Effectiveness of Pelvic Floor Muscle Training in Women with Diastasis Recti – A Randomized Controlled Trial

Pooja J [1*], Ponmathi P[2*], Sathyaprabha B[3*]

[1]*Post Graduate Student, Department of Women's Health, Faculty of Physiotherapy, Sri Ramachandra Institute of Higher Education and Research, Porur, Chennai, Tamilnadu, India*
[2]*Assistant Professor, Department of Women's Health, Faculty of Physiotherapy, Sri Ramachandra Institute of Higher Education and Research, Porur, Chennai, Tamilnadu, India. Email: ponmathi.p@sriramachandra.edu.in*
[3]*Professor, Department of Women's Health, Faculty of Physiotherapy, Sri Ramachandra Institute of Higher Education and Research, Porur, Chennai, Tamilnadu, India*
Corresponding Author: Ponmathi P

KEYWORDS
Diastasis recti, pelvic floor muscle training, abdominal training, finger width, vernier caliper, inter recti distance.

ABSTRACT
Background: Diastasis recti Abdominis (DRA) is a condition that occurs with increased distortion of linea alba. According to World Health Organization (WHO), Prevalence of DRA is 30–68% in postpartum women.
Objective: The study aims to determine the effect of pelvic floor muscle training on inter-recti distance among postnatal women with Diastasis recti.
Design: A Randomized controlled trial
Setting: The study was conducted at Sri Ramachandra Hospital, Chennai.
Subjects: 72 Subjects who satisfied the inclusion and exclusion criteria were included in the study. After obtaining an informed consent the subjects were randomly allotted into two groups.
Outcome Measures: Pretest and post test measures of IRD were taken using the finger width and vernier caliper methods. The control group received abdominal muscle training alone and the intervention group received PFM training with abdominal muscle training. The post test measurement were taken at the end of 12 weeks of intervention.
Result: The analysis of IRD shows that there was a statistically significant difference in both control and experimental groups (P value <0.05). Between-group analysis of IRD taken using the finger width and vernier caliper methods shows no statistically significant difference between control and intervention groups (P >0.05)
Conclusion: This study shows no significant effect of pelvic floor muscle training on inter-recti distance in women with Diastasis recti.

1. Introduction

Diastasis recti Abdominis (DRA)is a condition that occurs due to separation or increased distance in the rectus abdominis muscle. DRA is more common after delivery and also in final trimester of pregnancy.[2]. Rectus abdominis and linea alba undergo major changes during pregnancy.[1]. Disortion of linea alba resulting in a gap between the two recti muscles is termed as DRA.[1]

During pregnancy, the rise in intra-abdominal pressure and alterations in hormone levels, particularly relaxin, impact the abdominal musculature and connective tissues. This can result in elongation of the abdominal muscles and increased distortion of the linea alba, consequently contributing to and augments interrecti distance. Prevalence of DRA is 27–100% in late pregnancy and 30–68% for postpartum women.[7]

There are theories that support that DRA gets resolved spontaneously in the puerperium period but many research says that the Diastasis Recti is also found to increase or remain the same during the postnatal period [2]. Much research supports that DRA is not reversible, further, it poses a great financial burden and affects quality of life[3]. Few studies support that age, type of delivery, parity, and Body Mass Index may be a risk factor in developing DRA postnatally [4,5].

DRA is evaluated by finger width method which is a gold standard method known for reliability and feasibility. The other methods of measuring DRA is Vernier caliper and ultrasonography. Ultrasonography has been found to be the most reliable tool but availability and ease of use remain a

concern. Due to its quantitative analysis, Ultrasonography has become the standard evaluation tool of DRA in research.

Any Interrecti distance (IRD) more than 2.5cm width is termed as Diastasis Recti. DRA is measured at three levels (a:At the level of umbilicus,b:3 cm above umbilicus,c:3 cm below umbilicus). In many cases, diastasis recti is often observed at the level of the umbilicus, as opposed to above or below it.[2]

Immediately after labour, 68% of women have DRA above and 32% have DRA below the umbilicus. DRA is more prevalent at about 33.1% during pregnancy, 60.0% at puerperium, 45.5% at 6 months postpartum, and 32.6% at one year after delivery. [8].

DRA if untreated may result in back pain, gastrointestinal disturbances. Fecal and urinary incontinence, pelvic organ prolapses, and myofascial pelvic pain [5].

Awareness of DRA among physiotherapist is quite low, Most of DRA goes undiagnosed or untreated. Research supports different available intervention techniques ranging from core stabilization, the Tupler technique. Mutu technique etc. Tupler and core stabilization has the highest research evidence that it has very beneficial effect on DRA approximation. Pelvic floor muscles being one of the inner core muscles is not usually a part of exercise protocol in treating DRA patients. So this study aims to find the effect of pelvic floor exercises training over Diastasiis Recti.

