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The effectiveness of core stability exercises on pain in patients with low back pain: a meta-analysis

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ABSTRACT

Introduction: Lower back pain (LBP) results from stress in the muscles in the lower back. The pain patients with typical back pain feel is between the lower corner of the costa and the lumbosacral caused by muscle tension in the lower back area. Based on the Results of Basic Health Research (2018), people with low back pain cannot be ascertained in Indonesia, but it is estimated to be between 7.6% to 37%. One intervention that can be given to reduce pain in patients with LBP is core stability exercise. Meta-analysis studies using PICO. P: patients with non-specific LBP. I: core stability exercise. C: non-core stability exercise. O: decrease in pain.

Methods: The method of this study was a systematic review where data collection of the results of this research is carried out through searches on the PubMed and Scopus websites. Keywords used include: "low back pain" AND "non-specific low back pain" AND "core stabilization exercise" OR "core stability" OR "core exercise" AND "Randomized Controlled Trial." The selected articles are full-text articles with a randomized controlled trial method. The application is used to analyze reports in Review Manager 5.4.

Results: as many as nine articles analyzed came from Korea, China, Turkey, India, Iran, the USA, and London. Studies show that patients with non-specific low back pain who received core stability exercise experienced a lower pain reduction of 0.02 than those who did not get core stability exercise, thus improving quality of life, and this effect was claimed to be statistically significant (hazard ratio (HR)= -0.02; 95% CI=-0.87 to 0.47; $p<0.001$).

Conclusion: core stability exercise can reduce pain and have an impact on improving quality of life.

Keywords: core stability, exercise, non-specific low back pain, pain.

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INTRODUCTION

As times progress, more and more new types of diseases are discovered, but all conditions in the world have a cure. Lower back pain is a common musculoskeletal injury, which can be caused by overload/incorrect movement patterns at work, during exercise, or other accidents.[1] When someone does activities such as sleeping, sitting, walking, and standing that are not right for a long time will cause muscles to tense continuously, causing soreness (dull ache). Low back pain (LBP) refers to the pressure/strain on the back muscles, tendons, and ligaments felt during excessive activity, such as bending, standing, or being in the wrong position for too long.[2]

Lower back pain was the cause of global disability in 2015 in every country.[3] Every year, the world's lower back disease varies greatly, reaching 15-45%. Non-specific Low back pain (NSLBP) is described as low back pain with no apparent causal relationship between the symptoms, physical findings, and imaging findings.[4] The prevalence of LBP is high in healthcare workers, with an annual prevalence of 50%–77% and the highest overall incidence reported in nurses.[5] Patient-handling activities are considered the most significant risk factor for LBP among healthcare workers (odds ratio, 1.6).[6]

In addition, individuals with NSLBP were found to experience social difficulties and avoided work, ultimately influencing their quality of life. Whether or not they chose to seek treatment for NSLBP varied according to the patient's age, gender, willingness, and several other related factors. Forms of treatment also changed from home-based self-care to physical therapy to surgery.[7] Pain patients with low back pain feel between the lower corner of the costa to the lumbosacral caused by muscle tension in the back area. Pain that arises usually comes from the body's protective mechanism against injury. Nociceptors around the tissue injury will send signals to the spinal cord and forward calls to the brain, recognized as pain. Then the brain will send alerts to the muscle to contract to protect power in that area. Contraction of the muscle constantly occurs, which will cause hypoxia and tissue damage, increasing pain and disability.[8]

One intervention that can reduce pain is core stabilization. Core stability exercises that improve lumbopelvic stability and pain level may be included in prevention and clinical rehabilitation for patients with LBP.[9] Core muscle stability controls movement and body position through the pelvis and legs for

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optimal force control in kinetic chain movement. In the strength of the vertebral segment, some muscles play the most role during activity, one of which is the transversus abdominis. In LBP patients, weakness in power was found.[10]

