

Assessing the effectiveness of a developed therapeutic massage and exercise model for the rehabilitation of back musculoskeletal disorders

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Abstract:

Background: Back musculoskeletal disorders (MSDs) are a significant cause of pain and functional impairment, frequently arising from workplace activities and poor lifestyle habits. Despite the introduction of various rehabilitation programs, many fail to deliver sustained improvements in pain relief and functional recovery. **Aim:** This study aimed to evaluate the effectiveness of a newly developed, integrative therapeutic model combining massage therapy and targeted exercise interventions for the rehabilitation of back musculoskeletal disorders. **Materials & Methods:** A quasi-experimental design was employed, utilizing mixed methods to assess the impact of the intervention. The study involved 24 participants, comprising 5 males and 19 females aged 28 to 62. All participants were diagnosed with back musculoskeletal injuries. They were selected through purposive sampling. The intervention consisted of therapeutic massage sessions and structured exercise regimens aimed at improving flexibility, strength, and range of motion (ROM). Data were collected through field trials, with key outcome measures including pain levels (assessed via self-reported questionnaires), ROM (measured using a goniometer), and muscle strength (evaluated through sit-up and leg press performance tests). Statistical analysis was conducted using paired t-tests and Wilcoxon signed-rank tests to determine significant differences between pre- and post-intervention results. **Results:** The findings revealed statistically significant improvements across all measured variables. Participants reported reduced pain levels, increased ROM, and enhanced muscular strength post-intervention, with a p-value of less than 0.05, indicating the effectiveness of the therapeutic model. These results suggest that the integrative approach combining massage and exercise significantly contributes to alleviating pain and improving functional outcomes in individuals with back MSDs. **Conclusion:** The newly developed therapeutic massage and exercise model proved highly effective in reducing pain, increasing range of motion, and improving muscular strength among individuals suffering from back musculoskeletal disorders. This integrative approach shows promising results for enhancing rehabilitation outcomes and may serve as a viable option for addressing the limitations of traditional rehabilitation methods.

Keywords: Therapeutic massage, exercise, musculoskeletal disorders, rehabilitation, back pain, range of motion, strength improvement

Introduction

Musculoskeletal disorders (MSDs) are injuries that affect the human musculoskeletal system, which includes muscles, bones, tendons, nerves, ligaments, joints, blood vessels, and spinal discs. In fact, these elements are fundamental to human locomotion (Cento et al., 2022; Fikri et al., 2024; Goes et al., 2020; Romero-Morales et al., 2024; Tamene et al., 2020). These disorders can affect both the lower and upper extremities, encompassing conditions related to the neck, spine, lower back, sciatic nerve, lumbar region, chronic hip pain, chronic knee pain, strains, sprains, and ankle injuries (Ndayisenga et al., 2021). Environmental factors and the nature of work have been identified as primary contributors to the incidence of MSDs (Punchihewa & Gyi, 2016). Understanding the widespread nature and impact of MSDs is essential to addressing this significant global health concern.

The prevalence of MSDs is a significant concern worldwide. For example, Maheshwari (2015) found that 91% of physiotherapists in her study reported MSD cases, with 72.5% experiencing low back and neck pain. Similarly, Aldhafian et al. (2021) observed a 77.8% prevalence of musculoskeletal pain among staff members,

with the lower back and neck being the most commonly affected areas (38.9%). A broader cross-sectional study involving 1,179 clinical attendants revealed a high occurrence of MSDs, with 74.7% reporting issues in the previous year and 41.1% in the last week (Luan et al., 2018). If we look specifically at the pain location, the lower back (44.4%) and neck (44.1%) were the primary pain sites, with 37.8% of participants noting that these symptoms limited their work capacity. Region-specific studies, such as Doherty et al. (2014) in South Korea, reported that 33% of the population under 50 years old experienced MSDs, with upper extremity issues affecting 61.3% of the population. In Burundi, Ndayisenga (2021) found that back musculoskeletal disorders were widespread, with 61% of participants reporting upper back pain and significant portions of the population suffering from pain in various regions of the back and hips.

Beyond prevalence, the impact of MSDs on individuals and societies highlights the urgency of addressing this global issue. In many countries, the prevalence of MSDs has hindered population growth and development (Bevan, 2015). These disorders have significant socioeconomic impacts and adversely affect individuals' quality of life, burdening workers, businesses, and society (Rezaghali, 2016). A study conducted by Abaraogu (2016) estimated that approximately two million individuals worldwide, both male and female, have become figurative "slaves" to their workplaces due to these conditions.

