JURNAL SURYA
Jurnal Media Komunikasi Ilmu Kesehatan
Faculty of Health Sciences Universitas Muhammadiyah Lamongan
Volume 17 Issue 3 2025
e-ISSN: 2715-064X p-ISSN: 1979-9128

The Effect of Static Flexibility Training on Knee Joints Stiffness in Older Adults

Yasinta Lidia Sumarni, Rona Sari Mahaji Putri* and Hilda Mazarina Devi
Department of Nursing, Faculty of Health Science, University of Tribhuwana Tunggadewi, Malang, East Java, Indonesia

ARTICLE INFORMATION

Article process
Submission: June 4, 2025
Revision : December 24, 2025
Accepted : January 1, 2026

Co-Author
Rona Sari Mahaji Putri
ronasari@unitri.ac.id
Department of Nursing, Faculty of Health Science, University of Tribhuwana Tunggadewi, Malang, East Java, Indonesia

Cite this as:
Sumarni, Y. L., Putri, R. S. M., & Devi, H. M. (2025). The Effect of Static Flexibility Training on Knee Joints Stiffness in Older Adults. SURYA: J. Media Komunikasi Ilmu Kesehatan, 17 (3), 124-132. https://doi.org/10.38040/js.v17i3.1245

ABSTRACT

Introduction: Knee joint stiffness is a common musculoskeletal problem among older adults. Age-related physiological changes lead to a decline in physical function and mobility, resulting in a reduced range of motion in the joints. This study aimed to compare knee joint stiffness before and after the implementation of static flexibility training in older adults.

Methods: This quantitative experimental study employed a one-group pretest–posttest design. A total of 18 older adults experiencing knee joint stiffness at Betheseda Kasih Service Nursing Home were recruited using simple random sampling. Knee joint stiffness was measured using a goniometer and an observation sheet. Data were analyzed using the Wilcoxon signed-rank test. Static flexibility training was conducted six times over a two-week period (three sessions per week), with each session lasting approximately 15 minutes. Each session consisted of five movements performed for 10–20 repetitions.

Results: Prior to the intervention, the mean degree of knee joint stiffness was 75° (classified as stiff). Following the static flexibility training, the mean degree decreased to 48.89°, indicating a return to normal joint mobility. The Wilcoxon test showed a statistically significant effect of static flexibility training on reducing knee joint stiffness ($p = .000 < 0.001$).

Conclusion: Static flexibility training effective for improving joint mobility in older adults as a non-pharmacological approach. It is recommended to compare static and dynamic flexibility training effectiveness reducing knee joint stiffness among older adults in further study.

Keywords: Joint stiffness, Nutritional status, Older adults, Static flexibility training, Therapy

INTRODUCTION

Everyone experiences a life cycle that begins in infancy and progresses to old age. Older adults are defined as individuals, both male and female, aged 60 years and above. According to the World Health Organization (WHO, 2023), older

adulthood begins at the age of 60. Aging is accompanied by various physiological changes, including greying hair, facial wrinkles, reduced sensory acuity, and a gradual decline in physical endurance.

Joint stiffness is a common problem among older adults, particularly due to degenerative conditions such as osteoarthritis. The GBD (2019) reported that approximately 528 million people worldwide suffer from osteoarthritis, people worldwide were living with osteoarthritis, representing a 98% increase since 1990. About 73% of individuals with osteoarthritis are aged over 60 years, and 60% are women. The knee is the most frequently affected joint, followed by the hip and hand. In Indonesia, data indicated that the prevalence of osteoarthritis was approximately 73% among individuals aged over 55 years, with 60% sufferers were women. Furthermore, Prahastiwi (2023) reported that in East Java, the overall prevalence rates the overall prevalence of osteoarthritis was 6.72%, with the highest prevalence observed among individuals aged 75 years and older (18.95%).

Additional local data support these findings. A preliminary study conducted at the Kwanyar Health Center reported 184 cases of knee osteoarthritis in December 2022 (Rachmawati, 2022). In Malang Regency and Malang City, the prevalence of osteoarthritis in the older adults was reported to be 10% and 13.5%, respectively (Yohana et al., 2017). Knee joint stiffness is defined as a condition in which an individual experiences difficulty moving the joint smoothly, resulting in limited mobility (Shiel, 2024). Age-related declines in physical function and musculoskeletal capacity contribute to a reduction in joint range of motion, thereby increasing the risk of stiffness and functional impairment among older adults.

