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Original Research

Combination of Core Activation and Curl-Up Exercise on Reducing Diastasis Rectus Abdominis (DRA) in Multiparous Women

Yuniatri Woli[1*], Luh Putu Ayu Vita Listyawati[2], Ni Made Rininta Adi Putri[3], Ni Putu Dwi Larashati[4]

[1,2,3,4] Department of Physiotherapy Dhyana Pura University Bali, Indonesia

ABSTRACT

Background: *Pregnancy and childbirth cause physical changes in women, including pelvic floor muscle weakness and abdominal wall enlargement leading to the condition of Diastasis Recti Abdominis (DRA). Multiparous women are at higher risk of experiencing DRA due to repeated stretching of the abdominal wall. This study aimed to evaluate the effectiveness of combining core activation with curl-up exercises in reducing the degree of DRA in multiparous women.*

Methods: *This study was conducted in Desa Homba Rande using a pretest-post test control group design. A total of 24 multiparous women were selected through purposive sampling and divided into two groups: intervention (n=12) and control (n=12). The intervention group received core activation and curl-up exercises three times a week for 12 weeks. Inter-recti distance was measured using a digital caliper before and after the intervention period. Data were analyzed using the Paired T-Test and Independent T-Test.*

Results: *All research samples were multiparous women aged 20-45 years, with controlled BMI, type of delivery, number of pregnancies, number of births, and physical activity score (IPAQ-SF). The paired t-test showed a p-value of 0.001 ($p<0.05$), indicating a significant improvement after intervention. The independent t-test showed a p-value of 0.002 ($p<0.05$), indicating a significant difference in post-test data between groups.*

Conclusion: *Core activation combined with curl-up exercises is effective in reducing DRA in multiparous women. These exercises are recommended as part of routine postpartum rehabilitation to improve core strength and function.*

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CONTACT
Yuniatri Woli
✉
20121001041@undhirabali.ac.id
Department of Physiotherapy, Dhyana Pura University, Jln. Padang Luwih, Dalung, Badung Regency, Bali, Indonesia.

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INTRODUCTION

Pregnancy and childbirth lead to various physical changes in women, including the enlargement of the abdominal wall, weakening of pelvic floor muscles, and loosening of the vaginal canal. These changes are primarily due to the stretching of abdominal muscles as the uterus expands with fetal growth. This stretching results in Diastasis Rectus

Abdominis (DRA), a condition defined by the separation of the rectus abdominis muscles along the linea alba (Michalska et al., 2018). The prevalence of DRA varies across different stages of pregnancy and postpartum. At 21 weeks of pregnancy, the prevalence is 33.1%, increasing to 60% at six weeks postpartum. At six months postpartum, the prevalence decreases to 45.4%, and by 12 months postpartum, it is 32.6%. Multiparous women may be at greater risk of developing DRA due to repeated stretching of the abdominal wall (Hafeez et al., 2022).

According to a study conducted by Touran et al. (2011) as cited in Cavalli et al. (2021) involving 95 women, there is a positive association between parity and DRA. The study found that DRA was not detected in the nulliparous group, was present 2% of primiparous women, and increased to 59% in multiparous patients. DRA affects the stability of the trunk and pelvis, poor posture, breathing disorders, and limitations in physical activity due to lumbosacral pain and hip pain. Postural changes and trunk mechanics due to DRA can affect pelvic stability, making the spine more vulnerable to injury. Additionally, increased inter-recti distance can negatively impact women's quality of life and, in more severe cases, can cause abdominal hernia (Pramita & Sasmita, 2023).

Physical exercise, particularly those focused on strengthening the abdominal muscles, has been proven effective in reducing the inter-recti distance caused by DRA. One of the most recommended exercises is the curl-up. Research by Saleem et al. (2021) demonstrated that this exercise significantly reduces the DRA in postpartum women by increasing abdominal muscle strength. Additionally, an EMG study by Oliva-Lozano and Muyor (2020) demonstrated that the curl up is more effective in activating the rectus abdominis muscles compared to other abdominal exercises, such as the plank. However, addressing DRA is insufficient with curl-up exercises alone, as the primally activate Transversus Abdominis (TrA) muscles among the core muscles.

