

THE EFFECT OF BMI ON STRENGTHENING EXERCISE TO IMPROVE THE FUNCTIONAL ABILITY OF KNEE OSTEOARTHRITIS

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Abstract

Background: Osteoarthritis is a degenerative joint disease that can get worse over time. It can also cause reactive changes to the cartilage edges of the knee joint. One of the contributing factors is the body mass index. For obese people, this poses a high risk because body weight puts a strain on the joints, especially the knee joints. Aim: This study aims to determine the effect of BMI on strengthening exercise to increase the functional ability of knee osteoarthritis. Research Method Experimental This research was conducted through a two-group pre-test post-test design with a sample size for group I of normal BMI totaling 12 people and group II for overweight BMI totaling 12 people. The two groups were given strengthening exercise for 4 weeks with a frequency of 2 times a week. The functional abilities of the two groups were measured using the WOMAC Index. Result: Based on the results of the paired sample t-test hypothesis testing in groups I and II, the value was ($p < 0.05$) $p = 0.000$, which means that there is an effect of BMI on strengthening exercise to increase the functional ability of knee osteoarthritis. Conclusion: There is an effect of BMI on giving strengthening exercise to increase functional ability in knee osteoarthritis. Suggestion: Future researchers are expected to be able to control activities that affect sample activity.

Keywords: Body Mass Index, Strengthening Exercise, Osteoarthritis Knee, Functional Ability

PENGARUH BMI TERHADAP LATIHAN PENGUATAN UNTUK MENINGKATKAN KEMAMPUAN FUNGSIONAL PADA OSTEOARTHRITIS LUTUT

Abstrak

Latar Belakang: Osteoartritis merupakan penyakit sendi degeneratif yang dapat bertambah parah seiring berjalannya waktu. Osteoartritis juga dapat menyebabkan perubahan reaktif pada tepi tulang rawan sendi lutut. Salah satu faktor penyebabnya adalah indeks massa tubuh. Bagi penderita obesitas, hal ini menimbulkan risiko yang tinggi karena berat badan memberikan tekanan pada sendi, terutama sendi lutut. Tujuan: Penelitian ini bertujuan untuk mengetahui pengaruh IMT terhadap latihan penguatan untuk meningkatkan kemampuan fungsional pada penderita osteoartritis lutut. Metode Penelitian Eksperimental Penelitian ini dilakukan melalui desain two-group pre-test post-test dengan jumlah sampel untuk kelompok I dengan IMT normal berjumlah 12 orang dan kelompok II dengan IMT overweight berjumlah 12 orang. Kedua kelompok diberikan latihan penguatan selama 4 minggu dengan frekuensi 2 kali seminggu. Kemampuan fungsional kedua kelompok diukur dengan menggunakan Indeks WOMAC. Hasil: Berdasarkan hasil pengujian hipotesis paired sample t-test pada kelompok I dan II diperoleh nilai ($p < 0,05$) $p = 0,000$ yang berarti ada pengaruh IMT latihan penguatan terhadap peningkatan kemampuan fungsional osteoartritis lutut. Kesimpulan: Ada pengaruh IMT pemberian latihan penguatan terhadap peningkatan kemampuan fungsional pada osteoartritis lutut. Saran: Peneliti selanjutnya diharapkan dapat melakukan kontrol terhadap aktivitas yang mempengaruhi aktivitas sampel.

Kata kunci: Indeks Massa Tubuh, Latihan Penguatan, Osteoartritis Lutut, Kemampuan Fungsional.

1. Pendahuluan

Changes in increasing age have an impact on the physical deterioration of both bones and muscles, resulting in pathological conditions appearing, one of which is osteoarthritis. Osteoarthritis in Indonesia is increasing along with age. In developing awareness to obtain optimal levels of health, the will and ability for health is needed for the population. Optimal health is a state of physical, mental and social well-being that allows individuals to live productive lives socially and economically (Widodo et al., 2022).

According to WHO regarding the increase in the number of elderly people in various countries in the world, Indonesia is one of the countries facing this trend. The Central Statistics Agency released data on the number of elderly based on the results of the 2016 inter-census population survey, estimating the number of elderly (aged 60 years and over) in Indonesia at 22,630,882 people. This figure will increase to 31,320,066 people in 2022.

Osteoarthritis is a degenerative joint disease that worsens over time and causes the cartilage that covers the ends of the bones to begin to deteriorate and reactive changes occur at the edges of the joints and bones, resulting in pain and loss of movement. Damaged joints are characterized by fibrillation, fissures and deep ulceration of the joint surface (Permatasari, 2022).

