International Journal of Health Sciences and Research
www.ijhsr.org ISSN: 2249-9571

Original Research Article

Effects of an Exercise Program on Diastasis Recti in Women

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ABSTRACT

Introduction: The programs aimed at reducing diastasis recti reported in the scientific literature, are scarce. However, the diastasis recti is maintained in many women after their postpartum period. The objective of this work is to know the impact of an exercise program on reducing Diastasis Recti.
Materials and Methods: A quasi-experimental analytical study was carried out. The research study included all women who participated in the exercise program (9 weeks) between 2014 and 2016, that is, a total of 100 women. They were assessed in the beginning, at 3, 6 and 9 weeks after starting the program. The program consists of hypopressive abdominal exercises, transverse muscle activation exercises, and exercises of oblique and rectus abdominis activation.
Results: There was a reduction of the upper, medial and lower diastasis and in the abdominal circumference. The difference between the initial measurement and the measurement after 3 weeks is statistically significant; the same applies to the measurements of weeks 3 and 6 and the trend is maintained, finding statistically significant differences between the measurements of weeks 6 and 9.
Conclusions: The exercise program leads to a reduction in the diastasis recti. The results were obtained starting from the third week, and they gradually improved until the ninth week.

Key words: Exercise Therapy; Women; Diastasis, Muscle; Rectus Abdominis.

INTRODUCTION

Diastasis recti abdominis (DRA) consists of a gap between the two sides of the rectus abdominis muscle at the linea alba (LA), with widening and fibrous division of the LA. [1] It is common in pregnancy and in the immediate postpartum period, the maximum separation usually occurring at the level of the navel. [2–4] In pregnancy, DRA occurs due to hormonal changes causing loss of elasticity in the connective tissue, and to the mechanical stress on the abdominal wall determined by the growth of the fetus and the displacement of the abdominal organs. [4] It usually appears between the second and third trimester and everything spontaneously returns to normal within 1 to 8 weeks after delivery. [2,5]

In some women, this spontaneous resolution does not occur after giving birth, thus becoming a pathological situation that may be maintained even years after giving birth. [2] DRA is associated in most cases with the postpartum period, also it could be related to other factors, such as weight lifting and inadequate abdominal strengthening, advanced maternal age, a history of cesarean section through the midline of the abdomen, and multiparous

women or with multiple pregnancy. [6,7] Conversely, no risk factors were identified for the presence of DRA in a study by Mota el al. (2015). [8] It is not exclusive to women, there are also cases in men, who usually suffer an increase in intra-abdominal pressure due to obstructive pulmonary disease or obesity. [7]

DRA is traditionally considered a gap larger than two fingers-width between the rectus muscles. [9] There is a discrepancy in terms of the exact measurement considered to be pathological, starting from a 2-cm gap, classifying cases into mild (2, 3 or 4 cm) and severe (5-20 cm). [2,4,7,10,11] Palpation is one of the most used methods to assess diastasis. [4,9] It is reliable in clinical practice and has good inter-rater validity. [12] However, the gold standard to measure the DRA is the ultrasound because has been most widely researched with regards to its reliability, and showed a reliable method when the images were taken by experienced sonographers. [13]

The abdominal wall has important functions in posture, trunk and pelvic stability, breathing, trunk movement and support of the abdominal viscera. The increase of the gap between the rectus muscles can put these functions at risk. [5,10] In addition, the muscles and fascia of the lumbo-pelvic region play an important role in the trunk movement and the intersegmental and intra-pelvic stabilization. [10,14] An alteration in these segments could lead to lower back pain or dysfunctions in the pelvic floor muscles. The relationship between lower back pain and DRA should however be taken with caution, since many authors support it, [4,11,15,16] but there are studies in which no association was found. [8,17,18] The same applies to pelvic floor dysfunctions, considering that Bø et al., contrary to their hypothesis, found that women with diastasis were not more likely to have weaker pelvic floor muscles or more urinary incontinence or pelvic organ prolapse. [19]

