



ISSN: 2347-6567

International Journal of Allied Medical Sciences and Clinical Research (IJAMSCR)

IJAMSCR | Vol.14 | Issue 2 | Apr - Jun - 2026

www.ijamscr.com

DOI : <https://doi.org/10.61096/ijamscr.v14.iss2.2026.842-847>

Efficacy of Core Strengthening Exercise with Neuromuscular Electrical Stimulation for DRAM in Post Cesarean Mother

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Published on:

09.05.2026

Published by:

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Abstract:

Background: Diastasis recti abdominis muscle (DRAM) is a common condition among post-cesarean mothers, characterized by widening of the rectus abdominis muscles along the linea alba. This widening may lead to reduced core stability, low back pain, and impaired functional activities. Conventional core strengthening exercises are widely used for rehabilitation; however, combining them with neuromuscular electrical stimulation (NMES) may enhance muscle activation and functional recovery.

Aim: To determine the efficacy of a combined program of core strengthening exercises and neuromuscular electrical stimulation compared to core strengthening alone in reducing inter-recti distance (IRD) and improving abdominal muscle strength and function in post-cesarean mothers with DRAM.

Search Methods: Relevant literature was searched through PubMed, Google Scholar, Science Direct and Research Gate.

Selection Criteria: Articles were included based on the inclusion criteria focusing on cesarean mother aged 21 to 34 years, women in the postnatal period (6 Month), Presence of Diastasis rectus abdominis And Primiparous or Multiparous mother.

Objective: To determine the efficacy of a combined program of core strengthening exercises and neuromuscular electrical stimulation compared to core strengthening alone in reducing inter-recti distance (IRD) and improving abdominal muscle strength and function in post-cesarean mothers with DRAM.

Results: Post cesarean mothers with diastasis recti showed significant improvement after intervention. Both groups demonstrated reduced inter-recti distance and increased abdominal strength. However, participants receiving core strengthening with neuromuscular electrical stimulation achieved significantly greater reductions in diastasis, superior muscle activation, and better functional outcomes compared to exercises alone during postnatal rehabilitation.

Conclusion: Combining neuromuscular electrical stimulation with core strengthening exercises is more effective than exercises alone in improving abdominal muscle integrity, strength, and function in post-cesarean mothers with DRAM. Early integration of NMES in postnatal rehabilitation may accelerate recovery and enhance core stability.

Keywords: Diastasis recti, Core strengthening exercises, Neuromuscular electrical stimulation, Post cesarean mothers, Inter recti distance, Abdominal muscle strength.

Introduction:

Pregnancy and childbirth lead to profound anatomical and physiological changes in the abdominal wall. One of the most common postpartum conditions affecting women is **Diastasis Recti Abdominis Muscle (DRAM)**, characterized by the widening of rectus abdominis muscles along the **linea alba**. This widening results from the stretching and thinning of the connective tissue during pregnancy to accommodate the growing uterus 6. The prevalence of DRAM ranges from **30% to 70%** in late pregnancy and may persist in the postpartum period, particularly following **cesarean delivery**. The presence of DRAM is not merely a cosmetic concern; it is associated with **core muscle weakness, impaired trunk stability, pelvic floor dysfunction, and low back pain**, all of which negatively impact the quality of life of postnatal women. Therefore, early and effective rehabilitation targeting the abdominal and core muscles is essential for restoring functional stability and aesthetic appearance. Conventional management primarily involves **core strengthening exercises**, focusing on the activation of deep abdominal muscles such as the **transversus abdominis** and **pelvic floor muscles** 1. The incidence of DRA remains high in the early postpartum period and may persist in a significant proportion of women if not appropriately managed. Conservative rehabilitation strategies are widely recommended as the first line of treatment, with core strengthening exercises targeting the deep abdominal muscles—particularly the transversus abdominis—demonstrating effectiveness in reducing inter-recti distance and improving functional outcomes. These exercises aim to approximate the rectus muscles, improve core stability, and enhance lumbopelvic control. However, the effectiveness of voluntary muscle activation alone may be limited in the early postpartum period due to neuromuscular inhibition, tissue laxity, and reduced proprioception. To augment rehabilitation outcomes, **Neuromuscular Electrical Stimulation (NMES)** has been introduced as an adjunct to exercise therapy 4. NMES facilitates muscle contraction by stimulating motor nerves electrically, thereby enhancing **muscle re-education, strength, and activation of the deep stabilizing muscles**. When combined with core strengthening exercises, NMES may accelerate the recovery process by improving muscle recruitment and reducing inter-recti distance more effectively than exercises alone 9. Recent studies have reported promising results regarding the use of NMES in abdominal and pelvic floor rehabilitation; however, limited evidence exists on its **combined effect with core strengthening exercises** specifically in **post-cesarean mothers with DRAM**. Understanding this combined effect could provide valuable insight into developing more efficient and evidence-based postpartum rehabilitation protocols. Hence, the present study aims to evaluate the **efficacy of core strengthening exercises combined with neuromuscular electrical stimulation** in improving abdominal muscle strength, reducing inter-recti distance, and enhancing functional outcomes in post-cesarean mothers with DRAM 4. In recent years, neuromuscular electrical stimulation (NMES) has been introduced as an adjunct therapeutic modality to facilitate muscle activation, enhance neuromuscular recruitment, and improve muscle strength in weakened abdominal musculature. The integration of NMES with conventional exercise therapy may provide synergistic benefits by promoting more efficient muscle contraction and accelerating recovery.