The prevalence of osteoarthritis sufferers in America reaches 9.6% in men and 18% in women. The 2018 Basic Health Research (Risksdas) stated that the prevalence of joint disease in Indonesia was 7.3% with 6.1% in men and 8.5% attacked women, in Yogyakarta, osteoarthritis sufferers aged 50 years and over were 62.9% and under the age of 50 years were 37.1% (Widjaja, 2020). These data show that the risk of developing osteoarthritis increases with age, apart from the age factor it turns out that gender is also a risk factor, where women have a higher risk of developing osteoarthritis than men, especially those aged 50 years (Selviani 2018).

One of the factors for the occurrence of osteoarthritis is the body mass index (BMI), especially in the knee joint because half of the body weight or a person rests on the knee joint while walking. Body mass index (BMI) is related to osteoarthritis due to the high risk for those who are obese after the age of 60 years and over. Being overweight or obese is one of the drivers of osteoarthritis because fat deposits in the body can burden the joints, hips, waist, especially the knee joints (Rosdiana et al., 2019).

BodyMass Index (BMI) is a simple index of body weight for height that is used to classify overweight or obesity in adults. Body mass index measurement is a value taken from calculating two main components, namely body weight and height.

Populations that are overweight or obese have greater risk factors for knee osteoarthritis than normal weight populations. If you are overweight or obese, the work of the joints will be even harder and the risk factor for obesity itself is a lack of physical activity such as exercise which is needed to maintain the mechanism for burning fat accumulated in the body (Nata et al., 2020).

In research by Juriansari et al (2020), it is often found in patients with osteoarthritis that alignment abnormalities occur, namely changes in the angle formed by the quadriceps muscle group and the patella tendon which shows an angle to the patella tendon from the pressure of the quadriceps muscle group (Widodo et al. , 2022).

The American College of Rheumatology (2018) defines Osteoarthritis as a disease characterized by irregular new bone formation on joint surfaces and abrasion of joint cartilage (Selviani, 2018). There are several factors that exacerbate the degree of progression of severity in patients with osteoarthritis including age, gender, obesity, genetics, level of bone density, physical activity and muscle weakness. occurrence of osteoarthritis. Osteoarthritis is characterized by an imbalance between catabolic and anabolic activity in the joints and aging contributes to this imbalance (Swastini et al, 2022).

According to Law Number 8 of 2016 concerning Elderly Welfare, what is meant by elderly people are residents who have reached the age of 60 years and over. According to BPS data in 2022 the percentage of elderly people in Indonesia is 9.6% or around 25.4 million people. In 2025, Indonesia's population is projected to reach 273 million people

Patients with osteoarthritis of the knee usually have complaints of pain, joint stiffness, reduced proprioception and decreased quadriceps muscle strength associated with knee pain and functional ability to improve physiotherapy services in Osteoarthritis patients. most appropriate to be applied to patients who are mostly elderly so that patients are able to do the exercises correctly according to what physiotherapy teaches and want to do them at home so that the purpose of the exercises, namely reducing pain and increasing functional activity can be achieved. From a physiotherapy perspective, osteoarthritis can result in various levels of impairment, namely impairment such as reduced muscle strength, limited joint range of motion, presence of pain and level of functional limitation such as impaired walking, running, and up and down stairs. Even reduced participation restrictions, such as the inability

to engage in certain activities for example getting up from sitting, squatting, kneeling, standing for a long time, and others as a result of decreased mobility.

Physiotherapy treatment for osteoarthritis is more centered on symptom management, namely reducing pain, increasing joint function and joint stability so as to increase functional activity in patients. Pain is something that cannot be avoided in osteoarthritis and is also a major factor in the problems that occur in knee osteoarthritis strengthening exercise is an exercise given to strengthen muscles that experience weakness, such as strengthening the muscles around the knee joint that occurs in people with osteoarthritis. Strengthening is the ability of the entire muscle system to contract when receiving loads or resistance from external and internal and also as a basis for supporting components of physical condition (Susilo, 2022). Muscle is a tissue that can be excited in the form of contraction, so that muscles can be used to move parts of the skeleton that allow movement to occur. The knee is strengthened by two large muscle groups, namely the extensor group and the knee flexor group. The quadriceps muscle plays an important role in transferring loads across the knee joint. The quadriceps muscle is an extensor muscle.

