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Original Research

Kinesiotape Versus Home-Based Exercise for Reducing Pain and Disability in Elderly Osteoarthritis

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ABSTRACT

Background: *Osteoarthritis (OA) in the knee causes various health problems, including pain and limited movement that reduces productivity and quality of life, causing disability. This study aims to determine the comparative effectiveness between home-based exercise and kinesiotape in lowering pain and disability in the elderly with knee osteoarthritis.*

Methods: *It was an experimental study with a randomized pre-test and post-test control group design. There were 30 participants divided into 2 groups: Group 1 with Kinesiotape and Group 2 with Home-Based Exercise. The intervention was given 3 times per week for 4 weeks. Disability was measured by the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and pain was measured by the Visual Analogue Scale (VAS).*

Results: *The p-value for WOMAC and VAS scores before and after intervention is <0.001 in kinesiotape and Home-Based exercise interventions, which states that there is a significant improvement in lowering disability. Comparative analysis between groups also showed p< 0.001.*

Conclusion: *Kinesiotape and home-based exercises are both effective in reducing knee pain and disability in elderly with knee OA. However, home-based exercises have proven to be more effective than kinesiotape. Home-based exercises are recommended as the primary intervention to decrease pain and disability in elderly individuals with genetic knee OA.*

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INTRODUCTION

Osteoarthritis (OA) is a degenerative disease caused by inflammation of cartilage, bones, and synovium, making it the leading cause of disability in the elderly over 65 years old by 30% (Gao et al., 2023). Knee OA is one of the most common and debilitating forms of OA. It is often seen in the elderly, making it a significant health problem for this demographic. The knee joint is a major weight-bearing joint, and over time, it can be subject to wear and tear, especially in older adults. As the cartilage in the knee deteriorates, it leads to inflammation, pain, and limited movement (Gelber, 2024). The factors that cause knee OA are gender, age, and occupation, which are related to the balance between bone degradation and hormones (Muhyi et al., 2023).

According to Data from the World Health Organization (WHO) in 2017, OA sufferers in the world approximately reached 9.6% in men and 18% in women (Brennan-Olsen et al., 2017). Basic Health Research (Riskesdas) in 2018 stated that the incidence of joint complaints in Indonesia was 7.3%, of which the majority of 8.5%, were reported by women. These complaints increase with increasing age, with a prevalence of 18.6% in people over 65 years old and 18.9% in people over 75 years old (Budiman & Widjaja, 2020).

Knee OA in Indonesia affects 5% of individuals under 40 years old, 30% of those between 40 and 60 years old, and 65% of people over 61. Radiologically, the prevalence of knee OA is also notably high, with 15.5% of men and 12.7% of women showing signs of the condition. Global Burden of Disease (GBD) explained that from 1991-2019, there was a 114.5% increase in disability due to knee OA (Long et al., 2022). OA leads to a range of issues, including reduced physical function, changes in psychological well-being, restrictions in social interactions, challenges in fulfilling spiritual needs, and a decline in work productivity.

This has an impact on the psychological, economic, and social status of OA complaints is very large, for the sufferer, his family, and the environment (Masyhurrosyidi et al., 2024). Pain is a physiological problem in the elderly with OA. The impact of pain on OA is fatigue, decreased range of motion, and pain when moving. There is also severe morning stiffness when waking up. This causes a decrease in mobility, especially during extension, and limited physical mobility. It will result in disability and threaten the quality of life of the elderly (Masyhurrosyidi et al., 2024).

Physiotherapy treatment that can be provided for pain and disability conditions due to knee osteoarthritis in the elderly can be in the form of physiotherapy modality therapy and exercise therapy, as well as the addition of kinesiotapes. Exercise therapy that can be done independently or home-based exercise and kinesiotape in standard physiotherapy interventions can have a positive effect in reducing pain and disability (Widnyana et al., 2024). Unfortunately, we found that home-based exercise for reducing the complaint needs further research, and less research has been conducted to prove its effect compared to kinesiotape.

Kinesiotape also has pro and cons impacts and still needs further research to prove its impact on osteoarthritis complaints. Those interventions need to be implemented to improve the quality of life of the elderly. However, this type of home-based exercise is rarely applied. Researchers are interested in conducting further studies on this matter. This study aims to determine the comparative effectiveness between home-based exercise and kinesiotape in lowering pain and disability in the elderly with knee osteoarthritis.

MATERIALS AND METHODS

This study is an experimental design featuring a randomized pre-test and post-test control group. Its goal is to compare the effects of kinesiotaping and home-based exercise on reducing disability caused by OA. The research took place in private physiotherapy clinics in Denpasar and Badung, Bali, from July to September 2024. Participants were randomly assigned using the permutation block method.

