Effectiveness of the Combination of Effleurage and PNF on Reducing Chronic Knee Pain in the Elderly

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Abstract: Chronic knee pain is a prevalent condition among the elderly, often resulting in decreased mobility and reduced quality of life. Non-pharmacological interventions, including massage therapy and neuromuscular facilitation techniques, have been explored to manage pain and improve physical function. Among these approaches, effleurage massage and proprioceptive neuromuscular facilitation (PNF) have demonstrated potential benefits in pain reduction and muscle relaxation. This study aimed to evaluate the effectiveness of combining effleurage massage and PNF in reducing chronic knee pain. A quasi-experimental one-group pre-test post-test design was employed. The study population comprised 70 elderly individuals with chronic knee pain at Kasihan II Health Center, from which 18 participants were selected based on inclusion and exclusion criteria. The intervention, consisting of a combination of effleurage massage and PNF, was administered six times, with each session lasting 40 minutes. Pain levels were assessed using the Numeric Rating Scale (NRS), and data were analyzed using descriptive statistics, hypothesis testing, and the N-Gain formula to determine effectiveness. The results showed that the combination of effleurage massage and PNF significantly reduced pain levels in elderly individuals with chronic knee pain ($p < 0.05$), with a reduction rate of 48.43%. These findings suggest that this combined therapy is effective in alleviating knee joint pain and may serve as an alternative non-pharmacological treatment for pain management. Furthermore, effleurage massage and PNF can be widely implemented in various rehabilitation settings, including primary healthcare services.

Keywords: *Effleurage*, PNF, Chronic Knee Pain, Elderly.

INTRODUCTION

Joint pain is a musculoskeletal disorder that can affect joints, especially large joints that are responsible or work to support body weight. This condition causes pain, discomfort and pain when moved. Joint discomfort is a common problem that is often found in pre-elderly and elderly people, which often results in limitations in carrying out daily activities (Connelly, 2019). Joint disorders impact functional abilities such as difficulty standing, squatting, rising from a seated position, walking, climbing stairs, and performing other joint-straining activities, particularly involving the knee joints (Swandari et al, 2022).

Joint pain can be caused by various factors including heredity, allergies, infections, and the aging process. According to (WHO, 2023) key risk factors include *overuse,* joint injury, obesity, gender, hormones, and genetics. Other contributing factors include excess weight, smoking, alcohol, joint load and estrogen hormone level (Suwarni & Astriana, 2022) . Studies also shown that the prevalence of joint pain increases with age (Puspita & Praptini, 2018). Aging is a major risk factor, as physiological function decline over time, so that non-communicable diseases often appear in the elderly including joint disease (Widyaningrum & Umam, 2020) .

According to Riskesdas 2018 data, the prevalence of joint pain in Indonesia reached 7.3% with 6.1% in men and 8.5% attacking women (Dewi, 2023) . Joint pain can occur in all joints, especially in the joints that support the body such as the hip, knee, ankle, elbow, back and can even occur in the wrist joints. Among these, the knee joint the highest prevalence (Long et al., 2022) .

Pain and limited *range of motion* in joints can significantly impact an individuals health, quality of life, and productivity while also increase medical costs. Pain management therapy generally consists of pharmacological therapy, such as NSAIDs, which are effective in reducing pain, but may cause side effects if used long-term. As a result, people are increasingly turning to safer and more affordable non-pharmacological therapies, including massage, which has been trusted for generations. The high

prevalence of joint pain cases and the openness of information about alternative non-pharmacological therapies, effective treatment to improve the quality of life of sufferers is needed.

One of the non-pharmacological therapies that can be applied to patients with knee joint pain is a combination of *effleurage* massage and Propioceptive Neuromuscular Facilitation (PNF). Effleurage massage aims to reduce pain intensity and improve patients' quality of life. *Effleurage massage manipulation* carries out one of the massage manipulations that uses the thumb to massage it. Massage therapy is carried out only with the *effleurage technique* or stroking which is slightly given gentle pressure using the thumb. Continuous pressure using the thumb on the area around the knee is intended to smooth the flow of blocked blood and trigger the endorphin hormone to be released, so that it will create a feeling of comfort (Graha, 2023) . With the massage treatment of *effleurage* some time can loosen and relax the muscles so that it will reduce muscle tension and pain so that it can increase flexibility and range of motion (ROM) of the joints, especially the knee joints (Syahputra, 2020) . Giving massage to the knee joint will provide a gradual healing effect which is marked by reduced inflammation, as well as increasing the function of the knee joint for daily activities.

