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KINESIO TAPING AND VISCERAL MANIPULATION IN POSTPARTUM DIASTASIS RECTI: SYNERGISTIC OR STANDALONE APPROACHES? A RANDOMIZED CONTROLLED TRIAL

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ABSTRACT

Single intervention show significantly impacts quality of life in post-partum women with diastasis recti abdominis (DRA). This study aimed to evaluate the effectiveness of combined Kinesio Taping (KT) and Visceral Manipulation (VM) on physical and psychological well-being in postpartum women with DRA. A four-arm randomized controlled trial involving 72 postpartum women with DRA compared combined KT + VM, KT alone, VM alone, and core strengthening exercises (n = 18 each). Physical and psychological outcomes were assessed using the Postpartum Diastasis Recti Questionnaire, while preliminary DRA assessment by width (finger-width palpation), Ultrasound measurement of DRA, pelvic floor strength (pressure biofeedback), and pain intensity (VAS) were measured at baseline, 3-weeks and after 6 weeks. No baseline differences were observed ($p > 0.05$). Following the 6-week intervention, all groups demonstrated significant improvements ($p < 0.05$). Kinesio Taping effectively mitigated physical discomfort, pelvic floor exercises enhanced back pain and perceived abdominal strength, Visceral Manipulation improved functional capacity, and psychologically, Visceral Manipulation reduced appearance-related distress, KT enhanced emotional well-being and self-consciousness, whereas the combined intervention was associated with a decline in body image-related outcomes. VM alone and KT demonstrated domain-specific superiority over combined therapy for both physical and psychological domain in postpartum with DRA

KEYWORDS: Diastasis recti, postpartum, Kinesio Taping, Visceral Manipulation, physical function, psychological well-being

1. INTRODUCTION

Diastasis recti abdominis (DRA) is characterized by the broadening of the distance between rectus abdominis associated to extending stretching and relaxation of the linea alba during late pregnancy and postpartum women (Werner & Dayan 2019). The pathophysiology of DRA attribute to hormonal changes and mechanical factors resulting in stretching and thinning of the linea alba during pregnancy (Radhakrishnan & Ramamurthy, 2022). While pregnancy-related hormonal changes lead to connective tissue laxity and reduced tensile strength of the abdominal fascia, making the expanding uterus creates an increased intra-abdominal pressure (Wu et al., 2021). Recent anatomical studies have identified the variations at posterior insertion of rectus sheath may predispose individuals to DRA development (Cavalli et al., 2021). These physiological adaptations can result in persistent abdominal muscle separation that fails to spontaneously resolve in many women.

The DRA extends beyond half of postpartum women (Mota et al., 2015) with incidence range 42% and 83% (Cardaillac et al., 2020). Research conducted in Pakistan observed high prevalence of DRA among expectant mothers especially in the third trimester, but can escalate to 82% across more general cohorts of pregnant individuals (Yaseen et al., 2022) When attention shifts to the postpartum period, the numbers remain alarmingly elevated, with reported values of 30.8% in female during their third trimester (Aqsa et al., 2023) and estimates rising even further to 75.8% in a post-partum period (Iqbal et al., 2023). Such persistent rates underscore a clear, ongoing burden in the population and point decisively toward the urgent need for well-structured rehabilitation protocols to facilitate the recovery of affected women.

The consequences of postpartum DRA encompass a spectrum of functional impairment, namely compromised core stability, increased lumbar lordotic, reduced abdominal strength, and altered movement patterns (Lee & Hodge, 2018; Michalska et al., 2018), hence predisposed to low back pain (Gluppe et al., 2022). Despite being physical condition, it often cascades into broader consequences including body image dissatisfaction, reduced self-confidence, emotional distress, and limitations in social functioning, subsequently exert a significant impact on psychological well-being (Benjamin et al., 2014). Previous research has demonstrated an association between the severity of DRA and pelvic floor dysfunction, with women presenting with DRA reporting higher urinary symptom scores compared to those without the condition (Michalska et al., 2018).

The DRA has also been associated with compromised core stability, altered biomechanics, and particularly affecting activities of daily living and exercise tolerance, reduced quality of life (Benjamin et al., 2014; Carlstedt et al., 2021). Current treatment approaches for DRA are diverse and include conservative interventions such as exercise therapy, manual therapy techniques, and adjunctive modalities like Kinesiotaping (Kulli et al 2023) considered the cornerstone of DRA management, focuses on neuromuscular re-education, core strengthening, and functional movement restoration (Kulli et al 2023).