Sampling was conducted according to the inclusion and exclusion criteria. Inclusion criteria include individuals 60 years old and above; having knee pain almost every day in the past month due to knee OA according to a doctor's referral; average pain score of 3 and 7 on NRS 10 points; have good cognitive function MMSE Score 24-30; and able to walk independently on flat surfaces without assistive devices. The exclusion criteria for

this study include individuals with a history of joint replacement or knee arthroscopic surgery, those who have had other surgeries on the lower extremities within the past six months, and individuals with severe deformities of the lower extremities (such as varus or valgus knee).

Additionally, participants with health conditions that could lead to side effects during home exercise, including uncontrolled high blood pressure, myocardial infarction, cerebral infarction, unstable angina, arrhythmias, severe vision issues, or neurological dysfunction, are also excluded. The withdrawal criteria consist of: (1) the patient failing to return during the study, (2) a deterioration in the patient's condition after receiving therapy, and (3) voluntary resignation from the study. Sampling was conducted through a physiotherapy assessment, along with a doctor's referral indicating that the patient experienced pain and disability due to knee osteoarthritis.

The sample size is used by the G*Power application. The effect size was determined through research (Yilmaz et al., 2019). The α value of error probability is set at 0.05, and power (1- β error probability) is set at 0.80. Based on the calculation results, the number of subjects was 13. To avoid dropping out, subjects were added by 20% to 14.3 or 15 research participants in each group. The total number of research participants in both groups is 30.

Kinesiotape and home-based exercise were the independent variables, while the dependent variables were pain and disability associated with OA. The research procedure to achieve the research objectives is as follows: the researcher conducts a licensing process at the institution where the research is conducted with the number 2191/UN14.2.2.VII.14/LT/2024. The researcher prepares an informed consent form, which must be signed by the participant and approved by the physiotherapy supervisor.

This form confirms the participant's willingness to take part in the study until its completion. Additionally, the researcher provides educational information to the participants researching the benefits, objectives, how this research is conducted, and the importance of conducting this research. The application technique of kinesiotape used is in line with a study from Donec and Kubilius (2019), which uses two Y-shapes and two I-shapes. Home-based exercise involves 10 types of lower limb strengthening exercises.

The measuring tools evaluated in this study were pain and disability. Pain was measured by the Visual Analogue Scale (VAS), which had a good to excellent validity score on the relationship between VAS and NRS (r=0.941) and VAS and VRS (r=0.878), while the reliability score had an excellent value (r=0.97) on the test-retest reliability (Alghadir et al., 2018). Knee disability was measured using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) in the Indonesian Version, which had a good validity based on the assessment of orthopaedics experts and a high internal consistency score, tested with Cronbach’s Alpha, is 0.966 (Karsten et al., 2019).

After 6 weeks of exercise intervention and 12 intervention sessions and the researcher obtained complete data, then the researcher compared the results before and after the intervention in both groups with treatment and conducted a differential test. Data on disability and pain reduction before and after the intervention were analyzed using SPSS. The Shapiro-Wilk test showed p-values above 0.05, indicating normal distribution for WOMAC and VAS scores. Therefore, an independent t-test was used to compare the mean scores between the two groups.

RESULTS

The characteristics of the research subjects include age, gender, height, and weight. The description of the characteristics of the research subjects is presented in Table 1.

Table 1. Characteristics of Respondents Based on Age, Gender, Height, and Weight (n = 30 Elderly Individuals)

Characteristics	Group 1 (n = 15)	Group 2 (n = 15)
Age (years)	65.13 ± 3.4	65.4 ± 3.1
Gender		
Male	5 (33.3)	7 (46.7)
Female	10 (66.7)	8 (53.3)
Height (Cm)	161.5 ± 6.9	159.9 ± 5.9
Weight (Kg)	63.3 ± 9.5	66.5 ± 11.1

Based on Table 1 shows that the research subjects in Group 1 have an average age of 65.13 years, and Group 2 has an average age of 65.4 years. In group 1, there were 10 female subjects (66.7%), and more than 5 men (33.3%). In group 2, the subjects were male as many as 7 people (46.7%) and female as many as 8 people (53.3%). It can be concluded that the sample with female sex is more than the male sample in both group 1 and group 2. Based on Table 1 it shows that the research subjects in group 1 have an average height of 161.5 cm with an average weight of 63.3 kg, while group 2 with an average height of 159.9 cm and a body weight of 66.5 kg.