The process of restoring joint strength and function to its original state, in addition to massage, also requires a combination of additional exercise therapy (Yusuf, 2018) . One exercise therapy that can be done easily to restore knee joint strength is Proprioceptive Neuromuscular Facilitation (PNF) therapy. Proprioceptive Neuromuscular Facilitation (PNF) is a technique used to increase muscle flexibility and has been shown to have a positive impact on stretching movements, both active and passive. PNF itself is a stretching pattern to provide stimulation to proprioceptors to activate (Wanodyana, 2018)neuromuscular mechanisms. which is aimed at increasing ROM and restoring strength to injured joints.

The purpose of this study is to evaluate the effectiveness of combining effleurage massage and PNF therapy in reducing chronic knee joint pain in elderly individuals. These therapy will support pharmacological therapy by massage and PNF. These combination therapy may smooth blood flow, reduce inflammation, reduce pain and reduce contractions in the muscles. The massage technique used is by *effleurage* or stroking the knee joint area. Meanwhile, PNF exercise therapy to strengthen the knee joints that are experiencing pain with the aim of reducing pain and joint movement function. The study offers novelty in applying effleurage massage and PNF as a non-pharmacological approach to managing chronic knee pain in the elderly. The effectiveness of this combination therapy will be tested through a two-week intervention. The findings of this study are expected to provide recommendations for chronic knee pain rehabilitation in elderly patients, particularly in primary healthcare settings.

METHODS

This study is a quasi-experimental study, with a One Group Pre-test Post-test Design, which consists of one group without a control group. The sample group will be given active-passive effleurage and PNF massage manipulation treatment on the knee joint. Before treatment, the sample will be measured to obtain pre-test data. Then after getting the pretest results, the sample will be given effleurage and PNF massage manipulation treatment. After treatment, the sample will be measured again to obtain post-test results. Pre-test and post-test data will be used to determine the effectiveness of effleurage and PNF massage manipulation therapy treatment on reducing chronic pain in the knees of the elderly. The study ethically adhered to guidelines stipulated in the Helsinki Declaration and obtained approval from the Health Research Ethics Committee at Universitas Negeri Yogyakarta (Approval Number: T/64.4/UN34.9/PT.01.04/2024), with written authorization granted by the institution. The study's purpose and methodology were informed to all participants. The participation was voluntary, and confidentiality was assured

The population in this study were patients with knee pain in the work area of Kasihan II Health Center totaling 70 patients. Sampling was carried out non-probability, namely by using the Purposive Sampling technique. Technically, it is done by finding patients with knee pain who are then selected based on inclusion and exclusion criteria or with certain considerations. The inclusion criteria include: (1) Chronic knee pain sufferers, (2) Experiencing knee pain for at least the last 1-2 weeks, (3) Female, (4) Experiencing moderate pain 4-6 and or 7-9 (based on NRS), (5) Age 50-70 years , (6) Minimum initial NRS score is 4, (7) Experiencing decreased motor function and range of motion, (8) Sprain, strain

grade 1. While the exclusion criteria include: (1) Presence of fractures and open wounds, (2) Moderate to large swelling, (3) Having a history of chronic disease (heart, diabetes), (4) Sprain, strain grade 2 and 3, (5) *Osteoarthritis*. Based on the inclusion and exclusion criteria, a sample of 18 samples was obtained.

The data in this study were obtained using the Numeric Rating Scale (NRS) pain questionnaire. Data were collected through medical records and direct anamnesis. Data such as age, body mass index (BMI), duration of pain, and knee joint pain scale.

The data analysis technique in this study uses statistical analysis and effectiveness testing using the N-Gain formula. The statistical analysis used includes descriptive analysis and hypothesis testing with the T test.

