Available online at: http://journal.unj.ac.id/unj/index.php/gjik
Gladi: Jurnal Ilmu Keolahragaan 16 (01) 2025, 125-135
Permalink/DOI: https://doi.org/10.21009/GJIK.161.12

THE EFFECT OF STATIC STRETCHING ON MUSCLE FLEXIBILITY IMPROVEMENT IN TAEKWONDO ATHLETES

Muhamad Rasendria[1], Dede Rohmat Nurjaya[2*], Sagitarius[3], Mulyana[4]

[1234]Sports Coaching Education, Universitas Pendidikan Indonesia, Bandung, Indonesia

Corresponding author: dede-rohmat-n@upi.edu

Abstract. This study examines the impact of static stretching on flexibility improvement in Taekwondo athletes. Specifically, the purpose of the research is to observe the effects of implementing this method over 14 sessions (conducted three times per week). The research method used is an experimental design with a one-group pretest-posttest design. The sample in this study was selected using purposive sampling, consisting of 12 athletes. To measure flexibility, the study employed the Maximal Hip Flexion Activation Knee Extension (MHFAKE) test. Quantitative data were analyzed using the Wilcoxon test. The results show that static stretching significantly improves flexibility, with the average score increasing from 35.83 to 21.66 (50.00%). The Wilcoxon test indicated a p-value of 0.002 < 0.05, meaning the alternative hypothesis (Ha) is accepted, and there is a significant effect. In conclusion, static stretching has a significant impact on the improvement of flexibility in Taekwondo athletes' muscles.

Keywords: static stretching; muscle flexibility; taekwondo

Copyright © 2025 Muhamad Rasendria, Dede Rohmat Nurjaya, Sagitarius, Mulyana
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License

INTRODUCTION

In the realm of sports, muscle flexibility plays an essential role in optimizing athletic performance (Saputra et al. 2025). Flexibility directly impacts an athlete's range of motion, allowing for more fluid, efficient, and powerful movements (Sari et al. 2024). It is particularly crucial in sports such as Taekwondo, where high-intensity movements like powerful kicks, explosive jumps, and quick directional changes are vital for success. The ability to perform these movements with precision and force requires an athlete to possess superior muscle flexibility, which, in turn, helps reduce the risk of injury (Almansoof, Nuhmani, and Muaidi 2023; Stone et al. 2024). Among the various techniques available to improve flexibility, one of the most commonly utilized methods is static stretching. Static stretching refers to the practice of holding a stretch for an extended period without any dynamic movement.

During static stretching, a muscle is lengthened to the point of slight discomfort and held in that position for a specific duration—typically between 15 to 60 seconds. This method is known for its ability to enhance muscle elasticity by gradually lengthening muscle fibers and the connective tissues around the joints. Over time, consistent static stretching can lead to permanent increases in flexibility and improvements in the overall range of motion of the muscles and joints. Taekwondo is a highly dynamic and demanding martial art, requiring athletes to perform a wide range of movements, from high and powerful kicks to intricate footwork and sudden directional shifts (Wang et al. 2024; Yearby et al. 2024). To execute these actions with accuracy and power, athletes must maintain a high level of flexibility in key muscle groups such as the hip flexors, hamstrings, quadriceps, and calves. This flexibility allows athletes to perform more explosive movements and helps to prevent injuries that could arise from muscle tightness or limited range of motion. The study found that athletes who demonstrated better flexibility performed superior kicking techniques, had improved balance, and showed enhanced overall Taekwondo proficiency when compared to their less flexible counterparts.