2. Materials and Methods

A Single-blinded Experimental study was done to determine the effect of pelvic floor muscle training on IRD.

Sample:

The sample size included in the study is 72 with a confidence interval of 95%, a margin of error of around 10%, power at the level of 0.80 and allocation ratio 1.

Control Group-36 Intervention Group-36

Inclusion Criteria:

Post-natal women 20-40 years of age. Women with Diastasis recti postpartum. Primi and multipara, Vaginal delivery. Diastasis recti more than 2.5 cm. Assisted vaginal breech, or instrumental delivery. Early (3 weeks) postpartum period

Exclusion Criteria:

Presence of chronic mental illness/ postpartum depression. Cesarean section. Serious illness to the mother or child, Postnatal complications such as postpartum hemorrhage, uncontrolled hypertension post delivery and abdominal skin diseases, Lower limb deformities, spine and movement restrictions that inhibit exercise movements.

Protocol:

In this study, the sample collection was started once IEC clearance was obtained. A single-blinded study design was used to enroll patients with DR in which the assessor was blinded. The assessor assessed all postnatal subjects- 3 weeks postpartum from obstetrics and gynecology outpatient and inpatient department of Sri Ramachandra Hospital with a standard Performa and those who satisfied the inclusion and exclusion criteria were included in this study. Out of 620 postnatal mother’s 548 subjects were excluded based on the inclusion and exclusion criteria and finally,72 Postnatal women with Diastasis recti were identified. They were explained with the study completely and after getting their informed consent they were randomly allocated in to two groups through sealed huenvelop method. In sealed envelope method, Each subjects chose a envelope (sealed) which contained slots of experimental group and control group. Subjects were then allocated according to the slots they received.

- Group A (Experimental group)
- Group B (Control group)

Subjects in both the group were assessed through finger width method and digital caliper and documented. Group A subjects received 3 simple abdominal exercises with PFM training, while Group B received only 3 simple abdominal exercises for a period of 12 weeks. The exercise program consists of 5 min of warm up, 30 min of the main program, and 5 min of the cool-down. Each exercises hold period was10 seconds and was performed 10 times. During the first and final day of the program, subjects in both Group A and Group B was assessed by the finger width method and digital caliper.

Control Group:

The initial segment of the program comprised a 20-minute postural intervention. For postpartum women, the recommended posture entailed assuming a prone position. Utilization of cushions beneath the abdominal region facilitated the neutralization of lumbar lordosis. The subsequent portion of the regimen involved the performance of three uncomplicated exercises concomitant with extended exhalation.

MODES	EXERCISES	TIME	REPS/SETS AND REST PERIOD
WARM UP	BREATHING AND TOTAL BODY STRETCHING	5 min	3- 5 reps, 10-15 sec hold, 5 secs rest
MAIN EXERCISE	1) Curl up 2) Transverse abdominal contraction along with curl up 3) Transverse abdominal contraction with SLR (This exercise was repeated 10 times for each lower limb	30 min	10 reps, 10 sec holds for each rep
COOL DOWN	General relaxation exercises, Total body stretching	5 min	3- 5 reps, 10-15 sec hold, 5 secs rest

Figure 1: Control Group

Experimental Group:

The instructions for the group will be same as that of control group but with all the exercises subjects are instructed to hold pelvic floor muscles. The instructions are as

1.Control urine

2.Control motion

3.Contract vagina,

4.Contract three together, hold it for 5-10 counts and relax.

MODES	EXERCISES	TIME	REPS / SETS AND REST PERIOD
WARM UP	BREATHING AND TOTAL BODY STRETCHING	5 min	3- 5 reps, 10-15 sec hold, 5 secs rest
MAIN EXERCISE	1) curl up + PFM 2) transverse abdominal contraction along with curl up + PFM	30 min	10 reps, 10 sec holds for each rep

MODES	EXERCISES	TIME	REPS / SETS AND REST PERIOD
	3) transverse abdominal contraction with SLR + PFM (This exercise was repeated 10 times for each lower limb		
COOL DOWN	General relaxation exercises, Total body stretching	5 min	3- 5 reps, 10-15 sec hold, 5 secs rest

Figure 2: Experimental Group

3. Results

In our study 72 subjects with Diastasis recti, women were randomly allocated into two groups. 36 subjects to Control Group- with abdominal exercises and 36 subjects to Intervention Group with Pelvic floor muscle training and abdominal exercises.