Given the high prevalence of MSDs, there has been a growing focus on exploring effective rehabilitation techniques, such as massage therapy and exercise therapy, to reduce pain and improve functional performance. For example, some studies highlight the importance of targeted interventions in rehabilitation efforts (Liza et al., 2023; Yuniana et al., 2022) and the potential of targeted massage techniques in managing specific injuries and enhancing recovery times (Radziejowska et al., 2020; Radziejowski et al., 2023). Other instances demonstrate that chair massage and exercises like dance have been beneficial in reducing these disorders (Brawner et al., 2021; Dakić et al., 2023). Although massage alone may not significantly impact strength, endurance, or fatigue, it is still regarded as effective in increasing the range of motion and reducing pain (Brummitt, 2008; Dakić et al., 2023; Huth et al., 2006; Mattos Biasuz et al., 2015; Moraska, 2005; Trofa et al., 2020). Additionally, specialized kinesiotherapy programs have been developed to address core stabilization and low back pain in female athletes, underlining the importance of personalized rehabilitation approaches (Avramova, 2021). Other research has indicated that massage therapy can enhance respiratory and circulatory parameters in patients recovering from COVID-19, suggesting its broader benefits for recovery (Radziejowski et al., 2023).

When examining MSDs in detail, common pathologies include lumbar disorders, degenerative disc disease, sciatic nerve issues, and chronic spinal diseases, which collectively account for over 5,480 cases daily (Maheshwari, 2015). Globally, MSDs are identified as one of the primary causes of employee complaints (Abaraogu et al., 2016). To mitigate the effects, massage therapy has been shown to positively influence musculoskeletal recovery, especially in cases related to spinal and pelvic injuries, offering a promising complementary treatment to traditional rehabilitation techniques (Daskalaki et al., 2024). Furthermore, the integration of therapeutic exercises with imagery has proven effective in alleviating pain and improving flexibility and quality of life in individuals suffering from chronic low back pain (Daskalaki et al., 2024). Other studies showed that a combination of massage, exercise, and hypnotherapy can significantly improve rehabilitation outcomes for knee injuries, providing a holistic approach to treatment (Ilham et al., 2024). In Asia, previous studies demonstrated that individuals with back musculoskeletal disorders (MSDs) could resume their previous activity levels after receiving massage and therapeutic exercise (Harmanici et al., 2024; Mortazavi et al., 2015). However, the study did not establish a specific timeframe for how long it would take for individuals to fully return to their daily activities following treatment.

To address the negative impacts of MSDs, this research aims to evaluate the efficacy of a newly developed therapeutic approach that combines massage therapy and exercise therapy to restore functionality in individuals with MSDs. This study addresses critical issues such as the high prevalence of workplace-related BMSDs, which contribute to declines in productivity and increased absenteeism across various sectors. The study also aims to examine the delays in returning to work after injury, the short-term effects of therapeutic massage, and the absence of integrated therapeutic programs. Finally, it assesses the high costs associated with conventional therapeutic exercise, which often requires specialized equipment. This integrated approach is expected to provide a more effective and sustainable solution for managing and treating back musculoskeletal disorders.

Materials and Methods

Research Model

The study employed a quasi-experimental design with a mixed-method approach. The design allowed for both qualitative and quantitative data collection to provide a comprehensive understanding of the interventions' impacts.

Participants

This study selected 24 participants as research samples, consisting of 5 males and 19 females aged between 28 and 62 years. All participants were selected through purposive sampling and diagnosed with musculoskeletal back injuries. The characteristics of the participants are described in Table 1.

Table 1. Physical characteristics of participants by gender

Characteristics	Gender	
	Male (n=5)	Female (n=19)
Age (years)	52.4 ± 9.50	46.37 ± 9.38
Weight (kg)	65.60 ± 11.78	75.36 ± 10.64
Height (cm)	171.2 ± 18.075	162.89 ± 28.618
BMI (kg/m ²)	22.40 ± 2.98	28.61 ± 3.27

Research Procedure and Instruments

To meet the research objectives, both a field test and a treatment regimen comprising therapeutic massage and exercise were implemented. Initially, a pre-test was administered to evaluate the patient's baseline status. Subsequently, treatment sessions were conducted three times per week for five weeks. During the pre-test, the following variables were assessed: (1) pain level, (2) range of motion (ROM) measured using a graduated goniometer, and (3) strength assessed through sit-up and leg press exercises. Data collected from this phase allowed us to develop a treatment regimen consisting of massage, stretching, and strengthening exercises. The regimen was validated by subject matter experts and demonstrated intra-rater reliability. The data collection involved multiple instruments, such as a questionnaire to assess the participant's health status, a goniometer to measure a range of motion (ROM), and sit-up and leg press tests to evaluate muscle strength. Detailed descriptions of the program are presented in Table 2, Table 3, Figure 1, and Figure 2.