Recent systematic reviews have revealed that though low-quality scientific evidence, general exercises such as curl-up exercises have shown promise in improving abdominal muscle strength without worsening inter-recti distance in postpartum women (Gluppe et al., 2023) whereas, specific exercise programs of the abdominal exercise programs showed effective in reducing inter-rectus distance was reported (Gluppe et al., 2021a; 2021b) suggesting the core stabilizer for transverse abdominis and deep core muscles may provide support to the linea alba and facilitate muscle approximation (Chen et al., 2023). Pelvic floor muscle regards as part of core stabilizers that has gained attention in research as co-contraction between pelvic floor muscles in activating the deep abdominal muscles (Gluppe et al., 2020). Recent studies have shown that pelvic floor muscle exercises can lead to acute changes in inter-rectus distance, though the optimal application of these exercises remains under investigation (Theodorsen et al., 2020). A systematic review revealed that combined abdominal and pelvic floor muscle training yields a promising outcome (Hu et al., 2021). However, evidence regarding the relationship between DRA and lumbo-pelvic pain remains inconsistent (Gluppe et al., 2021a; 2021b). Though more high-quality evidence is needed to address -lumbopelvic strength and pain (Hu et al., 2021).

Recent systematic reviews and meta-analyses have proposed that Kiniseo taping (KT) can significantly reduce inter-rectus distance compared to exercise group (Salekzaman et al., 2023). The KT potentially providing fascial support, proprioceptive enhancement, and neurosensory modulation (Luz Júnior et al., 2019; Williams et al., 2012), promotes tissue healing by increasing circulation, improving proprioceptive input and muscle activation, and gently approximating the rectus muscles (Lee et al., 2017).

An innovative approach to DRA, using visceral manipulation (VM) to target the tightness or adhesions in the facial layer of myofascial-visceral interface around the abdominal wall and linea alba leading to persistent DRA and associated complications (Barral & Mercier, 2005; Hebgen & Barral, 2011). The VM stimulating facial fibroblasts, reducing the inflammation and improves facial glides which ultimately enhance the abdominal function (Du et al., 2025).

The efficacy for specific aspect of DRA management has been addressed isolated, with limited high-quality evidence comparing various treatment modalities in exploring the effectiveness of combined approaches (Keshwani et al., 2021). However, the bidirectional relationship between physical and psychological symptoms in DRA underscores the importance of holistic treatment approaches as multifaceted nature of DRA necessitates comprehensive therapeutic approaches that address both the physical manifestations and the associated psychosocial complications. The rationale for combination therapy stems from the multifactorial nature of DRA, which involves not only muscle weakness but also fascial dysfunction, altered proprioception, and potentially visceral restrictions. The effectiveness of combining approach using KT with deep core stability exercises, showing significant reductions in inter-rectus distance when compared to individual treatments (Pawar et al., 2023). frPotential interactions between intervention components, competing neuromuscular adaptations, or sensory overload might compromise the efficacy of individual intervention mechanisms (Hodges & Richardson 1996) and biopsychosocial aspect (Panjabi, 1992; Van Buskirk, 1990). Hence, this randomized controlled trial was to compare the effectiveness of combined KT and VM to single interventions on physical function and psychological well-being in postpartum women with DRA. Understanding the comparative effectiveness of combined versus individual interventions is crucial for optimizing clinical decision-making and resource allocation in postpartum DRA management. We hypothesized that the combined intervention would demonstrate superior efficacy in physical and psychological domain compared to single approach.

2. METHODOLOGY

2.1. Study Design and Setting

A four-arm, parallel-group randomized controlled trial was conducted across four major maternity hospitals in Karachi, Pakistan: Jinnah Post Graduate Medical Centre, National Medical Centre, Ashfaque Memorial Hospital, and Naila Maternity and General Hospital. These hospitals were strategically selected to encompass different zones of Karachi, mitigating spatial bias and ensuring a diverse sample population.

Postpartum women with clinically diagnosed DRA were initially assessed using the finger width palpation method. For accurate quantitative measurement, ultrasound imaging was performed under the supervision of specialized Gynecologist and Sonologist at data collection Centre. The study was conducted in accordance with the Declaration of Helsinki and Good Clinical Practice guidelines. Ethical approval was obtained granted from the Lincoln University college Ref. No:LUC/MKT/SP/01/861, LUC/MKT/SP/01/862, LUC/MKT/SP/01/863, LUC/MKT/SP/01/864, and institutional Review Board No.F.2-81/2025-GENL/276/JPMC and at ClinicalTrials.gov NCT06723353. All participants provided written informed consent after receiving detailed information about study procedures, potential risks, benefits, and their right to withdraw without affecting clinical care. Data confidentiality was maintained throughout the study, with all personal identifiers removed from the dataset.

The participants were recruited if they are: (1) postpartum women aged 35-45 years, (2) confirmed DRA diagnosis with inter-rectus distance >2.5 cm measured via finger-width palpation method, (3) minimum 6 months postpartum following normal vaginal delivery, vacuum delivery, forceps delivery, or lower section caesarian section, and (4) postpartum females bearing at least 1 child. The exclusion criteria included: (1) any other abdominal surgery, (2) sensitivity with taping (specific for KT group), (3) diagnosed with abdominal hernia, and (4) open abdominal wound. Participants were randomly allocated to one of four intervention groups using computer-generated random number sequences with concealed allocation. Block randomization with varying block sizes ensured balanced group allocation.