Muscle flexibility also plays a role in enhancing an athlete’s ability to recover after intense training sessions. The demanding nature of the sport often leads to muscle fatigue and stiffness, particularly in the legs and lower body. Without proper flexibility, recovery can be prolonged, and the athlete’s next training session or competition

performance may be compromised (Podlogar and Wallis 2022). Regular flexibility training, particularly static stretching, can help alleviate muscle tension, improve circulation, and aid in the recovery process (Gupta et al. 2023). While static stretching has been shown to enhance flexibility and improve performance, there is an ongoing debate regarding the optimal timing for its implementation within training programs. Some studies have suggested that performing static stretching before high-intensity training or competition may temporarily impair muscle strength and power output, which could potentially compromise an athlete's performance in activities that require explosive movements, such as Taekwondo (Gupta et al. 2023). This reduction in muscle stiffness could hinder an athlete's ability to generate maximal force during explosive actions such as high kicks or rapid footwork. However, other studies have shown that static stretching can be beneficial when applied at the right time, particularly after training or competition.

Stretching post-exercise can help alleviate muscle stiffness, reduce muscle soreness, and improve recovery times (Daneshjoo et al. 2024; Sohail et al. 2022). In Taekwondo, where training intensity can lead to significant muscle tightness, static stretching after practice may aid in restoring flexibility and reducing the risk of post-training muscle soreness (Zemková 2022). On the other hand, static stretching before training may not be as beneficial in the context of high-intensity, explosive sports like Taekwondo. In these cases, athletes may benefit more from dynamic stretching or a general warm-up that engages the muscles in a more active manner. Dynamic stretching involves controlled movements that gently move the muscles and joints through their full range of motion, which can prepare the body for high-intensity activity without the potential drawbacks of static stretching. However, the timing of static stretching is crucial. While it can be beneficial for recovery and flexibility maintenance when performed after training, it may not be ideal before high-intensity activities due to its potential to temporarily reduce muscle strength and power output. Therefore, Taekwondo athletes should aim to integrate static stretching at the appropriate times, alongside other flexibility training techniques, to maximize performance benefits while minimizing the risk of injury. Based on the background above, this study aims to analyze the effect of static stretching on the improvement of muscle flexibility in Taekwondo athletes. By gaining a deeper understanding of its impact, it is hoped that this research can provide

insights for coaches and athletes in developing more effective training strategies to enhance performance and prevent injuries.

METHOD

This research employs an experimental design with a one-group pretest-posttest approach. The study was conducted at the FPOK UPI Padasuka Campus, located in Bandung City, West Java, involving a total of 12 participants. Participants were selected based on the following criteria: 1) Actively practicing Taekwondo for more than 2 years, 2) Having participated in at least two Taekwondo competitions, and 3) Aged 19 years. The static stretching exercises were performed passively, with participants pairing up to carry out stretches such as the squat groin stretch, split, modified hurdle stretch, butterfly stretch, and knee-to-chest stretch. Each stretch was held for 8 seconds and repeated 3 times. To measure hamstring flexibility, the Maximal Hip Flexion Activation Knee Extension (MHFAKE) test was employed. This test assesses the knee extension angle to gauge the length of the hamstring muscle, with the smaller angle indicating better flexibility (Seref et al., 2018). The MHFAKE test was conducted both before and after the static stretching intervention. Initially, a pre-test measurement was taken, followed by 14 sessions of static stretching, and concluding with a post-test at the end of the sessions. The results of the study will be presented in various tables, including: 1) Sample Profile Table, 2) Descriptive Statistics Table, 3) Normality Test Results, 4) Homogeneity Test Results, and 5) Percentage Improvement Table. These tables will provide a comprehensive overview of the data, help analyze the effects of static stretching on hamstring flexibility, and present the findings clearly.