Table 2. Volume and manipulations used in massage therapy (10 minutes, 3 times per week for 5 weeks)

Manipulation	Instructions	Volume	Intensity	Duration
Swedish Massage				
Effleurage	From ventral layer position: apply effleurage from neck muscles to lower limbs.	10-15 strokes (1 set)	Low-moderate	2 min
Petrissage	Apply petrissage on the hips, scapula muscles, and neck muscles.	20-25 strokes (1 set)	Low-moderate	1 min
Friction	Apply friction to the specific area of muscle pain or injury.	20-25 strokes (1 set)	Moderate	1 min
Tapotement				
Cupping	Apply cupping to promote blood flow, cell repair, and create new blood vessels in the tissue.	20-40 strokes (1 set)	Moderate	20 secs
Hacking	Use hacking to stimulate nerves and blood flow.	20-40 strokes (1 set)	High	20 secs
Beating	Apply beating on adipose muscles (e.g., gluteus, latissimus dorsi, trapezius, deltoid) to break down myogenesis.	20-40 strokes (1 set)	High	20 secs
Deep Tissue				
Petrissage	Apply petrissage deeply to address myoglobin in muscles.	10-20 strokes (1 set)	High	1 min
Friction	Apply friction deeply to care for affected muscles.	10-20 strokes (1 set)	High	1 min
Soft Tissue Release				
Petrissage	Apply petrissage with soft tissue release to stimulate large nerves, increase endorphin levels, and improve ROM in the hips and shoulder joints.	20-30 strokes (1 set)	Moderate	1 min
Friction	Apply friction with soft tissue release.	20-30 strokes (1 set)	Moderate	1 min
Massage	Apply effleurage and vibration techniques.	20-30 strokes (1 set)	Moderate	1 min

Table 3. Programs for relieving musculoskeletal back injuries and improving strength, flexibility, and functional skills

Principle	Type of Exercise/Component	Instructions	Volume	Intensity	Frequency	Duration	Sets	Rest	Benefits
Readiness Principle	1. Knee lift	Perform exercises in a lying position. Perform individually or with a partner. Apply on each side or relevant member.	5 reps/ exercise	Moderate	3 times/week	20-35 minutes	2 sets	10 seconds	Stretching of low back muscles; Improving hip joint flexibility; Stretching of all back muscles; Stretching of the spine (C1-C7, T1-T12, L1-L5)
	2. Hip and low back stretch								
	3. Double hips rotation								
	4. Hips swinging								
	5. Squeeze								
Individual Principles	6. Sit up	Perform exercises 5-8 in a lying position for 10 seconds per side. For exercises 9-10, use side and ventral positions for 10 seconds each.	10 reps	Moderate-High	3 times/week	20-35 minutes	2 sets	15 seconds	Strengthening of hip muscles; Strengthening of the dorsi muscle; Strengthening of the upper scapula muscle
	7. Hamstring stretch								
	8. Bridging								
	9. Leg press								
	10. Side leg raises								
Progressive (Enhancement) Principle	11. Prone straight leg raise	Perform exercises in various positions as instructed.	Various repetitions	Moderate-High	3 times/week	10 minutes	2-3 sets	10-15 seconds	Relieve of lower back pain; Strengthening of shoulder and arm muscles; Decompression of lower back pain; Strengthening of all back muscles, hip, and arm muscles
	12. Sphinx pose								
	13. Cobra pose								
	14. Cat cow								
	15. Quadruped arm and leg raise								
	16. Quadruped reach								

We combined the two programs, massage and physiotherapeutic exercise, to treat musculoskeletal disorders.



Figure 1. Therapeutic exercise for musculoskeletal back injuries

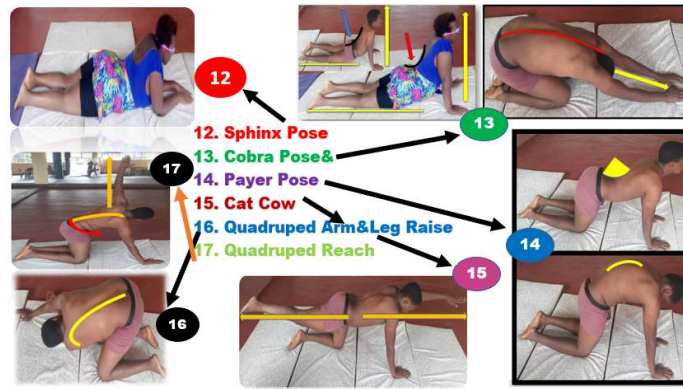


Figure 2. The second set of exercises for strengthening back muscles

Data Analysis

The data analysis was performed to assess the validity, reliability, and effectiveness of the interventions. Content validity was assessed using the validity coefficient V , as described by Aiken (1985). Meanwhile, reliability was assessed using the Intraclass Correlation Coefficient (ICC). To test the effectiveness of the interventions, a t-test was conducted. All data were analyzed using IBM SPSS Statistics v25. The normality of the data distribution was examined using the Shapiro-Wilk test ($p > .05$). For normally distributed data, a paired t-test was employed, while the Wilcoxon signed-rank test was applied for non-normally distributed data. A significance level of $p < .05$ was set for all statistical tests.