Sample size calculation was performed using Open Epi sample size calculator with a confidence interval of 95% and margin of error set at 5%. Sample size calculation was referred to expected effect sizes from Pawar et al. (2020) and preliminary studies on the mean change KT on

DRA after 4-weeks intervention, where the estimated sample size was 18 per group.

All the outcome measures were assessed at baseline, mid-intervention at 3 weeks, and post-intervention at 6 weeks by a qualified and trained assessor to control the inter-rater variability.

2.2. Interventions

Kinesio Taping Group (KT): Standardized KT application technique (crisscross method) was employed, focusing on abdominal muscle facilitation, fascial support, and proprioceptive enhancement (Lee et al., 2017). Tape was applied in specific patterns targeting the rectus abdominis, external oblique, and supporting fascial structures.

Visceral Manipulation Group (VM): Manual therapy techniques targeting visceral restrictions, abdominal organ mobility, and myofascial release were applied based on previous study done by (Kirk et al., 2021).Techniques included gentle visceral manipulation, fascial release, and mobility enhancement procedures. Patient's position was in supine lying with bended knees and feet flat on the plinth. Therapist had placed the hand on abdomen generally from the pubic symphyses and moved to the xiphoid process purpose of moving hand was to find out the mobility and tension present in the abdominal organs and tissue, moderate pressure was applied for six weeks within the comfort level of patient.

Combined Group (KT+VM): Participants received both Kinesio Taping and Visceral Manipulation during integrated treatment sessions. KT was applied using standardized techniques targeting abdominal fascial support, while VM involved gentle manual techniques addressing visceral restrictions and myofascial mobility.

Exercise Group: Structured exercise protocols focusing on core stabilization, progressive strengthening, and functional movement patterns in different positions were implemented. The program included breathing exercises, Hand-Knee bird dog exercise, transverse abdominis activation, and progressive resistance training (Safaee et al 2022).

Treatment frequency was standardized across all groups, with sessions conducted twice weekly for 6 weeks. All interventions were delivered by trained physiotherapists who are Doctor of Physical Therapy degree holders with specialized in gynecological rehabilitation with minimum 5 years of clinical experience in the respective field of training. They were blinded to group allocation throughout the data collection.

3. OUTCOME MEASURES

3.1. Inter-recti distance

Inter-recti distance was measured using the finger-width palpation method at three anatomical locations: above umbilical, at umbilical, and below umbilical regions protocol was adapted by Kirk et al. (2021). This method involves placing fingers horizontally across the midline of the subject's abdomen, with demonstrated test-retest reliability (ICC: 0.67-0.95) (Zavagni et al., 2023) and good concurrent validity with ultrasound measurements (r: 0.75-0.98) (Benjamin et al., 2020)

Core Stabilizers Strength: Assessed using Pressure Biofeedback Unit (PBU-Chattanooga Group, USA) which provides quantitative measurement of lumbar core stabilizers strength and endurance. The device demonstrated high consistency (ICC=0.96) for lumbar core stabilizers strength evaluation and includes measurements of maximum pressure during contraction and endurance testing during sustained contractions. (Hay-Smith et al., 2008)

Pain intensity: Pain intensity was evaluated using the Visual Analogue Scale (VAS), a validated 10-point scale (Kumari et al 2022), where participants indicate their pain intensity from no pain (0) to maximum conceivable pain. The VAS has demonstrated high reliability (ICC=0.97) in adult populations with good reproducibility of scores (Bijur et al., 2001)

3.2. Physical and Mental Well-being related to DRA Postpartum Questionnaire

Physical and psychological outcomes were assessed using the Physical and Mental Well-being Related to DRA (PMWDRA) questionnaire, a specialized instrument designed to evaluate the multidimensional impact of postpartum diastasis recti abdominis. The instrument's multidimensional approach allows for comprehensive evaluation of intervention effectiveness across both somatic and psychosocial domains relevant to postpartum recovery.

3.3. Statistical Analysis

Data was analyzed using Statistical Package for the Social Sciences (SPSS) software, version 21.0. Descriptive statistics were used for sociodemographic and other maternal and health characteristics. Between-group comparisons were conducted using one-way ANOVA with post-hoc Fisher's LSD tests for continuous variables and chi-square tests for categorical variables. Statistical significance was set at $p < 0.05$.

4. RESULTS

A total of 72 postpartum women with DRA has shown no statistical differences in respect of demographic and anthropometric characteristics across four groups suggested at baseline (Table 1).

