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Static and Dynamic Stretching Differences Toward Knee Joint Extension in The Elderly



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Abstract

The problem of a decrease in knee joint extension makes it difficult for the elderly to carry out their daily activities. Static and dynamic stretching exercises can help to maintain joint range of motion and minimize muscle flexibility loss. The goal of this research was to identify if static and dynamic stretching had different effects on knee joint extension in the elderly. With a pre-experimental research design, this research used a two-group pre-test post-test design. The participants in this research were divided into two groups: static stretching and dynamic stretching, with each group consisting of 18 people recruited by the purposive selection technique. Before and after the intervention, a goniometer was utilized to evaluate knee joint extension. To investigate the difference in influence, the Independent T-Test statistical evaluation was utilized, demonstrating that static and dynamic stretching had different effects on knee joint extension in the elderly. Both of these treatments had the ability to influence joint extension. Static stretching relaxes the muscles, allowing them to stretch further by moving one leg alternately and retaining the maximal position. Dynamic stretching increases joint flexibility by moving both legs simultaneously and slowly. This static and dynamic stretching is necessary for the elderly to avoid a reduction in joint extension during daily activities.

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INTRODUCTION

The aging process will affect changes in all body systems, one of which changes in the musculoskeletal system. Problems with the physical aspect of the elderly, one of which is a decrease in musculoskeletal function, especially in the joints, often manifests the appearance of joint pain (Masrurroh et al, 2021). These changes include the musculoskeletal system that affects bone density, changes in muscle structure, decreases cartilage function, decreases muscle strength, and decreases muscle and joint flexibility. The elderly who are not aware experience shortening of the body's muscles, one of which is the hamstring muscle. The hamstring muscle is a muscle group in the hip joint (hip joint) located on the back of the thigh that functions as a knee flexion movement, hip extension, as well as external and internal hip rotation movements (Kim D *et al*, 2019).

Disorders of the joints, is a disease that is often found in the elderly. Problems in the joints, especially the knee joints, are a common disease in people from the elderly group. In addition to the age factor, disorders of the knee joint arise because many elderly people cannot control their lifestyle, such as proper physical exercise or doing sports (Kurnia, 2015). The incidence of elderly people experiencing joint disorders reaches 73% of the entire population, while in Indonesia, according to the Indonesian Ministry of Health (2013), there are 4.1 million elderly or 63% of the entire elderly population who experience joint problems (Depkes, 2018). Data held by the East Java Data Research and Development Center (2013), the elderly who experience joint disorders are 67% for the elderly in urban areas and 63% for the elderly in rural areas. The high incidence of joint disorders is due to a decrease in flexibility as a result of lack of physical exercise and exercise habits (Puslitbang, 2013).

Based on preliminary research of the number of elderlies at the Elderly Posyandu in Mlancu Village, there were 8 elderly (80%) experiencing joint pain in the knee and 2 elderly (20%) saying they did not experience knee joint pain. The onset of joint pain in the knee, causes the elderly to experience limited movement and physical weakness. Due to limited movement and reduced joint use, there is a decrease in knee joint motion extension which affects the elderly who experience knee pain unable to carry out daily

activities as usual. There is a problem with knee joint pain in the elderly interfere with joint extension.

Knee extension is a movement to straighten the knee bones. Joint disorders often attack elderly patients in weight-bearing joints, especially the knee joints. The knee joint is the largest joint in the body, located between the upper and lower legs. The movements that occur in the knee joint are flexion and extension, occurring in the sagittal plane of motion with the transverse axis of motion. The process of walking on the knee occurs in two movements, namely flexion and extension, both movements begin with an extension movement before the initial contact phase, followed by flexion of the knee to the opposite leg in the mid stance phase, then continued relaxation of the hamstring muscles during a swing from the stance phase. In the mid to terminal stance phase, in the phase between mid-swing to terminal swing, the hamstrings act by contracting extension to prevent hyperextension of the knee (Walker, 2011).

Decreased joint extension experienced by some elderly. The occurrence of a decrease in joint extension itself, due to pain in the joints caused by immune mechanisms, metabolic factors, genetic factors, environmental factors, and age factors. However, that does not mean that the older you get, everyone will experience joint problems. Correct prevention from an early age in the elderly still has to be done so that they can carry out activities without being disturbed. The cause of the decreased of joint extension was due to pain of the joint so that the elderly maintains joint position so as not to feel pain, the elderly limits their movement resulting in joint stiffness so that it is difficult to walk. The pain caused can also interfere with daily activities (Nainggolan, 2012).