Table 4. Classification for data validity and reliability

Validity		Reliability	
Index V	Classification	ICC	Classification
$V < 0.4$	Low	> 0.80	Very high
$0.4 \leq V \leq 0.8$	Enough	$0.61-0.80$	High
$V > 0.8$	High	$0.41-0.60$	Enough
		< 0.41	Low

Findings

Validity and reliability

Nine experts evaluated the instrument's validity and reliability through written reports and discussions. These assessments facilitated the implementation of the massage and exercise program for patients. Table 5 presents the results after the product revision. The validity score was 0.87 (high), and the reliability score was 0.87 (very high). Based on these results, the program was considered suitable for patient use.

Table 5. Product validity and reliability

Experts (N=9)		Validity	$\bar{x}$	Reliability	Information	
					Validity	Reliability
Massage experts (n=3)		0.86	0.86	0.88	High	Very high
		0.85				
		0.86				
Exercise therapy experts (n=3)		0.87	0.86	0.85	High	Very high
		0.87				
		0.87				
Language experts (n=3)		0.91	0.89	0.90	High	Very high
		0.89				
		0.92				
$\bar{x}$			0.87	0.87	High	Very high

The effectiveness

The data analysis focused on comparing pre-test and post-test results for the variables tested: level of pain, range of motion (ROM), and strength. Table 6 outlines the causes of the injuries and the effects of the program on each tested variable.

Table 6. Data of subjects and measurements

Subject	Gender	Age (years)	Weight (kg)	Height (cm)	BMI (kg/m ²)	CPL		TPL		LBPL		Sit Up		LegPress		Causes
						Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	
1	F	54	75	165.5	27.38	10	4	10	4	10	0	35	42	33	58	Workplace, sports inactivity, overweight
2	M	62	75	173	25.05	9	4	9	4	9	6	18	28	38	50	Overweight/obesity, sports inactivity, workplace
3	F	28	55	155	22.89	9	0	9	0	10	0	23	25	33	58	Nervous sciatic, obesity, sports inactivity
4	F	32	55	156.5	22.45	8	0	8	0	10	0	3	10	50	66	Morbid obesity, sports inactivity, sciatic nervous
5	M	49	69	197	17.77	5	0	5	0	10	2	13	33	3	43	Overweight, sciatic nervous, sports inactivity, workplace
6	F	62	90	163	33.87	6	3	6	3	10	3	30	44	23	34	Stroke, social stress/cesarean
7	F	34	78	159.4	30.69	10	3	10	3	10	5	15	25	23	65	Repetitive bladder surgery, oldest, workplace
8	F	53	87	175	28.4	8	3	8	3	10	0	10	35	21	51	Road/Car accident
9	M	62	69	170	23.87	8	0	8	0	9	0	0	25	22	40	Workplace, sports inactivity
10	F	40	76	160	29.68	10	0	10	0	10	0	0	19	44	65	Obesity, sciatic nervous, sports inactivity, workplace
11	F	51	92	173	30.73	10	1	10	1	10	0	0	27	28	41	Obesity, sciatic nervous, coccyx arthritis, sports inactivity, workplace
12	F	46	86	168	30.47	8	3	8	3	8	0	21	43	43	52	Obesity, sciatic nervous, lumbar disease, sports inactivity, workplace
13	F	33	65	161.5	25.39	8	1	8	1	10	7	44	52	64	67	Sciatic nervous, lumbar disease, coccyx arthritis, sports inactivity, workplace
14	F	49	81	154	34.15	7	0	7	0	8	0	30	40	44	62	Obesity, sciatic nervous, lumbar disease, sports inactivity, workplace
15	F	47	72	160	27.69	10	6	10	6	10	5	25	46	20	61	Overweight, sciatic nervous, sports inactivity, workplace, lumbar disease
16	M	40	70	170	24.22	10	0	10	0	10	0	0	13	0	57	Stroke, nutrition
17	F	47	84	178	26.51	10	4	10	4	10	4	21	41	24	52	Sciatic nervous, sports inactivity, workplace, lumbar disease
18	F	40	65	165	25.79	10	0	10	0	10	0	0	13	0	57	Sciatic nervous, sports inactivity, workplace, lumbar disease
19	F	51	75	160	29.68	10	3	10	3	10	0	50	58	29	45	Sciatic nervous, workplace, lumbar disease, diabetes
20	F	53	76	154	32.04	10	0	10	0	10	2	0	10	36	64	Sciatic nervous, workplace, lumbar disease, diabetes
21	F	51	75	160	29.68	10	2	10	2	10	4	35	40	55	62	Sciatic nervous, workplace, lumbar disease
22	M	49	45	146	21.11	10	0	10	0	10	0	0	30	0	40	Workplace
23	F	52	65	165	25.79	10	0	10	0	10	5	10	30	41	50	Sciatic nervous, workplace, lumbar disease
24	F	58	80	162	30.48	10	2	10	2	10	3	8	30	44	50	Sciatic nervous, workplace, lumbar disease

Notes: Nr: Subject, CPL: Cervical Pain Level, TPL: Thoracic Pain Level, LBPL: Low Back Pain Level, G: Gender, W: Weight

Table 6 provides a comprehensive overview of the patients' characteristics and the treatment outcomes. The data include gender, age, spine level injuries, range of motion (ROM) of the hips, height, weight, body mass index (BMI), and the main causes of musculoskeletal injuries. Most of the patients were women, with ages between 28 and 62 years. The majority fell into the older age category.

