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The comparative effect of core stability exercise and aquatic exercise therapy on reducing pain in patients with low back pain

Nurul Fithriati Haritsah¹, Yoga Handita W², Nur Basuki³

^{1,2,3}Study Program in Physiotherapy, Health Polytechnics, Ministry of Health Surakarta, Surakarta, Central Java

ARTICLE INFO	ABSTRACT
<i>Article history:</i> Received Aug 29, 2024 Revised Aug 31, 2024 Accepted Sep 4, 2024 <i>Keywords:</i> Aquatic Exercise Therapy (AET) Core Stability Exercise (CSE) Low Back Pain	Low Back Pain (LBP) is a prevalent health issue caused by improper posture during activities, resulting in pain, stiffness, or muscle tension in the lower back (Minghelli, 2017). It is a major cause of disability, particularly among adults, and a common reason for seeking healthcare (Bento et al., 2019). The Indonesian Ministry of Health (2022) reports that 60-80% of the global population experiences at least one episode of LBP in their lifetime. This study used a pre- and post-test two-group design with random assignment. Group I received Core Stability Exercise therapy, while Group II received Aquatic Exercise Therapy. Both groups underwent treatment twice weekly for eight weeks. The study involved outpatients at KRMT Wongsonegoro Hospital, Semarang. Results: Core Stability Exercise significantly reduced pain in myogenic LBP patients ($p=0.00$). Aquatic Exercise Therapy also showed significant pain reduction ($p=0.00$). A significant difference was found between the two therapies ($p=0.036$), with Aquatic Exercise Therapy having a greater effect (mean=3.942) compared to Core Stability Exercise (mean=3.275). Core Stability Exercise and Aquatic Exercise Therapy both significantly reduce pain in myogenic LBP patients, with Aquatic Exercise Therapy being more effective

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Corresponding Author:

Nurul Fithriati Haritsah,
Study Program in Physiotherapy,
Health Polytechnics,
Ministry of Health Surakarta,
Jl. Adi Sumarmo, Tohudan, Colomadu, Karanganyar, 57173, Indonesia,
Email: nurulfithriati_haritsa@yahoo.com

INTRODUCTION

Low Back Pain (LBP) is a health issue often caused by improper posture during activities and is characterized by symptoms such as pain, stiffness, or muscle tension in the lower back (Minghelli, 2017). LBP is a leading cause of disability, particularly among adults, and is a common reason people seek healthcare (Bento et al., 2020).

The Indonesian Ministry of Health (2022) reports that approximately 60-80% of the global population has experienced at least one episode of LBP in their lifetime. LBP is a common

symptom in all countries, affecting populations in low, middle, and high-income nations. In recent decades, there has been an increase in disability due to LBP in low- and middle-income countries, including Asia, Africa, and the Middle East. Data from the 2009 National Health Interview Survey (NHIS) shows that 28.5% of the U.S. population suffers from LBP, making it the most common pain-related condition. In Indonesia, the exact number of LBP sufferers is unknown, but estimates range from 7.6% to 37% (Lestari et al., 2024). LBP is generally more prevalent in women than men and is most common among individuals aged 40-69 years (Nurhafizhoh, 2019)(Saputra, 2020)(Rosadi et al., 2021). In Central Java, it is estimated that 40% of the population over 65 years old has experienced LBP, with a prevalence of 18.2% in men and 13.6% in women (Panduwinata, 2014).

Non-specific low back pain is characterized by pain that is not related to known pathological conditions such as fractures, infections, or osteoporosis (Quentin et al., 2021). LBP has a significant impact on individuals, families, society, and businesses worldwide, often leading to reduced work productivity (Saputra, 2020)(Tessa, 2023)(Annissa et al., 2024)(Nurdahlia & Rosidawati, 2024) and economic challenges due to increased healthcare costs and social support needs (Hartvigsen et al., 2018). The symptoms include pain, muscle tension, and balance disturbances, which can affect core muscle stability, alter posture, and potentially lead to disability in patients with non-specific LBP.

Physiotherapy interventions for alleviating non-specific LBP include Core Stability Exercise (CSE) and Aquatic Exercise Therapy (AET). Core stability exercise involves activating the synergistic muscles of the inner trunk, known as the core muscles (Pramita et al., 2014). CSE also stabilizes the spine and strengthens the hip muscles with minimal load on the tissues (Kim et al., 2020).

