

RESEARCH ARTICLE

EFFECTIVENESS OF DBC ACTIVE SPINE® AND HYDROTHERAPY  
INTERVENTIONS ON PAIN AND DISABILITY DUE TO  
NON-SPECIFIC LOW BACK PAIN

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ABSTRACT

**Background:** Low Back Pain (LBP) is one of the most common painful condition that leading to disability and become a major public health problem. Non-specific low back pain accounts for almost 90% of all cases. This study aims to determine the effects of land-based exercise using Documentation Based Care (DBC) Active Spine® and Hydrotherapy interventions on pain and disability due to Non-specific Low Back Pain (NLBP).

**Methods:** A Quasi-experimental study on 24 samples obtained using a purposive sampling technique by considering the inclusion and exclusion criteria. The first and second groups consisted of 12 samples each receiving the hydrotherapy and DBC Active Spine® intervention. Measurement of pain and disability using the VAS and MODI instruments was carried out in the first intervention and the sixth intervention. The paired sample t-test was used to see the effect of each DBC Active Spine® and Hydrotherapy intervention on pain and disability. Independent sample t-test was used to see if there was a

significant difference between the two interventions in reducing pain and disability.

**Results:** The normality and homogeneity tests showed that the data obtained were normally distributed and had a homogeneous variance. DBC Active Spine® showed significant results on VAS and MODI which p-value=0.001 (the mean changes in VAS and MODI were  $2.58 \pm 0.90$  and  $13.33 \pm 11.82$ , respectively). Hydrotherapy intervention showed statistically significant in VAS and MODI with p-values of 0.002 and 0.001 respectively (the mean changes in VAS and MODI were  $2.33 \pm 0.98$  and  $27.83 \pm 9.00$ ). Independent Sample T-Test showed insignificant results. The mean difference in VAS was  $0.25 \pm 0.38$  (p-value 0.752), while the mean difference in MODI was  $14.5 \pm 4.3$  (p-value 0.277).

**Conclusion:** DBC Active Spine® and Hydrotherapy interventions have a significant effect on reducing pain and disability in NLBP patients. There was no statistically significant difference between the two interventions.

**Keywords** Exercise, hydrotherapy, aquatic therapy, low back pain, pain, disability.

INTRODUCTION

According to the 2019 Global Burden Disease data, among all musculoskeletal-related disorders, LBP is the biggest burden and is the condition that contributes the most to the number of rehabilitation services. The increase in the number of LBP sufferers is supported by an increase in population and older age groups, it is estimated that the number of LBP sufferers will increase in the future, especially in low and middle-income countries. With an increase in patient visits, the expenditure on patient care costs will certainly increase as well.<sup>1,2</sup>

Indonesia with very fast industrial growth followed by an increasing number of workers as well. Meanwhile, the prevalence of health problems related to work or ergonomics is still in the high category.<sup>3</sup> In adulthood, LBP is one of the main causes of retiring or quitting from work.<sup>2</sup>

LBP is a spectrum consisting of many types of pain (neuropathic, nociceptive, nociplastic, or non-specific). Anatomically, LBP is defined as a condition of pain or discomfort in the 12th rib down to the lower buttock crease with or without pain radiating to the leg. while the non-specific terminology of LBP is defined as pain in the lumbar area where the specific cause of pain or pain generator cannot be identified. As many as 90% of LBP cases have no known

exact cause, so they can be categorized as NLBP<sup>4</sup>. Subjects with LBP, especially chronic LBP, generally experience a decrease in core muscle strength and endurance, which affects spinal stability and flexibility.<sup>5</sup> Another risk factor is the lack of motor control of the deep trunk muscles such as the lumbar multifidus and transversus abdominis.<sup>6</sup>