A numeric pain scale ranging from 0 to 10 was used to assess pain levels, with the following categories: 0 = no pain; 1-3 = mild pain; 4-6 = moderate to severe pain; 7-8 = very severe pain; and 10 = worst pain

possible. Pre-test data revealed that most of the subjects experienced very severe pain in the cervical, thoracic, and lower back areas. The main causes of the injuries were (1) workplace injuries, (2) lack of physical activity, (3) advanced age, (4) road accidents, (5) bladder surgery, (6) obesity, (7) sciatica, (8) stroke, and (9) cesarean section.

Subsequently, post-test data indicated that the treatment significantly decreased pain, with most participants reporting only mild pain after receiving treatment three times per week for five weeks. During the treatment, the participants simultaneously received therapeutic massage and exercise. Preliminary observations revealed a significant difference between pre-test and post-test data, suggesting that the developed intervention positively impacted the relief of spine musculoskeletal injuries and increased the range of motion (ROM) in the hips. Additionally, the body mass index (BMI) showed that some participants were classified as obese, a condition that can contribute to low back pain. Therefore, regular exercise and proper management of nutrition and physical activity are crucial to balancing energy intake and expenditure.

The results of the therapy effectiveness of the intervention are presented in **Figures 3-6**.

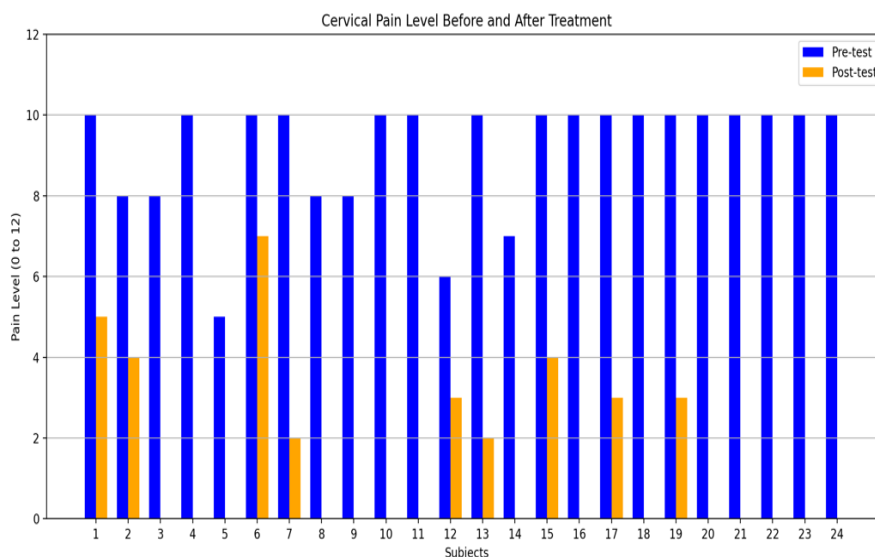


Figure 3. Cervical pain level

Legend: The blue color represents a pre-test cervical pain level, while the yellow color denotes the post-test pain level after treatment. This graphic shows that 22, or 91.66% of the surveyed subjects, experienced chronic pain higher than 7 out of 10 on the pain scale. After the treatment, the result from the graphic shows that the subject's pain significantly decreased.