Joint stiffness can be managed through both pharmacological and non-pharmacological approaches. Pharmacological management commonly involves the use of non-opioid analgesics, particularly non-steroidal anti-inflammatory drugs (NSAIDs), to reduce pain and inflammation (Leny, 2022). In contrast, non-pharmacological interventions include physical therapy, light exercise, manual therapy, surgery, electrotherapy, thermotherapy, acupuncture, and the use of assistive devices (Leny, 2022). Among these approaches, light exercise is considered a safe and accessible method for reducing joint stiffness, especially in older adults.

Flexibility refers to an individual's ability to perform movements through a wide range of motion or to bend in various directions (Corbin, 1984). Flexibility exercises play an important role in physical fitness by reducing acute muscle tightness and cramps (De Vries, 1966), lowering the risk of injury (McHugh & Cosgrave, 2010), enhancing physical performance (Kay & Blazevich, 2009; McHugh & Nesse, 2008), improving postural stability (Nelson et al., 2012), and delaying the onset of muscle soreness (Herbert et al., 2011).

Static flexibility training has been shown to reduce joint stiffness and improve blood circulation to the muscles. Additionally, this type of training contributes to better posture by balancing muscle tension throughout the body and increasing muscle and joint elasticity (Takeuchi et al., 2025). These benefits are supported by a study conducted by Ulliya

(2019), which involved eight older adults, of whom 87.5% were female and 12.5% were male, all experiencing limited joint movement for more than eight months. The study demonstrated an increase in the average flexibility of both the right and left knee joints during the second measurement (after three weeks of flexibility training) and the third measurement (after six weeks). A statistically significant improvement was observed between the first and second measurements ($p = 0.005$), as well as between the first and third measurements for left knee joint flexion ($p = 0.001$).

This study is considered important because many older adults with joint stiffness rely primarily on pharmacological treatment, which may lead to additional health complaints due to the long-term chemical effects of medications. If static flexibility training is proven effective in reducing knee joint stiffness, older adults may be encouraged to perform this exercise regularly as a safe and non-pharmacological intervention. Therefore, the purpose of this study was to determine the effect of static flexibility training on knee joint stiffness in older adults.

METHOD

This study employed an experimental design using a one-group pretest-posttest approach. The research was conducted at Betheseda Kasih Service Nursing Home. A total of 18 participants were recruited into the intervention group using a simple random sampling technique. The inclusion criteria were female older adults aged ≥ 60 years, in accordance with WHO (2019), who experienced knee joint stiffness, were able to perform standing activities, and were willing to participate in this study. Participants were also required to consent to completing static flexibility training six times over two-week period.

The static flexibility training was administered six times, three sessions per week for two weeks, with each session lasting approximately 15 minutes. Each session consisted of five movements performed for 10-20 repetitions (days 1-6). Knee joint stiffness was assessed using a goniometer. Pre-test measurements were conducted on day 1, with participants in a sitting position. Post-test measurements were taken on day 6 using the same procedure and positioning to ensure consistency. The independent variable in this study was static flexibility training, while the dependent variable was knee joint stiffness. Data were analyzed using the Wilcoxon signed-rank test to determine the effect of static flexibility training on knee joint stiffness.

RESULTS

The Characteristics of Respondents

Table 1 shows that all respondents were female (n=18, 100%), the majority of participants were aged 60-74 years (n=13, 72.4%), and most had an overweight nutritional status, with a body mass index (BMI) of 25-29.9 Kg/m2 (n=12, 66.7%).

Table 2 indicates that participants who received static flexibility training demonstrated an improvement in knee joint stiffness, with 14 respondents (77.8%) shifting from “stiff” category to the “normal” category following the intervention.