Despite growing interest, there is limited evidence specifically addressing the combined efficacy of core strengthening exercises and NMES in post-cesarean mothers with DRA. Therefore, this study aims to evaluate the effectiveness of core strengthening exercises with neuromuscular electrical stimulation in reducing diastasis recti and improving functional outcomes in post-cesarean women 5.

Objective:

To determine the efficacy of a combined program of core strengthening exercises and neuromuscular electrical stimulation compared to core strengthening alone in reducing inter-recti distance (IRD) and improving abdominal muscle strength and function in post-cesarean mothers with DRAM

Methodology

Search method and eligibility criteria

PubMed, Google Scholar and Science Direct were utilized to conduct a comprehensive literature search from the year 2015. Articles that were not published in English were eliminated. Here, the articles were searched with the keywords Diastasis recti, Core strengthening exercises, Neuromuscular electrical stimulation, Post cesarean mothers, Inter recti distance, Abdominal muscle strength.

Inclusion criteria

Peer-reviewed articles written in English

Studies involving human participants diagnosed with DRAM

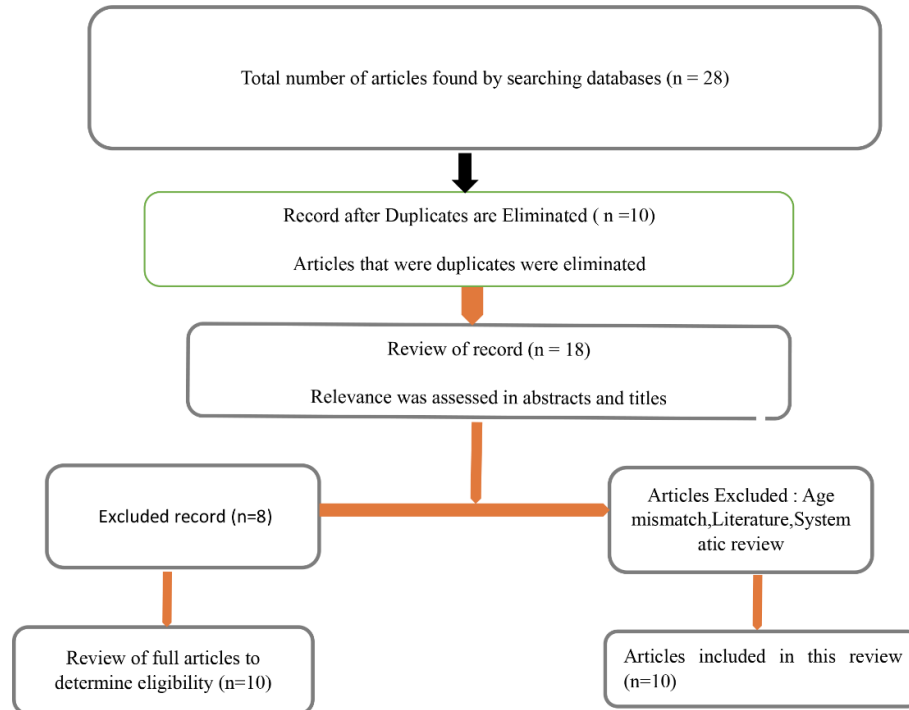
Research that evaluated the use of NMES as a treatment intervention

Exclusion criteria

Animal studies or case reports

Articles explaining surgical interventions

METHODOLOGY:



Results:

Recent systematic reviews and meta-analyses consistently demonstrate that conservative physiotherapy interventions are effective in reducing diastasis recti abdominis (DRA) in postpartum women, including those following cesarean delivery.