Exercise or training is one of the most common and recommended non-pharmacological interventions in LBP cases. Exercise therapy can improve function and reduce pain and is cost-effective. Until now there has been no recommendation of which type of exercise is better than one other, so the exercises are given based on patient preference and clinician experience.<sup>7</sup> Exercise both land-based and water-based can reduce pain and disability, as well as improve muscle function and strength.<sup>8</sup>

Studies on land-based exercises for 6 weeks, both segmental stabilization and strengthening exercises, are generally able to reduce pain and disability in chronic LBP.<sup>6</sup> Water-based exercises or also called hydrotherapy for 8 weeks significantly increased abdominal and spinal muscle activity in LBP patients.<sup>9</sup> Several important benefits can be obtained by training in water compared to on lands such as buoyancy and hydrostatic pressure. These two components can reduce pressure and joint loads on the spinal joints, facilitate balance, mobility, and control pain.<sup>8</sup>

The hypothesis in this study is that there is a difference between hydrotherapy and DBC Active Spine<sup>®</sup> intervention, where hydrotherapy will be more efficient in reducing pain and disability than DBC Active Spine<sup>®</sup> exercises.

## METHODS

Subjects in this study were recruited from outpatient clinic of Fatmawati General Hospital in Jakarta. Patients with NLBP was diagnosed by medical doctors followed by physiotherapy assessment. NLBP term refers to LBP which pathoanatomical cause is still unknown.

Purposive sampling technique was carried out through examination consists of anamnesis, inspection, palpation, quick test, and examination of active and passive basic movement functions. The inclusion criteria were: (1) patient with NLBP; (2) patient with 20 years of age and older with no neurological disorder; (3) not currently undergoing physiotherapy elsewhere; (4) good ability to follow instructions and willingness to complete the research program; (5) not currently taking pain medication. Participants were excluded due to: (1) presence of red flags (tumor, rheumatoid arthritis/ systemic, fracture, bladder and bowel dysfunction, neurological disorders in the form of muscle weakness in the myotome area of the leg, and loss of sensation in the dermatome area of the leg; (2) osteoporosis; (3) pregnant and post-partum women less than 6 months.

Twenty-four NLBP patients met the study criteria and assigned into 2 groups. The first group received land-based exercise with DBC Active Spine Care<sup>®</sup> and the second group received water-based exercise. According to NICE Guideline 2016, exercise is the first line treatment for non-invasive treatments for low back pain and sciatica. Frequency of both treatments is 2 times a week for 3 weeks and duration needs 45-60 minutes for every session. Pain and disability was measured in the baseline and after the sixth session using Visual Analogue Scale (VAS) and Modified Oswestry Disability Index (MODI). All the subjects comply and joint the research until finished. Statistical Package for Social Science (SPSS) version 22 (IBM Corp) was used to analyze the data.

### DBC Active Spine<sup>®</sup>

Documentation Based Care (DBC) Active Spine<sup>®</sup> is a part of DBC International's methods and technology since the 1980s. DBC applies the concept of documented spinal care which includes: documented treatment protocols, validated testing and follow-up protocols, patented and high-tech measurements, computerized patient management, quality assurance systems, and so on. The DBC Active Spine<sup>®</sup> concept consists of several integrated elements, namely:

1. Assessment of patients using examination instruments such as validated questionnaires.
2. Equipment components that support controlled, planned, and precise training in loading.
3. Relaxation program and functional exercise.
4. Cognitive Behavioral Support (CBT).
5. Follow-up procedures through scheduled reports that can be accessed by patients, doctors, and other related health workers.

The DBC Active Spine<sup>®</sup> used in this study is Active Back Care Devices which consist of 4 devices: LTE Lumbar Thoracic Extension, LTF Lumbar Thoracic Flexion, LTR Lumbar Thoracic Rotation, and LTL Lumbar Thoracic Lateral Flexion.