To maintain the range of motion of joints and soft tissues and minimize the loss of muscle flexibility, it is necessary to give stretching exercises in several ways, namely static stretching and dynamic stretching. Static stretching is an exercise by stretching, stretching movements in the muscles that are carried out slowly until tension occurs and achieves discomfort in the muscle, then maintains that position for 20 to 30 seconds so as to increase joint extension (Walker, 2011). While dynamic stretching is a stretching exercise by moving the body or limbs rhythmically without maintaining the farthest

stretching position. Dynamic stretching can stimulate the nervous system to progressively increase the space for joint existence and reduce the potential for injury, increase muscle temperature and stretch muscles so that (Suharjana, 2013). Static and dynamic stretching can increase the speed of nerve signal delivery and regulate body movements, facilitate the process of muscle contraction more quickly and efficiently, and increase joint flexibility so as to minimize friction that occurs due to joint stiffness. However, static stretching and dynamic stretching interventions have different capacities in exercise where static stretching movements in the muscles are carried out slowly until tension occurs while dynamic stretching moves rhythmically without maintaining the stretching position so that it is more effective to increase joint extension (Nainggolan, 2012). This research aimed to determine the difference in the effectiveness of static and dynamic stretching on knee joint extension in the elderly.

METHOD

The pre-experimental design with a two-group pre-test post-test design approach was the design of this research. This research aimed to

compare 2 treatments, one group was given static stretching exercise and one group was given dynamic stretching exercise. This research was conducted on April 20 until May 3, 2020. The sample in this research was taken using a sampling technique using purposive sampling, namely the elderly at the Elderly Posyandu, Mlancu Village, Kandangan District, a total of 36 people, which were divided into 2 intervention groups. The instrument in this research was the Geniometer. Geniometer is an instrument that measures angles or allows an object to be rotated to a certain position. The intervention in this research was static and dynamic stretching exercises given 6 times in 2 weeks, with the duration of 15 minutes for 2 weeks. After being given the intervention for 2 weeks, measurement of knee joint extension in both groups was carried out during pre-test and post-test. The data were analyzed using Paired T-Test and Independent Test with a significance level of 0.05.

RESULT

The results showed that the frequency distribution of respondent based on age, gender, occupation, exercise habit, smoking habit, history of disease, gout.

Table 1: Participant Characteristics (Socio economic and demographic)

Variable	f	%
Static Streatching Group		
Age		
65-70 years old	0	0
>70 years old	18	100
Gender		
Male	3	16,7
Female	15	83,3
Occupation		
Farmer	17	94,4
Entrepreneur	1	5,6
Exercise Habits		
Sometimes	6	33,3
Never	12	66,7
Smoking Habits		
Yes	3	16,7
No	15	83,3
History Of Diseases		
Yes	18	100
No	0	0
Gout Diseases		
Yes	5	27,8
No	13	72,2

Dynamic Streatching Group		
Age		
65-70 years old	3	16,7
>70 years old	15	83,3
Gender		
Male	6	33,3
Female	12	66,7
Occupation		
Farmer	18	100
Entrepreneur	0	0
Exercise Habits		
Sometimes	8	44,4
Never	10	55,6
Smoking Habits		
Yes	1	5,6
No	17	94,4
History Of Diseases		
Yes	18	100
No	0	0
Gout Diseases		
Yes	5	27,8
No	13	72,2

Based on table 1, it is known that the general data of the respondents. The first is that the respondents who were given the static tretching intervention found that all respondents (100%) were over70 years. Gender Almost all (83.3%) have a female gender. For all occupations (94.4%) are farmers. Most of the sports history (66.7%) claimed to have never exercised. Almost all of the smoking habits (83,8.8%) never smoked. All respondents (100%) had a history of rheumatic disease and most (72.2%) had gout.

For general data of respondents who were given dynamic stretching intervention, it was found that almost all respondents (83.3%) were

over 70 years. Partial genderthe majority (66.7%) were female. For all occupations (100%) are farmers. Most of the sports history (55.6%) claimed to have never exercised. All smoking habits (94.4%) never smoked. All respondents (100%) had a history of rheumatic disease and most (72.2%) had gout.

After the normality test using Shapiro-Wilk in each group, namely the Static stretching group, a significance value (Sig.) was 0.008 and the dynamic stretching group a significance value (Sig.) 0,010. The two groups were normally distributed. The homogeneity test obtained a significance value of 0,000.

Table 2: Joint extension tabulation before and after static stretching.