Table 2. Results of the Homogeneity Test of WOMAC Score and Pain in OA Knee Before and After Intervention (n = 30 Elderly Individuals)

Data Group	Homogeneity Test p value*
WOMAC Before Intervention	0.554
WOMAC After Intervention	0.871
VAS Before Intervention	0.719
VAS After Intervention	0.359

Note = *Levene's test

Based on Table 2, the results of the homogeneity test using Levene's test obtained a probability value for the WOMAC score value of the data group before treatment, which is p = 0.554, and the data value after treatment, which is p = 0.871. The results showed that the variation of WOMAC scores before and after treatment between the two groups was homogeneous (p>0.05). In the pain value based on VAS, the result before treatment is p = 0.719, and after treatment, which is p = 0.359, showing a p value > 0.05, which means that the value of VAS data before and after treatment is homogeneous.

Table 3. Effect of Intervention on Reduction of Disability and Pain in OA Knee (n = 30 Elderly Individuals)

Data Group	Before Intervention Mean ± SD	After Intervention Mean ± SD	p value*
VAS			
Group 1	5.35 ± 0.49	2.82 ± 0.96	<0.001
Group 2	5.29 ± 0.56	2.03 ± 0.46	<0.001

Data Group	Before Intervention Mean ± SD	After Intervention Mean ± SD	p value*
WOMAC			
Group 1	30.20 ± 5.1	19 ±3.66	<0.001
Group 2	28.73±4.78	13± 3.30	<0.001

Note = *The Independent T-Test

Table 3 shows the results of the hypothesis test conducted using the Independent T-test to determine the difference in knee disability in group 1. The calculation results obtained p-values for the WOMAC and VAS scores are <0.001, which states that disability and knee pain decrease significantly before and after the Kinesiotape intervention (p<0.001). Hypothesis testing to determine the difference in knee disability before and after treatment in group 2 also uses the Independent T-Test difference test. The calculation results obtained p-values for the WOMAC and VAS scores are <0.001, which states that there is a significant difference in the reduction of disability and knee pain because of the Home-Based exercise intervention.

Table 4. Effect of Intervention on Reduction of Disability and Pain in OA Knee in the Elderly Between Group (n = 30 Elderly Individuals)

Variable	Data Group	Mean ± SD	p value*
Pre-Test (VAS)	Group 1 Group 2	5.35 ± 0.49 5.29 ± 0.56	0.759
Post-Test (VAS)	Group 1 Group 2	2.82 ± 0.96 2.03 ± 0.46	<0.001
Difference (VAS)	Group 1 Group 2	2.52 ± 0.79 3.26 ± 0.34	<0.001
Pre-Test (WOMAC)	Group 1 Group 2	30.20 ± 5.1 28.73 ± 4.78	0.424
Post-Test (WOMAC)	Group 1 Group 2	19 ± 3.66 13 ± 3.30	<0.001
Difference (WOMAC)	Group 1 Group 2	11.20 ± 2.5 15.73 ± 3.2	<0.001

Note = *The Independent T-Test

The results of Table 4 show that the p-value of the difference between the two variables after treatment between groups is <0.001. These results indicate that there is a significant difference in the results of the implementation of the intervention in the two groups (p<0.001). From the table results, it can also be concluded that Home-Based Exercise reduces knee disability more than Kinesiotape, this can be seen in the results of group 2, which are closer to the p-value.

DISCUSSION

Reduction of Knee Disability and Pain due to OA Knee in the Elderly with Kinesiotape Intervention

From the data test of the results of group 1 research, there was a significant difference in the results before and after the kinesiotape intervention on the WOMAC and VAS scores of the subjects. Kinesiotape is a rehabilitative therapy using an elastic tape

made of polymer that can be stretched 120-140% (Azizah et al., 2024). The thickness and elasticity of the kinesiotape are adjusted like human skin, so it will not limit the scope of motion or put excessive emphasis on the adhesive area (Yuri et al., 2022).

The kinesiotape method was invented by Dr. Kase from Japan in the 1970s. The application of kinesiotape is in direct contact with the skin and left on for several hours with good adhesion and low risk of skin irritation. The good or bad results of kinesiotape depend on the application techniques used, such as Y, I, and Fan Shaped (Donec & Kubilius, 2019).

The application technique used is in line with a study from Donec and Kubilius (2019), which uses two Y-shapes and two I-shapes. Two of the Y-shaped techniques are applied to the vasodilation of blood vessels and lymphatics in overcoming effusion of the knee joint. Following this, an I-shaped strip is placed just below the lower boundary of the patella, above the patellar tendon, while the knee is fully bent and the subject is in a supine position, applying 100% tensile tension along with adhesive activation.