Additionally, as showed in the Table 3, there was a notable reduction in knee joint stiffness, as evidenced by a decrease in the mean pre-test value (75o)

Table 1. Characteristics of Respondents

Variable	n	(%)
Age		
60-74	13	72.4%
75-90	5	27.6%
Nutritional status		
18.5-24.9 (Normal)	4	22.2%
25-29.9 (Overweight)	12	66.7%
≥30 (Obesity)	2	11.1%
Total	**18**	**100%**

Table 2. Frequency Distribution Based on Knee Joint Stiffness

Knee joint stiffness	Number of participants			
	Pre		Post	
	n	(%)	n	(%)
0-<60° (Normal)	0	0%	14	77.8%
>60° - 180° (Stiff)	18	100%	4	22.2%
Total	**18**	**100%**	**18**	**100%**

compared to the post-test (48.89o). Statistical analysis using the Wilcoxon signed rank test revealed a significant effect of static flexibility training on knee joint flexion stiffness (p-value<0.001) among older adults at Betheseda Kasih Service Nursing Homes.

DISCUSSION

Knee Joint Stiffness Before and After Being Given Static Flexibility Training

Before the implementation of static flexibility training, almost all respondents at Bethesda Kasih Service Nursing Home were categorized as having stiff knee joints. This finding indicates that knee joint stiffness was prevalent among the study participants. Joint stiffness was identified based on goniometer measurements exceeding 60°, reflecting limited knee joint mobility.

Several factors are known to influence knee joint stiffness, one of which is age. In this study, most respondents were aged 60–74 years, an age group commonly associated with degenerative musculoskeletal changes. In line with Felson (2019) the aging process is accompanied by increased periarticular muscle weakness, reduced joint flexibility due to cartilage calcification, and decreased chondrocyte function, all of which contribute to the development of knee osteoarthritis. Supporting this, data from the Hong et al.,(2020) demonstrated prevalence of radiographic knee osteoarthritis (Kellgren–Lawrence grade ≥2): 35.1% overall. Age group 60–69 years: prevalence of radiographic knee osteoarthritis 50.2%. Age group ≥80 years: prevalence of radiographic knee osteoarthritis 78.7% (highest). Prevalence was higher in women than in men.

Gender also plays a significant role in knee joint stiffness. All respondents in this study were female, a group known to have a higher risk of osteoarthritis. Women are particularly vulnerable due to hormonal changes associated with aging and menopause. The osteoarthritis progression is more dominant in women. Following menopause, decreased estrogen levels affect osteoblast and endothelial cell activity, resulting in reduced production of transforming growth factor-β (TGF-β) and nitric oxide (NO) (Grant, 2023). These changes promote increased osteoclast differentiation and bone resorption. Additionally, reduced estrogen levels impair calcium absorption and renal calcium reabsorption,

Table 3. The Effect of Static Flexibility Training on Knee Joint Stiffness

Static flexibility training	n	Mean	Median	SD	*p-value*
Pre test	18	75	75	9.852	0.000
Post test	18	48.89	50	8.324	

leading to hypocalcemia and elevated parathyroid hormone levels, which further accelerate bone degradation and contribute to osteoarthritic changes.

Nutritional status is another important factor associated with knee joint stiffness. In this study, the majority of respondents were classified as overweight, suggesting an imbalance between dietary intake and physical activity. Reduced physical activity in older adults often leads to increased body weight, which places additional mechanical stress on weight-bearing joints. Messier identified obesity as a major contributing factor to osteoarthritis, noting that individuals with a body mass index (BMI) of 30 - 35 kg / m^3 have approximately twice the risk of developing osteoarthritis compared to those with normal weight (Messier et al., 2008). Furthermore, elevated BMI is associated with increased levels of inflammatory mediators that exacerbate joint degeneration (Wang & He, 2018). Excess body weight also increases joint loading, accelerates cartilage wear, and raises the likelihood of osteoarthritis occurrence (Robbins & Judge, 2009).

A history of trauma, including accidents and falls, also contributes to knee joint stiffness. In this study, most respondents reported a history of accidents, and nearly all had experienced falls, indicating a high prevalence of joint trauma. Previous research has shown that joint deformities resulting from trauma can lead to abnormal mechanical stress and increase the risk of osteoarthritis (Dilley et al., 2023). Acute knee injuries, such as cruciate ligament and meniscal tears, have been identified as significant risk factors for the onset of knee osteoarthritis (Prima et al., 2019).