Level	Pre test		Post Test	
	F	(%)	F	(%)
10	3	16,7	6	33,3
13	0	0	2	11,1
15	10	55,6	6	33,3
17	0	0	1	5,6
18	3	16,7	3	16,7
20	2	11.1	0	0
Mean	15,22		13,72	
Std.Deviation	2,981		3,064	

The results table 2 showed that before static stretching most of the respondents (55.6%) had a joint extension of 15 degrees, after static stretching almost half of the respondents (33.3%) had a knee joint extension of 15 and 10 degrees. This change in knee extension can be seen from the results of the difference in the mean before and after the intervention, which is 15.22 before the intervention and 13.72 after the intervention.

Static stretching is a stretching exercise by stretching the muscles slowly until the muscles feel sore. The mechanism of action for static stretching is when the muscles are active. When stretched, the first effect will occur on elastin (actin and myosin), muscle tension increases sharply, sarcomeres lengthen and if done continuously the muscles will adapt and will last for some time (Irfan & Natalia, 2008).

Table 3: Joint extension tabulation before and after dynamic stretching.

Level	Pre test		Post Test	
	F	(%)	F	(%)
0	0	0	7	38,9
10	6	33,3	5	27,8
15	5	27,8	2	11,1
18	1	5,6	0	0
20	6	33,3	4	22,2
Mean	15,17		10,61	
Std.Deviation	4,260		6,251	

Based on Table 3, showed before the dynamic stretching almost half of the respondents had a joint extension of 20 and 10 degrees. After dynamic stretching almost half of the respondents (38.9%) had a joint extension of 0 degrees or normal. This change in knee extension can be seen from the results of the difference in mean before and after the intervention, namely 15.17 before the intervention and 10.61 after the intervention. Dynamic stretching is a stretching exercise by moving the body rhythmically

without maintaining the furthest stretching position (Kisner,2014). Mechanism of action for dynamic stretching, which is stretching, eating will help Fibers or abnormal cross links as elastic components result in stretching of the sarcomere so that stretching will restore elasticity. Dynamic stretching where the muscles around the joints are trained with bouncing or repeated movements so that muscle flexibility can increase and the ability of the joints to move optimally, easily, without any obstacles and pain (Kisner, 2014).

Table 4: Result of Statistical Test

Paired T Test	
Pre-post with Static Stretching	P= 0,004
Pre-post with Dynamic Stretching	P= 0,000
Independent T Test	
Statis-Dynamic Stretching	P=0,004

Based on the table 4, the results of the independent t-test statistical test obtained the value of the effect of static stretching (P value=0.004) which means that static stretching has an effect on extension knee joint. While the dynamic stretching (p -value = 0.000) which means that dynamic stretching also affects the extension of the knee joint. Meanwhile, the independent t-test showed that there was a difference between knee joint extension in static stretching and dynamic stretching (p = 0,004). The mean of the static stretching group was 13.72 while the dynamic stretching group was 10.61. Based on this mean, there is a difference in the average knee joint extension in the elderly between the static and dynamic stretching groups, where the average knee joint extension in the static stretching group is higher than the dynamic stretching group, which means that dynamic stretching is more effective in reducing insomnia levels in the elderly respondents.

DISCUSSION

Identification of Knee Joint Extension with Static Stretching in the Elderly

The results showed that before static stretching most of the respondents (55.6%) had a joint extension of 15 degrees, after static stretching almost half of the respondents (33.3%) had knee joint extensions of 15 and 10 degrees. This change in knee extension can be seen from the results of the difference in the mean before and after the intervention, namely 15.22 before the intervention and 13.72 after the intervention. This shows that there is a change in the degree of joint extension which means that there is an effect of static stretching on the extension of the knee joint in the elderly.

The factor of impaired knee joint extension in the elderly is the aging process. Aging is a natural process that cannot be avoided, runs continuously, and continuously causes anatomical, physiological, and biochemical changes in the body, so that it will affect the functions and abilities of the body as a whole (Maryam, 2012). Entering the elderly will experience a physical decline; physical decline will result in a decrease in muscle mass and flexibility. Thus, it can affect the ability of the elderly to fulfill their activities. Physical decline due to the aging process can be prevented in the elderly by performing various components of exercise. Components of exercise in the elderly can be provided with flexibility exercises.