Aquatic Exercise Therapy (AET) involves physical exercises performed in water or a swimming pool. Water-based exercises are more effective in improving static and dynamic balance compared to land-based exercises, with significant differences observed between the two groups (Hashemi Javaheri et al., 2012). AET aims to reduce pain, increase range of motion, restore muscle strength, correct abnormal gait patterns, and improve overall fitness, playing a crucial role in functional capacity (Mehdi et al., n.d.).

RESEARCH METHOD

Study Design

This study employed a pre- and post-test two-group design. The subjects were randomly assigned into two groups: Group I received Core Stability Exercise (CSE) therapy, while Group II received Aquatic Exercise Therapy. Each group underwent treatment twice a week for 8 weeks. The study was conducted from May to July 2024 at KRMT Wongsonegoro General Hospital, Semarang. The study population consisted of outpatients receiving therapy at KRMT Wongsonegoro General Hospital, Semarang.

Population and Sample

The study population comprised patients with low back pain at KRMT Wongsonegoro General Hospital, Semarang. A total of 24 subjects were selected using purposive sampling, with those meeting the inclusion and exclusion criteria included in the sample. The sample criteria were as follows: (1) Subjects with localized pain in the lower back area. (2) Presence of spasms, trigger points, and loss of range of motion. (3) Subjects aged 30-60 years, of either gender. (4) Subjects who were cooperative and willing to follow the physiotherapy program from start to finish by signing an informed consent. (5) Subjects who were physically and mentally capable of receiving the intervention. (6) Pain level between 4-7 (moderate) as measured by VAS. (7) Negative results on compression test, SLR test, and slump test.

Study Variables

The independent variables in this study were: Core Stability Exercise and Aquatic Exercise Therapy. The dependent variable was: the reduction of pain in patients with myogenic low back pain. The independent variables in this study were: Core Stability Exercise and Aquatic Exercise Therapy. The dependent variable was: the reduction of pain in patients with myogenic low back pain.

Operational Definition and Variables

Low Back Pain: Pain associated with disorders of the muscles, tendons, or ligaments in the lower back. This pain is dull in nature and is caused by excessive and improper daily activities.

Core Stability Exercise (CSE): The ability to regulate the position during trunk, pelvis, and leg movements to produce optimal movement patterns, transfer, and segmental control within an integrated kinetic chain. CSE aims to strengthen and increase lumbar stability, thereby preventing and protecting against injuries or external factors that burden the vertebrae. CSE movements include (1) Close chain bridging, (2) Camel and cat, (3) Cobra. These movements are repeated 8 times. The exercise dose in this study was 8 weeks with a frequency of 2 times a week.

Aquatic Exercise Therapy (AET): A combination of several exercises that are biomechanically and physiologically safe, effective, and healthy. AET has several benefits, including natural buoyancy, hydrostatic pressure, thermodynamics, hydrodynamic forces, and water viscosity, which help reduce pressure on the trunk and surrounding muscles, predominantly alleviating pain and stiffness while improving neuromuscular function.

Pain: An unpleasant sensory and emotional experience resulting from tissue damage, measured using the Visual Analog Scale (VAS).

Study Instruments

The measurement tool used in this study was the Visual Analog Scale (VAS). The VAS was used to determine the level or scale of pain in Myogenic Low Back Pain. The VAS is a 100 mm horizontal line with verbal descriptors at each end to express the pain experienced, and the VAS score is determined by measuring in millimeters from the left end of the line to the point marked by the patient (Aprilia et al., 2021). Patients were asked to indicate the point on the line that represents the location of the pain along the VAS range (Merdekawati et al., 2019). According to Merdekawati et al. (2019), the VAS measurement scale has an accuracy of 50%, meaning it is accurate in assessing pain. Additionally (Hutagaol et al., 2022)(Dafwen, 2023)(Adina et al., 2024), in a study by Gallagher et al. (2002) on the validity and reliability of the VAS, it was found that the VAS is a valid and reliable measurement tool. Reliability was measured using ICC, and the result was ICC = 0.99, indicating very high reliability.