Table 1 describes pre and post test measures of inter recti distance using finger width method and Vernier caliper method of Control Group The mean of pre test inter recti distance using finger width method during curl up at the level of umbilicus is 3.08(0.368) and of post test is 2.15(0.312). The significance of P value is <.001 .This shows clinical significance of ($p<0.05$) and there is a statistical significance. The mean of pre test measure of inter recti distance using Vernier caliper method during curl at the level of umbilicus is 42.38(3.80) and of post test 32.31(3.40). The significance of P value <.001.This shows statistical significance.

Table 2 describes pre and post test measures of inter recti distance using finger width method and Vernier caliper method of Intervention group The mean of Pre test of inter recti distance using finger width method during curl up is 3.14(0.351) and of post test 2.11(0.270). The P value is <0.001.This shows statistical significance. The mean of Pre test of inter recti distance using Vernier caliper method is 42.38(3.80) and of Post test 32.31(3.40). The P value is <0.001, this shows statistical significance.

Table 3 Comparison of post test measure of inter recti distance using finger width method and Vernier caliper method between Control and Intervention group

The mean of post test of inter recti distance using finger width method during curl up at the level of umbilicus in control group is 2.15(0.312) and of intervention group is 2.11(0.270). The P value is 0.261 .This shows no statistical significance. The mean of post test of inter recti distance using Vernier caliper method in control group is 32.31 (3.40) and of post test of intervention group 30.31(3.44). The P value is 0.652. There exist no statistical significance.

4. Discussion

The literature says that pelvic floor muscles are weaker in women with larger inter recti distance. Fernandez L.C et.al.stated that Women with increased IRD had lower PFM function. This relationship between DR and pelvic floor dysfunction aroused the interest to include Pelvic floor exercise training with standard protocol for Diastasis recti correction.

In this study there was a significant reduction of inter recti distance in both finger width and Vernier caliper measurements after 12 weeks of PFM training along with standard protocol.

This can be better explained by the concept that pelvic floor and abdominal muscles work synergistically which shows that each muscle group enhances the contraction of the other. So this might affect the performance of pelvic floor musculature.

This is best supported with Sapsford et al.(2001), says that voluntary activation of abdominal or PFM influences activity in other muscle groups.[11]

The pelvic floor muscle forms the base of the abdominal canister and contributes to the change of pressure within the canister.Thus pfm training along with abdominal muscle training have produced an effect on inter-recti distance .The enhanced effect of PFM contraction and the abdominal contraction used in standard protocol produced a reduction in inter recti distance.

This study goes in hand with Thabet & Alisheri et al.(2019)found a significant improvement in IRD post 8 weeks of abdominal and PFM exercises.[6]

This goes in hand with Theodorsen et al.(2003), noted that co-contraction of PFM and transverse abdominus during the first 6 weeks postpartum had a beneficial effect over inter recti distance.[17]

This study shows statistical significance in intra-abdominal distance post-abdominal muscle training for period of 12 weeks. The result of the study coincided with previous research that shows abdominal exercises are effective in reducing the inter-recti distance.

Lee and HODGE (2016) documented that activation of TrA can increases the tension and decrease the linea alba distortion which make force to be transmitted across the midline thus reducing the inter recti distance.[13]

This study goes in hand with Walto et al.(2016), who found significant reduction in IRD post training with abdominal exercise, and Sanjivani Ramesh Khandale et al.(2016) who concluded that abdominal exercises are effective in reducing IRD[1,14]

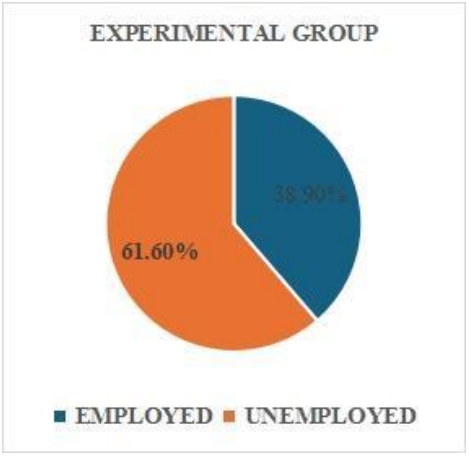
The results of this study shows that there is no significant difference in inter recti distance in both finger width and Vernier caliper between the two groups thus nullying the effect of pelvic floor muscles effect other than the standard protocol.It was established that contracting PFM should produce a deep contraction of lower and deep fibers of TrA.But our results contradict this by showing no statistical difference in inter recti distance.But our study shows clinical improvement with pelvic floor muscle training with better reduction in IRD than the standard protocol which provide the efficacy of pelvic floor muscles exercise addition into the exercise protocol of DR.