### Hydrotherapy

Hydrotherapy is a water-based exercise, which is a series of structured and planned movements of the limbs performed in water to increase joint range of motion, increase muscle strength and endurance, and reduce pain levels. Water characteristics such as hydrostatic pressure, buoyancy, and viscosity will reduce pressure on joints, and provide resistance, assistance, and support.<sup>9</sup> Ideally, the water temperature in hydrotherapy is in thermoneutral conditions of 35-35.5 °C, so that in 60 minutes of passive immersion there is no change in internal/core body temperature.<sup>10</sup>

In general, exercises performed in water include stretching exercises, aerobic warm-up in water, passive stretching, core aerobic movements, strengthening

exercises, and cooling down.<sup>11</sup> The hydrotherapy intervention in this study was carried out by physiotherapists with hydrotherapy/aquatic therapy certification. While the approach applied is a combination of techniques consisting of:

1. WATSU (Water Shiatsu)  
A technique that applies the principles and movements of Zen-Shiatsu from Japan to warm water. The focus of WATSU is deep relaxation, joint mobilization, mobilization of myofascial structures, and energy flow.<sup>10</sup>
2. Bad Ragaz Ring Method  
Using a modified PNF pattern technique where the patient is in a supine position and floating on the water. This technique aims to increase muscle tone, muscle re-education, muscle strengthening, and elongation. Bad Ragaz is synonymous with isotonic and isometric muscle contraction exercises.<sup>12</sup>
3. Halliwick Method  
The concept of holistic exercise in the water with the principles of hydrostatic, hydrodynamic, and body mechanics. The Halliwick method was developed in 1949 with the main objective of implementing control of breathing and balance, and freedom of movement or freedom of movement.<sup>13</sup>

### Pain and Disability

Examination of pain is done by the Visual Analogical Scale (VAS). The VAS consists of a 10-cm line, the left indicating "no pain" and the right indicating "unbearable pain". The patient will be asked to determine the level of pain that is felt at this time. Functional disability was determined based on the Modified Oswestry Disability Index (MODI) questionnaire, which is a functional scale for assessing the impact of LBP on daily activities. The questionnaire consists of 10 daily activity items, the subject will give a score of 0-5 according to current conditions Baseline examination and outcome measurement using VAS and MODI were done by 2 physiotherapist (AL for DBC and VR for hydrotherapy). VAS and MODI are the gold standard to measure pain and disability in LBP.

### ETHICAL APPROVAL

The research was conducted by following the principles of research ethics and having gone through an ethical review process with protocol number: 3674022P123442022070100001.

## RESULTS

Twenty-four patients (women=15 and men=8) aged between 23 and 67 years who had been diagnosed with NLBP volunteered for the study after signing an informed consent form. The mean age of the sample was 49.21 ± 11.31. Most of the samples (83%) are in the productive age.

**Table 1. The effect of the DBC Active Spine® intervention on the pain scale of NLBP patients at Fatmawati General Hospital**

DBC intervention	Means	SD	P-values
Before	5.25	1.485	0.001
After	2.67	1.303	

Based on table 1, it can be seen that the administration of the DBC Active Spine® intervention can reduce the pain scale (VAS) by an average of 2.58, from 5.25 (before active DBC exercise) down to 2.67 (after exercise). The results of the T-test obtained a p-value = 0.0001, meaning that statistically there was a significant difference between the pain scale before and after the DBC Active Spine® intervention in NLBP patients.

**Table 2. The effect of the DBC Active Spine® intervention on the disability score (MODI) of N LBP patients at Fatmawati Hospital**

DBC intervention	Means	SD	P-values
Before	18.08	4.926	0.002
After	11.42	4.719	

Table 2 shows that administering the DBC Active Spine® intervention can reduce the disability score (MODI) by 6.66, from 18.08 (before practice) down to 11.42 (after practice). The results of the T-test obtained a p-value = 0.002, meaning that statistically there was a significant difference between the disability scores before and after the DBC Active Spine® intervention in NLBP patients.