A recent meta-analysis demonstrated that in contrast with general exercises, core stability exercises are more effective in short-term pain reduction and physical function improvement in patients with chronic low back pain (CLBP).[11] Kliziene et al.[12] described that core stability exercises increase lumbar multifidus (LM) cross-sectional area in healthy women and women with CLBP. Moreover, Leonard et al. found that lumbopelvic core stability exercises significantly increase the thickness of transversus abdominis (TrA) in patients with CLBP during rest and contraction. Nonetheless, they did not describe other clinical outcomes, such as disability and quality of life.[13]

Many treatment options to reduce the pain felt by patients, such as myofascial release techniques, where the method uses roller massager media applied to the sacro-lumbar fascia/erector spine area; this tool uses devices to manipulate the skin, myofascial muscles, and tendon with pressure directly. This is considered less able to reduce patients' pain because this technique is only muscle relaxation. Research shows core stability exercise has a therapeutic effect, so patients with low back pain experience an increase in the pain threshold. Besides that, this treatment can also increase the flexibility of the lower body.[14] General pain-reducing exercises, such as tai chi, yoga, and pilates, are basic techniques based on the core stability exercise principle.[11]

METHODS

Design Study

This study uses a meta-analysis method where the search for information about the results of this research through searching the PubMed and Scopus websites. Keywords used include: "low back pain" AND "non-specific low back pain" AND "core stabilization exercise" OR "core stability" OR "core exercise" AND "Randomized Controlled Trial."

Meta-analysis Steps

The meta-analysis steps are as follows:
We select journals using PICO questions (Population, Intervention, Comparison, Outcome). See primary studies on articles from various electronic and non-electronic databases such as PubMed and Scopus. Determine the criteria for inclusion and exclusion following the survey. Extract preliminary study data and determine the size effect using the Rev Man 5.4 application. Drawing up results and conclusions.

Inclusion Criteria

Full article using randomized controlled trial (RCT) study, Non-specific Low Back Pain (NSLBP) sufferers, publishing scientific articles in 2012-2022, using Visual Analog Scale (VAS) measuring instruments.

Exclusion Criteria

Journals that are not full of articles do not use English, do not use randomized controlled trial (RCT) studies, and articles published before 2012.

Definition of operational variables

Search for articles eligible for inclusion and exclusion using PICO. The population in the study was non-specific low back pain sufferers with core muscle stability exercises to reduce pain. Activities to maintain an upright posture activate and strengthen core muscles, which is the definition of stability exercises in core muscles. Pain is a stimulus that touches nociceptors on the skin and internal organs of the body so that it releases inflammatory mediators that cause pain.

Study Instruments

Each identified study report is evaluated based on eligibility criteria. In meta-analyses, a critical component to strengthen the results is the quality and design of the research that has been analyzed. A quality assessment using a randomized controlled trial (RCT) method was published by CEBM University of Oxford in 2014.

Data Analysis

The collected data is reviewed using the Review Manage application (Rev Man 5.4) to review the average difference in pain calculated using VAS. The score results will be calculated to determine the final result of the meta-analysis.

RESULTS

Searching for journals through the electronic database PubMed and Scopus resulted in a review process seen in the PRISMA diagram in Figure 1. It was found that a total of 201 journals, after the deletion of double data, article reviews were carried out again to see articles that did not meet qualitative requirements. Seven articles were excluded for combining interventions in the experimental group: core stability exercise and general exercise. The final result of the article review process, nine qualitative articles meet the qualitative requirements for meta-analysis of the effectiveness of core muscle stability

exercises on pain sufferers' low back pain. The articles come from 3 continents of Asia, America, and Europe. Eight articles are from Asia, one is from the Americas, and 1 article is from Europe.

After assessing the article, there are a total of 9 articles using the randomized controlled trial method (Table 1), which will be used as a source of meta-analysis data on the effectiveness of core muscle stability exercises on pain in patients with low back pain; the articles come from 3 continents, namely, Asia, America, and Europe, then the articles are summarized according to the PICO study (Table 2).