In the static stretching exercise, the muscle is stretched for at least seven seconds; this is because the typing of the muscle proprioceptor on the stretched muscle spindle will produce an impulse signal that makes the muscle contract to fight the resistance of the stretch. Holding the movement for seven seconds will activate the Golgy tendon organ which will further inhibit the reaction of the muscle spindle and provide a relaxing effect so that the muscle can be stretched further (Faigenbaum, A., & McFarland Jr, JE (2005). With this stretch, also the muscle will be stretched passively the initial elongation occurs in the sarcomere component and the tension increases drastically. When the stretch is released, the sarcomere will return to its initial length before being stretched. This tendency of the muscle to return is called elasticity. Meanwhile, when the muscle is actively stretched, the first effect is will occur in elastin (actin and myosin), muscle tension increases sharply, sarcomere lengthens and if done continuously the muscles will adapt and will last for some time (Irfan & Natalia, 2008). get used to the muscles to change positions to a new position, however This is difficult to do considering that the longer this muscle lengthening state is carried out, the more intense the pain will be. This is in line with the incident when the research was conducted, the elderly complained of pain when withdrawing, moreover they also could not endure the pain they felt for too long. Each individual has a different pain limit, that's why the results given from static stretching are also different, but overall the respondents can't stand the pain until the maximum time is given. For this reason, the use of static stretching is considered less than optimal, coupled with other supporting factors.

Many things can affect the abnormality of joint extension in the elderly, one of which is age (Afonso, J *et al*, 2021). From the results of the research, all (100%) were over 70 years old resulting in a high chance of experiencing abnormal joint extensions. Increasing a person's age can affect a person's physical workload. The older a person gets, the elasticity of the blood vessels becomes less good so that blood circulation becomes not smooth and causes a decrease in flexibility and muscle strength. It is this decrease in flexibility that allows for abnormal joint extension changes such as the previously described process. In addition, the decrease in synovial fluid due to the aging process also contributes to the weight of the condition.

Changes that are not too significant or that do not bring results to a normal stage in knee joint extension in this case zero degrees (0°) make this static stretching intervention less effective in giving its effect on knee joint extension in the elderly, as also explained by the results. Sugiarto's research (2017) concluded that there was no significant difference in the effect of the duration of static stretching of the hamstring muscles on increasing knee joint extension in the elderly. It means that the duration of static stretching does not increase the extension of the knee joint in the elderly.

This is exacerbated by the characteristics of the respondents, where most (66.7) have never exercised. Elderly people who do not exercise to improve their mobility risk deteriorating their physical condition. By not developing mobility through exercise, the muscles' flexibility and joint motion are reduced, resulting in a problem with knee joint extension condition in the elderly. The elderly with good physical mobility will improve their physical balance control, lowering their chance of falling (Guccione, 2010). Good mobility can be obtained by doing physical exercises that are useful for maintaining good joint function and posture. Exercises are carried out in stages, adjusted to the abilities of the elderly. Although physical exercise is very much needed by the elderly even though it is useful for their health, most of the elderly still do not do this for their own reasons.

Besides that, there are still a small proportion (22.2%) of the elderly who still have the habit of smoking. Smoking has become a very common and widespread habit in society. The more often a person smokes, the more severe the impact will be felt when stepping on the elderly. The impact on musculoskeletal health is no exception. This habit is very difficult to get rid of because it has become a culture among the people, especially men, even though they know the impact is not good for health, but they cannot escape the culture that they have built since they were young.

Identification of Knee Joint Extension with Dynamic Stretching in the Elderly

From the table above, it can be seen that before dynamic stretching almost half of the respondents had a joint extension of 20 and 10 degrees, after dynamic stretching almost half of the respondents (38.9%) had a joint extension of 0 degrees or normal. This shows the effect of

dynamic stretching on knee joint extension in the elderly. Active movements that take joints and muscles through their full range of motion are known as dynamic stretching (Zhou, Wen-Sheng *et al*, 2019)

Characteristics of respondents who all (100%) have a history of rheumatic diseases triggering effusions and chronic inflammatory processes because the synovium which functions to produce synovial fluid, which is a lubricant in the joints, becomes inflamed. The knee joint has a strong ligamentous structure because it functions as a support for the body, this will also affect the possibility of stiffness in the knee joint (Papadopoulos, 2005) which causes abnormal knee joint extension in the elderly due to calcification in the elderly which reduces joint flexibility. Decreased joint flexibility and the formation of osteophytes in joint cartilage cause limited joint space. With this, dynamic stretching exercises are carried out because dynamic stretching can affect flexibility.

Flexibility can be defined as the ability of a joint and muscle, as well as the surrounding joint straps to move freely and comfortably within the expected maximum range of motion (Tortora & Grabowski, 2003). Flexibility is influenced by many factors, one of which is gender.