Table 1: Demographic, maternal and Health Characteristics of Participants (N=72)

Characteristics	KT(n=18)	VM(n=18)	KT+VM (n=18)	Exercise(n=18)	F-test, *p*-value
Age (years)	38.83 ± 3.71	39.39 ± 3.29	39.67 ± 3.09	39.67 ± 2.91	F=0.314, 0.815
Height (feet)	5.19 ± 0.48	5.16 ± 0.39	5.25 ± 0.53	5.24 ± 0.49	F=0.171, 0.916
Weight (kg)	75.06 ± 8.17	74.50 ± 8.23	73.89 ± 8.20	74.22 ± 7.43	F=0.089, 0.966
BMI (kg/m²)	29.37 ± 3.73	29.07 ± 3.37	28.61 ± 3.34	28.75 ± 4.00	F=0.166, 0.919
Birth weight (kg)	3.25 ± 0.86	3.22 ± 0.69	3.19 ± 0.78	3.29 ± 0.76	F=0.060, 0.981
Number of pregnancies	3.61 ± 1.14	3.78 ± 1.17	3.44 ± 1.04	3.72 ± 1.18	F= 0.780
Time since last birth (years)	5.56 ± 3.15	5.00 ± 3.01	5.78 ± 3.64	5.06 ± 3.60	F=0.258, 0.855
Weight gain in last pregnancy (kg)	8.78 ± 2.24	8.83 ± 2.81	8.33 ± 2.28	8.78 ± 2.46	F=0.179, 0.910

Note: KT = Kinesio Taping; VM = Visceral Mobilization; Combined = Combined KT+VM intervention; p<0.05.

Physical discomfort during daily activities showed the most pronounced between-group differences, with KT demonstrating superior effectiveness (change score: -1.33±0.69), significantly better than all other interventions (all p<0.001). Notably, VM showed minimal improvement (+0.05±0.64), while Combined and Exercise showed moderate improvements for functional limitations, VM showed the greatest improvement (change score: -0.78±0.55), significantly better than KT (p=0.010). Exercise therapy demonstrated superior effectiveness for perceived abdominal weakness (change score: -1.11±0.58), significantly better than all other interventions (all p < 0.05) (Table 2).

Table 2: Physical Domain Outcomes - Pre and Post-Intervention Comparisons

Physical Domain Item	KT (n=18)	VM (n=18)	Combined (n=18)	Exercise (n=18)	F-test, p-value
Back Pain Experience					
Pre-intervention	2.39±0.70	2.44±0.62	2.33±0.59	2.44±0.62	F=0.166, 0.919
Post-intervention	1.89±0.58	1.94±0.55	1.61±0.50	1.44±0.51	F=3.892, 0.012*
Change score	-0.50±0.51	-0.50±0.51	-0.72±0.46	-1.00±0.49	F=5.127, 0.003**
Physical Discomfort					
Pre-intervention	2.44±0.78	2.39±0.78	2.56±0.70	2.33±0.69	F=0.316, 0.814
Post-intervention	1.11±0.32	2.44±0.62	2.22±0.55	2.00±0.49	F=21.8, ***
Change score	-1.33±0.69	+0.05±0.64	-0.34±0.59	-0.33±0.49	F=18.9, ***
Functional Limitations					
Pre-intervention	2.11±0.58	2.17±0.62	2.28±0.57	2.06±0.73	F=0.443, 0.724
Post-intervention	1.83±0.51	1.39±0.50	1.55±0.51	1.66±0.59	F=2.69, 0.053
Change score	-0.28±0.46	-0.78±0.55	-0.73±0.46	-0.40±0.51	F=4.12, 0.010*
Perceived Abdominal Weakness					
Pre-intervention	2.22±0.65	2.06±0.64	1.94±0.54	2.17±0.62	F=0.798, 0.499
Post-intervention	1.78±0.55	1.61±0.50	1.50±0.51	1.06±0.24	F=9.87, ***
Change score	-0.44±0.51	-0.45±0.51	-0.44±0.51	-1.11±0.58	F=7.21, ***

*p < 0.05, p < 0.01**, p < 0.001***

4.1. Post Hoc Pairwise Comparisons - Physical Domains

The post hoc analysis revealed distinct intervention-specific advantages across physical outcome domains, demonstrating clear therapeutic hierarchies for different symptom presentations. Back pain experience showed Exercise therapy's pronounced superiority, with large effect sizes against both KT and VM (d=1.02, p=0.003 for both comparisons), while demonstrating a moderate effect trend compared to Combined intervention (d=0.57, p=0.062). The complete equivalence between KT and VM (d=0.00, p=1.000) indicates that neither fascial support nor visceral manipulation adequately addresses the neuromuscular mechanisms underlying postpartum back pain, reinforcing the importance of targeted strengthening approaches.

Physical discomfort during daily activities demonstrated the most dramatic intervention differences observed in the study, with KT showing overwhelming superiority across all comparisons. The comparison between KT and VM yielded the largest effect size in the entire analysis (d=2.31, p<0.001), followed by large effects against Combined (d=1.66, p<0.001) and Exercise (d=1.68, p<0.001) interventions. Notably, VM performed significantly worse than both Combined (d=0.65, p=0.026) and Exercise (d=0.63, p=0.030) interventions, suggesting that visceral manipulation may actually exacerbate activity-related discomfort or fail to provide the immediate proprioceptive support needed for functional activities.

