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EFFECT OF MUSCLE ENERGY TECHNIQUE AND MICROWAVE DIATHERMY ON PAIN DUE TO NON-SPECIFIC LOW BACK PAIN

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ABSTRACT

Non-specific low back pain (NSLBP) can cause pain, muscle imbalances, spasms, and postural alterations. It may also restrict lumbar mobility, compromise the stability of lower back and abdominal muscles, and potentially lead to disability. The application of Muscle Energy Technique (MET) combined with Microwave Diathermy (MWD) has been shown to effectively address these issues by reducing pain, improving muscle balance, relieving spasms, and restoring lumbar mobility. This combination therapy enhances the stability of the core muscles, thereby preventing further disability and improving patient outcomes. This study aimed to investigate the effect of MET combined with MWD on reducing pain in patients with NSLBP at Tadjuddin Chalid Hospital, Makassar. A quasi-experimental design with two groups and pre-test/post-test measurements was used. The study population comprised 21 individuals diagnosed with NSLBP. Using purposive sampling based on specific inclusion criteria and the Slovin formula, a total sample of 20 participants was selected. One individual was excluded for not meeting the criteria. Participants were randomly assigned to either the treatment group (n=10), which received MET combined with MWD, or the control group (n=10), which received Infrared (IR) and Transcutaneous Electrical Nerve Stimulation (TENS). Paired sample t-test results showed a statistically significant reduction in pain in both groups (p = 0.000). However, the independent sample t-test indicated a significant difference between groups (p = 0.001), with the treatment group demonstrating a greater mean reduction in pain (3.870) compared to the control group (2.290). In conclusion, the combination of MET and MWD was found to be more effective in reducing pain associated with NSLBP than conventional IR and TENS therapy.

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Kata Kunci:

Muscle Energy Technique;
Microwave
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Non-spesific low back pain

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ABSTRAK

Nyeri punggung bawah non spesifik dapat menimbulkan rasa nyeri, ketidakseimbangan otot, spasme, dan perubahan postur tubuh. Selain itu dapat menyebabkan keterbatasan mobilitas lumbal, mengganggu stabilitas otot punggung bawah dan perut, serta menyebabkan pasien menjadi cacat. Penerapan muscle energy techniques yang dikombinasikan dengan microwave diathermy telah terbukti dapat mengatasi masalah ini secara efektif dengan mengurangi rasa sakit, meningkatkan keseimbangan otot, mengurangi kejang, dan memulihkan mobilitas lumbal. Terapi kombinasi ini meningkatkan stabilitas otot punggung bawah dan perut, mencegah kecacatan lebih lanjut dan meningkatkan hasil pasien. Tujuan penelitian untuk mengetahui pengaruh pemberian teknik energi otot yang dikombinasikan dengan microwave diatermi terhadap penurunan nyeri akibat nyeri punggung bawah non spesifik di RSUD Tadjuddin Chalid Makassar. Metode penelitian ini adalah penelitian kuasi-eksperimental dengan metode desain pre-test dan post-test dua kelompok. Populasi dalam penelitian ini adalah orang yang mengalami nyeri punggung bawah non spesifik sebanyak 21 orang. Sampel dipilih menggunakan teknik purposive sampling berdasarkan kriteria inklusi, dan dihitung dengan rumus Slovin, menghasilkan jumlah sampel sebanyak 20 orang. Satu orang dari populasi tidak memenuhi kriteria inklusi yang ditetapkan, sehingga tidak dimasukkan dalam sampel. Jumlah sampel sebanyak 20 orang yang dibagi secara acak menjadi dua kelompok yaitu kelompok perlakuan yang diberikan kombinasi teknik energi otot microwave diatermi sebanyak 10 orang dan kelompok kontrol dengan Infrared dan Transcutaneous Electrical Nerve Stimulation sebanyak 10 orang. Berdasarkan hasil uji paired sample t test diperoleh nilai mean p = 0,000 pada semua kelompok baik pada kelompok perlakuan maupun kelompok kontrol yang berarti ada pengaruh yang

signifikan pemberian muscle energy technique dikombinasikan dengan microwave diatermi atau Infrared dan Transcutaneous Electrical Nerve Stimulation terhadap penurunan nyeri akibat nyeri pinggang bawah non spesifik. Berdasarkan uji group difference dengan menggunakan independent sample t test diperoleh nilai p = 0,001 (p < 0,05) yang berarti ada perbedaan yang signifikan antara kelompok perlakuan dengan kelompok kontrol dengan rata-rata selisih 3,870 (perlakuan) > rata-rata selisih 2,290 (kontrol). Kombinasi Muscle energy technique dan microwave diatermi terbukti lebih efektif dalam mengurangi rasa sakit dibandingkan dengan kelompok kontrol.