Therefore, it is crucial to activate all core muscles first to foster comprehensive collaboration. Chan et al. (2020) emphasized that all core muscles must be activated simultaneously to achieve increased stability and a significant reduction in DRA. This comprehensive activation helps unify the abdominal muscles, enhance the integrity of the linea alba, and increase fascial tension, leading to a more sustained reduction in DRA in the long-term.

This study examined the behavior of the linea alba during Transversus Abdominis (TrA) activation followed by a curl-up exercise. Participants lay in a supine position for approximately five seconds before performing a curl-up, which involved lifting the head and neck until the upper scapula cleared the bed, without specific instructions on abdominal contraction. The movement was executed slowly over about three seconds, held for three seconds, then followed by a controlled return. While no significant change in inter-recti distance (IRD) was observed, deformation and displacement of the linea alba were noted (Saleem et al., 2021).

These differences from previous findings may be due to broader core activation involving multiple abdominal muscles, a four-week intervention period allowing for adaptation, and a primary focus on IRD rather than biomechanical properties. The results suggest that although isolated TrA activation may not yield immediate IRD changes, consistent and integrated core strengthening, including curl-up exercises, can reduce IRD and minimize linea alba distortion over time, supporting its role in DRA rehabilitation (Saleem et al., 2021).

This study aims to assess the effectiveness of combining core activation with curl-up exercises in reducing the severity of DRA. The novelty of this research lies in the

approach of activating the core muscles before performing curl-up exercises, which is intended to achieve simultaneous and comprehensive engagement of the core muscles. This method is expected to enhance the integration of core muscle function, resulting in a faster and more sustainable reduction of DRA. The study hypothesizes that this combination of core activation and curl-up exercises will effectively decrease the inter-recti distance, thereby reducing the severity of DRA.

MATERIALS AND METHOD

This research utilized an experimental plan with a pretest posttest control group design to investigate the effects of a combination of core activation and curl-up exercises on reducing DRA in multiparous women. This study was conducted in Homba Rande Village, Southwest Sumba, East Nusa Tenggara Province, during the year 2024. A total of 24 participants were recruited and split into two groups randomly: the intervention group (n=12) received a combination of core activation and curl-up exercises, with training sessions held three times weekly for 4 weeks, and control group (n=12) did not receive any intervention (Dahlan, 2021).

Participants were chosen to use purposive sampling, according to specific inclusion and exclusion criteria (Polit & Beck, 2018). The inclusion criteria comprised women aged 20-45 years who have given birth vaginally 2-3 times, normal Body Mass Index (BMI), IRD greater than 2 cm, light to moderate physical activity levels, as measured using the Indonesian version of the International Physical Activity Questionnaire–Short Form (IPAQ-SF) and commitment to engage in the study and sign the informed consent. Exclusion criteria were women with a history of heart disease, respiratory issues, or those with a history of pelvic or abdominal surgery and gastrointestinal or bladder trauma.

Drop-out criteria included participants who missed three consecutive exercise sessions or withdrew from the study. Materials used in this study are a digital caliper for measuring DRA before and after the intervention period. The independent variable in this study was the core strengthening exercise program (including core activation and curl-up exercises), while the dependent variable was the change in IRD as an indicator of DRA improvement.

A total of 24 participants were involved in this study. Data analysis was conducted using SPSS, employing descriptive statistics to summarize demographic data and baseline characteristics. Prior to hypothesis testing, the normality of the data was assessed using the Shapiro–Wilk test, given the sample size was fewer than 50 participants. The results confirmed that the data were normally distributed. A paired t-test was then applied to compare the pre-test and post-test IRD within each group, while an independent t-test was used to compare post-test IRD between the intervention and control groups.

Ethical clearance was obtained from the Institute for Research and Community Service (LPPM) at Dhyana Pura University. The reference number for this approval is 001171/KEP Universitas Dhyana Pura/2024. Informed consent was secured from all participants, ensuring confidentiality and anonymity of their data.