A large network meta-analysis (27 RCTs, n = 1340) reported that exercise-based interventions significantly reduce inter-recti distance (IRD) compared to minimal or no treatment, confirming their role as the primary management strategy.

Similarly, another systematic review and meta-analysis found that core strengthening exercises targeting deep abdominal muscles produce the improvements in IRD and functional outcomes.

Evidence from earlier meta-analysis indicates that while abdominal and pelvic floor muscle training improves DRA, the overall quality of evidence is moderate, with variability in intervention protocols and outcome measures

REVIEW LITERATURE

Sl no	Author name	Year	Conclusion
1	Dalia M. Kamel	2016	The author conducted a study on Comparison of efficiency of core stabilization exercise and abdominal core set in the treatment of postpartum diastasis racti abdominis. Include the women were randomly divided Into 3 group 1st group core stabilization exercise, 2nd group combination of exercise & abdominal corset, 3rd group abdominal corset, the protocol of all 3 group was having only less then 0.05 important, more exercise to be added.

2	Lva Weingerl	2022	The author conducted a study on The Effects of Conservative Interventions for treating Diastasis Recti Abdominis in Postpartum Women: a Review with Meta-analysis the abdominal musculature, especially in the linea alba and rectus abdominis sheath, usually return to normal and have no significant impact on health. Recovery is most marked between 1 day and 8 weeks after delivery was given to selected people .The signification have highly improved group A showed the recovery.
3	Rutuja Amit Lalingkar	2019	The Author conducted study on Effect of Electrical Stimulation Followed by Exercises in Postnatal Diastasis Recti Abdominis, and the women's where randomly divided into two groups, one group with exercise and stimulation the second group receive only stimulation above umbilicus (2.000 ± 0.4714), at umbilicus (2.000 ± 0.6667) and below umbilicus (1.800 ± 0.4216). The author concluded present study provided evidence to conclude that electrical stimulation when given along with exercises for patients with diastasis recti abdominis in their postnatal period was more beneficial than conventional exercises alone.
4	Sandra B Gluppe	2023	The author conducted a study on Curl – Up Exercise improve abdominal muscle strength without worsening inter recti distance in Women with diastasis recti abdominis postpartum Include 70 primiparous, Multiple women, 6 to 12 month postpartum protocol improved, Exercises improved the DRAM 0.05
5	Ayse Kavasaglu Kaya	2023	The author conducted a study on Comparison of efficiency of core stabilization exercise and abdominal core set in the treatment of postpartum diastasis racti abdominis. Include the women were randomly divided Into 3 group 1st group core stabilization exercise, 2nd group combination of exercise & abdominal corset, 3rd group abdominal corset, the protocol of all 3 group was having only less then 0.05 important, more exercise to be added.
6	Sh Tadmara Georgian	2024	The author conducted a study on Comparison of abdominal exercises and Neuromuscular electrical situation on diastasis racti abdominis muscle in postnatal female with caesarean section In both pregnant & postpartum common helth problem in people. The A group received abdominal exercise, group B received NMES in addition to their activities, both 3 times a week, changes as be recorded before & after both group heighly significant improvement. Compare to group A. Group A was highly signifined NMES can have more significant.
7	Benjamin et al	2025	The author conducted a study on Comparison of efficiency of core st exercise and abdominal core set in the treatment of postpartum diastasis racti abdominis. Include the women were randomly divided Into 4 group. 1 and 2 group core exercise, 2nd group combination of exercise & abdominal corset, 3 and 4group abdominal corset, the protocol of all 4 group was having only less important, more exercise.
8	Chen et al	2025	The author conducted a study on Comparison of NMES and abdominal core set in the treatment of postpartum diastasis racti abdominis. Include the women were randomly divided Into 2 group 1st group NMES, 2nd group of exercise & abdominal corset, the protocol of all 2 group was having only 0.01. improvement
9	Chen	2023	The author conducted a study on Comparison, Postpartum training program in primiparous women. The both gropes have improved with stability core distance.
10	Thabet & Alshehr	2019	The author conducted a study on, Meta-analysis on core training for DRA.Core training significantly reduces inter-recti distance and improves abdominal strength compared to no intervention.For 2 gropes.

