

Effectiveness of Abdominal Hypopressive Technique on Diastasis Recti among Postpartum Women

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How to cite this article: Radhika Sekar, Vinodhkumar Ramalingam, Jeslin Godwin Nirmala et. al. Effectiveness of Abdominal Hypopressive Technique on Diastasis Recti among Postpartum Women. Indian Journal of Physiotherapy and Occupational Therapy / Volume 18, Year 2024.

Abstract

Background: Diastasis recti (DR) is the separation of the abdominis rectus muscles in the central region, along with the white linea, in postpartum women. Less attention given towards the management of DR results in further complications such as urinary incontinence, descending reproductive organs, both umbilical and abdominal hernias, low back pain, and pelvic pain.

Purpose: The aim of the study is to find the effectiveness of abdominal hypopressive techniques on diastasis recti in postpartum women.

Materials and Methods: A total of 44 participants were recruited from the Department of Obstetrics and Gynaecology, SMCH and randomly assigned into 2 groups- Hypopressive exercise group (n = 22) with the mean age of 27.22 ± 1.71 years and conventional abdominal exercise group (n = 22) in with mean age of 26.36 ± 2.25 years. The Digital Vernier caliper and Oswestry Disability Index (ODI) version 2.0 were used as outcome measures to assess the inter recti distance and low back pain at baseline and after 8 weeks. Both therapies were administered 3 times a week for eight weeks.

Results: At the end of the treatment session, both groups showed significant improvement in inter recti distance and pain, but the participants who underwent hypopressive exercises had statistically ($p < 0.05$) better results.

Conclusion: The study shows that hypopressive exercises can be utilized to treat individuals with diastasis recti in postpartum women.

Keywords: Rectus Muscle of Abdomen, Postpartum period, Inter recti distance, Hypopressive technique, Lower Back Pain.

Introduction

Pregnant and postpartum women frequently experience the condition diastasis recti; in other terms, it is represented as midline inter-recti separation. Postpartum women with a visible longitudinal

bulge have efforts and separation of not less than two centimetres at 1 or more than one points along the white linea that includes the umbilicus' level or 4.5 cm above or below it, which are required for determining the diastasis recti¹. Other contributing

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factors to the occurrence of diastasis recti are maternal age and BMI¹.

Diastasis recti alters the posture and create extra strain on the low back, which decreases the mobility causing low back discomfort².

In pregnancy, enlarging the uterus changes the position of the lumbar spine leading to exaggerated lordosis and lengthening of the abdominal muscles. The lines alba may extend and become flaccid in addition to the rectus abdominis muscles, resulting in a potential increase in the distance between the medial borders of the muscles³.

In postnatal women due to pregnancy period, the muscles in the abdomen are elongated, resulting in weakened and separation of rectus abdominis muscles. If this continues, trunk stability may be compromised, resulting in low back pain (LBP)⁴. According to Gandhi B et al., states that individuals who possess increased inter rectal distance obtain LBP⁴. Estimates show that 4 out of 10 women still experience low back and pelvic pain six months after giving birth⁵.

Coordination among abdominal and lumbopelvic muscles play a significant role in postural stabilization⁶. Together with the muscles in the abdomen, the diaphragm creates hydraulic effects in the abdominal region that helps stabilize the spine^{7,8}.

This mechanism is altered in diastasis of rectus abdominis (DRA) which contributes to chronic low back pain⁹. Abdominal Hypopressive technique (AHT) directly stimulates the transversus abdominis and strengthens the abdominal wall⁷. Strengthening the muscles responsible for trunk stability is frequently beneficial in reducing LBP^{7,8}.

Diastasis recti is diagnosed using computed tomography, magnetic resonance imaging, and ultrasound. Without the involvement of radiation, DR can also be diagnosed using finger width method or vernier caliper method^{9,10}.

When DR is diagnosed, conservative treatment is the first choice of treatment to improve the morphological, functional, and quality of life of patients¹¹. Michalska A et al., reported that core strengthening exercises, posture correction, instruction and training on proper lifting and

movement techniques are employed in the treatment of DR³.

Benjamin DR et al., suggested that abdominal sit-up, crunches, vigorous coughing without abdominal support and moving heavy objects increase the intra-abdominal pressure resulting in bulging of the abdomen leading to increase in space between the inter recti distance¹².