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INTRODUCTION

Low back pain (LBP) is one of the most common and debilitating musculoskeletal conditions worldwide. Approximately 90% of LBP cases are categorized as non-specific low back pain (NSLBP), meaning that no specific underlying pathology can be identified (Kim & Yim, 2020). NSLBP is a common, potentially disabling condition that is usually managed with self-care and over-the-counter medications (Wieland et al., 2022). It can cause pain, muscle spasms, and imbalances, which reduce the stability of the abdominal and lower back muscles. This condition also limits lumbar mobility, alters posture, and may lead to disability in affected individuals (Kurniawan, 2019). In most cases, no identifiable pathology explains the cause of LBP, and therefore, most patients are classified as having non-specific LBP. Despite this, LBP is frequently associated with both physical and psychological symptoms and is known to negatively impact quality of life and daily functioning. The global age-standardized point prevalence of LBP is 7.5% (95% CI: 6.8%–8.3%), with rates ranging from 3.9% in East Asia and 5.6% in Central Latin America to 13.2% in high-income Asia Pacific and 13.5% in Southern Latin America. Worldwide, the condition is more prevalent in women than in men (Zaina et al., 2023).

According to the Indonesian Ministry of Health, 40.5% of disease complaints among adults in 12 districts or cities include lower back pain (16%), cardiovascular diseases (8%), neurological disorders (6%), respiratory illnesses (3%), and ENT disorders (1.5%). Approximately 85% of LBP cases are non-specific, primarily caused by soft tissue abnormalities such as muscle injuries, ligament strain, spasms, or muscular disorders. In Indonesia, LBP is highly prevalent, with 71.3% of individuals in the community reporting lower back pain (Kemenkes RI, 2018). A recent study by Makkiyah (Makkiyah et al., 2023) revealed a 12-month prevalence of LBP at 44.29% among middle-aged adults.

Poor posture is a major contributor to NSLBP. It frequently affects individuals who sit for long periods, bend for extended durations, or lift heavy objects improperly. Sustained postural strain can overstretch ligaments and other soft tissues responsible for maintaining spinal alignment (Aristia & Yani, 2022).

Based on observations in several hospitals where the researchers conducted clinical practice, it was found that many patients reported prolonged sitting, poor posture, or lack of attention to ergonomics during work—all of which contributed to spinal discomfort.

Conventional physiotherapy treatments such as Transcutaneous Electrical Nerve Stimulation (TENS) and infrared therapy are commonly used in managing NSLBP. However, their limited effectiveness in addressing deep muscular imbalances highlights the need for alternative approaches. A promising solution is the combination of Muscle Energy Technique (MET) and Microwave Diathermy (MWD).

MET is a manual therapy involving isometric muscle contractions, starting at 20% and increasing to over 50% intensity. It reduces pain through activation of the Golgi tendon organ, which releases intermyofibrillar fascial adhesions and facilitates lymphatic and venous return. This process improves vascularization and tissue elasticity, ultimately decreasing pain (Tang et al., 2022). On the other hand, MWD offers deep heating effects that penetrate muscle tissue more effectively and promote relaxation (Lee & Cha, 2023).

MWD generates therapeutic deep heat by converting electromagnetic energy into kinetic energy at the molecular level, which increases tissue temperature. This study supports the effectiveness of MWD as a complementary intervention when combined with manual therapy.

The novelty of this research lies in its systematic comparison of MET and MWD against conventional treatments like TENS and infrared. By evaluating their combined effects, this study provides valuable contributions to the field of physiotherapy. The findings are expected to support clinical decision-making and the development of evidence-based protocols for NSLBP management.

This study addresses the limitations of conventional approaches by proposing a novel and synergistic combination of MET and MWD. By filling this research gap, it aims to offer a more effective, comprehensive, and patient-centered strategy for managing NSLBP, ultimately improving patient outcomes and reducing the overall burden of this widespread condition.

METHOD

Type of Research

This study employed a quasi-experimental design with a two-group pre-test and post-test structure. In this design, two groups were evaluated: one group (treatment group) received an intervention consisting of Microwave Diathermy (MWD) combined with Muscle Energy Technique (MET), while the other group (control group) received conventional physiotherapy treatment using Infrared (IR) and Transcutaneous Electrical Nerve Stimulation (TENS).