Functional limitations revealed a different pattern, with VM demonstrating clear advantages over KT (d=1.02, p=0.003) and Exercise (d=0.78, p=0.018), while showing equivalent outcomes to Combined intervention (d=0.10, p=0.892). Combined intervention also outperformed KT (d=0.92, p=0.009) and Exercise (d=0.68, p=0.032), indicating that techniques targeting fascial and visceral mobility may be particularly effective for addressing movement restrictions and compensatory patterns common in postpartum DRA.

Perceived abdominal weakness demonstrated Exercise therapy's unequivocal dominance, with consistently large effect sizes against all other interventions (d=1.33-1.35, all p<0.001). The negligible differences between KT, VM, and Combined interventions (all effect sizes d≤0.02, all p≥0.985) underscore that subjective strength perceptions require specific neuromuscular conditioning that only targeted exercise protocols can adequately address. This finding reinforces the fundamental role of progressive resistance training in comprehensive postpartum rehabilitation programs (Table 3).

Table 3: Post Hoc Pairwise Comparisons - Physical Domains

Domain	Comparison	Mean Difference	95% CI	p-value	Effect Size (Cohen's d)	Interpretation
Back Pain Experience						
	Exercise vs KT	-0.50	[-0.85, -0.15]	0.003*	1.02 (large)	Exercise superior
	Exercise vs VM	-0.50	[-0.85, -0.15]	0.003*	1.02 (large)	Exercise superior
	Exercise vs Combined	-0.28	[-0.63, 0.07]	0.062	0.57 (medium)	Trend favors Exercise
	Combined vs KT	-0.22	[-0.57, 0.13]	0.124	0.45 (small-medium)	No difference
	Combined vs VM	-0.22	[-0.57, 0.13]	0.124	0.45 (small-medium)	No difference
	KT vs VM	0.00	[-0.35, 0.35]	1.000	0.00 (no effect)	Equivalent
Physical Discomfort						
	KT vs VM	-1.38	[-1.73, -1.03]	<0.001**	2.31 (very large)	KT superior
	KT vs Combined	-0.99	[-1.34, -0.64]	<0.001**	1.66 (large)	KT superior
	KT vs Exercise	-1.00	[-1.35, -0.65]	<0.001**	1.68 (large)	KT superior
	VM vs Combined	0.39	[0.04, 0.74]	0.026*	0.65 (medium-large)	Combined superior
	VM vs Exercise	0.38	[0.03, 0.73]	0.030*	0.63 (medium)	Exercise superior
	Combined vs Exercise	-0.01	[-0.36, 0.34]	0.985	0.02 (negligible)	No difference
Functional Limitations						
	VM vs KT	-0.50	[-0.85, -0.15]	0.003*	1.02 (large)	VM superior
	VM vs Combined	-0.05	[-0.40, 0.30]	0.892	0.10 (negligible)	No difference
	VM vs Exercise	-0.38	[-0.73, -0.03]	0.018*	0.78 (medium-large)	VM superior
	Combined vs KT	-0.45	[-0.80, -0.10]	0.009*	0.92 (large)	Combined superior
	Combined vs Exercise	-0.33	[-0.68, 0.02]	0.032*	0.68 (medium-large)	Combined superior
	KT vs Exercise	0.12	[-0.23, 0.47]	0.721	0.25 (small)	No difference
Perceived Abdominal Weakness						
	Exercise vs KT	-0.67	[-1.02, -0.32]	<0.001**	1.35 (large)	Exercise superior
	Exercise vs VM	-0.66	[-1.01, -0.31]	<0.001**	1.33 (large)	Exercise superior
	Exercise vs Combined	-0.67	[-1.02, -0.32]	<0.001**	1.35 (large)	Exercise superior
	KT vs VM	0.01	[-0.34, 0.36]	0.985	0.02 (negligible)	No difference
	KT vs Combined	0.00	[-0.35, 0.35]	1.000	0.00 (no effect)	No difference
	VM vs Combined	-0.01	[-0.36, 0.34]	0.985	0.02 (negligible	

4.2. *Psychological Domain Outcomes*

There were significant improvements in respect of all five Psychological Domain items post 6-week intervention. For psychological distress related to abdominal appearance, VM alone showed the greatest improvement (47.6% reduction, $p< 0.001$) compared to other interventions: KT alone (32.6% reduction, $p< 0.001$), Combined VM & KT (32.0% reduction, $p< 0.001$), and pelvic floor exercises alone (9.9% reduction, $p< 0.05$).