One of the conservative techniques to prevent pelvic floor (PF) disorders after postpartum and for postural training is known as AHT¹³⁻¹⁵.

Similarly, in the same year at Europe, Low Pressure Fitness, commonly referred to as Hypopressive exercises, were developed with the aim of aiding postpartum women with the possible effects on the muscles of the abdomen and PF as well as perineal dysfunctions like prolapse or incontinence of the bladder¹⁶.

AHT procedure involves complete exhalation followed by apnea, closing of glottis and widening of thoracic cavity, stretching of diaphragm and producing involuntary stimulation of the deep muscles of the trunk. The addition of this approach to postural exercises promotes the coordinated activity of all postural muscles, including the deep muscle groups in the trunk¹⁷.

In terms of postural techniques, AHT is carried out in a series of postures that often begins with the performer standing up and ends with the performer lying down¹⁸.

Many postpartum women with DR commonly experience LBP due to altered trunk mechanics, impaired pelvic stability and postural change. Moreover, it can have an impact in parturition, trunk movements including (flexion as well as rotation, extension, side-bending) and the support of the viscera of the abdomen, PF functions¹⁹. Studies have reported the effect of various exercises²⁰, kinesiotaping²¹, electrical stimulation²² on reduction of the inter recti distance. However, to the best of our knowledge, no study has compared the effect of AHT with conventional abdominal exercises.

Aim

The aim of the study is to find the effectiveness of abdominal hypopressive techniques on diastasis recti in postpartum women.

Materials and Methods

This study was conducted at a private Hospital, Chennai from October 2022 to April 2023. A total of 64 postpartum women were referred from the Department of Obstetrics and Gynaecology to the Physiotherapy outpatient department. Out of 64 participants, 20 were excluded based upon the inclusion and exclusion criteria and the remaining 44 participants were included in this study.

Inclusion criteria:

- Subjects between the age group of 23 and 30 years who are diagnosed with diastasis recti in their post-partum period
- Subjects with increased inter recti distance > 2 to 5 cm and associated with low back pain persisting from 3 to 6 months or up to 1 year after delivery and difficulty getting up from a sitting or lying down position.
- Subjects who gave vaginal birth with or without episiotomy, who underwent caesarean section, both primi and multiparous women.

Exclusion criteria:

- Subjects with Untreated high blood pressure, cardiovascular illness, hernia
- Subjects who are Pregnant
- Subjects who underwent any recent abdominal surgeries (except caesarean section)

Outcome Measures

- Digital Vernier caliper
- Oswestry disability index (ODI) 2.0

Procedure

The informed consent was obtained from all the participants prior to the initiation of the procedure after thorough explanation of the study proceedings. ISRB clearance was taken before recruiting the participants. The participants included were randomized into two groups (group A and group B) using lottery method and were blinded. Participants were assessed for disability and pain of lower back using Oswestry disability index-(ODI) and inter-recti distance using Vernier caliper at baseline and 8th week. The vernier caliper was placed at the three sites:

on & at the level of umbilicus, 4.5cm below and above the level of umbilicus. The 10 ODI criteria are: the degree of pain, the ease of personal hygiene, carrying objects, work, standing and sitting, sleeping, sexual life, interaction with others, and traveling which are used to determine a patient's functional impairment. A patient has a very low level of disability if their ODI is between 0 and 20%, a moderate level of disability if it is between 21 and 40%, a very high level of disability if it is between 41% and 60%, profound functional disability if it is between 61 and 80%, and bedridden if it is between 81 and 100%.²³

Participants who receive hypopressive maneuver (group A) were instructed to hold their breath (apnea) and stretch their thoracic cage, which cause their abdominal wall to pull inward and downward without inhaling. The women were told to maintain the apnea and thoracic-cage expanding for around 10 seconds before returning to their normal breathing. Once the participants were capable of performing this technique while lying flat, sitting or standing, they were instructed to perform the maneuver in a series of "hypopressive postures." With a variety of both lower and upper limb positions in kneeling, standing, four-point kneeling, seated and lying positions, these positions are explained to the participants. The entire sequence happened 3 times per week for 20 minutes and was carried out for about 8 weeks. While keeping the hypopressive posture, with a rest breath between each session.