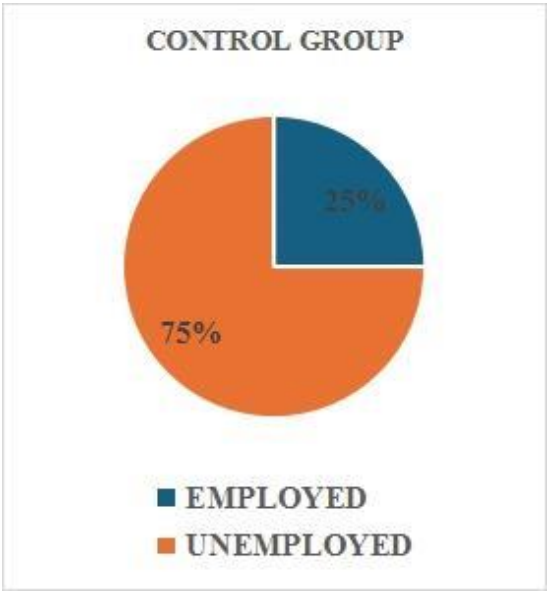
The conflicting theory of Increase in IRD with PFM contraction in few recent research helps to explain this results better.This was supported by Braz J phys ther.et al.(2021) stated that the PFM contraction had shown widening of IRD in minimal and does not influence DR.[15]

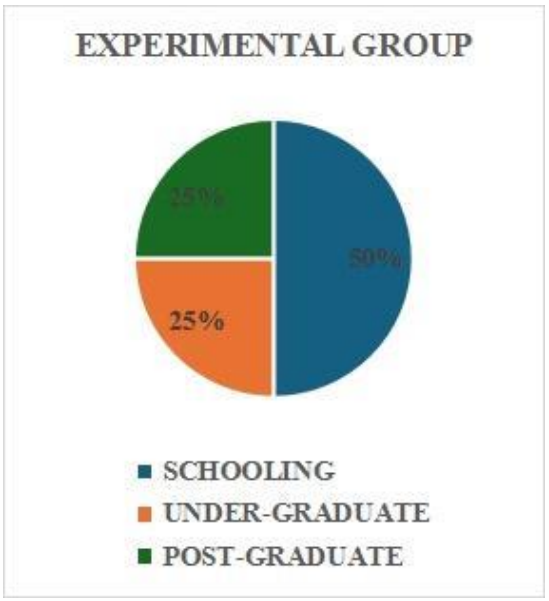
Gluppe et al. (2018) concluded that there was no significant difference in IRD reduction between groups trained with PFM and abdominal exercises compared with standard care.[16]

Adding PFM exercises to standard protocol did not influence IRD in any better way and produced an minimal extra benefit than standard protocol and also it has not produced any declining effect by widening DR too.Thus adding PFM to the standard protocol of DR will be beneficial to improve the pelvic floor muscles and a clinical extra benefit on IRD.

