



EFFECT OF QUADRICEPS ISOMETRIC EXERCISE ON REDUCING PAIN IN ELDERLY COMMUNITIES WITH KNEE OSTEOARTHRITIS

EFEKTIFITAS LATIHAN ISOMETRIK QUADRICEPS UNTUK MENURUNKAN NYERI SENDI PADA LANSIA DENGAN OSTEOARTHRITIS

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ABSTRACT

Background: It is necessary to make innovations that make it easier for osteoarthritis sufferers to do exercises independently at home. Patients can apply proper self-management, such as doing pain-reducing quadriceps muscle exercises. **Purpose:** This study aimed to analyze the effect of quadriceps isometrics on pain intensity in the elderly community with knee osteoarthritis. **Method:** This study uses a quasi-experimental design with pre and post-test control group design. The sample was selected using a consecutive sampling technique, which consisted of 30 older people divided into 15 older people for each intervention and control group. The intervention group sample was given a treatment of quadriceps isometric for weeks with a frequency of twice a week, and then the control group was given education. The analysis used is a statistical test paired sample T-test and an independent T-test. **Result:** The paired sample statistics obtained the average pain result in the pre-intervention category with a scale of 6.2, while after the intervention, it was 5.2 with a p-value < 0.05. In the paired sample statistics, the average pain result in the category before education was 7.28, while after education, it was 8.03 with a p-value < 0.05. In the independent T-test for the intervention and control groups, the results obtained were a p-value of 0.039 < 0.05. **Conclusion:** There was a significant difference between the average intervention and control groups of quadriceps isometric exercise in reducing pain intensity in elderly patients.

ABSTRAK

Latar belakang: Perlu adanya inovasi yang memudahkan penderita osteoarthritis untuk melakukan senam mandiri di rumah. Pasien dapat menerapkan *self-management* yang tepat seperti melakukan latihan otot quadriceps untuk mengurangi nyeri. **Tujuan:** Tujuan dari penelitian ini adalah untuk menganalisis pengaruh isometrik quadriceps terhadap intensitas nyeri pada komunitas lansia dengan osteoarthritis lutut. **Metode:** Penelitian ini menggunakan desain eksperimen semu dengan *pre and post test control group design*. Sampel dipilih dengan menggunakan teknik *consecutive sampling* yang terdiri dari 30 lansia yang terbagi menjadi 15 lansia untuk masing-masing kelompok intervensi dan kontrol. Sampel kelompok intervensi diberi perlakuan isometrik quadriceps selama 4 minggu dengan frekuensi 2 kali seminggu, kemudian kelompok kontrol diberikan edukasi. Analisis yang digunakan adalah uji statistik *paired sample T-test* dan *independent T-test*. **Hasil:** Statistik sampel berpasangan diperoleh rata-rata hasil nyeri pada kategori pra-intervensi dengan skala 6,2 sedangkan setelah intervensi 5,2 dengan p-value < 0,05. Pada statistik sampel berpasangan, rata-rata hasil nyeri pada kategori sebelum edukasi adalah 7,28 sedangkan setelah edukasi adalah 8,03 dengan p-value < 0,05. Pada uji independent T-test kelompok intervensi dan kontrol didapatkan hasil p-value sebesar 0,039 < 0,05. **Kesimpulan:** Terdapat perbedaan yang bermakna antara rata-rata kelompok intervensi dan kontrol latihan isometrik quadriceps dalam menurunkan intensitas nyeri pada pasien usia lanjut.

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INTRODUCTION

Osteoarthritis is a musculoskeletal disease that often occurs with heterogeneous conditions that cause joint symptoms and signs (Anzari, 2018; Sengul *et al.*, 2022). The prevalence of osteoarthritis globally is included in the high category, ranging from 2.3% to 11.3%, and ranks 12th among all existing diseases (Sengul *et al.*, 2022). Of the incidence of osteoarthritis in America aged 18 - 24 years, 7% of men and 2% of women describe osteoarthritis of the hand. At of 55 - 64 years, 28% of men and women have osteoarthritis of the knee and 23% of osteoarthritis of the hip (Kangeswari *et al.*, 2021). Between the ages of 65 - 74, 39% of men and women described osteoarthritis of the knee, and 23% described osteoarthritis of the hip. At the age of over 75 years, about 100% of men and women have symptoms of osteoarthritis (Sella *et al.*, 2017).