The participants in group B received the conventional abdominal exercises which included reverse sit-ups, posterior pelvic tilts, static abdominal contractions, and reverse trunk twists. All the participants in group B were instructed to complete three consecutive sets of twenty reps of each exercise, holding each contraction for 5 seconds and followed by relaxation for 10 seconds, 3 times a week for 8 weeks' period 20 minutes. Every participant was advised to incorporate the same workout practice into their regular routine at home, which was monitored through video call.

Data Analysis

In this study, IBM Statistical Package SPSS version 27.0 was used for statistical data analysis. Normality was tested using the Shapiro-Wilk test. Independent

t test and paired t was used to compare the difference between pre and post intervention in both the groups (group A and group B). The significant value was set as $p < 0.05$.

Results

A total of 44 participants were selected with the mean age of 27.22 ± 1.71 years in group A and 26.36 ± 2.25 years in group B. The baseline variables (age) were assessed for normality using Shapiro-Wilk test and were found to be normally distributed. Paired t test was used to analyse the differences in the baseline variables between the groups.

The p value for age was 0.161 indicating that the baseline variables had statistically no difference between the groups ($p > 0.05$).

In this study, Table 1 shows the mean and standard deviation (SD) values of both the

experimental groups (group A and group B) for inter recti distance at 3 levels using Digital Vernier caliper and Table 2 shows that the differences between the groups for ODI.

This study revealed that the mean reduction of pain using ODI was 82.68 ± 7.91 at baseline and 52.13 ± 7.79 was post intervention in group A and in group B 82.36 ± 5.26 at baseline and 56.72 ± 4.98 in group B as tabulated in table-2 and figure-5 and the mean Reduction of Inter-recti distance measured in three levels: at the level of umbilicus was 3.55 ± 0.71 at baseline and 2.55 ± 0.71 was post intervention in group A whereas it was 3.56 ± 0.71 pre intervention and 3.21 ± 0.79 in group B, below the level of umbilicus was 2.76 ± 0.22 was pre intervention and 1.74 ± 0.213 in post-intervention group A whereas it was 2.73 ± 0.22 pre intervention and 2.42 ± 0.26 in post-intervention group B, above the level of umbilicus was 2.42 ± 0.33 before intervention and 1.42 ± 0.33 after intervention in group A whereas it was 2.43 ± 0.35 before intervention and 2.21 ± 0.28 after intervention in group B as tabulated in table-1 and figure-2, 3, & 4. Both groups significantly improved as measured by the ODI and inter recti distance measured from Digital Vernier caliper. In comparison to group B, group A showed noticeably better improvement.

The inter recti distance measured at the three levels after the completion of intervention had a

p value of 0.006 at the level of umbilicus, $p = 0.001$ below the level of umbilicus and $p = 0.001$ above the level of umbilicus. Reduction of pain using ODI post intervention had p value of 0.025 which means that the both inter recti distance measured using digital Vernier caliper and ODI had significantly beneficial.

After the completion of the intervention, the mean and SD values of inter recti distance measured by Digital Vernier caliper at three levels of umbilicus for group A at the level of umbilicus was 2.55 ± 0.71 and for group B was 3.21 ± 0.79 , above the level of umbilicus for group A was 1.42 ± 0.33 and for group B was 2.21 ± 0.28 , below the level of umbilicus for group A was 1.74 ± 0.21 and for group B was 2.42 ± 0.26 . Similarly, the mean \pm SD values of reduction of pain using ODI group A was 52.13 ± 7.79 and for group B was 56.72 ± 4.98 . The differences in the mean \pm SD of the four variables indicated that the participants who received hypopressive exercise (group A) were highly benefitted compared to those who received conventional abdominal exercise protocol (group B).

Table 3 shows the analysis of non-parametric tests (Mann Whitney U test and Wilcoxon test). The Z score of the variables post intervention above the level of umbilicus was -5.420 and for the below the level of umbilicus was -5.549 indicating the statistical significance of hypothesis testing. Similarly, the p value for the variable above the level of umbilicus was 0.001 and for the level of umbilicus 0.001 indicating the significant reduction of inter-recti distance by the interventions.