The main part of the knee joint is very important for maintaining the stability and function of the knee joint. The quadriceps femoris consists of four muscles namely the rectus femoris, vastus medialis, vastus lateralis and vastus intermedialis which are the main driving muscles of the knee joint which are located in the anterior part, the posterior part is the biceps femoris muscle, the semitendinosus muscle, the semimembranosus muscle, the gastrocnemius muscle, the medial part is the muscle pesanserinus which consists of the Tensorfacialatae muscles.

The quadriceps muscle mechanism stabilizes the patella on all sides and regulates movement between the patella and the femur. The mechanism of action of the quadriceps is needed, such as when walking, the quadriceps muscle provides control of knee flexion during initial contact (loading response). Then knee extension for midstance then prewswing hell off to toe off in walking activities and in maintaining knee joint function when making movements to raise or lower the body (Pratama, 2019).

Mechanism of pain in osteoarthritis is due to the clamping of polymodal nerve endings around the joints caused by osteophytes, swelling and thickening of the soft tissue around the joints caused by osteophytes, swelling and causing pain (Ismaningsih 2018). Mechanism of functional ability in osteoarthritis sufferers Decreased functional ability caused by a decrease in the quadriceps muscles due to the activity of nosi receptors in the spinal cord. Weakness in the muscles will also disrupt the stability of the knee joint due to decreased proprioceptor function in responding to arthrokinematic reactions to any changes in movement (Imoto, 2012).

2. Metode

This research is an experimental research method, because research cannot fully control the sample in the study, and the design used is a pre and post test two group design. This design is used to determine the effect of BMI on strengthening exercise to increase the functional ability of knee osteoarthritis. In this study, 2 treatment groups were used: strengthening exercises before being given the sample treatment, the degree of knee pain and functional ability were measured using WOMAC. The required sample size in this study according to the slovin formula:

$$n = \frac{N}{1 + Ne^2}$$

Information :

n : Sample size N : Population

e : error tolerance limit (5% or 0.05)

From the results of calculations using the Slovin formula, the result was 24, so the number of samples in this study was 24 people as the experimental group which was divided into 2 groups. The samples in this study were taken from flamboyant elderly Posyandu women, Tinom Sleman DIY and willing to participate in the research. Sampling in this study took a purposive sampling technique, that is, the sample was selected by the researcher through a series of process criteria that represent the population that meets the criteria set by the researcher. Respondents who had signed informed consent and had successfully completed the training program set by the researchers were 24 respondents who met the inclusion criteria which were divided

There are 2 groups, namely group 1 who has a normal BMI and group II who has an overweight BMI. Furthermore, all samples were given treatment 2 times for 4 weeks and then measured their weight and height after that their functional abilities were measured with the WOMAC index. The characteristics in this study were age, sex, body mass index and WOMAC scores.

Distribution of respondents by age:

Table 4.1 Distribution of Respondents Based on Age

Usia	Kel 1		Kel 2	
	n	%	n	%
50-57	7	56,3%	7	56,3%
57-65	5	43,7%	5	43,7%
Jumlah	12	100	12	100
Mean ±SD	20,00± 00,00		57,25± 46,73	

Table 4.1 the age of the respondents in group 1 and group 2 the distribution of respondents consisted of ages 50-57 there were 7 people (56.3%) and ages 57-65 year there were 5 people (43.7%).

Distribution of Respondents Based on Gender

Table 4.2 Distribution of Respondents by Gender

Jenis Kel	Kel 1		Kel 2	
	n	%	N	%
Perempuan	12	100	12	100
Jumlah	12	100	12	100
Mean± SD	20,00± 00,00		20,00± 00,00	

Distribusi responden berdasarkan IMT (Indeks Massa Tubuh) totaling 12 (100%) people and Group 2 consisted of 12 people (100%). Distribution of respondents based on BMI (Body Mass Index)

Table 4.3 Distribution of Respondents Based on BMI

IMT	Kel 1		Kel 2	
	N	%	n	%
18,5 - <23	12	100	12	100
23 - <25	12	100	12	100
Jumlah	24	100%	24	100%
Mean±SD	20,98 ±16,13		24,62± 08,70	

Distribusi Responden Berdasarkan nilai WOMAC Based on table 4.3 in group 1 normal BMI (18.5<23) as many as 12 people (100%) and BMI in the overweight category (23 <25) as many as 12 people (100%). Distribution of Respondents Based on WOMAC Values