World Health Organization (WHO) in 2011, sufferers of osteoarthritis in the world reached 151 million and 24 million people in the Southeast Asian region. Meanwhile, the National Centers for Health Statistics estimates that 15.8 million (12%) adults between the ages of 25 - 74 years have complaints of osteoarthritis (American Rheumatism Association, 2016). The main clinical feature of osteoarthritis is pain (Anwer and Alghadir, 2014; Hasan *et al.*, 2022). Pain is a feeling that osteoarthritis patients complain to doctors when they first come to health services (Anzari, 2018).

Long-term use of pain medications of pharmacologic for osteoarthritis can have side effects on the body, such as peptic ulcers, and increase the risk of heart attack and stroke (Pratiwi, 2015). It is necessary to combine pharmacological and non-pharmacological treatment, with isometric quadriceps, making it easier for sufferers to do exercises independently at home as a home exercise. Sufferers can also apply proper self-management, such as doing quadriceps muscle exercises to reduce pain (Anwer and Alghadir, 2014; Khosrojerdi *et al.*, 2018). We need a method that can reduce pain by minimizing the use drug of pain. Therefore, it is necessary to research to examine the effect of isometric quadriceps on pain intensity in the elderly community with knee osteoarthritis in Ngemplak Village.

Based on the results of research on reducing knee joint pain and stiffness in patients with knee osteoarthritis who were given isometric quadriceps exercises and those who were not given quadriceps isometric exercises showed a significant difference (Laasara, 2018). Another study reported the results of their study of significant quadriceps isometric exercises in knee osteoarthritis patients aged 40 - 65 years (Anwer and Alghadir, 2014). Several studies on isometric quadriceps exercises have been performed on knee osteoarthritis patients of various ages, but no studies

that have focused only on elderly patients. Hence, it is necessary to research to examine "The effect of isometric quadriceps exercises on reducing pain intensity in the elderly community with knee osteoarthritis in Ngemplak Village."

MATERIAL AND METHOD

This study uses a quasi-experimental design of quantitative research. Quasi-experimental designs establish causal relationships and the effect of an intervention (Behi and Nolan, 1996). The design used in this study was the pre and post-test control group design. The sampling technique in this study was a consecutive sampling technique in which the researcher used the entire population for the sample (Bjørn *et al.*, 1998; Martínez-Mesa *et al.*, 2016). The sample consisted of 30 people, divided into 15 elderly in the intervention group and 15 elderly in the control group.

Inclusion criteria for respondents included in this study a) Elderly suffering from knee osteoarthritis in Ngemplak Demak Village, b) Patients aged ≥ 60 years and over with a diagnosis of knee osteoarthritis by physician after checked medical record, c) Patients with knee osteoarthritis (symptom criteria) who are willing to become respondents, d) Patients with knee osteoarthritis who being able to communicate with others and have normal cognitive function (MMSE ≥ 26), e) Osteoarthritis patients who are undergoing therapy with analgesic drugs (NSAIDs). As for the exclusion criteria: a) Patients who refuse to be respondents, b) Patients with a history of cardiovascular disease.

In the intervention group, the elderly were given treatment in the form of isometric quadriceps for four weeks with a frequency of twice a week with exercise doses: Intensities: 1 set of exercise, with a delay time of 6 seconds, a total of 12 repetitions, in the control group they were given education for 4 weeks with a frequency of 2 times a week with the same education every session with education about strenuous activities that affect joint pain such as going up and down stairs, lifting heavy weights. The analysis used is a statistical test paired sample *T-test*. Meanwhile, to find out differences in pain intensity in the control and treatment groups using the independent *T-test*, but if the data distribution is not normal, the Wilcoxon test can be used. This research was conducted after the publication of the statement of ethical clearance No. 072/ EC/ FK/ 2021.

RESULT

The sample in this study were patients aged ≥ 60 years with knee osteoarthritis. There are three categories in the sample used: before the intervention, after the intervention (intervention group) and patients who were not given the intervention (control group).