RESULTS

This section presents the research findings based on the data obtained during the intervention process. Below is the analysis of the results of this research:

Table 1. Respondent Characteristics by Group (n = 24 Multiparous Women)

Characteristic	Experimental Group (n =12)		Control Group (n =12)	
	Min-Max	Mean ± SD	Min-Max	Mean ± SD
Age (years)	21-45	32.75 ± 8.63	32.25-44	32.25 ± 7.43
Gravida	2-3	2.42 ± 0.51	2.50-3.00	2.50 ± 0.52
Parity	2-3	2.42 ± 0.51	2.50-3.00	2.50 ± 0.52
Body Mass Index/BMI (kg/m²)	20.6-24.4	22.24 ± 1.18	22.24-24.40	22.24 ± 1.18

Note: SD = Standard Deviation

Table 1 presents the baseline characteristics of the respondents, consisting of 24 multiparous women equally divided into an experimental group (n = 12) and a control group (n = 12). The average age in the experimental group was 32.75 ± 8.63 years, with a range of 21–45 years, while the control group had an average age of 32.25 ± 7.43 years, ranging from 32.25 to 44 years. The average number of pregnancies (gravida) was 2.42 ± 0.51 in the experimental group and 2.50 ± 0.52 in the control group, both ranging from 2 to 3 pregnancies.

Similarly, the average number of live births (parity) was 2.42 ± 0.51 in the experimental group and 2.50 ± 0.52 in the control group. Regarding Body Mass Index (BMI), both groups had the same mean value of 22.24 ± 1.18 kg/m². In the experimental group, BMI ranged from 20.6 to 24.4 kg/m², while in the control group it ranged from 22.24 to 24.40 kg/m². These findings indicate that the two groups were comparable at baseline in terms of age, reproductive history, and BMI, supporting the internal validity of subsequent comparisons between groups.

Table 2. Inter-Recti Distance Before and After Intervention by Group (n = 24 Multiparous Women)

Time Point	Experimental Group (n = 12)		Control Group (n = 12)	
	Min–Max (cm)	Mean ± SD (cm)	Min–Max (cm)	Mean ± SD (cm)
Pre-test	2.35–4.33	3.70 ± 0.54	2.72–4.43	3.70 ± 0.46
Post-test	1.27–3.81	2.79 ± 0.75	2.72–4.43	3.71 ± 0.46

Note: SD = Standard Deviation

Table 2 presents the IRD measurements before and after the intervention for both experimental and control groups, each consisting of 12 multiparous women. At the pre-test time point, both the experimental and control groups exhibited identical mean IRD values of 3.70 cm, with standard deviations of 0.54 cm and 0.46 cm, respectively. The range of IRD in the experimental group was 2.35–4.33 cm, while the control group ranged from 2.72–4.43 cm.

Following the intervention, the experimental group demonstrated a notable reduction in IRD, with a mean value of 2.79 ± 0.75 cm and a range of 1.27–3.81 cm. In contrast, the control group showed no meaningful change, maintaining a mean IRD of 3.71 ± 0.46 cm, identical to its baseline range. These results suggest that the intervention applied to the experimental group was effective in reducing the inter-recti distance, indicating potential clinical benefits for postpartum abdominal muscle rehabilitation.

Table 3. Mean Reduction in Diastasis Recti Abdominis (DRA) Before and After Intervention (n = 24 Multiparous Women)

Groups	Pre-test Mean ± SD (cm)	Post-test Mean ± SD (cm)	Mean Difference (cm)	Percentage Reduction (%)	p-value*
Experimental (n = 12)	3.70 ± 0.54	2.79 ± 0.75	0.91	24.60	**0.001**
Control (n = 12)	3.71 ± 0.46	3.71 ± 0.46	0.00	0.00	0.339

Note: SD = Standard Deviation; * Paired T-Test

The paired sample t-test results show that the experimental group experienced a significant reduction DRA after the intervention, with a mean decrease of 0.91 cm (24.6% reduction) and a p-value of 0.001, indicating statistical significance ($p < 0.05$). This confirms the effectiveness of the treatment in reducing DRA. In contrast, the control group showed no change in mean DRA values between pre-test and post-test (mean difference = 0.00 cm) with a p-value of 0.339, indicating no statistically significant difference ($p > 0.05$). This suggests that no improvement occurred without the intervention.