RESULTS AND DISCUSSION

Description results study:
1) Age

The age range of the subjects in this study was 50 to 70 years, with an average age of 59 years. Age data subject study served in table following:

Table 1 Research Sample Age Data

Age	Frequency	Percentage
50-55 years	7	38.88%
56-60 years	1	5.56%
61-65 years	5	27.78%
66-70 years	5	27.78%
Total	**18**	**100%**

Table 1 it can be seen that the group of subjects with the most knee pain are in the age range of 61-70 years, with the number of samples consisting of 10 people (55.56%) of the total 18 samples. Subjects with knee pain in second place occur in the age group of 50-55 years (38.88%) consisting of 7 people, in third place joint pain is experienced by individuals in the age range of 56-60 years as many as 1 person (5.56%).

2) Body Mass Index (BMI)

The BMI range of the research subjects was 19-35, with an average of 26.57. The BMI category data of the research subjects based on the WHO classification is presented in the following table:

Table 2 BMI Categories of Research Subjects

Category	IMT	Amount	Percentage
Underweight	<18.5	0	0%
Normal	18.5-22.9	2	11%
Excessive Weight (*Overweight*)	23-24.9	4	22%
Obesity I	25-29.9	8	44%
Obesity II	≥30	4	22%
Total		**18**	

Table 2, it can be seen that the majority of research subjects are in the obesity I category with a total of 8 people. The overweight and obesity II categories are in second place with each category total 4 people, then the third place is the normal category with a total of 2 people.

3) Duration of Pain

The data on the duration of pain of the research subjects has a range of pain duration of 1-3 months with an average of experiencing pain for 2.5 months. The data on the duration of knee pain in the research subjects are presented in the following table:

Table 3Duration of Knee Pain

Duration of Pain	Frequency	Percentage
1-2 weeks	0	0%
1 month	3	17%
1-2 months	7	39%
>3 months	8	44%
Total	**18**	**100%**

Table 3, it can be seen that many research subjects experienced knee pain for more than the last 3 months with a percentage of 44%. The knee pain experienced by the subjects was included in the chronic category, due to the pain experienced repeatedly and for months based on the interview results.

4) Pain Scale

Knee joint pain scale data were obtained using *the Numeric Rating Scale* (NRS) pain scale to obtain pre-test and post-test *data*. The data collected were the level of joint pain felt when it was relapsing, the level of pain was measured from 0: no pain, 1-3: mild pain, 4-6: moderate pain, 7-9: severe pain and 10: the most severe pain felt. The following is the knee joint pain scale data on the research subjects:

Table 4Category, Frequency, Percentage of Knee Joint Pain Scale

Pain Scale Categories	Pre-test		Post-test	
	Frequency	Percentage	Frequency	Percentage
Scale 0	-	-	-	-
Scale 1-3	-	-	8	44%
Scale 4-6	2	11%	10	56%
Scale 7-9	16	89%	-	-
Scale 10	-	-	-	-
Total	**18**	**100%**	**18**	**100%**

Table 4, it shows that in the *pre-test data*, the majority of research subjects felt severe pain when experiencing a relapse in the knee joint with a percentage of 89%. This is because the majority of subjects included chronic pain who had a history of less than optimal injury healing and high activity that burdened the knee joint so that the subject often experienced a relapse. While in the *post-test data*, the majority of research subjects felt moderate pain with a percentage of 56%.

Hypothesis Testing:

Hypothesis test of pain scale using non-parametric *Wilcoxon test*. The results of *Wilcoxon test* are presented in the following table:

Table 5*Wilcoxon* Pain Scale Test

Data News	N	Positive Ranks	Negative Ranks	Ties	Z	Asympt. Sig. (2-tailed)
Pretest-Posttest	18	0	18	0	-3.753	0.000

Table 5 *Wilcoxon test* above, it is known that all 18 research subjects experienced a decrease in the pain scale. The standardized normal Z value of the post-test pre-test pain data is -3.753 (based on *positive ranks). Based on the decision making of the Wilcoxon* hypothesis test, it can be concluded that the hypothesis in this study is accepted (value 0.000 <0.05), because the sig. value of the *Wilcoxon test* on the pain scale shows a value of 0.000, it can be stated that there is a significant change between the pre-test pain scale and the post-test pain scale. It can be concluded that the combination of effleurage and proprioceptive Neuromuscular facilitation has been proven to be effective in significantly reducing the level of pain in elderly chronic knee pain sufferers.