5. Figures and Tables


EXPERIMENTAL GROUP
38.90%
61.60%
EMPLOYED
UNEMPLOYED


CONTROL GROUP
25%
75%
EMPLOYED
UNEMPLOYED


EXPERIMENTAL GROUP
25%
50%
25%
SCHOOLING
UNDER-GRADUATE
POST-GRADUATE

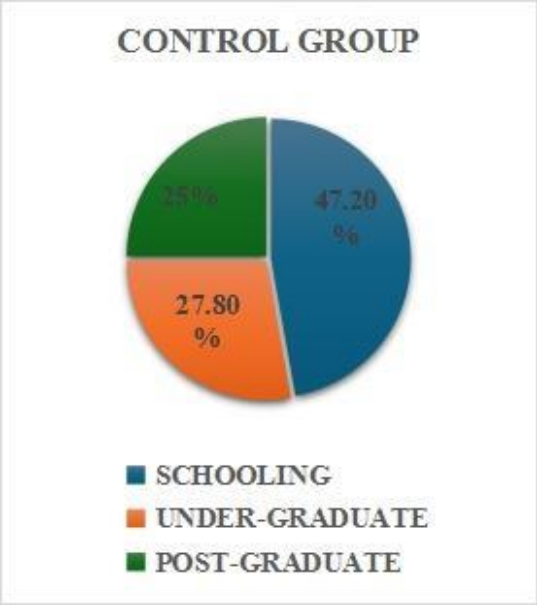


Figure 3: Baseline characteristics of age, BMI, Occupation and education

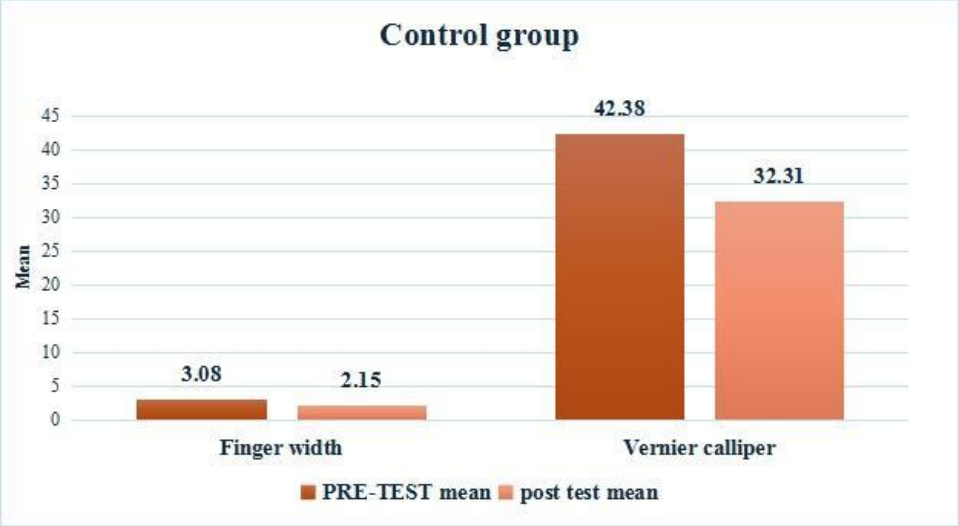


Figure 4: Pre and Post test measures of inter recti distance using finger width and Vernier caliper in control group

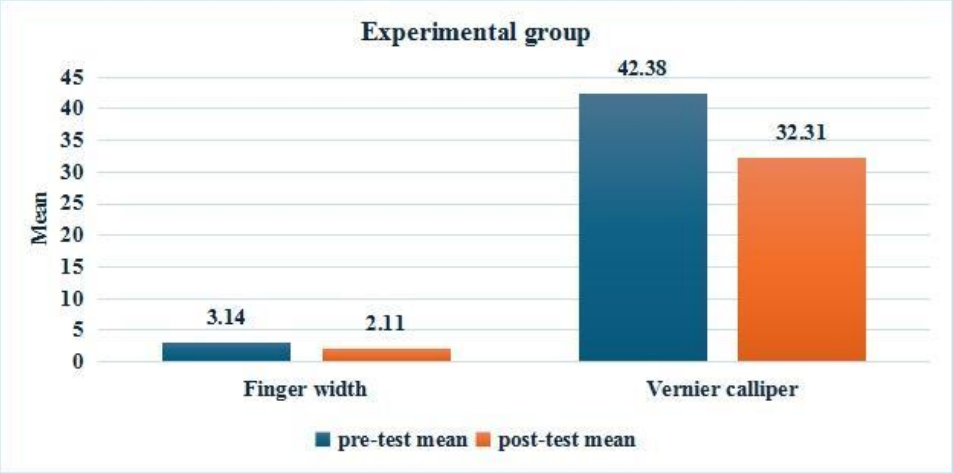


Figure 5 : Pre and Post test measures of inter recti distance using finger width and Vernier caliper in Experimental group

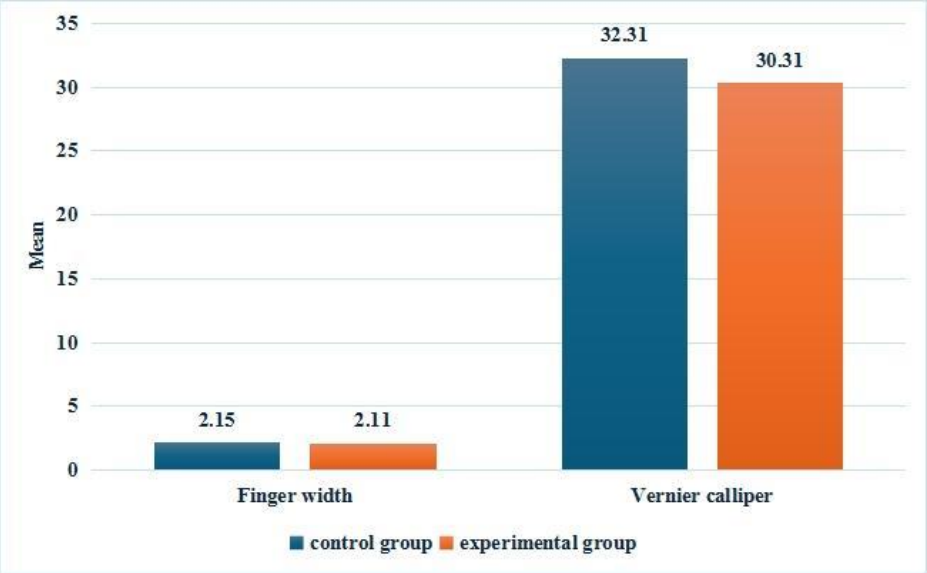


Figure 6: Comparison of post test measures of inter recti distance using finger width method and Vernier caliper method between control and intervention groups