For the treatment of diastasis recti, there is a surgical option, in which the correction is made by means of abdominoplasty or laparoscopy. [20] Conservative treatment could be an alternative to surgery, with there being no consensus as to which is the best option, further studies being necessary to assess different treatments for DR. There are no clinical guidelines for the treatment of diastasis recti, [21] but studies suggest that transverse abdominal muscle training could help restore their function in lumbo-pelvic stability, during load transfer, and reduce the gap between the rectus muscles. [10,22,23]

The programs aimed at reducing diastasis recti in the postpartum period reported in the scientific literature, are scarce. There are studies to confirm the positive influence of exercise on reducing the inter-recti distance but it has not been assessed which abdominal exercise is the most effective. [24,28]

In 2012, Keeler et al [7] conducted a survey among physiotherapists to learn about the DRA treatments they had carried out. 296 surveys were analyzed and it was found that most of the treatments were based on exercises aimed at strengthening the transverse abdominal muscle and at activating it during activities of daily living.

"No Más Diástasis" is a 9-week exercise program developed in the Maternity Hospital (Madrid), focused on the training of the deep abdominal muscles. This method consists of hypopressive abdominal exercises, transverse muscle activation exercises, and in more advanced stages of the program, exercises of oblique and rectus abdominis activation.

The objective of this work is to know the impact of the 'No Más Diástasis' program on reducing DRA. As secondary objectives, the study also seeks to find out whether women's personal and obstetric factors have an influence on the results of the program, as well as to understand the effects on abdominal circumference.

MATERIAL AND METHODS

2.1. Study design

A quasi-experimental analytical study was carried out, assessing the results of the ´No Más Diástasis´ program in women with DRA.

2.2. Participants

The study population was made up of all the women who participated in the ´No Más Diástasis Program´ at the Maternity Hospital in Madrid, since January 2014 until December 2016.

Participants were women who had had children, presented a gap of the rectus abdominis muscle ≥ 2.5 cm, and the period since they had given birth exceeded 8 weeks. Pregnant women and women with high blood pressure were excluded.

The research study included all women who participated in the ´No Más Diástasis´ exercise program between 2014 and 2016 (in order to have access to a higher number of subjects), and who met the inclusion and exclusion criteria, that is, a total of 100 women.

3.3. Description of variables

– **Personal and obstetric factors**

They were collected through a personal interview with all participating women in the first assessment session. Data were obtained in terms of age, weight, height, number of children, weight of the largest baby, type of delivery, and time elapsed since the last delivery.

– **Abdominal circumference and DRA**

The perimeter of the waist was measured with a measuring tape placed midway between the lower edge of the costal arches and the upper edge of the iliac crest. The measurement was performed in the standing position, with the patient in an anatomical position, and taking the measurement after a normal expiration.

The DRA assessment was carried out through palpation. The person is placed in the supine position, with the legs bent and with one hand behind the head. The patient is asked to relax her abdomen, and the evaluator is placed at the level of the navel, pressing gently with the fingertips. Next, the patient raises her head making sure that the ribcage is close to the pelvis.

The evaluator moves the fingers up and down to find the rectus muscles and observe the gap above and below the navel. The result is positive if the gap between both muscles is wider than 2.5 centimeters. Three measurements were taken, at the level of the navel, 4 cm above, and 4 cm below. These measurements are referred to as upper diastasis, medial diastasis and lower diastasis, respectively. The measurement has been made by the same examiner and a Caliper was used to determinate the cm of the inter rectus abdominis distance.

2.4. Procedure

All women participated in the assessment session, where they were asked about personal, obstetric and gynecological factors. In addition, this assessment included the measurements of the waist circumference and diastasis recti.

The subjects started the 9-week program, once it was determined that they met the inclusion criteria to participate.

The 'No Más Diástasis' method, developed at the Maternity Hospital, consists of hypopressive abdominal gymnastics, transverse muscle activation exercises, and, in the final stage of the program, exercises of oblique and rectus abdominis activation.