Effectiveness Test:

The percentage of effectiveness of treatment after *effleurage* and PNF massage in reducing pain was calculated based on the average value of the pre-test and post-test using the N-Gain formula. Through the calculation of effectiveness, the following values were obtained:

$$\text{Effectiveness} = \frac{Posttest - Pretest}{Pretest} \; x \; 100\%$$

$$\text{Effectiveness} = \frac{3{,}78 - 7{,}33}{7{,}33} \; x \; 100\% = 48{,}43\%$$

Based on N-Gain formula test results, percentage effectiveness decline scale painful after given treatment massage *effleurage* and PNF obtained mark effectiveness 48.43% for decline degrees pain in sufferers painful knee chronic.

Based on the results of the study, subjects who experienced joint pain had an average age of 61-70 years, which in this age range has experienced a decline in muscle and bone function, which is one of the main factors causing joint pain, especially in the knee joint. The aging process is one of the factors causing joint pain due to a decline in physiological function, especially in the elderly. Changes in physiological conditions that occur in the elderly include changes in the muscle and bone system, hearing, vision, cells, cardiovascular system, respiratory system, nervous system, digestive system, urinary system, bladder, vagina, endocrine or hormonal system, and skin conditions (Sugiyo & Caesaria, 2015) .

Most elderly female participant in this study were classified as overweight which increased the load on weight-bearing joints. BMI is related to the elderly due to decreased muscle strength or ability. This will have an impact on functional limitations and has been identified as overweight which has worse performance (Nugrahana, 2022) . A person with a high BMI and lack of physical activity will result in increased joint pain.

Joint pain, especially in the knee joints with obesity category will result in recurring pain and in the long term which is exacerbated by age factors and improper recovery process. As shown in Table 3, most elderly participants had experienced knee pain for three months or more, leading to increased discomfort and decreased daily activity levels.

Given these findings, appropriate treatment is necessary to alleviate chronic knee pain in the elderly while minimizing side effect Non-pharmacological therapies, such as manual therapy (massage) and physical exercise, are effective in reducing pain, restoring the biomechanical balance of joints and tissues, and improving joint function. Effleurage massage and Proprioceptive Neuromuscular Facilitation (PNF) exercises are particularly recommended for managing chronic knee pain in the elderly.

Massage manipulation applied to treat chronic pain ~~can~~ helps relieve muscle tension and improve pituitary gland function, thereby increasing endorphin hormone secretion. This process will affect the reduction of pain because the muscles are more relaxed and comfortable (Andarmoyo, 2013) . In simple terms, the level of pain can be reduced due to the application of massage techniques to the muscles around the knee joint, including muscles that include the *biceps femoris, gastrocnemius, semimembranosus, semitendinosus, sartorius, gracilis, plantaris, popliteus, rectus femoris, and tensor fasciae latae* . Massage manipulation provides a relaxing and comfortable effect on individuals during massage manipulation management, so that pain will be reduced due to increased endorphin hormones that work to reduce pain (Putri, 2023) . Pain in people with joint pain can be reduced by administering massage manipulation due to the *gate control theory.* In the *gate control theory*, pain can be inhibited by defences or protection mechanisms that exist along the central nervous system. Massage manipulation can activate alpha beta fibres on the surface of the skin, which react to light massage so that signals are transmitted faster. This stimulation causes the primary signal from the alpha beta fibres to work to close the gate and pain impulses cannot be transmitted to the cerebral cortex (the outer layer of the cerebrum) to be interpreted as pain (Rismawati et al., 2022) .