Table 1. Frequency distribution of sex in the intervention and control group

Category	Man	Woman	Total
Intervention	2	13	15
Control	8	7	15

Based on Table 1, shows that the respondents in the intervention group consisted of 2 men (13.3%) and 13 women (86.7%), with a total of 15 respondents. Meanwhile, the control group consisted of 8 men (53.7%) and 7 women (46.7%), with a total of 15 respondents. Based on Table 2, the results show that before the intervention, the frequency of pain, at least

the patients were on the severely controlled pain scale of 1 (6.7%) and the most on the moderate pain scale at 11 (73.3%). Meanwhile, after the intervention, the frequency of the pain scale was the least in mild pain at 5 (33.3%) and the most on the moderate pain scale at 10 (66.7%). It was found that in the control category before observation, the frequency of the pain scale was at least 1 (6.7%) mild pain, and the most in the controlled severe pain scale was 9 (60%). In the category after observation, the least frequency was on a mild pain scale of 2 (13.3%), and the highest pain scale was controlled severe pain of 13 (86.7%).

Table 2. Frequency distribution of scale pain in the intervention and control group

Category	Before				Post			
	Intervention	n(%)	Control	n(%)	Intervention	n(%)	Control	n(%)
No pain	0	0	0	0	0	0	0	0
Mild pain	3	20	1	6.7	5	33,3	0	0
Moderate pain	11	73.3	5	33.3	10	66.7	2	13.3
Controlled Severe pain	1	6,7	9	60	0	0	13	86.7
No controlled severe pain	0	0	0	0	0	0	0	0
Total	15	100	15	100	15	100	15	100

Table 3. Univariate analysis of intervention and control group

Category	Mean	Minimal value	Maximal value	Std deviating	Intervention
Before intervention	6.25	0	0	0	0
Post intervention	5.19	3	1	6.7	5
Before control	2	9	5	33.3	10
Post control	8	1.62	9	60	0

Table 4. Bivariate analysis of intervention and control group

Group	Test of Normality	Mean	Mean Difference	Coefficient correlation	CI 95%		p value
					Lower	Upper	
Group Intervention							
Before intervention	0.461	6.2	1.058	0.022	0.865	1.252	0.012
Post intervention	0.134	5.2					
Group control							
Before observation	0.184	7.28	-0.75	0.015	-0.975	-0.525	0.03
Post observation	0.448	8.03					

Description: Significant at 5 percent significance level (*p-value* < 0.05)

Table 5. Bivariate analysis of intervention group with control group

Groups	Test of homogeneity	Mean	Mean difference	Test of equality	CI 95%		p-value
					Lower	Upper	
Intervention	0.825	5.191	-2.842	0.082	-3.833	-1.85	0.0398
Control		8.03					

Based on Table 3, the results of the average pain scale before the intervention were 6.25 ± 1.62 with a minimum value of 3 and a maximum value of 9. Meanwhile, after the intervention, there was a decrease in the average pain scale of 5.19 ± 1.71 with a minimum of 2 and a maximum of 8. The results show that the average value in the control group before observation was 7.28 ± 1.046 with a minimum value of 4 and a maximum value of 8. Meanwhile, the category after observation was 8.03 ± 1.781 , with a minimum value of 6 and a maximum value of 9.

Based on Table 4, it was found that the normality test results in the categories before and after the intervention were 0.461 and $0.134 > 0.05$, so the value data before and after the intervention were normally distributed. Thus, the *T*-test was fulfilled. In the paired sample statistics, the average pain result in the category before the intervention was 6.2; after the intervention, it was 5.2. The correlation coefficient value in the intervention group was $0.02 < 0.05$, so the pain scale before and after the intervention had a relationship. The results obtained from the Paired Sample t-test were a *p*-value of $0.012 < 0.05$, then H_0 was rejected, and H_a was accepted. So, there is an average difference between pain before and after. The mean paired difference is 1.058, which indicates the difference between the average pain before and after the intervention, and the difference between the differences is between 0.87 and 1.25. The results of the normality test in the categories before and after the observation were found to be 0.180 and $0.448 > 0.05$. The value data before and after the observations were normally distributed. Thus, the t-test was fulfilled. In paired sample statistics, the average pain result in the category before observation was 7.28; after observation, it was 8.03. The correlation coefficient value in the intervention group was $0.015 < 0.05$, so the pain scale before and after the intervention had a relationship. The results from the paired sample *T*-test had a *p*-value of $0.03 < 0.05$, then H_0 was rejected, and H_a was accepted. So, there is an average difference between pain before and after observation. The mean paired difference is -0.75, which indicates the difference between the average pain before and after observation, and the difference (95% CI) is between -0.975 and -0.525.