In summary, knee joint stiffness among older adults in this study was influenced by multiple interrelated factors, including age, female gender, overweight nutritional status, and a history of joint trauma. These factors collectively contributed to limited knee joint flexion, resulting in a high degree of stiffness among respondents prior to the static flexibility training intervention.

Knee Joint Stiffness in Older Adults After Static Flexibility Training

Following the implementation of static flexibility training, almost all respondents at Bethesda Kasih Service Nursing Homes demonstrated an improvement in the degree of knee joint stiffness compared to their pre-intervention condition. This finding indicates that static flexibility training was effective in reducing knee joint stiffness, with most participants transitioning from the “stiff” category to the “normal” category. These results suggest that static flexibility exercises can enhance joint mobility in older adults.

Flexibility training is recommended to be performed at least twice within each exercise session, particularly during the warm-up and cool-down phases. An individual’s level of flexibility can be

assessed based on joint range of motion and muscle elasticity. Muscle elasticity tends to decline when physical exercise is performed infrequently or discontinued for extended periods. Adequate flexibility facilitates daily activities and reduces the risk of musculoskeletal injury. Stretching is widely recognized as an effective method for maintaining and improving flexibility (Ayers, 2011).

Flexibility is defined as the ability of muscles and joints to move optimally through their full range of motion (Health, 2025). Laughlin recommended static flexibility exercises to be performed at least three times per session, slowly and continuously, with each stretch held for 10–30 seconds (Laughlin, 2014). These exercises can be applied to all joints or targeted to specific joints affected by pathological conditions. Static flexibility training aims to promote musculoskeletal health by increasing muscle elasticity and the extensibility of joint connective tissues, reducing muscle tension and mechanical stress, and minimizing the risk of injury (Ingram et al., 2024).

In conclusion, static flexibility training represents an effective non-pharmacological approach for managing knee joint stiffness in older adults. The benefits of this intervention include improved posture through balanced muscle tension, enhanced muscle and joint elasticity, reduced muscle stress and tension during movement, and a lower risk of injury during both exercise and daily activities. These findings support the regular incorporation of static flexibility exercises into physical activity programs for older adults to maintain joint function and mobility.

The Effect of Static Flexibility Training on Knee Joint Stiffness in Older Adults

The results of this study demonstrated a significant effect of static flexibility training on knee joints stiffness among older adults. A clear difference was observed in the degree of knee joint stiffness before and after the intervention, indicating that static flexibility training effectively reduced joint stiffness.

Joint stiffness is a condition when a person cannot move the joint smoothly. Decreased joint stiffness is due to the meniscus strengthening against the tibia which moves against the femur, when the meniscus strengthens due to the ligament associated with the joint capsule, it will be pulled anteriorly and upward, preventing movement between the condylus on the opposite side (Ibrahim et al., 2015). The anterior cruciate ligament will tighten during extension and relax during flexion, this occurs when there are flexion and extension movements in static flexibility exercises (Marieswaran et al., 2018). In this study, static flexibility exercises were carried out six times for two-weeks in a sitting position, the exercise movements were carried out slowly and continuously, and each movement was held for approximately 10 seconds. Participants were instructed to perform warm-up exercises prior to the intervention to prepare the muscles and joints and reduce the risk of injury.

The findings of this study are consistent with previous research. A study reported a significant effect of joint range-of- motion exercise on the flexibility among older adults (p value<0.05), with knee joint flexibility before performing stretching exercises improving from a value 80 to 50

after the intervention (Ibrahim et al., 2015). Similarly, a study demonstrated increased knee joint flexibility due to the influence of expanding the knee joint range of motion (Wahyuni et al., 2024). These findings support the effectiveness of static flexibility training in improving knee joint mobility.

Based on these results, the research hypothesis stating that static flexibility training has a significant effect on reducing knee joint stiffness among older adults at Betheseda Kasih Service Nursing Home is accepted.

CONCLUSION

The findings of this study indicate that static flexibility training has a significant effect on reducing the degree of knee joint stiffness among older adults, as evidenced by a statistically significant difference in stiffness levels before and after the intervention (p-value<0.001). The intervention resulted in a meaningful reduction in knee joint stiffness, demonstrating the effectiveness of static flexibility training as a non-pharmacological approach for improving joint mobility in older adults.