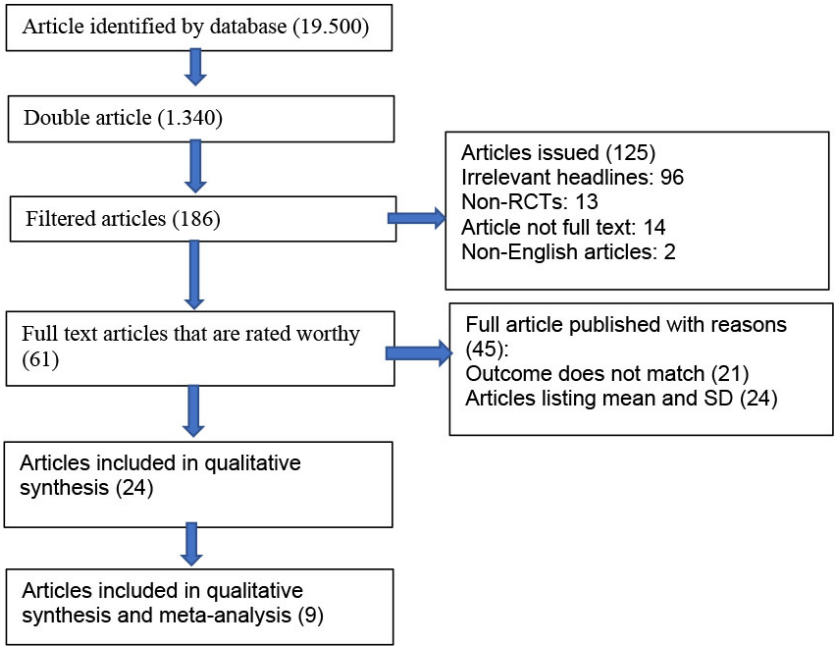

Figure 1. Preferred reporting items for systematic reviews and meta-analyses (PRISMA) flow diagram results.

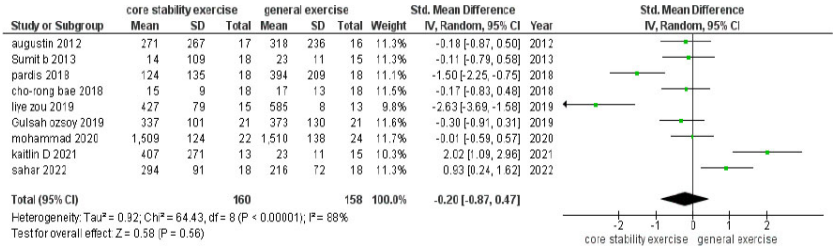

Figure 2. Forest plot of the effectiveness of core stability exercises on pain in low back pain sufferers.

Based on the results of the forest plot (Figure 2), core muscle stability exercise was able to reduce pain in patients with non-specific low back pain than non-core stability exercise, and the effect was statistically significant hazard ratio (HR)=-0.02; 95% confidence interval (CI)=-0.87 to 0.47; $p<0.001$. The estimated heterogeneity of the study in this meta-analysis is high, $I^2 = 88\%$; this can also be seen from the widening confidence interval (96% CI) with the confidence interval of the study (lower limit <-0.87 upper limit >0.47). Therefore, it is estimated that the main study was calculated using the random effect model mode approach. After giving core stability exercise, it was found that there was a decrease in pain in patients with non-specific low back pain lower by -0.20 compared to non-core stability exercise (95% CI: -0.87 to 0.47). This shows that patients with non-specific low back pain who are given core stability exercise interventions can reduce pain compared to non-core stability exercise ($p<0.001$).

This meta-analysis study discusses the effectiveness of core muscle stability exercises on the pain of LBP sufferers. Core stability intervention to reduce pain in non-specific low back pain sufferers is vital because the pain patients feel disrupts daily activities. Core stability-based intervention for pain reduction in non-specific low back pain patients was processed using Rev Man 5.4 with a continuous method to analyze standardized mean difference (effect size) in bivariate data of two groups with confounding factors controlled by randomization (Table 3).