Based on Table 5, the results of the homogeneity test of the intervention and control groups after observation were $0.825 > 0.05$, so the data is said to be homogeneous. The average in the intervention group was 5.2, while in the control group, it was 8.03. Based on *Levene's test* for equality of variance of $0.082 > 0.05$, the data variance between the intervention and control groups is homogeneous or the same. Thus, to determine differences in pain intensity between the intervention and control groups, the independent *T*-test can be continued with the independent t-test. It is known that the *p*-value is $0.039 < 0.05$, so it can be concluded that H_0 is rejected. H_a is accepted, so there is a significant (absolute) difference between the average intervention.

DISCUSSION

The sample in this study were patients aged ≥ 60 years with knee osteoarthritis. In this study, two groups were the intervention and control groups. The intervention group consisted of 2 men (13.3%) and 13 women (86.7%), comprising 15 respondents. Meanwhile, the control group comprised eight men (53.7%) and seven women (46.7%), comprising 15 respondents. It was found that there was a decrease in pain intensity in the intervention group of elderly patients with knee osteoarthritis. Patients with osteoarthritis of the knee experience functional limitations such as changing positions from sitting, standing and lying down, walking, climbing stairs, praying, and in more severe cases, they can cause disability, requiring assistive devices to walk (Guo *et al.*, 2022; Sengul *et al.*, 2022). The main clinical feature of knee osteoarthritis is pain in the movement of the knee. One of the treatments for knee osteoarthritis is quadriceps isometric exercise (Achens *et al.*, 2022). Isometric quadriceps exercise helps relax muscles more quickly and efficiently, increases joint flexibility to minimize friction due to increased joint stiffness, and stimulates the release of endorphins, which can reduce pain sensations (Price and Wilson, 2013).

Of the 15 respondents in the intervention group doing the quadriceps isometric exercise who experienced moderate pain disorders were 11 elderly, three elderly experienced mild pain, and one older adult experienced controlled severe pain. After doing the isometric quadriceps exercise, patients with controlled severe pain experienced a decrease in pain level and pain frequency in 10 elderly who experienced moderate pain disorders, and five people experienced mild pain disorders. This can lead to risk factors that can result in depressive symptoms and reduced life expectancy (Mahmoud *et al.*, 2017).

Changes in pain intensity in the intervention group with moderate pain disorder were 11 respondents, three respondents had mild pain and one person had controlled severe pain. There was a decrease in the number of respondents at the level of pain intensity to ten respondents experiencing moderate pain disorder and five people experiencing mild pain disorder. Contraction in strong quadriceps isometric exercises will facilitate the pumping action mechanism so that metabolic processes can take place properly in local circulation as a result of vasodilation and relaxation after maximal contraction of the muscle (Anwer and Alghadir, 2014; Limsakul *et al.*, 2023). Thus, the transport of metabolic wastes through the inflammatory process can run smoothly so that pain intensity and irritation to the nerves that cause pain can be reduced (Pemar, 2014).

Changes in intensity frequency that occurred in the control group before observation were severe pain controlled by as many respondents, moderate pain by five respondents and mild pain by one respondent. The increase occurred after observation to control severe pain by 13 respondents and moderate pain by two

respondents. There were significant differences in the *Numeric Rating Scale* (NRS) scores of the intervention group and the control group which showed a decrease in pain in the intervention group with a one-month treatment time (Anwer and Alghadir, 2014; Hasan et al., 2022; Sengul et al., 2022). This is caused by changes in the length of the quadriceps femoris muscle in the knee joint, which helps stabilize the joint, decreases neuromuscular impulses, and slows axoplasmic transport, thereby reducing the muscle load on the knee joint during activities (Smithard et al., 2022). Routine therapy in patients with osteoarthritis can trigger strength in muscle movement and improve blood flow, balance, and stability of the knee joint and joint muscle coordination (Huang et al., 2018).