The knee is then positioned at a 20–30° bend, and the adhesive is continued over the medial and lateral collateral ligaments, using about 75% tensile tension with adhesive activation. After this, the subject is instructed to fully straighten the knee, with the tip of the I-shaped strip (approximately 10 cm) directed to the posterolateral side of the thigh (ensuring no overlap at the back) with 0% tension and adhesive activation. A second I-shaped strip is then applied in the same manner, ensuring it does not overlap the first one.

According to the study by Donec and Kubilius (2019), there was a significant reduction in generalized knee pain, including pain at night, during the day, when changing body positions, and during prolonged activities such as running, climbing stairs, and walking ($p < 0.05$). At rest, the pain reduction was similar for participants in both groups ($p = 0.421$). Kinesiotape was applied for three days, with periodic replacements done three times a week.

This protocol implies that kinesiotaping is intended to be used regularly to maintain its effects. The periodic replacement of the tape ensures that it remains effective in providing support and alleviating pain. Given the regularity of tape replacement, it can be inferred that continuous and consistent use is necessary for maintaining pain relief and potentially improving the long-term outcomes for individuals with knee pain (Donec & Kubilius, 2019).

Magnetic Resonance Imaging (MRI) was used to assess issues in the limb after kinesiotape was applied over the skin along the tibialis anterior muscle with a pull of approximately 50%. The study indicated that kinesiotape exerts mechanical effects not only on the superficial tissues but also on deeper layers, leading to heterogeneous deformation throughout the limb. Ruffini corpuscles and interstitial receptors are found in the boundary zone of soft tissue layers (Donec & Kubilius, 2019).

Applying kinesiotape with a slight pull in a specific direction can enhance afferent stimulation and decrease skin friction. Additionally, a study by Castrogiovanni et al. (2016) reported that the application of kinesiotape with tensile tension resulted in a more significant long-term analgesic effect compared to application without tension. The VAS pain scores indicated that, across all groups, patients exhibited lower scores after both 15 days and 3 months. However, in Group 3, the scores remained unchanged between the 15-day and 3-month marks.

The kinesiotape intervention given to group 1 with knee OA functioned to provide stability to the joints with a micro-lifting mechanism to help increase blood and lymphatic circulation, vasodilation, and reduce the occurrence of pressure by body weight on

inflamed joint structures (Yuri et al., 2022). The occurrence of vasodilation of blood vessels creates a metabolic system in the knee, causing inflammatory substances such as bradykinin, prostaglandins, and histamine to be dissolved and washed with the bloodstream, so that local pain will decrease. Stabilization of the installed kinesiotape provides a proprioceptive stimulus of sensory feedback to help the subject be more aware of the position of the knee joint, which can later reduce the risk of unwanted movements or worsen disability (Azizah et al., 2024).

This study is in line with Widnyana et al. (2024), namely the addition of kinesiotape after intervention modalities of ultrasound therapy, transcutaneous electrical nerve stimulation, and massage, proven to be effective in improving functional ability in patients with knee OA. In this study, an independent t-test was used, which stated that there was a significant difference in WOMAC scores between the two groups before and after the intervention, with a value of $p<0.05$. Functional ability in the treatment group increased by 30.57% from the conclusion of kinesiotape addition after the intervention.

The mechanism of action of kinesiotape in improving functional ability here with sensory responses to the skin in the muscle belly and attached tendons can increase the strength of the quadriceps muscles. The concentric contraction generated by the kinesiotape pull is fitted with a facilitation technique from origo to insorcio, with a 40% pull will recruit more unit motors. We know that in the elderly, changes in the posture of the "X" and "O" shaped legs often occur; the function of the kinesiotape as a stabilizer can maintain the position of the patella according to its structure, so that disability in the knee can be reduced.

Reduction of Knee Disability and Pain due to OA Knee in the Elderly with Home-Based Exercise Intervention

In the current study, the home-based exercise intervention given in group 2 showed a significant difference in the reduction of knee disability before and after the intervention. Home-based exercise is a collection of several trainings that can be done independently at home to reduce pain, increase muscle strength, flexibility, and maintain the scope of motion of the knee joint (Si et al., 2023). Without the need for expensive tools or large costs, home-based exercise can be done efficiently and only requires leisure time and a convenient place to do it (Mao et al., 2024).

Knee OA sufferers are also characterized by the presence of thigh muscle weakness of up to 20-45%, depending on age. In the knee joint, the quadriceps muscles as an important protective function, that is working in eccentric conditions during the initial standing phase of walking to dampen the knee joint and acting to slow down the limb before the heel hits the ground, thus reducing excessive impulsive loads. Weakness in the quadriceps muscle can be attributed to increased load on the knee joint, loss of patellofemoral cartilage, and narrowing of the tibiofemoral joint space (Mao et al., 2024).