**Table 3. The effect of hydrotherapy intervention on the pain scale of N LBP patients at Fatmawati Hospital**

Hydrotherapy Intervention	Means	SD	P-values
Before	3.83	0.58	0.0001
After	1.50	0.52	

Based on Table 3, it can be concluded that the provision of interventions Hydrotherapy can reduce the pain scale (VAS) with an average of 2.33, from 3.83 before hydrotherapy and down to 1.50 after hydrotherapy. The results of the T-test obtained a p-value = 0.0001, meaning that statistically there was a significant difference between the pain scale before and after the hydrotherapy intervention in NLBP patients.

**Table 4. The effect of hydrotherapy intervention on the disability score (MODI) of N LBP patients at Fatmawati General Hospital**

Hydrotherapy Intervention	Means	SD	P-values
Before	42.83	11.8	0.0001
After	15.00	5.29	

Table 4 shows that giving interventions Hydrotherapy can reduce the disability score (MODI) with an average of 27.83, from 42.83 (before practice) down to 15.00 (after practice). The results of the T-test obtained p-value = 0.0001, meaning that statistically there was a significant difference between the disability score before and after the hydrotherapy intervention in NLBP patients

**Table 5. Differences in the average reduction in pain and disability scales between DBC Active Spine® and hydrotherapy interventions in N LBP patients at Fatmawati General Hospital**

Variable	Mean difference	SD	P-values
Painful	0.250	0.385	0.752
Disabilities	14.5	4.3	0.277

Table 5 shows that there is no statistically significant difference in both pain and disability variables between the two treatments (p-value > 0.05).

## DISCUSSION

The purpose of this study was to see the effect of the DBC Active Spine® and Hydrotherapy interventions on pain and disability and to see a comparison of the two interventions in reducing pain and disability due to NLBP. Both interventions were effective in reducing pain and disability, but there was no significant difference between the two interventions when viewed from the average reduction in pain and disability scores.

In the LBP population, changes in spinal and pelvic neuromotor control are often found, with general weakness in the abdominal muscles and muscles of the pelvic area. Intervention recommendations in LBP conditions are more directed to the form of exercise. Although there is no definite evidence for the type of exercise that is specific and appropriate for treating LBP conditions. Exercise programs both on land and in water have shown positive results such as reducing pain and disability levels and increasing muscle strength and function.<sup>8</sup> However, for the initial phase of the rehabilitation program, it is recommended to start with water exercises if you find it difficult to conduct exercises on land.<sup>14</sup>

DBC Active Spine® exercise can reduce pain and disability in NLBP patients. Increasing the load and repetition of DBC exercises regularly will improve the strength and flexibility of the spinal and abdominal muscles, as well as increase the patient's confidence to move and carry out daily activities. This is in line with studies that aim to synthesize the benefits of exercise in LBP patients through 110 experimental studies. It was concluded that the neuromuscular mechanism (muscle relaxation, increased motor control, increased muscle strength) is the most common benefit.

Aging is associated with disruption in tissue integrity, reducing response to physiological stressor. In aging skeletal muscle, the proportion and the cross-sectional area (CSA) of type II fibers are significantly reduced (attributed to multiple changes such as the loss of muscles mass and comprised ability to recruit the muscle voluntary). It is possible that there were differences in results between the range of age. Psychological factors are the second factor that has the biggest role in the mechanism of reducing pain and disability. Changes occur in self-efficacy, fear of movement, and changes in catastrophizing tendencies that are often found in LBP. Several studies state that this is related to the mediating effect of interventions, such as increased level of physical activity, and cognitive behavioral therapy.<sup>7</sup>

Types of exercise include general aerobic exercise, and muscle-strengthening exercises targeting specific muscles that increase lumbopelvic stability. Research shows that physiologically, the effect of water immersion can increase cardiac output and cerebral blood flow, potentially reducing heart rate and pain.<sup>8</sup> Other studies have shown that aerobic water exercise can increase muscle blood flow by reducing sympathetic neural outflow, which stimulates trunk muscle activation in a coordinated manner and results in a stiffening mechanism in the spinal structures, where the effect is more significant than land-based exercise on a treadmill.<sup>14</sup> Research conducted by Psycharakis in 2022 showed that squats in water resulted in high muscle activity when recorded with EMG, and single-leg squats also resulted in high muscle activity in the gluteal muscles. In this case, the buoyancy effect has an assistive and resistive role thereby increasing muscle activity and training intensity.