– Hypopressive exercises are performed with the objective of reflexively strengthening the transverse abdominal muscle. [29,30] They were then asked to perform expiratory apnea and, with the glottis closed, expanding and raising their rib cage by contracting accessor inspiratory muscles (serratus anterior, intercostals, scalene and sternocleidomastoid). [31]
– The exercises focused on strengthening the transverse abdominal muscle, its identification by the patient and its activation. These are exercises in which strength is voluntarily worked on. The aim of the repetition of these exercises is that the activation of this muscle to be

reflected in situations in which a good abdominal competence is required: lifting weights, lifting the children up, coughing, laughing, running, jumping, etc. [10] In addition, the activation of the transverse abdominal muscle is also implied when there is a daily situation that leads to increased intra-abdominal pressure.

- The exercises of oblique and rectus abdominis activation, as long as the patient are able to activate the transverse abdominal muscle in an effective way.

The performance of the exercises and the change in difficulty were adapted to the conditions of each woman, turning 'No Más Diástasis' into a tailored program, adapted to the characteristics of each patient.

To complete the program, all women came to the center one day per week, and they performed daily exercises at home, provided through an online platform. On this platform, through videos, photos and documents, women were reminded of the exercises performed in the classroom and they were given a series of exercises per day.

In addition, all women were recommended to follow a balanced diet and to perform aerobic exercises (avoiding activities that involve increased pressure in the abdomen area, such as running).

They were assessed again at 3, 6 and 9 weeks after starting the program, the last measurements coinciding with the final assessment.

2.5. Data analysis

All data were recorded in a database in an orderly manner for analysis. The software used was SPSS IBM version 22.0.

Descriptive statistics were performed, showing the means and frequencies for each of the variables. With regard to the progress of diastasis recti throughout the period under study, a comparison of means was carried out through the Student's t-test for related samples. Finally, to check whether there is a relationship between diastasis recti measurements and abdominal circumference, and personal and obstetric factors, the Pearson's correlation was performed in order to relate them to the quantitative variables and Student's t-test for the qualitative variables. A critical level of $p<0.05$ was considered statistically significant.

RESULTS

3.1. Description of participants' personal and obstetric characteristics

First, a descriptive analysis of the personal and obstetric variables of the women who participated in the study was conducted. Table 1 shows the age mean, BMI, the time elapsed since the last delivery, and the weight of the largest baby, along with the percentages of the types of pregnancy, types of delivery, and number of children of the women who participated in the study.

Table 1. Description of variables

PARTICIPANTS' CHARACTERISTICS		
Age (years) *		39.25 (SD: 4.76)
BMI *		22.16 (SD : 2.54)
Time elapsed since the last delivery (months)*		27.26 (SD: 49.8)
Weight of the largest baby (grams)*		3421 (SD: 573.594)
Type of pregnancy **	Simple Multiple	85.7% 14.3%
Type of birth **	Vaginal delivery Cesarian Section Several types	47.9% 41.7% 10.4%
Number of children **	1 child 2 children 3 children 4 or more children	27.6% 54.1% 16.3% 2%

SD: Standard deviation; **BMI:** Body mass index
*Values are shown as means
**Values are shown as percentages

Progress of diastasis recti abdominis

To check the progress of diastasis recti, a comparison of the means was made at different moments in time. Figure 1, 2, 3 and 4 show the progress over time in the different measuring points of the upper, medial, lower diastasis, and abdominal circumference, respectively.

