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INTERVENTION OF INFRARED (IR) AND PASSIVE EXERCISE ON PAIN REDUCTION IN PATIENTS WITH SHOULDER PAIN

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Abstract
Shoulder pain is a musculoskeletal disorder that can cause discomfort, limited upper body movement, and a reduced quality of life. Physical activities or sports that involve repetitive use of the upper extremities, such as badminton, volleyball, or weightlifting, often cause spasms or injuries to the shoulder muscles. Infrared (IR) therapy provides superficial heat that can increase vasodilation, improve blood circulation, and reduce muscle spasms, while passive exercises aim to maintain or increase ROM and muscle strength. However, research on the combined effects of IR and passive exercises on shoulder pain is still limited. This study is an experimental study (quasi-experimental) with a one-group pretest-posttest design involving 10 respondents with shoulder pain. The intervention was carried out for 16 treatments with a frequency of 3-4 times a week. IR was administered at a distance of ± 30 cm from the skin surface in the shoulder area for 10-20 minutes per session. Pain levels were measured using the VAS before and after the intervention. Data were analyzed using the paired sample t-test. The results showed a significant decrease in pain levels from 7.60 ± 1.50 to 1.80 ± 1.13 (p=0.000) with an average decrease of 5.80 and a very large effect size (Cohen's d = 4.4). The combination of IR and passive exercises was proven to be effective in reducing shoulder pain through improved blood circulation, muscle relaxation, and increased ROM. This combination therapy can be recommended as a simple, safe, and effective non-pharmacological physiotherapy intervention for patients with shoulder pain.
Keywords: Infrared, Passive Exercise, Shoulder Pain, Injured

INTRODUCTION

Musculoskeletal health is a fundamental component of overall physical well-being, as it directly affects an individual's ability to perform daily activities, work tasks, and physical exercise. Disorders of the musculoskeletal system not only cause pain and functional limitations but also contribute to decreased productivity and quality of life. In recent years, musculoskeletal disorders have gained increasing attention in public health and sports medicine due to their rising prevalence

and long-term impact on physical function, particularly among physically active individuals and athletes.

The *International Labour Organization* (ILO) reports that musculoskeletal disorders are currently experiencing an increase in prevalence in many countries (Prahastuti *et al.*, 2021). According to RISKESDAS, 7.9% of musculoskeletal disorders in Indonesia are diagnosed by health workers (Rusdani *et al.*, 2025). *Musculoskeletal Disorders* (MSDs) are health disorders in the form of pain, tension, or functional disorders in muscles, bones, ligaments, and other soft tissues caused by physically lifting, pulling, or carrying loads (Dwiseli & Wenas, 2025). Musculoskeletal health is very important because it plays a role in supporting movement, strength, and stability of the body, enabling a person to perform daily activities optimally.

Sports involving upper extremity movements, such as athletics and contact sports (e.g., volleyball, martial arts, or basketball), carry a high risk of musculoskeletal injuries to the shoulder. Repetitive high-intensity movements or direct impacts can cause muscle spasms and shoulder pain, which are commonly experienced by athletes (Palmizal *et al.*, 2025) (Mustaqim *et al.*, 2022). The shoulder is a highly mobile joint that allows for a wide range of movements, but this also makes it more prone to injury and pain. Shoulder pain is one of the most common musculoskeletal disorders (MSDs) and has an impact on the sufferer's range of motion and quality of life (Puspitasari & Ariyanto, 2021). This complaint can arise due to continuous excessive strain or sudden unexpected movements (Lestari *et al.*, 2023). Other contributing factors include trauma from impact or falls, as well as excessive repetitive activities such as lifting heavy loads or intense exercise (Maulana *et al.*, 2024). The muscles, tendons, and joint structures of the shoulder play an important role in maintaining stability and mobility but are very susceptible to injury due to trauma or overuse. Damage to these structures triggers an inflammatory response in the form of pain, swelling, and limited movement, which significantly reduces shoulder function (Nuruddin & Setiawan, 2024).