Figure 1: Participant from the experimental group performing Abdominal Hypopressive technique



Figure 2: Measurement of Inter Recti Distance with Digital Vernier Caliper

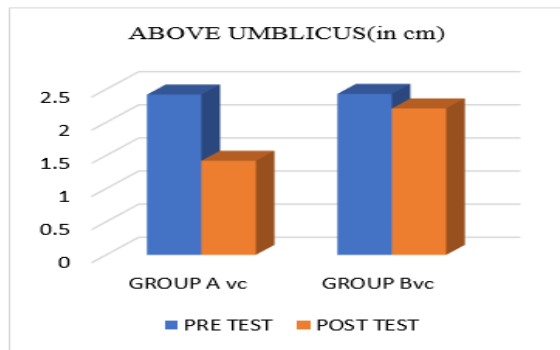


Figure No. 3

Interpretation: Groups A and B's pre and post Inter recti distance (in cm) above the level of umbilicus

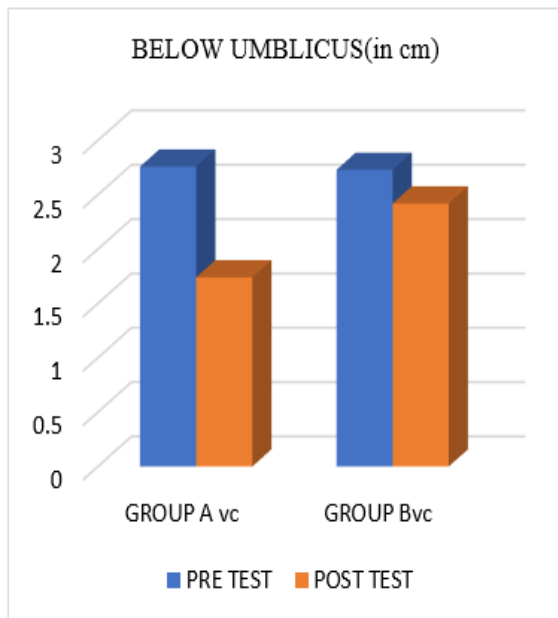


Figure No. 4

Interpretation: Groups A and B's pre and post Inter recti distance (in cm) below the level of umbilicus

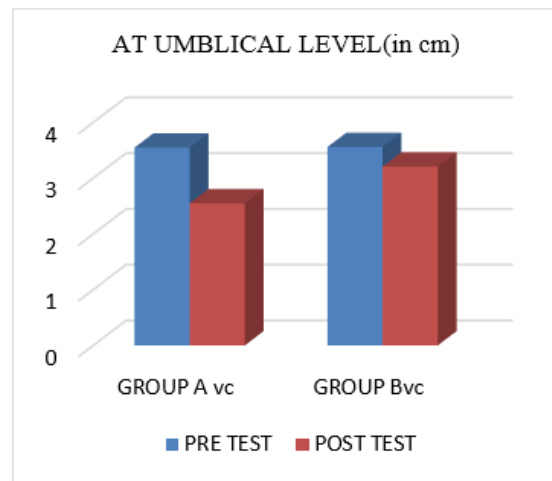


Figure No. 5

Interpretation: Groups A and B's pre and post inter recti distance (in cm) at umbilical level

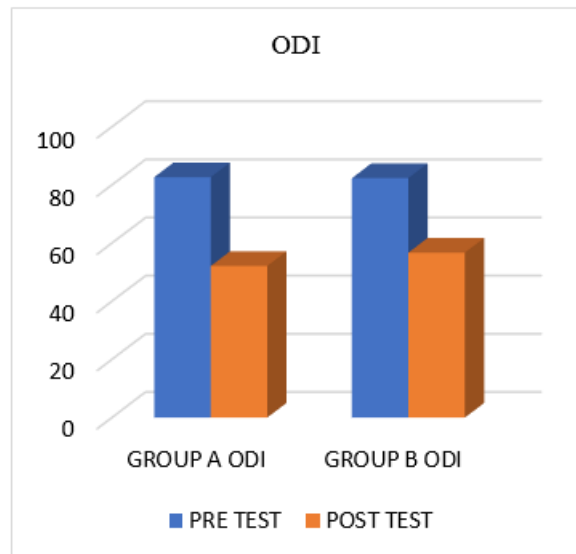


Figure No. 6

Interpretation: Groups A and B's pre and post-ODI scores

Table 1: Analyses of differences between group A and group B for inter recti distance at 3 levels using Digital Vernier Caliper:

