38-39)reported that although the use of Kinesio tapes may have some therapeutic effects, it does not lead to increased strength in healthy adults. Also**, (**40) reported that KT application on RAM did not cause a significant change on power–velocity variables of muscle. Many previous studies concluded that the placebo effect, which alters muscle strength and endurance because of psychological variables such as motivation, expectancy, and conditioning, and the interaction of these variables with physiological variables, leads to better sport performance outcomes could be one explanation for this rather than the effect of KT (41). The limitation of present study includes no follow-up on the KT long lasting effect was performed; therefore, the longevity of its therapeutic effect is unknown. More research into the most effective methods of physical therapy and supportive treatment for IDR in postpartum women is necessary.

Conclusion

In summery our study concluded that adding KT to abdominal exercise in women with postnatal DRA result in decreased WC and thus reduces DRA

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