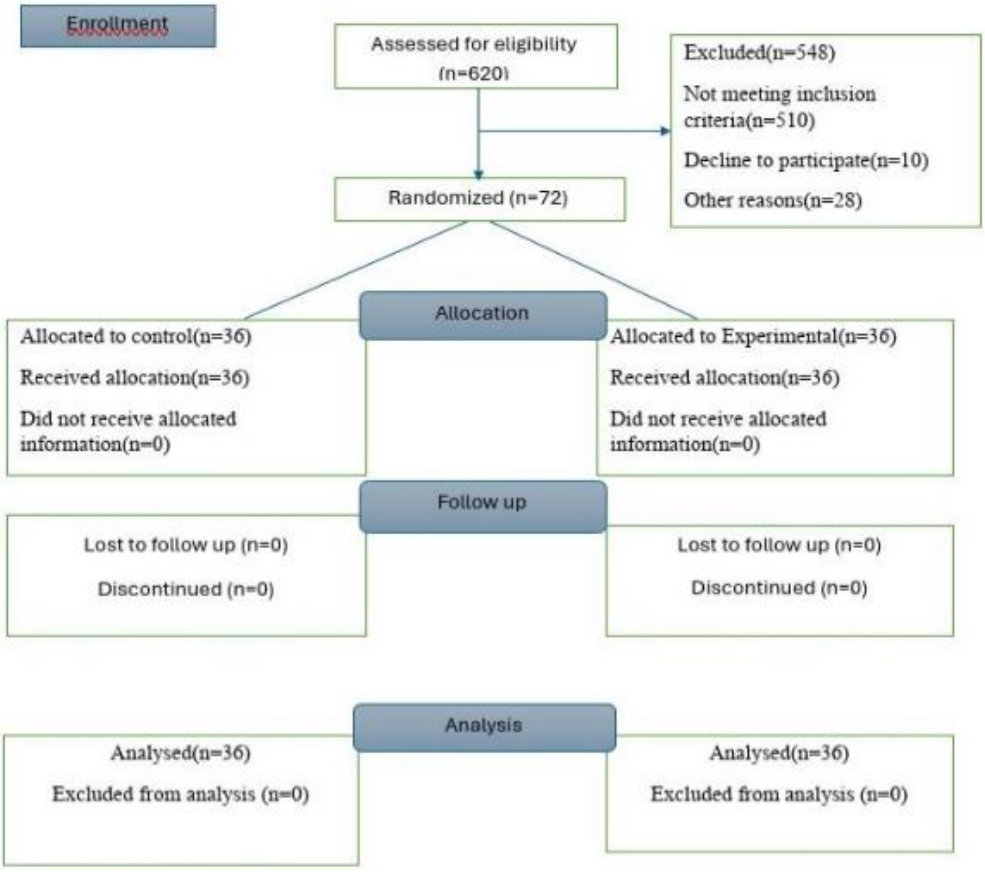


Chart 1. Consort Chart

Table-1 Baseline characteristics of age, BMI, Occupation and education

Variables N=72	**Control group**		**Experimental group**	
	Mean	**SD**	**Mean**	**SD**
Age	26.92	4.27	26.81	4.17
BMI	25.29	2.75	25.49	3.42

		Frequency	
Education	Schooling	17(47.2%)	18(50%)
	Under-graduate	10(27.8)	9(25%)
	Post-graduate	9(25%)	9(25%)
Occupation	Employed	9(25%)	14(38.9%)
	Unemployed	27(75%)	22(61.6)

Table 2: Pre and Post test measures of inter recti distance using finger width and Vernier caliper in control group

VARIABLES N= 36	**PRETEST**		**POST TEST**		**t- value**	**p -value**
	Mean	**SD**	**MEAN**	**SD**		
FINGER WIDTH (AT THE LEVEL OF UMBLICUS)	3.08	.368	2.15	.312	18.83	<.001
VERNIER CALLIPER (AT THE LEVEL OF UMBLICUS)	42.38	3.80	32.31	3.40	20.12	<.001

Table 3: Pre and Post test measures of inter recti distance using finger width method and Vernier caliper method in Experimental group