Various interventions can be performed to treat shoulder pain, both pharmacologically through medication and non-pharmacologically, such as physiotherapy, the use of physical therapy modalities, and exercises to reduce pain and restore shoulder movement function. Non-pharmacological interventions such as physical therapy play a crucial role, as they have been proven effective in reducing pain, preventing stiffness, enhancing muscle strength, and restoring joint range of motion (Irianto *et al.*, 2023). Previous studies also confirmed that structured physical exercises are effective non-pharmacological interventions in improving body function and physiological parameters. Physical exercise is known to improve circulation and metabolism (Sari, Indika, *et al.*, 2025)(Sari, Yusriana, *et al.*, 2025). In fact, the combination of exercise therapy and infrared modalities has also been reported to reduce pain, increase range of motion, and improve

functional ability in cases of shoulder dislocation (Salim & Saputra, 2021).

Infrared (IR) is a physiotherapy modality based on the principle of delivering superficial heat through electromagnetic radiation, which works to increase tissue vasodilation, improve metabolism, and reduce pain and muscle spasms (Puspita *et al.*, 2024). The heat generated also provides a relaxing effect on sensory nerve endings, making it effective in treating shoulder injuries (Abdillah *et al.*, 2021). Due to its therapeutic effects, infrared (IR) is often chosen to prepare tissues before physical therapy exercises, ensuring interventions are more effective.

Injuries to the upper extremities, especially in the shoulder area, are quite common in physical activities, with a prevalence of 33.3% of all athletic injuries One intervention that can be combined after IR is passive exercise, because heated tissue becomes more relaxed so that exercise can be done effectively and comfortably. Passive exercise is performed to maintain or improve the level of perfection in the ability to move joints normally and completely to increase muscle mass and tone (Agusrianto & Rantesigi, 2020). Additionally, passive exercise helps reduce pain, prevent stiffness, and increase joint range of motion, thereby optimizing shoulder function recovery after IR administration (Salim & Saputra, 2021). The combination of IR with passive exercises has been proven to be more effective because IR reduces pain and spasms, while passive exercises help increase ROM (Range of Motion) and muscle strength, resulting in more optimal recovery of movement function (Mintasnim *et al.*, 2024).

Although many studies have proven the effectiveness of IR and passive exercises separately in reducing pain and improving shoulder function, studies on the effectiveness of combining the two in cases of shoulder pain are still limited. Therefore, this study is important to determine the effect of infrared (IR) and passive exercise interventions on pain in patients with shoulder pain.

METHODOLOGY

This study involved 10 participants consisting of men and women aged between 18 and 26 years with a history of shoulder injury. Inclusion criteria included patients with shoulder pain who were still able to perform light activities, were willing to participate in the intervention until completion, and were not undergoing other similar therapies. Exclusion criteria were patients with a history of shoulder surgery, fractures, infections, or other medical conditions that would interfere with the therapy. This study was an experimental study (quasi-experimental) with a one-group pretest-posttest design. In this study, the intervention consisted of a combination of infrared (IR) modality and passive exercises. Measurements were taken twice, at the pretest (before treatment) and posttest (after treatment). The intervention was carried out for 16 treatments with a frequency of 3 to 4 times a week. IR was administered at a distance of ±30 cm from the skin surface on the

shoulder area for 10-20 minutes per session. After IR irradiation, passive exercises were performed on the shoulder joint with flexion, extension, abduction, adduction, and rotation (external rotation and internal rotation) movements slowly according to the patient's pain tolerance.

The data obtained in this study were analyzed using SPSS 20 software. The data were tested for normality to determine whether the data distribution was normal, using the Shapiro Wilk test because the number of participants in this study was less than 50. Then, a hypothesis test was conducted using the paired sample t-test to determine whether there was a significant effect on the level of shoulder pain before and after the intervention. If the p-value was < 0.05, H0 was rejected, indicating that the application of infrared (IR) and passive exercises was effective in reducing pain in patients with shoulder pain.