Statistical analysis of Digital Vernier Caliper	Group	Mean \pm SD		p-value
		Pre-test	Post-test	
Above the level of umbilicus	Group A (n=22)	2.42 \pm 0.33	1.42 \pm 0.33	0.001*
	Group B (n=22)	2.43 \pm 0.35	2.21 \pm 0.28	
At the level of umbilicus	Group A (n=22)	3.55 \pm 0.71	2.55 \pm 0.71	0.006*
	Group B (n=22)	3.56 \pm 0.71	3.21 \pm 0.79	
Below the level of umbilicus	Group A (n=22)	2.76 \pm 0.22	1.74 \pm 0.21	0.001*
	Group B (n=22)	2.73 \pm 0.22	2.42 \pm 0.26	

Table 2: Analyses of differences between group A and group B for ODI:

Statistical analysis of Oswestry disability index(ODI)	Group	Mean \pm SD		p-value
		Pre-test	Post-test	
Oswestry disability index(ODI)	Group A (n=22)	82.68 \pm 7.91	52.13 \pm 7.79	0.025*
	Group B (n=22)	82.36 \pm 5.26	56.72 \pm 4.98	

Table 3: Analyses of non- parametric test statistics:

	Post above umbilicus	Post below umbilicus
Mann- Whitney U	12	7.5
Wilcoxon W	265	260.5
Z	-5.420	-5.549
p value	<.001	<.001

Discussion

The current study aimed to determine the effect of abdominal hypopressive exercise for Diastasis recti and low back pain among postpartum women. The participants in our study were randomly divided into 2 groups: group A which received hypopressive exercises and group B received conventional abdominal exercises.

The inter recti distance was measured at 3 levels by using Digital Vernier caliper. The mean value of inter recti distance above the level of umbilicus for group A at pre intervention was 2.42 \pm 0.33 and post intervention was 1.42 \pm 0.33, and for group B in pre intervention was 2.43 \pm 0.352 and post intervention was 2.29 \pm 0.283. The mean value of inter recti distance at the level of umbilicus for group A before intervention was 3.55 \pm 0.710 and after intervention was 2.55 \pm 0.710 and for group B before intervention was 3.56 \pm 0.710 and after intervention was 3.218 \pm 0.793. The mean value of inter recti distance below

the level of umbilicus for group A at baseline was 2.763 \pm 0.225 and post intervention was 1.745 \pm 0.213 and for group B at baseline was 2.731 \pm 0.225 and post intervention was 0.422 \pm 0.265. The mean values of Oswestry Disability Index which was used to evaluate the low back pain for group A at baseline was 82.68 \pm 7.91 and after intervention was 52.13 \pm 7.790, similarly for group B before intervention it was 82.36 \pm 5.26 and after intervention was 56.72 \pm 4.98.

This data shows that the subjects in both the groups have shown a significant difference in their outcome measures. Compared to conventional exercise, abdominal hypopressive exercise was much more effective in reducing inter-recti distance and low back pain as the diaphragm was consistently activated throughout the session unlike intermittent contraction in conventional exercise. A study done by Ramírez-Jiménez M et al., at 2023 has stated that hypopressive exercise programmes had a positive impact on reducing diastasis recti for postpartum women²⁴. But in that study the involvement of the control group was not implemented. This study aimed to compare the effect of hypopressive exercise and conventional abdominal exercises to two different groups.

Cañamero-de León S et al.,2019 has reported the effect of an exercise program called as 'No Más Diastasis exercise program' which involved

hypopressive abdominal gymnastics, transverse muscle activation exercises, exercises of oblique and rectus abdominis activation in reducing the diastasis recti in women who had children and since their pregnancy was longer than 8 weeks. The results were obtained (by using a palpation method at three levels of the umbilicus – above the level, at the level, below the level) and concluded that improvements started from the 3rd week and progressed until the 9th week. However, Cañamero-de León S et al., did not evaluate the isolated effect of hypopressive abdominal exercise and presence of a control group to compare the effect of the intervention was not established²⁵.