Emotional well-being outcomes favoured KT alone, which showed the greatest improvement (35.1% reduction, $p< 0.001$), significantly better than Exercise (5.8% reduction, $p < 0.05$), with trends toward better outcomes compared to VM (18.5% reduction, $p = 0.063$). For self-consciousness about appearance, KT demonstrated the most substantial improvement (41.0% reduction, $p< 0.001$), significantly compared to Combined intervention (14.3% increase, $p=0.009$) and Exercise (0.0% change, $p=0.035$). Similarly, KT alone demonstrated significant improvement in psychological comfort with body image (37.0% reduction, $p< 0.001$) compared to combined intervention (58.6% increase, $p< 0.001$) and Exercise alone (9.0% increase, $p< 0.008$). Both VM alone (14.8% reduction, $p< 0.05$) and KT alone showed improvements (37.0% reduction, $p< 0.001$), while Combined intervention (58.6% increase, $p< 0.001$) and Exercise alone showed deterioration (9.0% increase, $p< 0.05$) (Table 4).

Table 4: Psychological Domain Outcomes – Pre- and Post-Intervention Comparisons

Variable	KT (n=18)	VM (n=18)	Combined (n=18)	Exercise (n=18)	F-test, p-value
Psychological Distress (Abdominal Appearance)					
Pre-intervention	2.39±0.70	2.33±0.59	2.28±0.57	2.22±0.65	F=0.270, 0.847
Post-intervention	1.61±0.50	1.22±0.43	1.55±0.51	2.00±0.59	F=8.41, ***
Change score	-0.78±0.55	-1.11±0.58	-0.73±0.46	-0.22±0.55	F=9.15, ***
Emotional Well-being					
Pre-intervention	2.22±0.73	2.11±0.68	2.17±0.62	2.06±0.73	F=0.243, 0.866
Post-intervention	1.44±0.51	1.72±0.57	1.66±0.59	1.94±0.64	F=2.89, 0.041*
Change score	-0.78±0.55	-0.39±0.50	-0.51±0.51	-0.12±0.49	F=6.77, 0.001**
Social Functioning					
Pre-intervention	2.28±0.67	2.11±0.68	2.00±0.59	2.11±0.68	F=0.598, 0.618
Post-intervention	1.72±0.57	1.55±0.51	1.83±0.51	1.99±0.64	F=2.29, 0.086
Change score	-0.56±0.51	-0.56±0.51	-0.17±0.38	-0.12±0.49	F=4.85, 0.004**
Self-consciousness About Appearance					
Pre-intervention	2.17±0.62	1.94±0.54	1.61±0.50	1.72±0.57	F=3.25, 0.026*
Post-intervention	1.28±0.46	1.50±0.51	1.84±0.51	1.72±0.57	F=4.52, 0.006*
Change score	-0.89±0.58	-0.44±0.51	+0.23±0.43	0.00±0.49	F=12.1, ***
Psychological Comfort with Body Image					
Pre-intervention	2.11±0.68	1.89±0.58	1.33±0.49	1.78±0.65	F=5.89, 0.001**
Post-intervention	1.33±0.49	1.61±0.50	2.11±0.58	1.94±0.64	F=7.21, ***
Change score	-0.78±0.55	-0.28±0.46	+0.78±0.55	+0.16±0.38	F=28.4, <0.001*

*$p < 0.05$, $p < 0.01$**, $p < 0.001$***

4.3. *Post Hoc Pairwise Comparisons*

The post hoc analysis reveals distinct patterns of intervention effectiveness across psychological domains, with several key clinical insights emerging from the pairwise comparisons.

Psychological Distress (Abdominal Appearance) showed VM's clear superiority, with statistically significant advantages over KT (p=0.032), Combined intervention (p=0.018), and particularly Exercise (p<0.001, large effect size d=1.68). Notably, KT and Combined interventions showed no significant difference between them (p=0.892), but both significantly outperformed Exercise alone.

Emotional Well-being demonstrated KT's dominance, with significant superiority over VM (p=0.026, medium-large effect) and Exercise (p<0.001, large effect d=1.25). The comparison between KT and Combined intervention approached significance (p=0.063), suggesting a trend favoring KT. VM showed marginal benefits over Exercise (p=0.063), while Combined intervention significantly outperformed Exercise (p=0.026).

Social Functioning revealed identical effectiveness between KT and VM (p=1.000, no effect), with both interventions showing large effect sizes compared to Combined and Exercise groups. The similarity between Combined and Exercise interventions (p=0.892) indicates minimal therapeutic benefit from either approach for social functioning.

Self-consciousness About Appearance exhibited the most pronounced intervention differences, with KT demonstrating very large effect sizes compared to Combined (d=2.12) and Exercise (d=1.68) interventions. VM also showed significant benefits over Combined (p<0.001, large effect) and Exercise (p=0.012) groups, while Combined intervention showed no significant difference from Exercise (p=0.124).

Psychological Comfort with Body Image presented the most dramatic findings, with KT showing very large effect sizes against Combined (d=3.05) and Exercise (d=1.84) interventions. VM also demonstrated very large effects compared to Combined intervention (d=2.07), highlighting the concerning deterioration seen in the Combined group. The significant difference between Combined and Exercise (p<0.001, d=1.21) indicates that Combined intervention actually performed worse than Exercise alone (Table 5).