Tabel 4.4 Distribution Responden Based WOMAC values

Nilai WOMAC	Kel 1				Kel 2			
	Pre	%	Post	%	Pre	%	Post	%
20-30	1	8,4%	1	8,4%	0	0	0	0
31-40	9	75%	5	41,6%	10	83,3%	11	91,6%
41-70	2	16,6%	6	50%	2	16,7%	1	8,4%
Jumlah	12	100	12	100	12	100	12	100
Mean	67,61		39,36		62,58		35,58	

Based on table 4.4, the WOMAC value in group I had an average WOMAC value before treatment was 67.61 and after treatment, the average WOMAC value was 39.36. Then in group II the average WOMAC value before treatment was 62.68 and after treatment it produced a WOMAC value of 35.58.

Data Normality

Test Analysis Test Results

This test aims to find out whether the sample from the population obtained is normally distributed or not. The sample in this study consisted of 24 people who were divided into 2 groups, so the Shapiro Wilk test was used as a data normality test, because the normality test is more accurate for samples with less than 50 samples. The results of the Shapiro Wilk test can be seen in the following table:

Tabel 4.5 Uji Normalitas with *saphiro wilk test*

Variabel	Nilai <i>p</i>
WOMAC (IMT Normal) Pre	0,802
WOMAC(IMT Normal) Post	0,744
WOMAC (IMT Overweight) Pre	0,745
WOMAC(IMTOverw eight) Post	0,055

Based on table 4.5, it was found that the *p* value in group I before the intervention was 0.802 and after the intervention was 0.744 where $p > 0.05$ which means that the sample was normally distributed, the *p* value in group II before the intervention was 0.745 and after the intervention was 0.055 where $p > 0.05$ which means sampel berdistribusi normal. Uji Homogenitas normally distributed samples. Homogeneity Test in this research, it is to see the homogeneity of the data or to ensure that the population variance is the same or not. The WOMAC values of group I and group II were tested for homogeneity using the Lavene's test, which can be seen in the following table:

Data Normality Test Analysis Test Results

This test aims to find out whether the sample from the population obtained is normally distributed or not. The sample in this study consisted of 24 people who were divided into 2 groups, so the Shapiro Wilk test was used as a data normality test, because the normality test is more accurate for samples with less than 50 samples. The results of the Shapiro Wilk test can be seen in the following table:

Tabel 4.6 Uji Homogenitas with *Lavene's test*

Kelompok I dan II	Nilai <i>p</i>
WOMAC pre	0,071
WOMAC post	0,896

Based on table 4.6, the results of the homogeneity test calculation using Lavene's test from the WOMAC values for group I and group II before the intervention obtained a *p* value of 0.071 and after treatment *p* 0.896, where the *p* value was > 0.05 , it can be concluded that the variance in the second group is significant. homogeneous. These results mean that at the start of the study there was no significant difference in the value of knee functional ability. Hypothesis test to determine the effect of BMI on strengthening exercise on increasing functional ability in knee osteoarthritis using a paired sample *t*-test because it has a normal data distribution both before intervention and before intervention

Tabel 4.7 Uji hipotesis pada kelompok I dan II

Pemberian Terapi	Mean	SD	Nilai <i>p</i>
Pre	27,62	1,05	0,000
Post	4,17	1,66	

Based on table 4.7, the test results show that $p=0.000$ means $p<0.005$, meaning H_a is accepted and H_o is rejected. So it can be concluded that there is an effect of BMI on the provision of Strengthening Exercise to increase functional ability in knee osteoarthritis.

3. Hasil

Characteristics of the sample based on age In this study the sample totaling 24 people who are members of the flamboyant elderly Posyandu Tinom Sleman DIY who have osteoarthritis. Based on table 4.1, the ages of respondents in group 1 and group 2, the distribution of respondents consisted of 7 people aged 50-57 (56.3%) and 12 people aged 57-65 years (43.7%), meaning that the older they get, the higher the level of increased risk of osteoarthritis. According to Kowalak (2016) which states that age is one of the reinforcing factors for someone experiencing osteoarthritis.

According to Connor's research (2017) the prevalence of osteoarthritis increases by 3 times higher for women than men. The woman who entered the period. Menopause will experience a decrease in the hormone estrogen and other physiological functions of the body, while one of the functions of the estrogen hormone is to help strengthen bones.

Sample characteristics based on BMI

In this study the characteristics of respondents according to Body Mass Index in respondents with normal and overweight criteria, namely there were 12 people in each treatment. Based on table 4.3, in group 1 normal BMI ($18.5 < 23$) were 12 people (100%) and BMI in the overweight category ($23 < 25$) were 12 people (100%).