Based on the results obtained, a significant difference was seen in the decrease in pain intensity in knee osteoarthritis patients in the intervention group after quadriceps isometric exercise. Before doing the quadriceps isometric exercise, the average pain intensity in patients was 6.2. After doing the exercise, the average pain intensity experienced by patients was 5.2. Isometric quadriceps exercises can trigger the movement of the quadriceps muscles and strengthen the strength of the muscles around the knee (Khosrojerdi et al., 2018; Wirayuni and Arista, 2021). This stimulates the release of endorphins, which can reduce the sensation of pain, and stimulates large-diameter type I and II afferent fibers (proprioceptors) so that the activity of these afferent fibers can reduce muscle spasms as well as improve the peripheral circulatory system to reduce pain (Anwer and Alghadir, 2014; Limsakul et al., 2023; Smithard et al., 2022). This type of exercise, especially isometric quadriceps, is recommended for the elderly with osteoarthritis to strengthen muscles and joint mobility, relieve pain, and prevent further deformities (Anzari, 2018; Kangeswari et al., 2021; Syahputra and Nurwijayanti, 2021). The results of this study are supported by previous studies (Anggraeni, 2020).

Research conducted by Anwer explains that quadriceps isometric exercises strengthen function and reduce pain in patients with knee osteoarthritis. The results of this study were that patients felt there was a strengthening of the quadriceps muscles and a decrease in pain compared to before doing the exercise. Muscle strength can maintain joints for better movement, reduce pain when shocks occur in joints, and reduce pain when collisions occur in joints because the joint fulcrum does not depend on just one point but is spread so that the joint load can be reduced efficiently (Anwer and Alghadir, 2014).

Based on the results obtained, there was a significant difference between the average reduction in pain intensity in knee osteoarthritis patients in the intervention and control groups. In the intervention group, the average decrease in pain intensity was 1.058, with a *p-value* of 0.012. In the control group there was

an increase in pain intensity of 0.75 with a *p-value* of 0.03. The control group also showed significant results, possibly due to education during the study in reducing knee load activities that were not carried out before the study. This shows that treatment with Isometric quadriceps exercise intervention has more potential to reduce pain intensity than just giving education.

Quadriceps isometric exercise is a home-based stretching exercise that can be done at home by the elderly who experience knee pain and joint stiffness. The mechanism of quadriceps isometric exercise on the muscles will reduce joint pain and increase joint range of motion. The quadriceps isometric exercise stimulates the *Mechano Growth Factor* (MGF). MGF is one of the insulin in muscles that has similarities with growth factor (IGF-1). MGF gets into muscle fibers, repairs muscle tissue, and prevents muscle cell death. MGF stimulation increases plastic substances, which act as precursors to stimulate *Glycosaminoglycans* (GAGs), which will help reduce abnormal adhesive formation in knee joint stiffness (Anas, 2019). According to Onwunzo's research, quadriceps isometric exercise is effective in reducing pain and increasing range of motion, leading to good function in patients diagnosed with knee osteoarthritis. Therefore, quadriceps isometric exercises can be used to manage patients with knee osteoarthritis (Onwunzo et al., 2021).

CONCLUSION

In this study, it was concluded that there was a significant difference between pain intensity in the intervention group before and after being given quadriceps isometric exercise, there was a significant difference between pain intensity in the intervention group and the control group, and there was an effect of quadriceps isometric exercise on reducing pain intensity. The limitation of this study is the limited cost, so X-photo investigations were not carried out to diagnose knee osteoarthritis in respondents. Thus, the grade of osteoarthritis was not known. Based on the results of the research that has been done, the suggestion that the researcher can convey is that the next researcher should use a larger sample. Moreover, be more specific in screening respondents, for example, by performing an X photo genu examination to determine the severity of osteoarthritis and control and monitor the use of drugs to control bias.

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