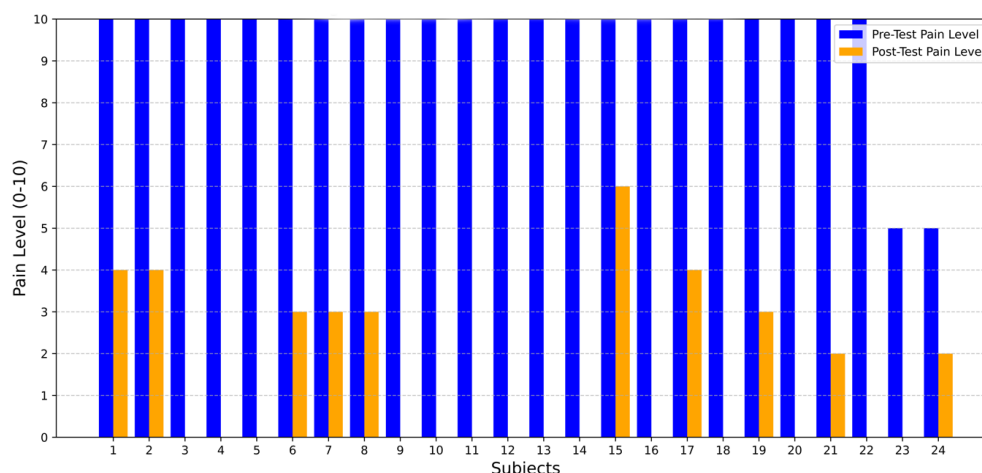


Figure 4. Thoracic level pain pre and post-test

The pre-test results revealed that 22 subjects experienced severe pain, while only 2 subjects reported moderate pain. After treatment, there was a significant reduction in thoracic pain since 45.83% of subjects were completely pain-free, and 54.17% reported only minor pain. These results suggest that the treatment is effective in alleviating thoracic pain.

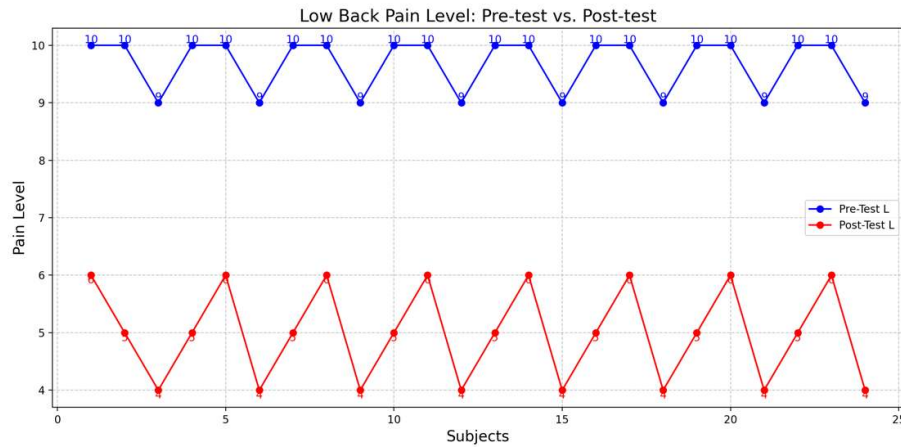


Figure 5. Low back pain level pre and post-test

Figure 5 above shows that 100% of the surveyed subjects experienced severe low back pain before treatment. After treatment, 70.83% (17 out of 24) were completely pain-free, while 28.17% still experienced minor pain. These results suggest that the treatment is effective in reducing low back pain.

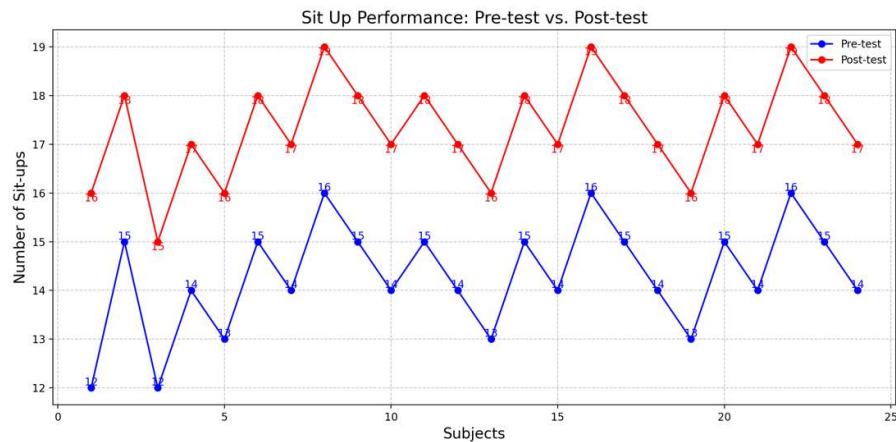


Figure 6. Sit-up data pre and post-test

The result from Figure 6 shows a clear difference between pre-test data and post-test data. The findings indicate that the program effectively increases core strength, as evidenced by the participants' sit-up improvement.

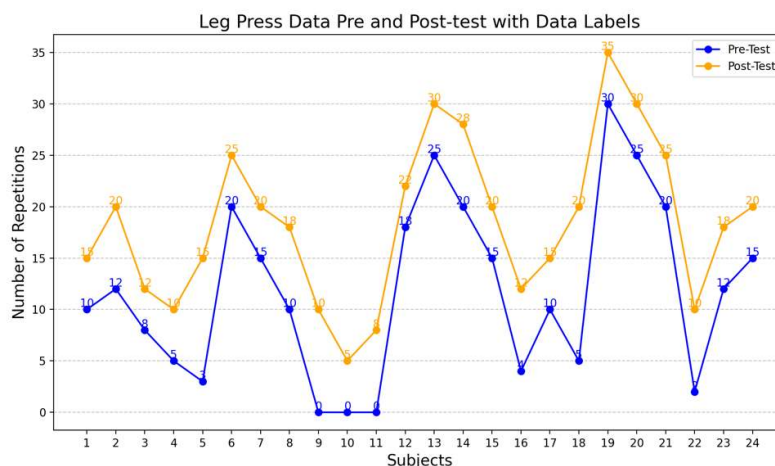


Figure 7. Leg press data pre and post-test

The results from Figure 7 show a significant difference between pre-test data and post-test data. These findings suggest that the program effectively increases the subject's leg press.