RESULTS

This study involved 10 participants aged between 18 and 26 years. Descriptive characteristics such as age, weight, and height can be seen in Table 1.

Table 1. Description of Characteristics in Patients with Shoulder Pain

Variables	Mean ± SD	Min	Max
Age	23 ± 3,4	18	26
Weight	53,8 ± 6,9	42	64
Height	160,3 ± 5,9	149	168

Normality Test

The Shapiro-Wilk test is used to examine the normality of data prior to further analysis. As shown in Table 2, the results indicate that the shoulder pain data is normally distributed (P > 0.05).

Table 2. Normality Test with Shapiro-Wilk

Normality Test			
Shapiro-Wilk			
Variables	Statistic	Df	P
Pretest	0,969	10	0,886
Postest	0,933		0,479
Legend: Normality distributed data (P > 0.05)			

Hypothesis Test Results

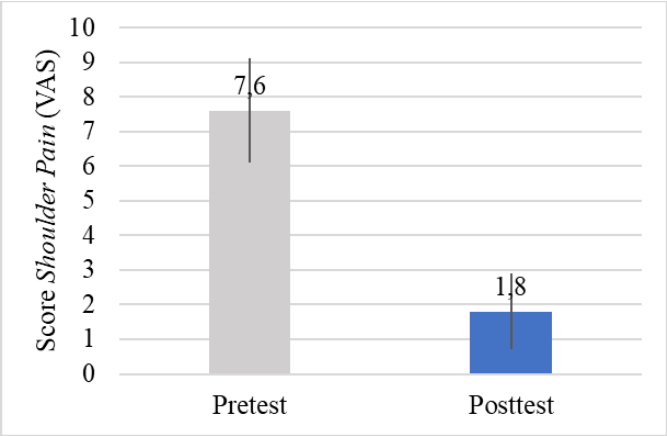
The results of the Paired Sample T-Test analysis show a significant decrease in shoulder pain levels after 16 exercise sessions. The average shoulder pain level before the intervention was 7.60 ± 1.50, while after the intervention, this figure decreased to 1.80 ± 1.13, with an average decrease of 5.80 (p=0.000). The effect size (Cohen's d) was 4.4, indicating that the intervention had a very

large clinical impact. Details of the intervention results are presented in Table 3.

Table 3. Paired Sample T-Test

	Paired Differences							
	Pretest	**Posttest**	**Mean difference**	**Std. Deviation**	**95% CI**		**t**	**Sig.**
					Lower	**Upper**		
Pretest-Posttest	7,60	1,80	5,80	1,03	5,06	6,53	17,75	0,00

As shown in Picture 1, the level of shoulder pain decreased significantly after infrared (IR) intervention and passive exercise.



Picture 1. Statistical Analysis Results

DISCUSSION

The effectiveness of physiotherapy interventions in managing shoulder pain has been widely discussed in clinical and rehabilitation research, particularly interventions that aim to reduce pain while restoring functional movement. Combining physical therapy modalities with therapeutic exercise is considered a comprehensive approach, as it addresses both physiological and neuromuscular aspects of recovery. In this context, the present study evaluates the effect of combining infrared (IR) therapy with passive exercise as an integrated intervention for reducing shoulder pain.

This study shows that intervention in the form of a combination of infrared (IR) and passive exercise reduced shoulder pain levels from 7.60 ± 1.50 to 1.80 ± 1.13. The average reduction was 5.80, as shown in Figure 1, with a p-value of 0.000. This reduction falls into the category of a highly significant effect (Cohen's d = 4.4), which has a major clinical impact.

The heat generated by infrared (IR) can increase superficial tissue vasodilation, thereby

improving metabolism and causing a relaxing effect on sensory nerve endings and reducing muscle spasms (Muhbaedillah *et al.*, 2024). The improvement in tissue oxygenation plays an essential role in recovery, similar to oxygen-assisted aerobic exercise which effectively reduced oxidative stress indicators such (Sari, Maliza, *et al.*, 2025). The application of IR before exercise is very beneficial. IR irradiation is applied to the affected area, and the heat that penetrates will influence increased metabolism. The therapeutic effect of IR light reduces pain due to mild heating of the superficial tissues, causing counter-irritation that leads to pain reduction (Karima & Susanti, 2024).