VARIABLES N = 36	**PRE-TEST**		**POST-TEST**		**t- value**	**p -value**
	Mean	**SD**	**MEAN**	**SD**		
FINGER WIDTH (AT THE LEVEL OF UMBLICUS) DURING CURL UP	3.14	.351	2.11	.270	21.161	<.001
\VERNIER CALLIPER (AT THE LEVEL OF UMBLICUS) DURING CURL UP	42.38	3.80	32.31	3.40	20.12	<.001

Table 4: Comparison of post test measures of inter recti distance using finger width method and Vernier caliper method between control and intervention groups

Variable		**Control group**		**Experimental group**		**T value**	**P value**
		Mean	**SD**	**Mean**	**SD**		
Finger width (at the level of umbilicus)	Pre-test	3.08	0.368	3.14	0.351	0.655	0.593
	Post-test	2.15	0.312	2.11	0.270	-0.606	0.261
Vernier calliper(at the level of umbilicus)	Pre-test	42.38	3.81	41.79	3.72	-0.671	0.632
	Post-test	32.31	3.40	30.31	3.44	-2.48	0.652

6. Conclusion

- This study shows no significant effect of pelvic floor muscle training on inter recti distance in women with Diastasis recti.
- But It has produced an clinical improvement of IRD than the standard protocol

7. Limitations and Recommendations

- Intervention can be of longer duration
- Biofeedback training of PFM muscles for better understanding for PFM muscles to the subjects.
- Can be tried in middle aged women after one year of delivery to evaluate their PFM strength and train accordingly

References:

[1] Walton, Lori Maria & Costa, Adislen & LaVanture, Donna & McIlrath, Sarah & Stebbins, Brittney. (2016). The effects of a 6 week dynamic core stability plank exercise program compared to a traditional supine core stability strengthening program on diastasis recti abdominis closure, pain, oswestry disability index (ODI) and pelvic floor disability index scores (PFDI). Physical Therapy and Rehabilitation. 3. 3. 10.7243/2055-2386-3-3.

[2] Ponmathi P, Jayalakshmi T, Sivakumar V. PR: Prevalence of diastasis recti among postpartum women-An observational study. Indian J Physiother Occup Ther. 2016;10(4):125-30.

[3] Zhu Y, Jiang L, Ye T, Liu Y, Sun L, Xiao L, Chen J, Wang T, Ren Y, Xu H, Zhao H. Risk Factors and Patient-Reported Outcomes in Chinese Women with Postpartum Diastasis Recti Abdominis: An Observational Study. International Journal of Women's Health. 2024 Dec 31:179-92.

[4] Wang Q, Yu X, Chen G, Sun X, Wang J. Does diastasis recti abdominis weaken pelvic floor function? A cross-sectional study. Int Urogynecol J. 2020;31(2):277–283. Doi:10.1007/s00192-019-04005-9

[5] Kaufmann RL, Reiner CS, Dietz UA, Clavien PA, Vonlanthen R, Käser SA. Normal width of the linea alba, prevalence, and risk factors for diastasis recti abdominis in adults, a cross-sectional study. Hernia. 2021;26(2):609–618. Doi:10.1007/s10029-021-02493-7.

[6] Thabet, A. A., & Alshehri, M. A. (2019). Efficacy of deep core stability exercise program in postpartum women with diastasis recti abdominis: a randomised controlled trial. Journal of musculoskeletal & neuronal interactions, 19(1), 62–68.

[7] Starzec-Proserpio, M., Lipa, D., Szymański, J., Szymańska, A., Kajdy, A., & Baranowska, B. (2022). Association Among Pelvic Girdle Pain, Diastasis Recti Abdominis, Pubic Symphysis Width, and Pain Catastrophizing: A Matched Case-Control Study. Physical therapy, 102(4), pzab311. https://doi.org/10.1093/ptj/pzab311

[8] Sperstad, J. B., Tennfjord, M. K., Hilde, G., Ellström-Engh, M., & Bø, K. (2016). Diastasis recti abdominis during pregnancy and 12 months after childbirth: prevalence, risk factors and report of lumbopelvic pain. British journal of sports medicine, 50(17), 1092–1096. https://doi.org/10.1136/bjsports-2016-096065

[9] Bobowik, Patrycja & Dabek, Aneta. (2018). Physiotherapy in women with diastasis of therectus abdominis muscles. Advances in Rehabilitation. 2018. 11-18. 10.5114/areh.2018.80964)

[10] Gluppe, S. L., Hilde, G., Tennfjord, M. K., Engh, M. E., & Bø, K. (2018). Effect of a Postpartum Training Program on the Prevalence of Diastasis Recti Abdominis in Postpartum Primiparous Women: A Randomized Controlled Trial. Physical therapy, 98(4), 260–268. https://doi.org/10.1093/ptj/pzy008

[11] Sapsford, R. R., Hodges, P. W., Richardson, C. A., Cooper, D. H., Markwell, S. J., & Jull, G. A. (2001). Co-activation of the abdominal and pelvic floor muscles during voluntary exercises. Neurourology and urodynamics, 20(1), 31–42. https://doi.org/10.1002/1520-6777(2001)20:1<31::aid-nau5>3.0.co;2-p

[12] Laframboise, F. C., Schlaff, R. A., & Baruth, M. (2021). Postpartum Exercise Intervention Targeting Diastasis Recti Abdominis. International journal of exercise science, 14(3), 400–409.