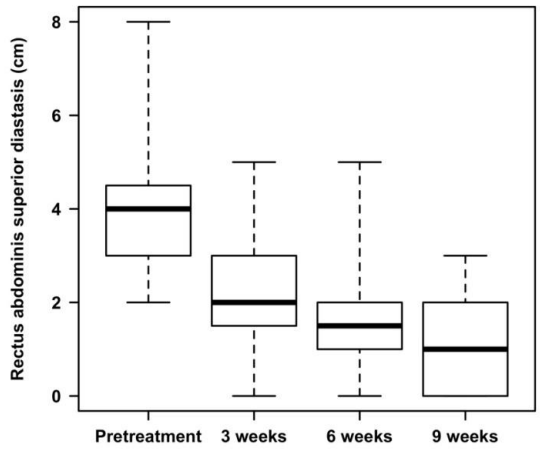

Figure 1. Progress of the upper diastasis

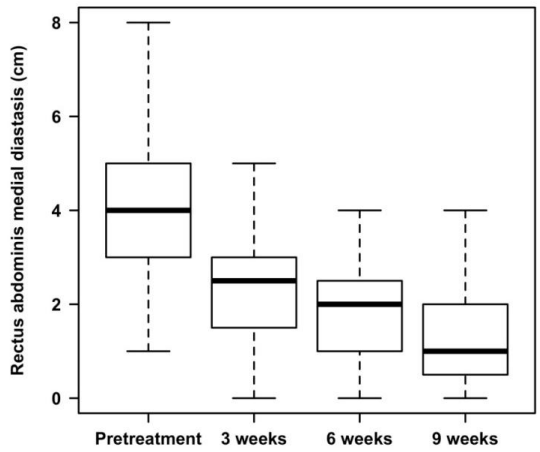

Figure 2. Progress of the medial diastasis

There was a reduction of the upper, medial and lower diastasis, as well as a statistically significant reduction of the abdominal circumference starting as early as 3 weeks after the first assessment (p=0.00). In other words, the difference between the initial measurement and the measurement after 3 weeks is statistically significant; the same applies to the measurements of weeks 3 and 6 (p=0.00), and the trend is maintained, finding statistically significant differences between the measurements of weeks 6 and 9 (p=0.00). Table 2 shows the means at each point in time

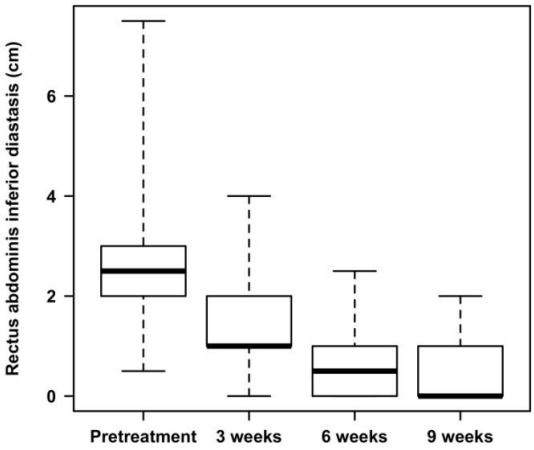

Figure 3. Progress of the lower diastasis

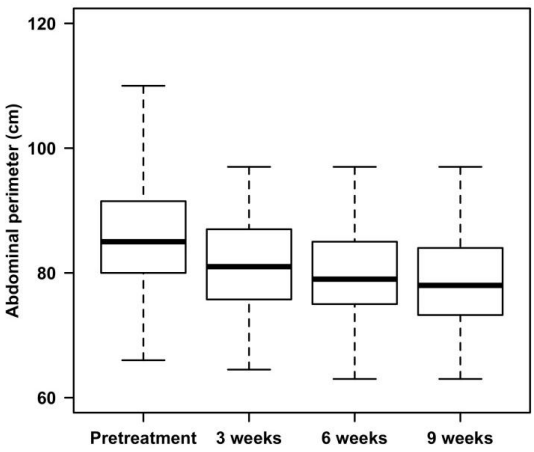

Figure 4. Progress of the abdominal circumference

Table 2. Initial measurements, at 3 weeks, at 6 weeks and 9 weeks.

	Pretreatment	3 weeks	6 weeks	9 weeks
Upper diastasis recti	3.98 (SD: 1.15)	2.27 (SD: 1.06) *	1.51 (SD: 0.99)**	1.02 (SD: 0.85)***
Medial diastasis recti	4.02 (SD: 1.21)	2.42 (SD: 1.15) *	1.77 (SD: 1.02)**	1.27 (SD: 0.10)***
Lower diastasis recti	2.61 (SD: 1.06)	1.23 (SD: 0.88) *	0.60 (SD: 0.65)**	0.39 (SD: 0.59)***
Abdominal circumference	85.64 (SD: 7.89)	81.61 (SD: 7.28) *	79.389 (SD: 7.02)**	78.52 (SD: 6.61)***

*p<0.01 - Comparison between pretreatment measurements and measurements at 3 weeks.
**p<0.01 – Comparison between measurements at 3 and 6 weeks.
***p<0.01 – Comparison between measurements at 6 and 9 weeks.