Passive exercises performed continuously according to procedure can increase muscle strength, thereby expanding joint movement in both flexion and extension. This exercise can maintain or preserve muscle flexibility and strength, maintain joint mobility and prevent deformities, stiffness and contractures, as well as increase muscle mass and muscle tone (Andrianti *et al.*, 2020)(Daulay *et al.*, 2021). Passive exercise induces chemical, neuromuscular, and muscular stimuli that increase muscle contraction activity. These stimuli trigger the release of calcium ions and the formation of energy from ATP, which is used in the muscle contraction process, while neuromuscular stimulation increases the production of acetylcholine, which strengthens contractions (Sholihany *et al.*, 2021). Overall, this exercise improves muscle cell mechanisms and tone, so that when done regularly, it can increase the strength of the limb muscles.

The combination of infrared (IR) and passive exercise works synergistically because IR helps increase vasodilation, improve blood circulation, and reduce muscle spasms, thereby relaxing the tissues and preparing them for exercise. After the tissues receive the warming effect of IR, passive exercise can be performed more optimally to improve muscle contraction, strength, and functional movement patterns. The synergy of these two therapies accelerates tissue recovery and provides more significant pain relief (Safitri & Rakasiwi, 2022). These research results are in line with the findings of Salim & Saputra (2021) who stated that the combination of infrared (IR) modality and physiotherapy exercises is effective in reducing pain and increasing joint range of motion in cases of shoulder dislocation. Another study by Abdillah *et al*. (2021) also showed that heat therapy with IR can provide muscle relaxation and reduce spasms, thereby helping to alleviate pain in the shoulder area. Additionally, Mintasnim *et al*. (2024), reported that the combination of exercise therapy with physical therapy modalities resulted in a significant improvement in Range of Motion (ROM) and muscle strength. Thus, the results of this study reinforce the evidence that the combination of IR and passive exercise provides a more optimal therapeutic effect than when used separately.

The results of this study indicate that the combination of infrared (IR) therapy and passive exercise can be used as a simple, safe, and effective physiotherapy intervention to reduce pain in

patients with shoulder pain. This combination provides muscle relaxation, improves blood circulation, and increases range of motion (ROM), so it can be applied to patients with limited movement due to minor injuries, muscle tension, or non-fracture musculoskeletal pain. This approach also has the potential to increase patient compliance with the physical therapy program because it provides comfort during the therapy process.

This study has several limitations, including a small sample size (10 respondents) and the absence of a control group, so the results cannot be generalized widely. In addition, factors such as age, level of physical activity, duration of pain, and differences in heat tolerance may also influence the results of therapy. The study also did not observe the long-term effects of the combination of IR and passive exercise on shoulder function maintenance.

In conclusion, the findings of this study support the use of combined infrared (IR) therapy and passive exercise as an effective physiotherapy intervention for reducing shoulder pain and improving functional outcomes. Despite the limitations related to sample size and study design, the results provide preliminary evidence that this combination therapy offers meaningful clinical benefits. Future studies with larger samples, control groups, and long-term follow-up are recommended to strengthen the evidence base and further explore the sustainability of therapeutic effects on shoulder function.

CONCLUSION

This study proves that the combination of infrared (IR) and passive exercise is effective in reducing pain levels in patients with shoulder pain, with a significant decrease from 7.60 ± 1.50 to 1.80 ± 1.13 ($p = 0.000$) and a very large effect size (Cohen's $d = 4.4$). Thus, the combination of IR and passive exercise can be used as a simple, safe, and effective physiotherapy intervention alternative for patients with shoulder pain, although further research with a larger sample size and a more robust design is still needed to expand the generalization of the results.

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