Studies on the effects of the Bad Ragaz Ring method in chronic stroke patients with balance disorders confirm that the Bad Ragaz method significantly increases lower extremity strength and improves balance.<sup>15</sup> This is in line with Aboufazeli's study in 2020, namely involving strengthening the hip abductor muscles will activate both fast and slow twitch muscles in the multifidus, so that it can be assumed to be a driver for increasing the recovery level of muscle thickness/mass with the type of intensive exercise (maximum/submaximal dose, 2x a week with a load of 90/100% from 1 RM and 80% load from 1RM for 3x a week).

The use of underwater aids such as noodle/wall support and leg movements while floating in the water is proven to be effective in activating the abdominal muscles. Exercises that can significantly increase the activation of the abdominal muscles in the water can be done by: (1) floating in a supine position with support for both shoulders and head, then doing knee flexion towards the chest and extension to the initial position, (2) the same with the starting position of the first exercise, flex both knees then do side to side movements with trunk rotation, (3) floating supine position with support on both shoulders and head on the edge of the pool, do side to

side body movements by keeping the hips straight, so that movement occurs on the upper trunk which results in high activity in the oblique abdominal muscles.<sup>8</sup>

Another benefit of hydrotherapy that plays a role in improving the function of LBP patients is increasing self-esteem, self-knowledge, and self-appreciation. The ability to make more free and flexible movements in the water, and learning to dominate and control the body will foster a positive self-image. This satisfaction then develops a positive perception and appreciation of oneself.<sup>16</sup>

The exercise program between the two interventions, both DBC Active Spine® and Hydrotherapy, has similarities consisting of muscle strengthening, flexibility exercises, stabilization exercises, and a psychological approach. The following components made the two interventions able to significantly reduce pain and disability:<sup>7</sup>

- **Neuromuscular**  
Increasing the strength and flexibility of the spinal muscles, increase soft tissue flexibility, and correct posture alignment. Exercise can increase the stabilizing and strengthening effect on spinal muscle structures.
- **Psychosocial**  
Reducing pain and disability by treating the fear of pain / pain-related fear, or kinesiophobia. Reduction in pain, avoidance, anxiety, emotional distress, perceived pain, and disability, as well as self-efficacy.
- **Neurophysiology**  
Releases pain-relieving neuropeptides such as endorphins and serotonin. Affecting dysfunctional descending pain inhibition mechanisms.
- **Cardiometabolic**  
Increasing aerobic capacity which clinically and statistically correlates with reducing pain. Body weight affects the amount of compressive force on the lumbar spine structure.
- **Healing tissues**  
Circulation of blood and nutrients accelerates the healing process and reduces the stiffness that causes LBP. Leukocytes and macrophages in injured tissue contribute to exercise-induced analgesia.

#### **LIMITATION**

Vast range of age in this study probably increased the bias. Future research is expected to use an age range that is not too wide so as to reduce confounding factors.

#### **CONCLUSION**

Based on the results and discussion of this study, it can be concluded that:

1. The DBC Active Spine® intervention was able to reduce pain and disability in NLBP patients at Fatmawati General Hospital.

2. Hydrotherapy intervention can reduce pain and disability in NLBP patients at Fatmawati General Hospital.

3. There was no significant difference between the two interventions in reducing pain and disability in NLBP patients at Fatmawati General Hospital.

#### **CONFLICT OF INTEREST**

The authors declare that they have no competing interest.

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