[13] Lee, D., & Hodges, P. W. (2016). Behavior of the Linea Alba During a Curl-up Task in Diastasis Rectus Abdominis: An Observational Study. The Journal of orthopaedic and sports physical therapy, 46(7), 580–589. https://doi.org/10.2519/jospt.2016.6536

[14] Khandale, Sanjivani & Hande, Deepali. (2016). Effects of Abdominal Exercises on Reduction of Diastasis Recti in Postnatal Women. International Journal of Health Sciences. 6. 182-191.

[15] Gluppe, S., Engh, M. E., & Bø, K. (2021). What is the evidence for abdominal and pelvic floor muscle training to treat diastasis recti abdominis postpartum? A systematic review with meta-analysis. Brazilian journal of physical therapy, 25(6), 664–675. https://doi.org/10.1016/j.bjpt.2021.06.006

[16] Gluppe, S. L., Hilde, G., Tennfjord, M. K., Engh, M. E., & Bø, K. (2018). Effect of a Postpartum Training Program on the

Prevalence of Diastasis Recti Abdominis in Postpartum Primiparous Women: A Randomized Controlled Trial. Physical therapy, 98(4), 260–268. https://doi.org/10.1093/ptj/pzy008

[17] Theodorsen, Nina & Inger, Liv & Bø, K.. (2018). Effect of pelvic floor and transversus abdominis muscle contraction on inter-rectus distance in postpartum women: a cross-sectional experimental study. Physiotherapy. 105. 10.1016/j.physio.2018.08.009.

[18] Vesting, S., Gutke, A., Fagevik Olsén, M., Rembeck, G., & Larsson, M. E. H. (2024). The Impact of Exercising on Pelvic Symptom Severity, Pelvic Floor Muscle Strength, and Diastasis Recti Abdominis After Pregnancy: A Longitudinal Prospective Cohort Study. Physical therapy, 104(4), pzad171. https://doi.org/10.1093/ptj/pzad171

[19] Simpson, E., & Hahne, A. (2023). Effectiveness of Early Postpartum Rectus Abdominis versus Transversus Abdominis Training in Patients with Diastasis of the Rectus Abdominis Muscles: A Pilot Randomized Controlled Trial. Physiotherapy Canada. Physiotherapie Canada, 75(4), 368–376. https://doi.org/10.3138/ptc-2021-0111

[20] Lee, N., Bae, Y. H., Fong, S. S. M., & Lee, W. H. (2023). Effects of Pilates on inter-recti distance, thickness of rectus abdominis, waist circumference and abdominal muscle endurance in primiparous women. BMC women's health, 23(1), 626. https://doi.org/10.1186/s12905-023-02775-5

[21] Gluppe, S. B., Ellström Engh, M., & Bø, K. (2023). Curl-up exercises improve abdominal muscle strength without worsening inter-recti distance in women with diastasis recti abdominis postpartum: a randomized controlled trial. Journal of physiotherapy, 69(3), 160–167. https://doi.org/10.1016/j.jphys.2023.05.017

[22] Kaya, A. K., & Menek, M. Y. (2023). Comparison of the efficiency of core stabilization exercises and abdominal corset in the treatment of postpartum diastasis recti abdominis. European journal of obstetrics, gynecology, and reproductive biology, 285, 24–30. https://doi.org/10.1016/j.ejogrb.2023.03.040

[23] Shohaimi, S., Husain, N. R. N., Zaki, F. M., & Atan, I. K. (2023). Split Tummy Exercise Program for Reducing Diastasis Recti in Postpartum Primigravidae: A Randomized Controlled Trial. Korean journal of family medicine, 44(2), 102–108. https://doi.org/10.4082/kjfm.22.0035.

[24] Benjamin, D. R., Frawley, H. C., Shields, N., Peiris, C. L., van de Water, A. T. M., Bruder, A. M., & Taylor, N. F. (2023). Conservative interventions may have little effect on reducing diastasis of the rectus abdominis in postnatal women – A systematic review and meta-analysis. Physiotherapy, 119, 54–71. https://doi.org/10.1016/j.physio.2023.02.002