Relationship between the improvement of diastasis recti and personal and obstetric variables

Finally, the relationship between the obstetric and personal variables of each woman, and the reduction of diastasis recti was examined, with the aim of detecting certain negative or positive factors related to the effectiveness of the program.

An improvement percentage between the initial and final assessment was calculated for the upper, medial, and lower diastasis recti, 100% being considered the difference between the initial measurement of diastasis recti of each woman and the 0 value (0 cm of inter-rectus distance). On the other hand, for the abdominal circumference, the difference (in cm) between the initial and the final circumference was taken as an improvement measure, since in this case there is no target measure, each woman having different anthropometric characteristics.

Once these calculations were made, they were related to the obstetric and personal variables, that is, with age, BMI, the time elapsed since the last delivery, weight of the largest baby, the type of pregnancy, the type of delivery, and the number of children.

Relationships were found only between BMI and the number of children. Regarding the first variable, the higher the BMI, the greater the percentage of improvement of the upper diastasis recti ($p = 0.001$) and the abdominal circumference ($p = 0.04$). In the case of the number of children, having had more children is related to a lower percentage of improvement in the upper diastasis recti ($p = 0.003$).

DISCUSSION

After the data analysis, a discussion is carried out, organized in different sections.

4.1. Participants' characteristics

The women who participated in the study were an average of 39.25 years (SD = 4.76). The only thing that mattered to most of them, when they came to the center, was the reduction of the waistline, despite presenting other symptoms related to the diastasis recti, such as lower back pain [4,11,14,16] or urinary incontinence. [3,32]

The time elapsed since the last delivery varies from 2 months to 35 years, with an average of 27.26 months (SD 49.8). Many of the women participating in the study had had diastasis recti for years, and this fact confirms that the diastasis recti does not resolve on its own after 8 weeks from delivery. [2,33]

However, in 48% of the women, it had been less than a year since they had given birth. This justifies, to a certain extent, the choice of the type of exercise program, requiring assistance from the hospital only 1 day per week, the rest of the days being able to perform the exercises through the online platform at home. In addition, 72.4% of the women in our sample had more than one child, which exacerbates the above-mentioned issues.

Regarding women's type of delivery, there is a similar percentage among women who had children by vaginal delivery (47.9%), and by cesarean section (41.7%). This does not coincide with the data obtained from the Spanish National Institute of Statistics published in 2015, in which the percentage of natural births is 73.34%, much higher than in our data. This raises the issue of whether the cesarean section is a risk factor for diastasis recti. This coincides with Candido et al. (2005), [6] who indicated that the Cesarean section led to a greater risk to suffer an increase in the inter-rectus distance during the postpartum period.

4.2. Results of the 'No Más Diástasis' program

The proposed exercise program produced improvements starting from the 3rd week, and these improvements increase at weeks 6 and 9. In other words, the effects of the program are observed from the 3rd week, but there is no standstill of the reduction process, the inter-rectus distance

continuing to diminish until week 9. In those women who had not completely reduced the diastasis recti at the end of our program, it would be necessary to check whether they keep improving by continuing to perform exercises for some time.

At this point, it would also be interesting to check whether the results achieved are maintained over time. Thus, our further research is aimed at following up on the results achieved weeks or even months after completing the 'No Más Diástasis' program.

It is important to stress that some of the basics of the exercise program proposed is the correct postural hygiene and the protection of the abdomen by activating the transverse abdominal muscle every time a hyperpressure occurs. This muscle is an essential component for lumbo-pelvic stability during load transfer. [10,21-23,34] Therefore, the results would be expected to be maintained, provided that women took into account these care measures.

In addition to the diastasis recti, the abdominal circumference was also reduced, associated with the reduction of the inter-rectus distance and with the strengthening of the abdominal muscles. No BMI measurements were taken at the end of the program, thus the circumference reduction could also be due to the weight loss associated with an intense exercise program such as this one. This is especially true if they were sedentary women who did not practice any sports, some of them perhaps because of the lack of knowledge on which sport is the most suitable for their problem.