Digital palpation with calipers, which has a high level of inter-rater reliability, was used; due to the lack of funding for the present study, quantitative assessment methods such as ultrasonography were not used. Another limitation was that both the therapist and the assessor were not blinded. Future recommendation is to evaluate the effect of AHT on obese men with DR. As DR is quite prevalent in the postpartum period, therapists are recommended to teach AHT as a part of postnatal care since it is effective.

From this study, it appears that in hypopressive exercises, the abdominal muscles, diaphragm, and spine stabilizers are targeted simultaneously, whereas in conventional abdominal exercises, a specific group of muscles is targeted at a single time. Hence, hypopressive exercises in group A are said to be more significant and recovery faster in patients with diastasis recti than conventional abdominal exercises.

Conclusion

This study results concludes that the hypopressive exercise group showed a statistically superior improvement in inter-rectus distance reduction than those in the conventional abdominal exercise group. Hence, it is important to incorporate Hypopressive exercise to improve posture thus reducing the occurrence of back pain.

Ethical Clearance: ISRB clearance was taken before recruiting the participants.

ISRB number- 01 /054 /2022 /ISRB / PGSR/ SCPT

Funding: Self

Conflict of Interest: Nil

References

1. Thabet AA, Alshehri MA. Efficacy of deep core stability exercise program in postpartum women with diastasis recti abdominis: a randomised controlled trial. *Journal of musculoskeletal & neuronal interactions*. 2019;19(1):62.
2. Olsson A, Kiwanuka O, Wilhelmsson S, Sandblom G, Stackelberg O. Cohort study of the effect of surgical repair of symptomatic diastasis recti abdominis on abdominal trunk function and quality of life. *BJS Open*. 2019 Sep11;3(6):750-8.
3. Michalska A, Rokita W, Wolder D, Pogorzelska J, Kaczmarczyk K. Diastasis recti abdominis – a review of treatment methods. *Ginekologia polska*. 2018;89(2):97-101.
4. Gandhi B, Dhankar S. Impact of Diastasis Recti Abdominis and low back pain on Quality Of Life in Post-partum female. *Indian Journal of Forensic Medicine & Toxicology*. 2021;15(1):887-9.
5. Parker M, Millar L, Dugan S. Diastasis rectus abdominis and lumbo-pelvic pain and dysfunction - Are they related? *J Womens Health Phys Therap*. 2009;33(2):15-22.
6. Ithamar L., de Moura Filho A.G., Benedetti Rodrigues M.A., Duque Cortez K.C., Machado V.G., de Paiva Lima C.R.O., Moretti E., Lemos A. Abdominal and pelvic floor electromyographic analysis during abdominal hypopressive gymnastics. *J. Bodyw. Mov. Ther*. 2018; 22:159-165.
7. Vicente-Campos D, Sanchez-Jorge S, Terrón-Manrique P, Guisard M, Collin M, Castaño B, Rodríguez-Sanz D, Becerro-de-Bengoa-Vallejo R, Chicharro JL, Calvo-Lobo C. The Main Role of Diaphragm Muscle as a Mechanism of Hypopressive Abdominal Gymnastics to Improve Non-Specific Chronic Low Back Pain: A Randomized Controlled Trial. *J Clin Med*. 2021 Oct 27;10(21):4983.
8. Finta R., Nagy E., Bender T. The effect of diaphragm training on lumbar stabilizer muscles: A new concept for improving segmental stability in the case of low back pain. *J. Pain Res*. 2018; 11:3031-3045.
9. Doubkova, L., Andel, R., Palascakova-Springrova, I., Kolar, P., Kriz, J., & Kobesova, A. (2018). Diastasis of rectus abdominis muscles in low back pain patients. *Journal of Back and Musculoskeletal Rehabilitation*, 31(1), 107-112. Bobowik PŽ, Dąbek A. *Physiotherapy in*