Table 5: Post Hoc Pairwise Comparisons - : Psychological Domain

Domain	Comparison	Mean Difference	95% CI	p-value	Effect Size (Cohen's d)	Interpretation
Psychological Distress (Abdominal Appearance)						
	VM vs KT	-0.33	[-0.68, 0.02]	0.032*	0.62 (medium)	VM superior
	VM vs Combined	-0.38	[-0.73, -0.03]	0.018*	0.71 (medium-large)	VM superior
	VM vs Exercise	-0.89	[-1.24, -0.54]	<0.001**	1.68 (large)	VM superior
	KT vs Combined	-0.05	[-0.40, 0.30]	0.892	0.09 (negligible)	No difference
	KT vs Exercise	-0.56	[-0.91, -0.21]	0.004*	1.06 (large)	KT superior
	Combined vs Exercise	-0.51	[-0.86, -0.16]	0.007*	0.97 (large)	Combined superior
Emotional Well-being						
	KT vs VM	-0.39	[-0.74, -0.04]	0.026*	0.74 (medium-large)	KT superior
	KT vs Combined	-0.27	[-0.62, 0.08]	0.063	0.51 (medium)	Trend favors KT
	KT vs Exercise	-0.66	[-1.01, -0.31]	<0.001**	1.25 (large)	KT superior
	VM vs Combined	0.12	[-0.23, 0.47]	0.721	0.23 (small)	No difference
	VM vs Exercise	-0.27	[-0.62, 0.08]	0.063	0.51 (medium)	Trend favors VM
	Combined vs Exercise	-0.39	[-0.74, -0.04]	0.026*	0.74 (medium-large)	Combined superior
Social Functioning						
	KT vs VM	0.00	[-0.35, 0.35]	1.000	0.00 (no effect)	Equivalent
	KT vs Combined	-0.39	[-0.74, -0.04]	0.026*	0.82 (large)	KT superior
	KT vs Exercise	-0.44	[-0.79, -0.09]	0.012*	0.93 (large)	KT superior
	VM vs Combined	-0.39	[-0.74, -0.04]	0.026*	0.82 (large)	VM superior
	VM vs Exercise	-0.44	[-0.79, -0.09]	0.012*	0.93 (large)	VM superior
	Combined vs Exercise	-0.05	[-0.40, 0.30]	0.892	0.11 (negligible)	No difference
Self-consciousness About Appearance						
	KT vs VM	-0.45	[-0.80, -0.10]	0.009*	0.85 (large)	KT superior
	KT vs Combined	-1.12	[-1.47, -0.77]	<0.001**	2.12 (very large)	KT superior
	KT vs Exercise	-0.89	[-1.24, -0.54]	<0.001**	1.68 (large)	KT superior
	VM vs Combined	-0.67	[-1.02, -0.32]	<0.001**	1.27 (large)	VM superior
	VM vs Exercise	-0.44	[-0.79, -0.09]	0.012*	0.83 (large)	VM superior
	Combined vs Exercise	0.23	[-0.12, 0.58]	0.124	0.44 (small-medium)	No difference
Psychological Comfort with Body Image						
	KT vs VM	-0.50	[-0.85, -0.15]	0.003*	0.98 (large)	KT superior
	KT vs Combined	-1.56	[-1.91, -1.21]	<0.001**	3.05 (very large)	KT superior
	KT vs Exercise	-0.94	[-1.29, -0.59]	<0.001**	1.84 (large)	KT superior
	VM vs Combined	-1.06	[-1.41, -0.71]	<0.001**	2.07 (very large)	VM superior
	VM vs Exercise	-0.44	[-0.79, -0.09]	0.012*	0.86 (large)	VM superior
	Combined vs Exercise	0.62	[0.27, 0.97]	<0.001**	1.21 (large)	Exercise superior

5. DISCUSSION

This randomized controlled trial provides valuable insights into the comparative effectiveness of combined versus individual interventions for managing both physical and psychological aspects of postpartum DRA. Contrary to our initial hypothesis, the findings demonstrate that single interventions often outperformed the combined approach across multiple outcome domains, challenging conventional assumptions about the superiority of combination therapy.

The exercise therapy has shown significance effectiveness for back pain reduction that aligns with established evidence supporting targeted neuromuscular interventions for postpartum musculoskeletal complaints (Gutke et al., 2011; Pennick & Liddle, 2013) The mechanical reinforcement provided by structured exercise protocols on core stability and pelvic floor muscle appears particularly effective for addressing the biomechanical dysfunctions underlying postpartum back pain, surpassing the benefits offered by fascial support or visceral manipulation alone.

The remarkable efficacy of KT for reducing physical discomfort during daily activities highlights its unique value in enhancing functional comfort through proprioceptive feedback and fascial support mechanisms (Kase et al., 2003; Thelen et al., 2008) This finding suggests that the immediate neurosensory modulation provided by KT application may be particularly beneficial for activity-related symptoms, offering advantages over exercise-based strengthening or visceral manipulation approaches.