The results of the forest plot showed that patients with non-specific low back pain who received core stability exercise had a lower pain reduction of 0.02 compared to those who did not get core stability intervention (HR=-0.02; 95% CI=-0.87 to 0.47; $p<0.001$). The estimation of heterogeneity of research data shows $I^2=88\%$, so the distribution is

Table 1. Critical appraisal checklist using physiotherapy evidence database (PEDro) scale

Author	Criteria											Total
	1	2	3	4	5	6	7	8	9	10	11	
(Bae et al., 2018)	√	√	X	√	X	X	X	√	X	√	√	5/10
(Ozsoy et al., 2019)	√	√	X	√	X	X	√	√	X	√	√	6/10
(Gorji et al., 2022)	√	√	√	√	X	X	X	√	X	√	√	6/10
(Shamsi et al., 2020)	√	√	X	√	X	X	X	√	X	√	√	5/10
(Zou et al., 2019)	√	√	X	√	X	X	√	√	X	√	√	6/10
(Lyons et al., 2021)	√	√	X	√	X	X	X	√	X	√	√	5/10
(Inani et al., 2013)	√	√	X	√	X	X	X	√	X	√	√	5/10
(Noormohammadpour., 2018)	√	√	√	√	X	X	√	X	√	√	√	7/10
(Aluko et al., 2013)	√	√	X	√	X	√	√	X	X	X	√	5/10

Table 2. Summary of the primary randomized control trial study with population, intervention, control, and outcomes (PICO)

Author (Year)	Country	Sample	P	I	C	O
Bae et al. (2018)[15]	Korea	36	Chronic NSLBP	Sit-up exercise	Core stabilization exercise	Relieves Pain
Ozsoy et al., (2019)[14]	Turki	42	Elderly patients with NSLBP	Core stabilization exercise	Core stabilization execise+myofascial release technique	Relieves Pain
Gorji et al., (2022)[16]	Iran	36	Chronic low back pain	Pain neuroscience education+ motor control exercise	Core stability exercise	Relieves Pain
Shamsi et al., (2020)[17]	Iran	46	Non-spesifik low back pain	Core stability exercise	General exercise	Relieves Pain
Zou et al. (2019)[18]	China	28	Sufferer NSLBP	Core stability exercise	No interventions	Relieves Pain
Lyons et al. (2021)[19]	USA	26	Soldiers with low back pain	Core exercise	Whole body vibration+core exercise	Relieves Pain
Inani et al., (2013)[20]	India	30	Patient NSLBP	Core stabilization exercise	Conventional exercise	Relieves Pain
Noormohammadpour., (2018)[21]	Iran	36	Nurses with chronic low back pain	Core stability exercise	No intervention	Relieves Pain
Aluko et al., (2013)[22]	London	33	Acute NSLBP	Core stability exercise	General exercise	Relieves Pain

Table 3. Effect estimates of all primary studies

Authors (year)	Core stabilization exercise		Non-core stabilization exercise	
	Mean	SD	Mean	SD
Bae et al., (2018)[15]	1.5	0.9	1.7	1.3
Ozsoy et al., (2019)[14]	3.37	1.01	3.37	1.3
Gorji et al., (2022)[16]	2.94	0.19	2.16	0.072
Shamsi et al., (2020)[17]	15.09	12.4	15.1	13.8
Zou et al. (2019)[18]	4.27	0.79	5.85	0.8
Lyons et al. (2021)[19]	40.7	27.1	30.9	21
Inani et al., (2013)[20]	1.4	10.9	2.3	1.1
Noormohammadpour., (2018)[21]	12.4	13.5	39.4	20.9
Aluko et al., (2013)[22]	27.1	26.7	31.8	23.6

claimed to be heterogeneous (random effect model).