Place and Time of Research

The research was conducted at the Physiotherapy Polyclinic of Dr. Tadjuddin Chalid Hospital, Makassar, during the period of January to February 2024.

Population and Sample

The study population consisted of 21 patients diagnosed with non-specific low back pain who were receiving physiotherapy services at Dr. Tadjuddin Chalid Hospital. The sample was selected using a purposive sampling technique, based on predetermined inclusion and exclusion criteria. Inclusion criteria included patients with non-specific low back pain, male and female patients aged 30–60 years, willingness to participate as respondents. Exclusion criteria include patients with a history of spinal fractures and patients with a history of HNP or spondylolisthesis. The final sample size was calculated using the Slovin formula with a 5% margin of error, resulting in 20 eligible participants. One individual from the initial population did not meet the inclusion criteria and was excluded from the study .

Data Collection

Data collection was conducted in several structured phases. Initially, eligible participants were screened based on inclusion criteria. Those who qualified and agreed to participate signed informed consent forms.

Prior to the intervention, baseline pain intensity was measured using the Visual Analog Scale (VAS). The VAS tool was introduced to the participants, the procedure was explained, and the pre-test scores were recorded.

Participants in the treatment group received MET combined with MWD twice per week. MET was administered through isometric muscle contractions in two types of movements, each held for 10 seconds and repeated three times. MWD was applied three times per week, with each session lasting 5–15 minutes. During treatment, patients lay in a comfortable position free from clothing and metal, and the physiotherapist explained the procedure beforehand to ensure understanding and comfort. Post-test pain intensity was measured using the same VAS tool and procedure, conducted one day after the final intervention session. All data were documented for further analysis

Data Analysis and Processing

Data analysis included both descriptive and inferential statistics. Descriptive statistics were used to summarize participant characteristics (e.g., age and gender). The Shapiro–Wilk test was used to assess data normality. If the p-value was > 0.05, the data were considered normally distributed. For normally distributed data, parametric tests were applied. These included the paired sample *t*-test to compare pre-

and post-intervention outcomes within groups, and the independent sample *t*-test to compare differences between the treatment and control groups. These statistical tests supported hypothesis testing and validated the research findings.

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Ethical approval

This study protocol was reviewed and approved by the Health Research Ethics Commission of the Makassar Health Polytechnic (Approval Number 1017/M/KEPK-PTKMS/I/2024).

RESULT

This study was conducted at Tadjuddin Chalid Hospital, Makassar, involving patients with non-specific low back pain. Data were collected before and after the intervention over a four-week period. Participants were divided into two groups: a treatment group and a control group. A total of 20 participants were selected using purposive sampling. To provide comprehensive information on the demographic characteristics of the sample, including age and gender, the data are presented in the table below.

Table 1. Frequency Distribution of Respondent Characteristics (n=20)

Respondent Characteristics	Intervention Group		Control Group	
	n	Percentage (%)	n	Percentage (%)
Age				
40-45	1	10	0	0
46-50	2	20	4	40
51-55	2	20	3	30
56-60	5	50	3	30
Sex				
Male	4	40	4	40
Female	6	60	6	60

Table 1 presents the age and gender distribution of participants in both the treatment and control groups, with ages ranging from 40 to 60 years. In the treatment group, the largest proportion of participants were in the 56–60 age range, accounting for 5 individuals (50%), while the smallest proportion was in the 40–45 age range, with only 1 individual (10%). Conversely, in the control group, the highest proportion of participants were aged 40–45 years, totaling 4 individuals (40%), while both the 51–55 and 56–60 age groups consisted of 3 individuals each (30%).

The gender distribution was identical in both groups, with males representing 40% and females 60% of the participants.

Table 2. Distribution of Pre-Test and Post-Test Pain in the Intervention Group and Control Group.

Pain Scale	Intervention Group				Control Group			
	Pre Test		Pre Test		Pre Test		Pre Test	
	n	%	n	%	n	%	n	%
Mild Pain	0	0	8	80	0	0	3	30
Moderate Pain	4	40	2	20	6	60	7	70
Severe Pain	6	60	0	0	4	40	0	0

Table 2 illustrates a reduction in pain levels in both the treatment and control groups. Prior to the intervention, among the 10 participants in the treatment group, 4 individuals (40%) reported moderate pain, while 6 individuals (60%) experienced severe pain. Following the intervention, pain levels decreased significantly, with 8 participants (80%) reporting mild pain and 2 participants (20%) reporting moderate pain. In the control group, prior to the intervention, 6 participants (60%) experienced moderate pain and 4 participants (40%) experienced severe pain. After the intervention, pain levels shifted, with 3 individuals (30%) reporting mild pain and 7 individuals (70%) reporting moderate pain.