In terms of women's personal and obstetric variables, no important relationships were found, except for the BMI and the number of children. The higher the body mass index, the higher the percentage of improvement of the upper diastasis recti and the abdominal circumference. Regarding the number of children, no relationship was found with the initial values of diastasis recti, although having had several births is considered a risk factor for a wider diastasis recti. [6] It was found that multiparous women obtained less percentage of improvement during the program. One should note that no association was found between the type of delivery and the percentages of improvement, which matches the data found in the study conducted by Sancho et al. [35]

4.3. Type of exercises for the reduction of diastasis recti

There is much controversy regarding which is the best type of exercise for the reduction of diastasis recti, contrary results being obtained when the literature is reviewed. This could be due to the fact that there is no "best exercise" for the reduction of diastasis recti, but the "best exercise" for each woman, hence the importance of the assessment, of the detection of movement compensations when performing the exercises, and the correction thereof. That is why, it is of great importance that any exercise program is monitored by a healthcare professional.

Some of the consulted studies assess the immediate effect of different types of exercises on the inter-rectus distance, that is, what happens with this distance during the performance of different types of abdominal exercises. The classic abdominal exercise seems to favor the reduction of the inter-rectus distance. [8,23,36,37]

It is not only important to achieve the closeness of muscle bellies of the anterior rectus muscles, but also to create tension in the linea alba. [23, 37] The abdominal wall is essential for the lumbo-pelvic function, including the transfer of the fascial tension, hence the importance of generating tension. [10]

Pascoal et al. (2014) [37] and Lee & Hodges (2016) [23] indicated that in order to create tension in the linea alba, and to produce a reduction of the inter-rectus distance, the activation of the transverse abdominal muscle was necessary, along with the performance of a classic abdominal exercise. In these previous studies the immediate effects have been assessed and the exercise was repeated only once; this

leads us to reflect on whether these participants could perform several repetitions or whether, on the contrary, the activation of the transverse abdominal muscle, and consequently the tension of the linea alba would be lost. This aspect could explain the good results obtained with the 'No Más Diástasis' program. At first, it emphasizes the strengthening and awareness of the deep abdominal muscles (transverse exercises and hypopressive exercises). Later, it includes this contraction during the performance of concentric or eccentric abdominal exercises during the last phase of the program, and protects the abdomen during activities of daily living, which entail an increase in pressure. We believe that with this formula, the tension in the abdominal fascia could be ensured, while the abdominal muscles are strengthened, and, in the last assessment, the reduction of the diastasis recti is achieved.

Regarding the study of exercise programs for the reduction of diastasis recti, it should be pointed out that little literature was found, but with good results. [21,24,27]

In the case study conducted by Litos in 2014, [21] which lasted 4 months, the use of a wrap is proposed, along with exercises for abdominal, trunk and pelvic floor activation, advising against classic abdominal exercises. On the other hand, in 2017, for Kamel et al. [27] the objective was to study the effects of electrostimulation, along with the performance of classic abdominal exercises. Study by Acharry et al (2015) including abdominal exercises with bracing. [24]

4.4. Study limitations

The assessment method is digital palpation with caliper, which has high inter-rater validity, but there are other, more precise methods, such as ultrasound. [12,13] The 'No Más Diástasis' program relies on partly performing the exercises at home, which means that, despite the fact that the platform is intended to serve as guide as much as possible, it is impossible to know the adherence to the exercise program.

The absence of a control group is another limitation. However, the fact that some of the women have had diastasis recti for years could be considered control, because if no treatment was received, the diastasis recti would not spontaneously resolve, except for the first weeks after giving birth. [2,33]

CONCLUSIONS

The 'No Más Diástasis' exercise program leads to a reduction in the diastasis recti in women who had children. The results were obtained starting from the third week, and they gradually improved until the ninth week. Likewise, a reduction of the abdominal circumference was achieved.

In general, no relationship between the obstetric and personal variables, and the results of the program was found, and further research is needed to confirm the findings obtained in some of the variables, such as BMI or having had more than one child.

We consider that the success of the exercise program lies in the awareness and strengthening of the transverse abdominal muscle, as a basis for the performance of other activities, including the classic abdominal exercises.

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How to cite this article: León SC, Cuña-Carrera ID, de la Hoz GCA et.al. Effects of an exercise program on diastasis recti in women. Int J Health Sci Res. 2019; 9(10):90-99.

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