Based on these findings, future research is recommended to compare the effects of static and dynamic flexibility exercises to determine the relative effectiveness of each intervention in reducing knee joint stiffness among older adults.

REFERENCES

Ayers, J. (2011). Resolving The Adaptation Paradox: Exploring The Potential For Deliberative Adaptation Policy-Making In Bangladesh. Global Environmental Politics, 11(1), 62–88.

Corbin, C. B. (1984). Flexibility. Clinics In Sports Medicine, 3(1), 101–117.

De Vries, H. A. (1966). Quantitative Electromyographic Investigation Of The Spasm Theory Of Muscle Pain. American Journal Of Physical Medicine & Rehabilitation, 45(3), 119–134.

Dilley Je, Bello Ma, Roman N, Mckinley T, Sankar U. (2023). Post-Traumatic Osteoarthritis: A Review Of Pathogenic Mechanisms And Novel Targets For Mitigation. Bone Rep. Jan 30;18:101658. Doi: 10.1016/J.Bonr.2023.101658. Pmid: 37425196; Pmcid: Pmc10323219.

Felson, D.T.,Neogi T Felson David T., Neogi T. (2019). Osteoarthritis. Harrison's Principles Of Internal Medicine Seventeenth Edition. New York, United States Of America. Mcgraw-Hill Companies Inc. : 2158-2165.

Grant, A. (2023). Ross & Wilson Pathophysiology E-Book. Elsevier Health Sciences.

Gbd 2019: Global Burden Of 369 Diseases And Injuries In 204 Countries And Territories, 1990–2019: A Systematic Analysis For The Global Burden Of Disease Study 2019. Https://Vizhub.Healthdata.Org/Gbd-Results/.

Hong Jw, Noh Jh, Kim Dj. (2020).The Prevalence Of And Demographic Factors Associated With Radiographic Knee Osteoarthritis In Korean Adults Aged ≥ 50 Years: The 2010-2013 Korea National Health And Nutrition Examination Survey. Plos One. 2020 Mar 20;15(3):E0230613. Doi: 10.1371/Journal.Pone.0230613. Pmid: 32196540; Pmcid: Pmc7083301.

Health, Uc Davis. (2025). Flexibility: Sports Medicine Resources. Flexibility Is Described As The Ability Of A Joint To Move Through An Unrestricted, Pain-Free Range Of Motion. Diakses Dari Https://Health.Ucdavis.Edu/Sports-Medicine/Resources/Flexibility

Herbert, R. D., De Noronha, M., & Kamper, S. J. (2011). Stretching To Prevent Or Reduce Muscle Soreness After Exercise. Cochrane Database Of Systematic Reviews, 7.

Ingram, L. A., Tomkinson, G. R., D'unienville, N. M. A., Gower, B., Gleadhill, S., Boyle, T., & Bennett, H. (2025). Optimising The Dose Of Static Stretching To Improve Flexibility: A Systematic Review, Meta-Analysis And Multivariate Meta-Regression. Sports Medicine (Auckland, N.Z.), 55(3), 597–617. Https://Doi.Org/10.1007/S40279-024-02143-9

Ibrahim, R. C., Polii, H., & Wungouw, H. (2015). Pengaruh Latihan Peregangan Terhadap Fleksibilitas Lansia. Ebiomedik, 3(1).

Kay, A. D., & Blazevich, A. J. (2009). Moderate-Duration Static Stretch Reduces Active And Passive Plantar Flexor Moment But Not Achilles Tendon Stiffness Or Active Muscle Length. Journal Of Applied Physiology, 106(4), 1249–1256.

Laughlin, P. (2014). Holistic Customer Insight As An Engine Of Growth. Journal Of Direct, Data And Digital Marketing Practice, 16(2), 75–79.

Leny, B. N. (2022). Studi Penggunaan Obat Pada Pasien Osteoarthritis Usia Lanjut Di Instalasi Rawat Jalan Rumah Sakit Umum Daerah Provinsi Ntb Periode 2019. Jurnal Ilmu Kefarmasian, 3(2).