Table 3. Average of Pre-Test and Post-Test Pain in the Intervention Group and Control Group.

Group	Pre Test		Post Test		Difference	
	mean	SD	mean	SD	mean	SD
Intervention Group	7,290	0,9207	3,420	0.1798	3,870	0,7498
Control Group	6,540	1,3277	4,250	1,0448	2,290	0,2829

Table 3 presents the mean pre-test and post-test pain scores in both the treatment and control groups. In the treatment group, the average pre-test score was 7.290 ± 0.9207, while the post-test score decreased to 3.420 ± 0.1798, resulting in a mean difference of 3.870 ± 0.7498. In the control group, the average pre-test score was 6.540 ± 1.3277, and the post-test score was 4.250 ± 1.0448, with a resulting mean difference of 2.290 ± 0.2829

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Table 4. Normality Test.

Group	Statistic	p
Intervention Group		
Pre test	0,920	0,356
Post test	0,936	0,514
Control Group		
Pre test	0,929	0,440
Post test	0,944	0,602

The results of the normality test for both the treatment and control groups indicated that the data were normally distributed. The probability (p) values for both the pre-test and post-test scores in each group were greater than 0.05 ($p > 0.05$), indicating no significant deviation from normality. Therefore, parametric statistical tests were deemed appropriate for further analysis.

Table 5. Paired Sample T Test Results.

Variable	Pre Test		Post Test		Difference		P-value
	mean	SD	mean	SD	mean	SD	
Intervention Group	7,290	0,9207	3,420	0.1798	3,870	0,7498	0,000
Control Group	6,540	1,3277	4,250	1,0448	2,290	0,2829	0,000

Table 5 shows the results of the paired sample *t*-test. In the treatment group, the *p*-value was 0.000 ($p < 0.05$), indicating that the intervention using Muscle Energy Technique combined with Microwave Diathermy led to a statistically significant reduction in pain among patients with non-specific low back pain. Similarly, the control group also showed a *p*-value of 0.000 ($p < 0.05$), suggesting that the conventional intervention using Infrared (IR) and Transcutaneous Electrical Nerve Stimulation (TENS) also resulted in a significant reduction in pain. These results demonstrate that both intervention methods—MET combined with MWD and conventional IR-TENS therapy—were effective in reducing pain among the study participants

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Table 6. Independent Sample T Test Analysis Results

Group	N	Mean	SD	P-value
Intervention Group	10	3,870	0,7498	0,001
Control Group	10	2,290	0,2829	

Table 6 presents the results of the independent sample *t*-test, showing a *p*-value of less than 0.05 ($p < 0.05$), which indicates a statistically significant difference between the two groups. The treatment group, which received Muscle Energy Technique combined with Microwave Diathermy, showed a greater mean reduction in pain (3.870) compared to the control group, which received Infrared and TENS therapy (2.290). These findings suggest that the combined MET and MWD intervention was more effective in reducing pain associated with non-specific low back pain than the conventional treatment provided to the control group.

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DISCUSSION

Based on Table 1, the participants in both the treatment and control groups are classified as older adults. This is consistent with Rizal et al. (2021), who reported that at the age of 50–60 years, muscle strength decreases by approximately 25%, and sensorimotor abilities decline by up to 60%. Furthermore, individuals over 60 years of age typically possess only 50% of the physical work capacity of those aged 25. Therefore, older adults who frequently adopt poor posture are at a higher risk of experiencing non-specific low back pain. Similarly, Shokri et al. (2023) noted that the incidence of non-specific low back pain is highest among individuals aged 50–54 years and increases with age, with those over 50 experiencing NSLBP at rates three to four times higher than individuals aged 18–30 years.

In terms of gender, Table 1 shows that both the treatment and control groups had similar distributions, with women more commonly affected by NSLBP than men. This finding aligns with Bizzoca et al. (2023), who explained that the higher prevalence in women may be due to factors such as hormonal fluctuations during menstruation, pregnancy-related biomechanical changes, and anatomical differences. These hormonal variations, particularly in estrogen and progesterone levels, can increase pain sensitivity and alter pain perception. Moreover, biomechanical changes during pregnancy can influence spinal and pelvic alignment, increasing the likelihood of NSLBP.