According to Swastani et al., 2022, body weight is a factor that can cause knee pain so that it can improve the function and mobility of the knee joint. Pain is something that cannot be avoided in osteoarthritis and is also a major factor in the problems that occur in knee osteoarthritis. Based on the results of hypothesis testing with a mean value of 27.62 in groups I and II, it can be explained that in this study there is an influence of BMI on giving strengthening exercise on increasing functional ability

in osteoarthritis knees but there is no difference in the influence between Normal and Overweight BMI with giving exercise. strengthening exercise to improve functional ability.

According to José Manuel et al., 2022 entitled Effectiveness of Strengthening Exercise in Patients with Overweight or Normal Suffering from Knee Osteoarthritis: A Systematic Review and Meta-Analysis explains that the population with excessive body weight or obesity has greater risk factors for knee osteoarthritis compared with the normal weight population. If you are overweight or obese, the work of your joints will be even harder and the risk factor for obesity itself is a lack of physical activity such as exercise. Based on the results of research conducted by Jose Manuel et al., 2022, by providing strengthening exercises there was also no difference between normal BMI and overweight BMI.

Strengthening Exercise in Patients with Overweight or Normal Suffering from Knee Osteoarthritis: A Systematic Review and Meta-Analysis explains that populations who are overweight or obese have greater risk factors for knee osteoarthritis than populations of normal weight. If you are overweight or obese, your joints will work even harder and the risk factor for obesity itself is a lack of physical activity such as exercise. Based on the results of a study conducted by Jose Manuel et al., 2022 by providing strengthening exercises there is also no difference between normal BMI and overweight BMI.

Sample Characteristics Based On Value Womac

Examination of functional ability for osteoarthritis is the WOMAC index. This scale is often used to assess functional ability for people with osteoarthritis. The mean in strengthening exercise group I before treatment was 67.61 and after treatment the average WOMAC value was 39.36. And in group II the mean before treatment was 62.58 and after treatment was 35.58. Based on the decrease in the mean values of the two groups, it can be concluded that the lower the WOMAC value, the lower the functional limitations experienced by patients with osteoarthritis.

According to Putri Intan Sari et al., 2022, this research shows that strengthening exercise in osteoarthritis patients provides effective results which can be used as a basis for providing interventions to increase quadriceps muscle strength in osteoarthritis sufferers because the quadriceps muscle contributes to stabilizing the knee joint, joint stabilization can be disturbed when Weak quadriceps muscles can increase the risk of damage to the structure of the knee joint, which can cause inflammation and trigger pain. Thus, strengthening the quadriceps muscle group can have an effect on increasing muscle strength and increasing functional ability.

Hypothesis

Research from Tekla A.Serin, Novtiyas in 2022 entitled "Physiotherapy Management of Knee Osteoarthritis With Ultrasound and Quadriceps Setting Exercise" in 2022, the research design is a case study, this research was conducted by interview, observational, examination of a patient with pain conditions and decreased functional activity in OA.

In the research, the results of the strengthening exercise treatment were obtained which were carried out twice a week for 4 weeks with the respondents sleeping on their backs and then asked to contract the quadriceps muscles 45° with the legs flexed at the hip and the knees still extended, then held for 5 seconds and repeated for 10 repetitions. The results obtained with the WOMAC value before treatment obtained a mean of 67.61 with an SD of 3.72 and after being given treatment the mean was 39.36 with an SD of 4.80. During the 4 weeks of treatment, this is a phase where there is an increase in functional ability and muscle flexibility. The exercise is carried out 10 times with the aim of increasing the strength of the quadriceps muscles with a contraction time of 5 seconds. Then at the end of the measurement after being given strengthening exercise treatment, it was carried out using a paired sample t-test so that it could be concluded that there was an influence of BMI on giving strengthening exercise to increase the functional ability of the osteoarthritis knee with a value of $p=0.000$, meaning $p<0.005$.

4. Kesimpulan

Based on the results and discussion in the thesis entitled The effect of BMI on Strengthening Exercise to improve the functional ability of knee Osteoarthritis, it can be concluded as follows:

1. There is an influence of BMI on the provision of Strengthening Exercise to improve the functional ability of the Osteoarthritis knee

Saran

From the results of this research, this exercise should continue to be applied to respondents regularly so that quadriceps muscle strength continues to be maintained so that functional abilities are maintained well.

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