- women with diastasis of the rectus abdominis muscles. *Advances in Rehabilitation*. 2018;32(3):11-7.
10. Pascoal AG, Dionisio S, Cordeiro F, Mota P. Inter-rectus distance in postpartum women can be reduced by isometric contraction of the abdominal muscles: a preliminary case-control study. *Physiotherapy*. 2014 Dec 1;100(4):344-8.
 11. Radhakrishnan M, Ramamurthy K. Efficacy and Challenges in the Treatment of Diastasis Recti Abdominis—A Scoping Review on the Current Trends and Future Perspectives. *Diagnostics*. 2022 Aug 24;12(9):2044.
 12. Benjamin DR, Van de Water AT, Peiris CL. Effects of exercise on diastasis of the rectus abdominis muscle in the antenatal and postnatal periods: a systematic review. *Physiotherapy*. 2014 Mar 1;100(1):1-8.
 13. Bellido-Fernández L, Jiménez-Rejano JJ, Chillón-Martínez R, Gómez-Benítez MA, De-La-Casa-Almeida M, Rebollo-Salas M. Effectiveness of massage therapy and abdominal hypopressive gymnastics in nonspecific chronic low back pain: a randomized controlled pilot study. *Evidence-Based Complementary and Alternative Medicine*. 2018 Jan 1;2018.
 14. Caufriez M, Fernández J, Guignel G, Heimann A. Comparación de las variaciones de presión abdominal en medio acuático y aéreo durante la realización de cuatro ejercicios abdominales hipopresivos. *Rev. Iberoam. Fisioter. Kinesiol*. 2007;10:12-23.
 15. Juez L., Núñez-Córdoba J.M., Couso N., Aubá M., Alcázar J.L., Mínguez J.Á. Hypopressive technique versus pelvic floor muscle training for postpartum pelvic floor rehabilitation: A prospective cohort study. *Neurourol. Urodyn*. 2019;38:1924-1931.
 16. Moreno-Muñoz MD, Hita-Contreras F, Estudillo-Martínez MD, Aibar-Almazán A, Castellote-Caballero Y, Bergamin M, Gobbo S, Cruz-Díaz D. The effects of abdominal hypopressive training on postural control and deep trunk muscle activation: a randomized controlled trial. *International Journal of Environmental Research and Public Health*. 2021 Mar 8;18(5):2741.
 17. Sáez MM, Rebullido TR, Medrano IC, Soidán JL, Tormo JM. ¿ Puede un programa de ocho semanas basado en la técnica hipopresiva producir cambios en la función del suelo pélvico y composición corporal de jugadoras de rugby?. *RETOS. Nuevas Tendencias en Educación Física, Deporte y Recreación*. 2016(30):26-9.
 18. Stüpp L., Resende A.P.M., Petricelli C.D., Nakamura M.U., Alexandre S.M., Zanetti M.R.D. Pelvic floor muscle and transversus abdominis activation in abdominal hypopressive technique through surface electromyography. *Neurourol. Urodyn*. 2011;30:1518-1521.
 19. Spitznagle TM, Leong FC, Van Dillen LR. Prevalence of diastasis recti abdominis in a urogynecological patient population. *Int Urogynecol J Pelvic Floor Dysfunct*. 2007;18(3):321-8.
 20. Sancho, M.; Pascoal, A.; Mota, P.; Bø, K. Abdominal exercises affect inter-rectus distance in postpartum women: A two-dimensional ultrasound study. *Physiotherapy* 2015, 101, 286-291.
 21. Preethi PA, Vijayalakshmi K, Moses S, Mathipriya K, Pavithralochani V. Effects of Kinesiotaping along with abdomen and pelvic floor exercise on diastasis recti abdominis for postpartum women in normal delivery versus LSCS. *Biomedicine*. 2022 Mar 5;42(1):143-7.
 22. Kamel, D.M.; Yousif, A.M. Neuromuscular Electrical Stimulation and Strength Recovery of Postnatal Diastasis Recti Abdominis Muscles. *Ann. Rehabil. Med*. 2017, 41, 465-474.
 23. Yates M, Shastri-Hurst N. The Oswestry disability index. *Occupational Medicine*. 2017 Apr 1;67(3):241-2.
 24. Ramírez-Jiménez M, Albuquerque-Sendín F, Garrido-Castro JL, Rodrigues-de-Souza D. Effects of hypopressive exercises on post-partum abdominal diastasis, trunk circumference, and mechanical properties of abdominopelvic tissues: a case series. *Physiother Theory Pract*. 2023 Jan;39(1):49-60.
 25. Cañamero-de León S, Da Cuña-Carrera I, de la Hoz González C, Soto-González M. Effects of an exercise program on diastasis recti in women. *International Journal of Health Sciences & Research*. 2019;9(10):90.