The Effect of Muscle Energy Technique Combined with Microwave Diathermy on Reducing Pain

Muscle Energy Technique reduces pain by inducing maximal isometric contraction followed by relaxation, which activates the Golgi tendon organ. This process facilitates the release of intermyofibrillar fascial adhesions and enhances lymphatic and venous return, leading to improved vascularization, greater tissue elasticity, and pain relief (Tang et al., 2022).

These findings are consistent with Abdul & Anggi (2018), who found that Microwave Diathermy (MWD) induces physiological responses through temperature elevation. A 1°C increase in local tissue temperature can enhance cellular metabolism by approximately 13%, promote vasomotion of local sphincters, and induce vasodilation, thereby supporting tissue repair. This therapeutic effect also contributes to pain reduction, normalization of muscle tone, improved metabolism, and decreased tissue contracture. Additionally, Pollet et al. (2023) in a systematic review and meta-analysis confirmed that electromagnetic diathermy—including MWD—is effective in reducing pain, improving tissue elasticity, and enhancing functional outcomes in musculoskeletal disorders.

This study also aligns with findings by Ojeniweh et al. (2015), who demonstrated that infrared therapy can significantly reduce pain through increased tissue extensibility, expanded joint range of motion, and accelerated healing of soft tissue injuries. The heating effect promotes cellular activity and circulation while reducing inflammatory metabolites such as bradykinin and histamine. Sari (2017) further supported this, stating that IR combined with TENS can relieve NSLBP through a sedative effect on superficial sensory nerve endings caused by mild heat.

Al malif (Al Matif et al., 2023) reported that MET significantly—but modestly—reduces pain and functional disability in chronic LBP patients, particularly when used as part of high-quality clinical interventions. On the other hand, Mahfud et al. (2023) found no significant difference in pain reduction between a combination of MWD + TENS and High-Intensity Laser + TENS, suggesting that while both approaches are effective, their comparative benefits may vary depending on context.

Difference in Effect between Treatment and Control Group

As shown in Table 6, the independent sample *t*-test revealed a statistically significant difference between the treatment and control groups ($p = 0.001$, $p < 0.05$). The mean reduction in pain was greater in the treatment group (3.870 ± 0.7498) compared to the control group (2.290 ± 0.2829). This indicates that MET combined with MWD was more effective in reducing pain due to non-specific low back pain than the conventional IR and TENS methods.

This study is in line with research by Tang et al. (2022) which demonstrated the effectiveness of MET and MWD in alleviating LBP. Similarly, Tamsil (Tamsil et al., 2024) highlighted the synergistic effect of MWD when used in combination with manual techniques such as Mulligan's Bent Leg Raise, reporting improved tissue extensibility and functional outcomes in patients with myogenic LBP.

Moreover, Islam et al. (2024) found that a combined intervention involving Proprioceptive Neuromuscular Facilitation (PNF), Core Stability Exercises, and MWD significantly improved lumbar function in chronic LBP patients.

Santos et al. (2022) also reported that MET is effective in reducing pain intensity, particularly through isometric contractions that help stretch shortened muscles, strengthen weak muscles, reduce edema, and mobilize joints with limited range of motion.

CONCLUSION AND SUGGESTION

This study concludes that the administration of Muscle Energy Technique (MET) combined with Microwave Diathermy (MWD) has a significant effect in reducing pain associated with non-specific low back pain (NSLBP). Furthermore, this combination therapy was found to be more effective than the conventional intervention using Infrared (IR) and Transcutaneous Electrical Nerve Stimulation (TENS). Clinically, these findings suggest that MET-MWD can be considered a preferred physiotherapy intervention due to its dual therapeutic mechanism—mechanical and thermal. This synergistic approach effectively reduces pain, improves tissue elasticity, and enhances mobility. The intervention is particularly advantageous for older adults, addressing age-related musculoskeletal decline. Moreover, its application in outpatient settings is feasible and low-risk, making it a practical and accessible solution in routine physiotherapy practice.

Future studies are recommended to investigate the long-term effects of MET-MWD on pain reduction, functional improvement, and recurrence of NSLBP. Comparative research involving other physiotherapy techniques would also be beneficial in determining the relative effectiveness of MET-MWD. Expanding the sample size to include larger and more diverse populations is crucial to enhance the generalizability of findings. Additionally, cost-effectiveness analyses could offer valuable insights for healthcare policy and resource allocation. Integrating wearable technologies to monitor muscle activation during MET or heat distribution during MWD may further enhance treatment precision and outcomes. Addressing these aspects will strengthen the clinical applicability of MET-MWD and contribute to the advancement of evidence-based physiotherapy interventions.

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