Table 7. Pre-test and post-test of hip Range of Motion (ROM) for Large Trial Test

Subjects	Trunk	Flexion		Right Extension		HIPS ROM Left Extension	
		(reps)		(reps)		(reps)	
		Pre- test	Post- test	Pre- test	Pos t-test	Pre- test	Post- test
1	81	112	23	46	30	40	
2	20	38	20	38	20	36	
3	60	111.	7	23	11	36.5	
			5				
4	0	85	11	22	9	20	
5	28	90	29	39	25	39	
6	40	90	12	24	18	23	
7	50	114	18	39	25	33	
8	12	99	15	35	23	40	
9	62	79	12	26	14	26	
10	102.	119.	23	39	14	35	
		5	5				
11	0	50	0	24	12	27	
12	107	110	30	37	22	36	
13	103	106	34	36	32	37	
14	93	100	25	40	35	45	
15	44	47	10	32	10	32	
16	0	52	0	20	0	20	
17	98	118	38	42	39	40	
18	0	47	0	20	0	20	
19	100	107	26	40	31	42	
20	90	100	5	10	0	15	
21	106	120	30	40	26	40	
22	0	90	0	50	0	30	
23	88	120	30	30	32	40	
24	114	116	29	42	35	50	

Table 7 shows the Range of Motion (ROM) of the hips before and after treatment. The ROM was assessed in terms of (1) forward flexion, (2) right extension, and (3) left extension using a goniometer. Pre-treatment assessments revealed that patients had significant pain during these movements, which contributed to their limited flexibility. In addition to pain, muscle pressure also contributed significantly to the restricted ROM. After the treatment, there was a notable improvement in motion capability, and the ROM increased significantly. Most patients initially struggled with bending and lifting objects from the ground due to discomfort from spine injuries. However, after treatment, they made marked improvements, making these movements easier to perform.

As shown in Table 7, the data clearly indicate that pre-test values for each variable differed from the post-test values. The post-test results showed a significant improvement in flexibility, reflecting the effectiveness of the treatment.

Table 8. Wilcoxon test

	Cervical Pain	Thoracic Pain	Hips Pain	Sit Up - Sit Up	Leg Press
	Pre-&Post-test	Pre-&Post-test	Pre-&Post-test	Pre-&Post-test	Pre-&Post-test
Z	-3.627 ^b	-4.300 ^b	-4.326 ^b	-4.200 ^c	-4.287 ^c
Asymp. Sig. (2-tailed)	.000	.000	.000	.000	.000

Table 8 presents the p-values for each variable in the pre-test, all of which were found to be less than 0.05. This indicates a significant impact of the developed program on spine musculoskeletal injuries. The hypotheses for this study were as follows:

H₀: There is no significant difference between the pre-test and post-test for the variables tested.

H_a: There is a significant difference between the pre-test and post-test for the variables tested.

Data were analyzed using the paired-samples t-test to assess differences between pre-test and post-test scores. The results revealed that the p-values for cervical pain (p = 0.000), thoracic pain (p = 0.000), and low back pain (p =

0.000) were all less than 0.05. The p-values for the sit-up and leg press exercises were also less than 0.05.

Since all p-values were below 0.05, the null hypothesis (H_0) was rejected, and the alternative hypothesis (H_a) was accepted, indicating a significant difference between pre-test and post-test data.

In other words, the developed therapeutic massage and exercise program had a substantial positive impact on relieving musculoskeletal spine injuries. In other words, the newly developed therapeutic massage and exercise program had a substantial positive impact on relieving musculoskeletal spine injuries.

The sit-up exercise was used to evaluate spinal muscle capacity and pain levels before and after treatment by assessing the number of sit-ups performed in one minute. Meanwhile, the leg press exercise was employed to evaluate hip muscle strength, as many subjects experienced severe pain. This exercise measured the number of leg presses the patient could perform in one minute. The results of these evaluations are presented in Table 9.

Table 9. Analysis of pre-test and post-test Range of Motion (ROM) using paired samples test

		Paired Differences			95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Forward Flexion –	-37.083	27.531	6.489	-50.774	-23.393	-5.715	17	.000
	Flexion Forward								
Pair 2	Right Extension –	-15.278	6.506	1.534	-18.513	-12.042	-9.963	17	.000
	Right Extension								
Pair 3	Left Extension –	-13.694	6.605	1.557	-16.979	-10.410	-8.797	17	.000
	Left Extension								

The results presented in the table indicate that the p-values for each variable in the pre-test and post-test were less than 0.05, demonstrating a positive effect of the developed intervention on spine musculoskeletal injuries. The hypotheses were as follows:

H_0 : There is no significant difference between pre-test and post-test range of motion (ROM) data.