DISCUSSION

As known in a research article, after a short-term evaluation at the end of exercise after the 14-week intervention, an increase in visual analogue scale (VAS) scores in both groups ($p<0.05$) was observed to be significant, with pain data scores from the core stability exercise group (mean=1.5; standar deviation (SD)=0.9 vs mean=1.7; SD=1.3), the results of the ultrasound showed that the ratio of the thickness of TrA statically increased significantly in the core stability group, proving that core stability is effective in activating deep muscle.[15]

After six weeks of intervention, both groups had a statistically significant decrease in resting VAS scores (mean=3.37; SD=1.01 vs. mean=3.37; SD=1.30). The research was conducted.[14] After the intervention was given eight wee, a comparison between time and group was made. Overall, there was a significant improvement between the start and after eight weeks of intervention for both groups (mean=2.94; SD=0.91 vs mean=2.16; SD=0.072). The post-test showed a difference in mean pain scores (-0.78) pain neuroscience education (PNE)/motor control education (MCE), effect size (ES)=2.14, core stability exercise (CSE), ES=3.43). This can reduce the level of disability in sufferers, thereby increasing daily activity.[16]

There was a difference between CSE and general exercise (GE) interventions in pain ($p=0.72$) (mean = 15.09; SD=12.4 vs mean=15.1; SD=13.8).[17] The research article showed a significant difference in VAS scores (mean=4.27; SD=0.7 vs mean=5.85; SD=0.8) after 12 weeks of intervention between

core stability training (CST) and the control group (p<0.01) in the process of degeneration of neuromuscular parameters CST proved to be able to weaken the process, CST itself was able to increase the peak torque of left dorsiflexion (p<0.05) and left flexion plantar endurance. Researchers show that CST has the effect of reducing chronic low back pain in ageing individuals.[18]

There was a significant difference in VAS scores between the first and second days after the foot march (t=2.852, p=0.004), indicating that LBP pain continued to decrease two days after the foot march (FM). Finally, the VAS score (mean=40.7; SD=27.1 vs mean=30.9; SD=21.0) was significantly lower during FM2 compared to FM1 (t=-2.701, p=0.007). With these results, it is crucial for therapists as a reference for providing interventions for people with LBP.[19]

Research showed a faster increase in dependent variables in the experimental group compared to the control group. Analysis between groups showed a much more significant increase in VAS scores (mean=1.4; SD=10.9 vs. mean=2.3; SD=1.1). VAS and disability presentation differed between groups at the end of the 3-month intervention (t=2.273, p=0.0303) (t=3.443, p=0.0018). This study found that the core muscle stability program significantly reduced the pain experienced by LBP sufferers.[20]

Research articles VAS scores were found to decrease significantly in the intervention group after the experiment (approximately 30 points) (p<0.001) after being given the intervention for eight weeks. After eight weeks of intervention, VAS scores decreased (about 6 out of 10 points) in the intervention group compared to the control group (about 4.5 out of 10 points). These findings suggest that core stability exercise can effectively reduce CLBP pain in female nurses and improve patients' quality of life and functionality (mean=12.4; SD=13.5 vs mean=39.4; SD=20.9).[21]

The research found that, on average, the identical pain scores at each stage of the study, the groups had differences in baseline-adjusted pain levels not statistically significant at three weeks (30%; 95% CI, 0.8-2.2; p=0.3), six weeks (20%; 95% CI, 0.7-2.0; p=0.6) or three months (0%; 95% CI, 0.5-1.9; p=1.0). Pain reduction was shown using a VAS measuring instrument, measured at the end of the intervention for six instead (mean=27.1; SD=26.1 vs mean=31.8; SD=23.6).[22] This study's limitation is not carrying out the methods used to assess the risk of bias in the included studies. In the future, studies can be carried out with more advanced methods.

CONCLUSION

After processing data from 9 articles from 3 continents, namely Asia, Europe, and America, studies show that patients with non-specific low back pain who received core stability exercise experienced a lower pain reduction of 0.02 than those who did not get core stability exercise; thus, improving quality of life and this effect was claimed to be statistically significant (HR=-0.02; 95% CI=-0.87 to 0.47; p<0.001).

ETHICAL CONSIDERATIONS

This meta-analysis used publicly accessible documents as evidence and did not require institutional ethics approval.

CONFLICT OF INTEREST

There is no conflict of interest that the author declares following the publication.

FUNDING

This study received no grant from any institution.

AUTHOR CONTRIBUTION

WW conceived the study design, collected and analyzed the data, and drafted the manuscript; NEK drafted the manuscript and interpreted the data analysis.

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