Figure 1. Reliability was measured using ICC, and the result was ICC = 0.99, indicating very high reliability

Data Analysis

In this study, the data consisted of numerical data obtained from the pain scores measured by the VAS in millimeters before and after the intervention. SPSS 22 software was used for data analysis. Normality was tested using the Shapiro-Wilk test because the number of subjects was less than 50. Homogeneity was tested using Levene's test. The difference between pre- and post-intervention in the core stability and aquatic exercise groups was tested using the paired sample t-test. To compare the post-test results between the core stability and aquatic exercise groups, an independent sample t-test was used.

Research Ethics

Ethical approval for the study was obtained from the Research Ethics Committee of KRMT Wongsonegoro General Hospital, Semarang, with No. 019/Kom.EtikRSWN/IV/2024.

RESULTS AND DISCUSSIONS

The subjects in this study consisted of 24 patients, including 8 males (33.33%) and 16 females (66.66%). The pain measurement before the core stability exercise treatment (pre-test) showed a minimum value of 7 mm and a maximum value of 8.8 mm. The pain measurement after the core stability exercise treatment (post-test) showed a minimum value of 3 mm and a maximum value of 6 mm. The pain measurement before the aquatic exercise therapy (pre-test) showed a minimum value of 6.5 mm and a maximum value of 8.8 mm. The pain measurement after the aquatic exercise therapy (post-test) showed a minimum value of 3.5 mm and a maximum value of 5.0 mm. The details can be seen in Table 1.

Table 1. Characteristics of research subjects at KRMT Wongsonegoro Hospital

Variables	Mean	SD	Min.	Max.
Pain before the Core Stability Exercise intervention	7,858	0,5351	7,0	8,8
Pain after the Core Stability Exercise intervention	4,583	0,9003	3,0	6,0
Pain before the Aquatic Exercise Therapy intervention	7,875	0,6566	6,5	8,8
Pain after the Aquatic Exercise Therapy intervention	3,933	0,4519	3,5	5,0

The homogeneity test was conducted using Levene's test. The results showed a p-value of 0.53 ($p > 0.05$), indicating that the variance between the two groups is homogeneous. The difference between pre-test and post-test in the core stability exercise and aquatic exercise therapy groups was analyzed using paired samples statistical tests. The results from the paired samples test in Table 2 indicate that pain measurement before the Core Stability Exercise intervention (Mean = 7.858; SD = 0.5351) was higher than the pain after the Core Stability Exercise intervention (Mean = 4.583; SD = 0.9003).

Table 2. The influence of core stability exercises on the reduction of lower back pain

Pain	Mean	SD	p
Pre Intervention	7,858	0,5351	0,000
Post Intervention	4,583	0,9003	

From the results of the paired samples test shown in Table 3, the pain measurement before the aquatic exercise therapy intervention (Mean = 7.875; SD = 0.6566) was higher compared to the pain measurement after the intervention (Mean = 3.933; SD = 0.4519).

Table 3. The influence of core stability exercises on the reduction of lower back pain

Respiratory rate	Mean	SD	P
Pre Intervention	7,875	0,6566	0,000
Post Intervention	3,933	0,4519	

Using the mean difference test, it was found that aquatic exercise therapy had a greater effect on reducing pain in cases of myogenic lower back pain, with a value of 3.942, compared to core stability exercises, which had a value of 3.275.

There is an effect of core stability exercises on the reduction of lower back pain

Core stability exercise is a physiotherapy intervention that can be provided to patients with lower back pain complaints. Core stability exercises activate the core and trunk muscles with the goal of enhancing spinal stability, strengthening the core muscles, preventing injuries, and

reducing pain (Akuthota et al., 2008). The model of core stability exercises can improve the ability to control body movement through the legs and pelvis for optimal movement (Januarshah, 2016).

Non-specific lower back pain results in dysfunction of the lower back muscles, leading to muscle spasms and pain. Core stability exercises cause vasodilation, which increases blood circulation. This vasodilation leads to an increased supply of nutrients and oxygen to the myofascial tissues, resulting in reduced muscle spasms and decreased tension in the fascia, thereby alleviating pain (Akuthota et al., 2008).

A randomized controlled trial titled "Core Stability Exercise versus General Exercise for Chronic Low Back Pain," conducted by (Coulombe et al., 2017), involved adult men and women with lower back pain lasting at least 3 months. The subjects were divided into a control group with general exercise and an experimental group with core stability exercises. The results showed that core stability exercises were more effective than general exercises in reducing pain and improving function in patients with lower back pain.