Table 4. Comparison of Diastasis Recti Abdominis (DRA) Between Groups Before and After Intervention

Time Point	Mean Difference (cm)	p-value*
Pre-test	0.004	0.984
Post-test	0.923	**0.002**

* The independent t-test

The independent samples t-test showed no significant difference in DRA between the experimental and control groups at baseline (pre-test), with a p-value of 0.984, indicating homogeneity between groups before intervention. However, after the treatment (post-test), a statistically significant difference was observed between groups ($p = 0.002$, $p < 0.05$), with a mean difference of 0.923 cm. This suggests that the intervention had a significant effect on reducing DRA in the experimental group compared to the control group.

DISCUSSION

This study provides further evidence that DRA is significantly influenced by multiple physiological and biomechanical factors, including age, BMI, delivery type, physical activity level, and parity. The findings align with previous research by Wu et al. (2020), which reported that DRA prevalence is highest in younger women, particularly those under 45, and declines with age due to cumulative pregnancies and deliveries. Additionally, BMI plays a critical role in DRA severity, with higher rates observed in overweight and obese individuals, likely due to increased intra-abdominal pressure leading to greater rectus abdominis muscle separation.

Our study strengthens the understanding of physical activity's role in DRA development and rehabilitation. The inclusion of only multiparous women with normal vaginal deliveries was a deliberate methodological decision to eliminate confounding factors, such as the potential impact of cesarean sections on linea alba integrity (Wu et

al., 2020). Furthermore, limiting participants to light-to-moderate activity levels ensured that the intervention results were not skewed by excessive mechanical stress, which has been shown to worsen DRA progression (Werner & Dayan, 2019).

The intervention findings strongly support the efficacy of combining core activation and curl-up exercises in reducing DRA. The experimental group demonstrated a significant reduction in inter-recti distance (IRD) after 12 sessions over four weeks, whereas the control group exhibited no significant changes. This reinforces previous findings Arranz-Martín et al. (2022) and Saleem et al. (2021) that highlight the superiority of targeted core strengthening techniques over conventional exercises.

The effectiveness of this approach can be attributed to the synergistic activation of deep and superficial abdominal muscles, which improves linea alba tension, promotes connective tissue remodeling, and enhances abdominal muscle co-contraction (Skoura et al., 2024). Recommendation suggests optimal contraction of internal and synergistic muscles during the postpartum period for DRA rehabilitation (Dufour et al., 2019). Notably, deep core activation alone has been found insufficient to reduce IRD in some studies. However, when integrated with curl-up exercises, this approach appears to generate greater structural adaptation and functional recovery, suggesting that a multi-faceted core rehabilitation program is preferable to isolated exercises for postpartum DRA management.

In contrast, the control group, which did not receive the intervention, exhibited no significant changes in IRD. However, an interesting finding was that one participant experienced a slight increase in DRA (0.05 cm), likely due to engagement in heavy physical activities such as prolonged standing and walking during harvesting. This aligns with the findings who reported that frequent strenuous activity contributes to worsening DRA by increasing intra-abdominal pressure and mechanical stress on the abdominal wall. Heavy physical activities can exacerbate DRA by increasing intra-abdominal pressure and mechanical stress on the abdominal (Werner & Dayan, 2019). Nevertheless, the impact on the overall control group was minimal, as the majority of participants did not engage in excessive physical exertion.

Despite its strengths, this study has several limitations that warrant further investigation. Firstly, the relatively short intervention duration restricted the ability to assess the long-term effects of the exercise program. Future studies should implement extended follow-up periods to determine whether the observed benefits are sustained over time. Secondly, variations in participants' physical activity levels, despite attempts to control them, may have influenced the outcomes. Future research should consider more rigorous activity monitoring methods to ensure greater standardization of participant activity levels.

CONCLUSION

From the research carried out, it can be inferred that the combination of core activation and curl-up exercises is effective in reducing DRA in multiparous women. Future researchers can develop this research into sustainable home-based exercise program over a longer period while still controlling physical activity, to prevent other musculoskeletal disorders due to DRA, such as lower back pain and poor posture.

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