VM's superiority in addressing functional limitations underscores the potential importance of visceral mobility and fascial integration in comprehensive DRA management (Finet & Williame, 2000; Kuchera & Kuchera, 1994). The mechanisms underlying these benefits likely involve improved biomechanical efficiency, reduced compensatory movement patterns, and enhanced visceral-somatic integration. The mechanisms underlying these benefits involve both mechanical and psychological pathways that work synergistically to improve function. Mechanically, VM techniques target fascial restrictions and adhesions that develop during pregnancy and delivery, particularly affecting peritoneal attachments and visceral mobility around the abdominal cavity (Schleip et al 2022). By restoring optimal visceral mobility, these techniques reduce mechanical tension on the abdominal fascia and improve the functional relationship between deep core muscles and surrounding visceral structures, facilitating more efficient force transmission and reducing compensatory movement patterns. Mechanically, releasing fascial restrictions improves diaphragmatic motion, intra-abdominal pressure regulation, and neuromuscular synchrony between the diaphragm, transversus abdominis, and pelvic floor (Fernandez-Lopez et al 2021). This enhanced mechanical efficiency reduces strain and sends afferent feedback to the central nervous system that the body is functioning in a more balanced and less threatened state (Kirk et al., 2021).

As mechanical tension decreases, proprioceptive and interoceptive feedback from visceral and fascial mechanoreceptors becomes more accurate, influencing the brain's perception of bodily comfort and safety (Gunther 2022). The improved mechanical environment contributes to psychological relaxation through activation of the parasympathetic system and downregulation of stress-related sympathetic responses (Gunther 2022) . Manual visceral contact also stimulates cutaneous and subcutaneous mechanoreceptors that enhance body awareness and recalibrate aberrant neuromuscular control patterns via improved cortical representation (Penasso et al., 2022). These effects may collectively restore homeostatic regulation and promote a sense of calm and embodiment, illustrating how mechanical release can cascade into psychological relaxation and improved motor control through neurophysiological pathways (Kirk et al, 2021; Tozzi, 2025).

The psychological domain findings revealed particularly interesting patterns, with VM demonstrating superior effectiveness for psychological distress related to abdominal appearance. This superior effect can be attributed to the direct therapeutic touch provided by manual VM techniques, which offers immediate tactile feedback about abdominal contour and tissue quality improvements. The hands-on nature of VM allows patients to experience real-time changes in tissue tension and mobility, providing concrete evidence of therapeutic progress that directly addresses appearance-related concerns. Additionally, the therapeutic relationship established through skilled, non-judgmental manual contact may enhance patient confidence and body acceptance in the area of greatest concern. While KT excelled in emotional well-being and self-consciousness reduction, these differential effects suggest that intervention mechanisms address distinct psychological pathways, with visceral mobilization techniques influencing body perception through improved abdominal contour and function (Shults et al., 2025), while KT enhances psychological comfort through immediate proprioceptive feedback and visible support (Cash et al., 2012; Paulse et al., 2008).

The consistently poorer performance of the Combined intervention across multiple domains represents a significant and unexpected finding.

This pattern suggests potential interference effects when KT and VM are applied concurrently, possibly due to competing neuromuscular adaptations, sensory overload, or mechanical interactions that compromise the efficacy of individual intervention components (Hodges & Moseley,2003). These findings have important clinical implications, suggesting that sequential rather than concurrent application of interventions might offer more optimal outcomes.

The study's strengths include its randomized controlled design, comprehensive outcome assessment, and focus on both physical and psychological domains. However, limitations include the inability to blind participants and therapists, relatively small sample size, and potential for therapist-specific effects. Additionally, the study did not assess long-term outcomes or cost-effectiveness considerations.

Future research should explore optimal sequencing of interventions, dose-response relationships, and individual patient factors that might predict differential response to specific intervention approaches. Investigation of the mechanisms underlying the apparent interference effects in combination therapy would also provide valuable insights for clinical practice optimization.

6. CONCLUSION

This study demonstrates that individual therapeutic intervention alone may offer superior outcomes compared to combined approaches in both physical and psychological aspects of postpartum DRA management. These findings support a targeted, domain-specific approach to intervention selection, challenging the assumption that combination therapy necessarily provides enhanced clinical benefits. Clinicians should consider the specific presenting symptoms and patient goals when selecting optimal intervention strategies for postpartum DRA management.

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CLINICAL TRIAL REGISTRY:

https://clinicaltrials.gov/study/NCT06723353

ETHICAL APPROVAL:

Ethical approval was taken by LUC and then from the data collection centers.

Ethics LUC0861, Ethics LUC0862, Ethics LUC0863, Ethics LUC0864

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest related to the publication of this article. The study was conducted independently without any financial support, sponsorship, or institutional influence.

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