H_a : There is a significant difference between pre-test and post-test ROM data.

Data were analyzed using paired-sample t-tests to assess differences between pre-test and post-test scores. The results showed that the p-values for forward flexion, right extension, and left extension were all .00. These findings led to the rejection of the null hypothesis (H_0) and acceptance of the alternative hypothesis (H_a), confirming a significant effect of the therapeutic massage and exercise program on restoring range of motion. After treatment, participants reported improved functional ability without barriers.

Discussion

The combined therapeutic massage and exercise program proved more effective than either intervention alone (Ilham et al., 2024). All variables tested showed significant improvements, with p-values less than 0.05, indicating the efficacy of the combined program in treating musculoskeletal injuries. The significant decrease in pain levels and enhanced range of motion suggest that this approach addresses both symptomatic relief and functional recovery, making it an ideal candidate for comprehensive rehabilitation.

After applying the program to patients with various back musculoskeletal injuries, the results demonstrated a rapid and effective recovery. Participants not only reported subjective improvements in pain reduction but also showed objective gains in muscle strength and flexibility, further supporting the program's holistic impact. This finding aligns with research by Allen (2016), highlighting the importance of therapeutic massage in treating common back injuries such as pain, sciatica, and scoliosis. Similarly, Joseph et al. (2018) found that combining massage with lumbopelvic stability exercises was more effective than standard massage therapy alone in managing low back pain. These findings are particularly relevant, as they emphasize the role of core stabilization in reducing strain on the lower back, which may explain the program's success in preventing re-injury. Moreover, studies suggest a combined approach is superior to single interventions for chronic musculoskeletal back injuries. This integrated program not only increased strength and improved motor function but also reduced stress and enhanced overall well-being. The stress reduction may be attributable to the relaxation effects of massage therapy, which could have contributed to improved mental health and emotional resilience during recovery. A systematic review and meta-analysis by Moreira-Silva et al. (2016) found that while some studies on low back injuries and musculoskeletal issues related to the arm, elbow, wrist, hand, and fingers were not statistically significant, physical activities remain crucial for alleviating musculoskeletal pain. This reinforces the importance of physical exercise in rehabilitation programs, particularly for chronic pain conditions, as movement restores normal function and prevents stiffness. The therapeutic massage and exercise program were notably effective in treating low back pain, thoracic pain, cervical pain, shoulder pain, elbow pain, wrist pain, and finger pain.

The proposed exercises significantly strengthened the lower body, which is critical for spinal health, as a strong lower body supports the core and minimizes the risk of further injury by improving balance and posture (Hlaing et al., 2021; Yasul et al., 2023; Zemková & Zapletalová, 2022).

Additionally, the comprehensive application of therapeutic massage improved overall bodily function. This suggests that the program offers broad musculoskeletal benefits, addressing both localized and systemic issues related to muscle tension and joint mobility. The developed program is easy to implement, accurate, and safe for rehabilitating musculoskeletal injuries. Its simplicity and adaptability make it accessible for widespread clinical use, potentially reducing healthcare costs associated with long-term musculoskeletal care.

Conclusion

The effectiveness of the developed therapeutic massage and exercise model for back musculoskeletal disorders rehabilitation revealed a highly significant difference between pre-test and post-test results, with a p -value < 0.05 . This statistical significance highlights the model's robust impact on pain reduction, Range of Motion (ROM), and muscle strength improvements, confirming its potential as a key intervention for musculoskeletal rehabilitation. The program proved to be highly feasible for massage therapists to apply. It was evaluated for accuracy and safety, with patients consistently reporting that it was not only effective but also well-tolerated, with minimal discomfort during both massage and exercise sessions. This model is easy to implement and does not require extensive equipment.

In addition, the developed program has substantially impacted the healing and restoration of back musculoskeletal disorders by enhancing flexibility and strengthening muscles. One of its key advantages is its ability to address both acute and chronic musculoskeletal conditions, offering long-term benefits for a wide range of back injuries. Unlike other therapeutic programs that target only specific body parts, this model takes a holistic approach, addressing the entire body.

This holistic approach ensures that compensatory stress on adjacent muscles and joints is minimized, promoting a more balanced and sustainable recovery. The program does not require complex tools. Instead, it utilizes simple items such as mats, stretching, and strengthening bands, eliminating the need for expensive equipment or complex procedures used in previous therapeutic programs. Its simplicity, cost-effectiveness, and ease of integration into existing therapeutic frameworks make it an ideal option for both clinical settings and home-based rehabilitation, allowing for quick adoption and consistent application.

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Conflict of Interest The authors declare that there are no conflicts of interest. All authors have no financial or personal relationships that could have influenced the outcome of this research.

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