There is an effect of aquatic exercise therapy on the reduction of lower back pain

There are several benefits of Aquatic Exercise Therapy (AET), including natural buoyancy, hydrostatic pressure, thermodynamics, hydrodynamic forces, and water viscosity, which work to reduce pressure on the trunk and surrounding muscles affected by pain and stiffness, as well as improve neuromuscular function. AET also includes water waves that provide benefits for body balance (Lau et al., 2014).

According to (Kisner & Colby, 2012), the specific goals of aquatic exercise therapy are to facilitate functional recovery by providing an environment that enhances the patient's and/or practitioner's ability to perform various therapeutic interventions. The goals are as follows: (1) Facilitate range of motion (ROM) exercises, (2) Conduct resistance exercises, (3) Facilitate weight-bearing activities, (4) Enhance the delivery of manual techniques, (5) Provide three-dimensional access to patients, (6) Facilitate cardiovascular exercise, (7) Initiate replication of functional activities, (8) Minimize the risk of injury or reinjury during rehabilitation, and (9) Improve patient relaxation.

A 2021 study by Aidha Maya and Rina Sri titled "The Effect of Aquatic Exercise Therapy on Reducing Pain in Patients with Low Back Pain at RST Dr. Soerojo Magelang" showed a p-value of 0.000, indicating a significant effect ($p < 0.005$). Conclusion: Aquatic exercise significantly reduces pain in myogenic low back pain.

There is a difference in the effect of core stability exercises and aquatic exercise therapy on the reduction of pain in patients with myogenic lower back pain

Non-specific lower back pain leads to dysfunction in the lower back muscles, causing muscle spasms and pain. Core stability exercises induce vasodilation, which increases blood circulation. Due to vasodilation, there is an enhanced supply of nutrients and oxygen to the myofascial tissues, resulting in reduced muscle spasms and decreased tension in the fascia, thus alleviating pain (Akuthota et al., 2008).

A study conducted by Cavin Surya, Arif Pristanto, et al., titled "Effectiveness of Aquatic Exercise Program on Pain Reduction in Low Back Pain Patients," found that pain occurs due to decreased strength and endurance of the abdominal and gluteus maximus muscles, as well as muscle tension in the iliopsoas and erector spinae. Utilizing water physics, such as buoyancy to reduce joint pressure, viscosity for resistance exercises, hydrostatic pressure to decrease blood pressure to the heart, and water temperatures ranging from 33-37 degrees Celsius, can reduce muscle tone and alleviate muscle guarding.

Aquatic exercise has a greater effect on reducing pain in cases of myogenic lower back pain compared to core stability exercises

Using the mean difference test, it was found that aquatic exercise has a greater effect on reducing pain in cases of myogenic lower back pain, with a value of 3.942, compared to core

stability exercises, which had a value of 3.275. Aquatic Exercise Therapy (AET) offers several benefits, including natural buoyancy, hydrostatic pressure, thermodynamics, hydrodynamic forces, and water viscosity, which help reduce pressure on the trunk and surrounding muscles affected by pain and stiffness, and improve neuromuscular function. AET also includes water waves that provide benefits for body balance (Lau, 2014).

Core stability exercises are a physiotherapy intervention that can be given to patients with lower back pain complaints. Core stability exercises activate the core and trunk muscles to enhance spinal stability, strengthen the core muscles, prevent injuries, and reduce pain (Akuthota et al., 2008). The core stability exercise model can improve the ability to control body movement through the legs and pelvis for optimal movement (PARETTA & SOMALINGGI, 2019)(Saiful, 2023)(DESI, 2023).

CONCLUSION

Core stability exercises and aquatic exercise therapy are effective in reducing myogenic lower back pain, but aquatic exercise therapy demonstrates a greater impact. Aquatic exercise therapy benefits from water's unique properties such as buoyancy, hydrostatic pressure, and viscosity – which help reduce pain by decreasing pressure on muscles and enhancing neuromuscular function. In contrast, core stability exercises focus on strengthening core muscles and improving spinal stability. Research shows that aquatic exercise therapy provides a more significant reduction in pain compared to core stability exercises, making it a superior option for managing lower back pain.

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