Marieswaran, M., Jain, I., Garg, B., Sharma, V., & Kalyanasundaram, D. (2018). A Review On Biomechanics Of Anterior Cruciate Ligament And Materials For Reconstruction. Applied Bionics And Biomechanics, 2018, 4657824. Https://Doi.Org/10.1155/2018/4657824

Mchugh, M. P., & Cosgrave, C. H. (2010). To Stretch Or Not To Stretch: The Role Of Stretching In Injury Prevention And Performance. Scandinavian Journal Of Medicine & Science In Sports, 20(2), 169–181.

Mchugh, M. P., & Nesse, M. (2008). Effect Of Stretching On Strength Loss And Pain After Eccentric Exercise. Medicine And Science In Sports And Exercise, 40(3), 566.

Messier, W. F., Glover, S. M., Prawitt, D. F., Paisley, N., & Springate, G. C. (2008). Auditing & Assurance Services: A Systematic Approach. Mcgraw-Hill Irwin Boston, Ma.

Nelson, A. G., Kokkonen, J., Arnall, D. A., & Li, L. (2012). Acute Stretching Increases Postural Stability In Nonbalance Trained Individuals. The Journal Of Strength & Conditioning Research, 26(11), 3095–3100.

Prima, A., Kridasuwarso, B., Setiakarnawijaya. (2020). Latihan Fleksibilitas Statis Bagi Persendian Ekstremitas Inferior Lansia Static Flexibility Exercise For Inferior Extremity Joints Of The Elderly. Jurnal Sportif: Jurnal Penelitian Pembelajaran, 6(1)

Rachmawati, D. (2022). Hubungan Usia Dan Riwayat Cedera Sendi Lutut Dengan Kejadian Osteoarthritis Pada

Lansia Menggunakan Womac (Studi Di Wilayah Kerja Puskesmas Kwanyar). Stikes Ngudia Husada Madura.

Prahastiwi ,Ra. (2023). Perbandingan Proporsi Panjang Tungkai Terhadap Imt Pada Petani Dengan Osteoarthritis Dan Non-Osteoarthritis Genu Di Desa Jenggawah Kabupaten Jember. Universitas Jember.Repository. Https://Repository.Unej.Ac.Id/Handle/123456789/123782?Utm_Source=Chatgpt.Com

Robbins, S. P., & Judge, T. (2009). Organizational Behavior. Pearson South Africa.

Shiel, Wv.(2024). Arthritis (Joint Inflamation). Medicinenet. Https://Www.Medicinenet.Com/Arthritis/Article.Htm

Takeuchi, K., Nakamura, M., Konrad, A., Mizuno, T.(2025). Long-Term Static Stretching Can Decrease Muscle Stiffness: A Systematic Review And Meta-Analysis. Scand J Med Sci Sports, 33(8). Https://Pubmed.Ncbi.Nlm.Nih.Gov/37231582/

Ulliya, S., Soempeno, B., & Kushartanti, B.W. (2019). Pengaruh Latihan Range Of Motion (Rom) Terhadap Fleksibilitas Sendi Lutut Pada Lansia Di Panti Wreda Wening Wardoyo Ungaran. Nurse Media Journal Of Nursing, 1(2)

Wahyuni, A., Safei, I., Hidayati, P. H., Buraena, S., & Mokhtar, S. (2024). Karakteristik Osteoarthritis Genu Pada Lansia Yang Mendapatkan Rehabilitasi Medik Di Rsud Hajjah Andi Depu. Fakumi Medical Journal: Jurnal Mahasiswa Kedokteran, 4(1), 62–72.

Wang, T., & He, C. (2018). Pro-Inflammatory Cytokines: The Link Between Obesity And Osteoarthritis. Cytokine & Growth Factor Reviews, 44, 38–50. Https://Doi.Org/10.1016/J.Cytogfr.2018.10.002

Who, W. (2023). Ageing. Https://Www.Who.Int/Health-Topics/Ageing#Tab=Tab_1

Yohana, Y., Hariyanto, T., & Rosdiana, Y. (2017). Perbedaan Intensitas Nyeri Osteoartritis Pada Lansia Sebelum Dan Sesudah Dilakukan Kompres Hangat Di Kelurahan Tlogomas Malang. Nursing News: Jurnal Ilmiah Keperawatan, 2(1).