Effleurage massage with gentle pressure can create a feeling of comfort and relaxation, thus reducing pain (Anifah et al., 2022) . Soft tissue massage treatment with gentle pressure movements on the skin surface will increase the release of large A beta sensory fibers originating from tactile receptors in the periphery, which will suppress the transmission of pain as a result of local lateral inhibition in the spinal cord (spinal cord), so that pain is not transmitted or will be reduced.

Reducing pain by stretching and resistance movement (PNF) can reduce the degree of pain due to decreased *spasm* and increased blood circulation in the muscles which is influenced by the dilation of blood vessels. According to (Song et al., 2020) PNF movements can reduce pain which is explained through *the gate control theory. Reducing the degree of pain by stretching muscles is related to the gate control* theory. *control,* which states that pain will feel stronger when thought about, but pain will decrease if there is a distraction that can divert attention to pain (Nurcahya, 2020). Shen et al., (2022) stated that during PNF stretching, afferent input from muscle spindles, joints, and tendons inhibits the transmission of pain signals to *the dorsal horn* in *the gray area* of the spinal cord. In performing resistance-relaxation stretching techniques, antagonistic muscles are activated to achieve maximum isometric contraction which will inhibit pain signals.

The gate control theory, states that pain and pressure stimuli activate different receptors simultaneously. Peripheral pain receptors are connected to tactile C fibres while pressure receptors are connected to larger myelinated afferent nerve fibres (group A). Each type of afferent fibre is connected to the same interneuron in the spine, and because pressure afferent fibres are larger and myelinated, the pressure signal reaches the spine before the pain signal when they are stimulated simultaneously. This inhibition of pain signals occurs in the dorsal horn when large fibres send signals (Hindle et al., 2012) .

The study findings indicate a significant reduction in knee joint pain after effleurage massage and PNF therapy. Statistical analysis showed a significant difference between pretest and posttest pain scores ($p = 0.000$, $p < 0.05$), with an effectiveness rate of 48.43%. Additionally, the percentage of participants experiencing severe pain decreased from 89% in the pretest to 56% in the posttest, indicating a shift toward moderate pain levels. These results confirm that the combination of effleurage massage and PNF exercises is an effective non-pharmacological intervention for reducing knee joint pain and improving mobility in elderly individuals.

This study has several limitations. First, the sample size was relatively small and limited to elderly female participants, which may affect the generalizability of the findings. Future studies should include a larger and more diverse sample to enhance external validity. Second, the study only measured short-term effects, without long-term follow-up to assess sustained pain relief and functional improvements. Further research should explore the long-term effectiveness of effleurage massage and PNF therapy. Third, pain assessment was based on subjective self-reports, which may introduce bias. Future studies should incorporate objective measures, such as biochemical markers of inflammation or gait analysis, to provide more comprehensive results.

Future studies should focus on expanding the sample population, including male participants and individuals with varying degrees of knee joint pain, to increase the generalizability of the results. Long-term follow-up studies are needed to determine the sustained effects of massage and PNF therapy on pain relief and mobility. Additionally, comparative studies evaluating the effectiveness of effleurage massage and PNF therapy against other non-pharmacological treatments, such as acupuncture or hydrotherapy, could provide further insights into optimal treatment strategies. Lastly, integrating advanced pain assessment tools, such as electromyography (EMG) and imaging techniques, may enhance the accuracy of pain evaluation and treatment outcomes.

CONCLUSION

Chronic joint pain in the elderly knee can be reduced with non-pharmacological treatment through *effleurage massage manipulation and PNF. The application of effleurage* massage manipulation and PNF has been proven to reduce the degree of pain when carried out in a programmed, consistent, and targeted manner according to the abilities of each individual. Effleurage massage and PNF serve as alternative pain management methods and can be widely implemented in rehabilitation centres, including primary healthcare facilities. These therapies should be administered by trained professionals in medicine, physiotherapy, massage, or sports health. A recommended therapy duration of two weeks is suggested to observe significant improvements. Future research should explore the long-term effects of effleurage massage and PNF on joint function and mobility in the elderly. Additionally, studies comparing the effectiveness of different massage techniques and exercise therapies in reducing chronic knee pain could provide further insights. Investigating the impact of these therapies on various populations, including individuals with comorbid conditions, would also be beneficial.

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