Discussion:

Diastasis rectus abdominis (DRA) is a common postpartum musculoskeletal impairment, particularly prevalent among women who have undergone cesarean delivery. The present review highlights the growing

body of evidence supporting the use of core strengthening exercises, both alone and in combination with neuromuscular electrical stimulation (NMES), for the management of DRA in post-cesarean mothers. Overall, the findings suggest that a multimodal rehabilitation approach may offer superior outcomes compared to isolated interventions.

Core strengthening exercises targeting the deep abdominal musculature—particularly the transverse abdominis and pelvic floor muscles—have consistently demonstrated positive effects on reducing inter-rectus distance (IRD) and improving functional core stability. These exercises emphasize controlled activation, breathing coordination, and postural alignment, which are especially important in post-cesarean women due to surgical incision, pain, and delayed neuromuscular recruitment. The reviewed studies indicate that such targeted exercises facilitate tension generation across the lineal alba, promoting improved load transfer and abdominal wall integrity.

The addition of NMES appears to further enhance the therapeutic effects of exercise-based interventions. NMES facilitates involuntary muscle contractions, which may be particularly beneficial in the early postpartum period when voluntary activation of abdominal muscles is compromised. Several studies included in this review reported greater reductions in IRD and increased muscle thickness when NMES was combined with core strengthening exercises, compared to exercise alone. This suggests a synergistic effect, whereby NMES augments neuromuscular activation and accelerates muscle re-education. NMES may improve motor unit recruitment, increase muscle strength, and enhance proprioceptive feedback, all of which are essential for restoring abdominal wall function. In post-cesarean mothers, where protective inhibition and fear of movement are common, NMES may serve as a valuable adjunct to initiate muscle activation without excessive mechanical strain on the healing tissues. Additionally, improved local circulation induced by electrical stimulation may contribute to tissue healing and remodeling of the linea alba.

Despite these promising findings, the evidence base remains heterogeneous. Variations in study design, sample size, postpartum duration, outcome measures, and NMES parameters limit direct comparisons across studies. Furthermore, most studies focus on short-term outcomes, with limited data on long-term maintenance of improvements in IRD and functional performance. This highlights the need for standardized assessment protocols and long-term follow-up studies.

Limitation:

Another important consideration is the safety and individualization of interventions. Post-cesarean mothers present unique clinical challenges, including scar sensitivity, altered sensation, and psychological factors such as fear of movement. Therefore, NMES application and exercise progression must be carefully tailored, ensuring appropriate intensity, timing, and patient education to maximize adherence and minimize discomfort. One major limitation is the methodological heterogeneity across studies. The evidence base includes randomized controlled trials, quasi-experimental designs, and observational studies with varying levels of rigor. Inadequate blinding, inconsistent control groups, and differences in study quality increase the risk of bias and limit the strength of conclusions drawn from pooled findings.

The lack of standardized outcome measures further complicates comparison across studies. Inter-rectus distance (IRD) is commonly assessed; however, measurement techniques vary widely, ranging from ultrasound imaging to manual palpation methods, which differ in accuracy and reliability. Additionally, IRD alone may not fully reflect functional recovery, as outcomes related to core strength, functional performance, and quality of life are inconsistently reported.

Considerable variability in intervention protocols also limits interpretation. Core exercise programs differ in content, intensity, and duration, while NMES parameters such as frequency, intensity, and electrode placement are often inconsistently applied or insufficiently reported. This lack of standardization hinders replication and identification of optimal treatment parameters. Most studies focus on short-term outcomes, with limited long-term follow-up to determine the sustainability of improvements. Adherence and psychosocial factors influencing participation are also rarely addressed.

Conclusion

The findings of this study suggest that the combined approach of core strengthening exercises and neuromuscular electrical stimulation (NMES) is effective in reducing the inter-recti distance and improving abdominal muscle strength among post-cesarean mothers with diastasis recti abdominis muscle. Participants who received both interventions demonstrated greater improvement compared to those who performed exercises alone, indicating a synergistic effect of NMES in facilitating muscle activation and enhancing core stability.

However, due to limitations such as small sample size, short duration of intervention, and lack of long-term follow-up, the results should be interpreted with caution. Further studies with larger populations, standardized protocols, and extended observation periods are recommended to validate these findings and establish clinical guidelines for the management of DRAM in postpartum women

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