From most of the respondents, the results showed that most of the respondents (66.7%) were female. This is explained by Suharjana (2013) that physiologically, women's muscle strength is lower than men's and women's muscle strength is only about two-thirds of men's muscle strength so that men's muscle endurance is higher than women's muscles. The occurrence of the difference between the muscle strength of men and women is also influenced by their activities, men are more likely to do habits or work that uses muscles and bones than women because men are considered to have more strength than women.

In addition to gender, there are also other factors that affect flexibility related to the aging process. The aging process will affect changes in all body systems such as affecting the decrease in bone density, changes in muscle structure, decreased cartilage function, decreased muscle strength, and decreased flexibility of muscles and joints themselves. Lack of flexibility can lead to slower movement and susceptibility to injury to muscles, ligaments, and other tissues. With age, a person's flexibility will decrease. The best way to increase flexibility is with dynamic stretching

exercises. This is because when performing dynamic stretching exercises, the muscles around the joints are trained with bouncing or repeated movements in seconds so that muscle flexibility is expected to increase. Flexibility is the ability of joints to move with full ROM (Range of Motion), easily, without any obstacles and pain (Kisner, 2014). Therefore, this dynamic stretching intervention is suitable to provide changes to the abnormal knee joint extension in the elderly.

The characteristics of respondents who all (100%) work as farmers also have a good effect on increasing physical mobility in the elderly so as to train muscle and joint flexibility. Other research shows that the elderly does not have health problems in the musculoskeletal system with a habit of smoking because the majority of respondents are farmers whose daily activities help in training muscle and joint flexibility so that there are no significant complaints in the musculoskeletal system (Ibrahim, 2013).

Analysis of Differences between Static and Dynamic Stretching on Knee Joint Extension in the Elderly

From the results of research on knee joint extension after static stretching and dynamic stretching, the results of statistical tests using T-Test showed that static stretching had an effect on knee joint extension ($p=0,0004$) and dynamic stretching also affects knee joint extension ($p=0000$), while the difference in the magnitude of the effect shows p-value 0.004, this indicates that dynamic stretching is higher than static stretching on knee joint extension in the elderly.

Static stretching can affect knee joint extension, but changes in knee extension are not as good as the results of dynamic stretching. That is because dynamic stretching is a stretching movement that involves muscles and joints, this stretching movement is carried out slowly and controlled with the base of the movement being the base of the joint. The key and emphasis in this stretch is in how it is done slowly and in a controlled manner. As for what is meant by slow movement, which is done in a smooth way and not stomping. While the controlled movement, meaning that the movement is carried out until it reaches the range of motion of the joints that are subjected to exercise (Wiguna, 2012). In addition, dynamic stretching will quickly heat up the body and can eliminate stiffness in the joints. This happens because dynamic stretching is usually

done by moving the body or limbs rhythmically (rhythmically) with circular movements or bouncing the limbs. limbs, in such a way that the muscles are trained so that there is an increase in metabolism that makes the body hot and the muscles feel stretched, and the intention is to progressively increase the range of motion of the joints.

The goal of dynamic stretching is to maintain and increase the flexibility of joints, tendons, ligaments and muscles. The differences that occur between static and dynamic stretching, especially when carrying out the movement and the targets imposed in the exercise. Movement in static stretching after reaching pain (uncomfort) is maintained for some time, while in dynamic stretching it is the opposite, which is actively stretched as wide as the range of motion of the joints being trained. Static stretching does not have a significant effect on joint extension because it only relies on muscles and joints to get used to their new conditions and not train them, while the effectiveness of dynamic stretching is more effective because dynamic stretching has more effect on joint flexibility because the movements are repeated slowly. which has a high influence on flexibility (Pamungkas, 2016). As research conducted by Abbas and Sultana (2014) concluded that more active stretching has a greater effect on increasing hamstring flexibility. So it can be concluded that there is a significant difference in increasing hamstring flexibility by using the active method rather than passive stretching (Abbas & Sultana, 2014). Another opinion states that dynamic heating can increase power and performance of muscle strength compared to static heating (Shaharuddin et al, 2015)

CONCLUSION

According to the findings of the research, statistical testing utilizing the Paired T Test revealed that static stretching had an influence on knee joint extension, and dynamic stretching had an effect as well. Both of these treatments have the ability to influence joint extension. There was a difference between static and dynamic stretching when it came to knee joint extension. Static and dynamic stretching is required to avoid joint extension reduction during daily activities of elderly.

SUGGESTION

The elderly is expected to perform static and dynamic stretching activities that can be done in their daily lives to help them maintain their knee joint extension.

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