The mechanism of quadriceps muscle weakness in knee OA, this weakness is Arthrogenic Muscle Inhibition (AMI), an ongoing nerve block that prevents the quadriceps muscle from being fully activated. AMI can cause muscle atrophy in the quadriceps. A characteristic feature seen in knee OA is stiffness in the joints. Joint stiffness can be described as discomfort or difficulty during movement because the joint is perceived as inflexible and restricted. A decrease in the amount of Surface-Active Phospholipid (SAPL) production in the synovial membrane results in the erosion of cartilage in the joint (Si et al., 2023).

As a result, friction occurs between the bones of the joints and inhibits the movement of the joint's range of motion. Early pathological changes in knee OA primarily occur on the surfaces of articular cartilage in areas experiencing the highest loading stress. In response to matrix loss, there is an increase in chondrocyte proliferation. Some chondrocytes transform into hypertrophic chondrocytes, resembling those found in the hypertrophic zone of the growth plate (Widnyana et al., 2024).

During the degradation phase of OA, substantial matrix loss takes place due to ongoing protease production, which is stimulated by proinflammatory cytokines. These cytokines encourage chondrocytes to generate even more cytokines and proteases. Furthermore, significant matrix damage results from cell loss, largely due to chondrocyte apoptosis (Heika et al., 2020).

Many of the issues related to knee OA have been addressed in this study. The primary goals include enhancing thigh muscle strength, increasing the knee joint's range of motion, and improving muscle and joint flexibility. The program is implemented in stages, beginning with an initial training phase that involves four sessions of approximately 30 minutes each over the first two weeks, followed by follow-up appointments at monthly intervals. Participants are encouraged to perform exercises for both legs for 20-30 minutes daily, gradually increasing to a maximum of 20 repetitions per leg. Adherence to the program is monitored through a self-reported diary, collected weekly (Si et al., 2023).

This home-based self-training program aims to enhance mobility and reduce pain in the elderly with OA. The exercises include strengthening and stretching movements, such as sitting in a chair, isometric hamstring and hip adductor exercises, isotonic hip extension and abduction exercises while lying down, narrow and wide squats, as well as hamstring stretching while seated and quadriceps stretching while lying sideways. This series of exercises is designed to improve joint stability, muscle strength, and flexibility to support daily functional activities (Si et al., 2023).

Research by Mao et al. (2024) found similar results, indicating that HBE significantly reduces pain (SMD=-0.38, 95% CI (-0.58, -0.18); P = 0.001), enhances joint function (SMD=-0.60, 95% CI (-1.01, -0.19); P = 0.004), improves balance (SMD=-0.67, 95% CI (-1.00, -0.34); P = 0.001), and increases mobility in activities of daily living (ADL) (SMD=0.51, 95% CI (0.19, 0.82); P = 0.002) for patients with knee OA. Thus, it can be concluded that HBE not only alleviates complaints associated with knee OA but also enhances walking quality. However, its effectiveness depends on consistent and regular practice (Mao et al., 2024).

Comparison of Kinesiotape and Home-Based Exercise in Reducing Knee Disability and Pain due to OA Knee in the Elderly

Based on the research that has been done, the administration of home-based exercise is more effective compared to kinesiotape. home-based exercise has the advantage of being easy to apply independently, improving disability function, reducing pain, and having no need to spend money. However, home-based exercise has shortcomings, namely the need for consistency and compliance in undergoing training and the need for supervision and assistance from the family, where the subject here is an elderly person. In addition, the ability to be flexible and the strength of the elderly will certainly affect the intervention of home-based exercise (Castrogiovanni et al., 2016).

Kinesiotape interventions have the advantage of accelerating the reduction of joint inflammation, reducing pain, and stabilizing the knee joint. However, the application of

kinesiotape requires consumables, and installation must also be monitored to be accurate and correct. The study did not include a long-term follow-up period to assess the sustainability of pain relief after the kinesiotaping was discontinued. It would be valuable to evaluate whether the benefits of kinesiotaping persist over time or if pain levels return once treatment stops.

CONCLUSION

The results of the analysis and discussion of the research indicate that both home-based exercises and the use of kinesiotape are effective in reducing pain and disability in the knees of elderly individuals with OA. However, home-based exercises demonstrated superior results compared to kinesiotape. Therefore, home-based exercises are recommended as the primary non-pharmacological intervention for elderly individuals with knee osteoarthritis.

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