RESULT

The results of this study are analyzed based on the characteristics of the participants. The participants met the following criteria: 1) They have been actively practicing Taekwondo for more than 2 years, 2) They have participated in at least two Taekwondo competitions within their respective categories, and 3) They are aged 19 years. These criteria were used to ensure that the participants had sufficient experience in Taekwondo and were physically mature enough to engage in the study's static stretching

interventions. A total of 12 athletes have been tested in the pre test and posttest for more details can be seen in the table below:

Table 1. Pretest and Posttest Test Data

No	Name	Age	Pre-Test	Post-Test	Difference	Precentage of difference
1.	BR	19 Years Old	40°	30°	10°	5,9%
2.	MI		50°	30°	20°	11,8%
3.	EL		50°	30°	20°	11,8%
4.	RF		40°	20°	20°	11,8%
5.	HB		40°	30°	10°	5,9%
6.	RT		30°	20°	10°	5,9%
7.	HF		30°	20°	10°	5,9%
8.	DV		20°	10°	10°	5,9%
9.	HN		40°	30°	10°	5,9%
10.	YL		40°	20°	20°	11,8%
11.	JN		30°	10°	20°	11,8%
12.	RF		20°	10°	10°	5,9%

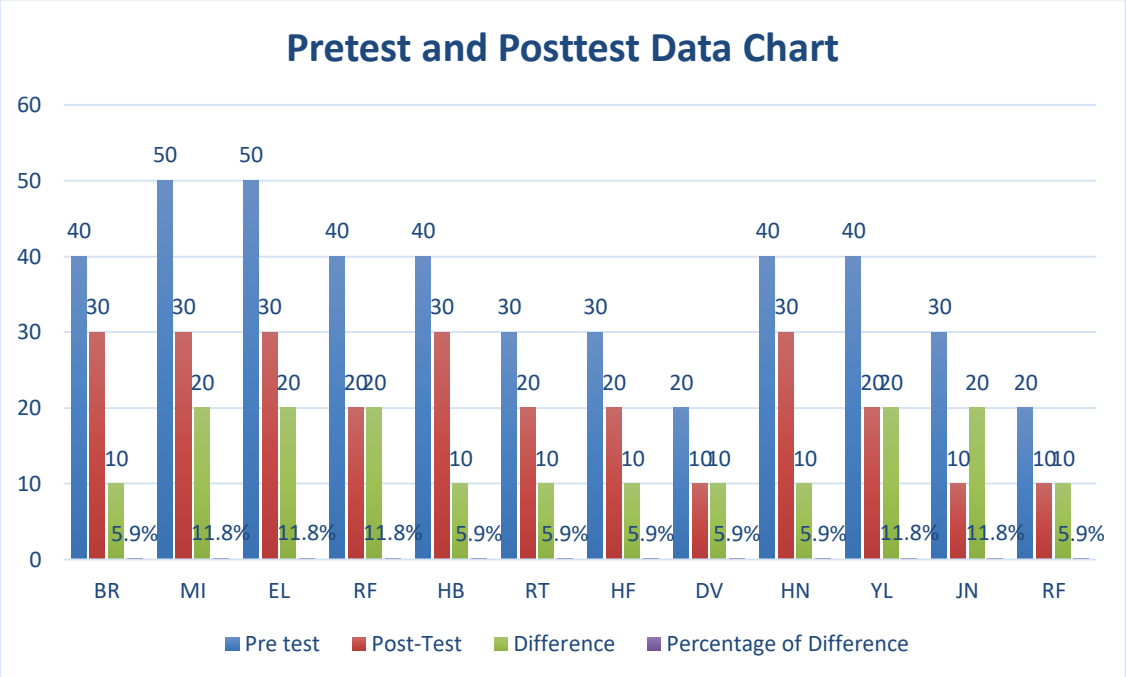

Figure 1. Pretest and Posttest MHFAKE (Maximal Hip Flexion Active Knee Extension Test)

Based on the data presented in Table 1 and Table 2, the results from the pretest and posttest for the experimental group of 12 athletes are as follows: The highest pretest score was 20, while the highest posttest score was 10. Conversely, the lowest pretest score

was 40, and the lowest posttest score was 30. The smallest difference between pretest and posttest scores was 20, and the largest difference was 10. These results suggest that the athletes showed varying levels of improvement in flexibility, with some demonstrating more significant progress than others. The smallest difference indicates that one athlete experienced a lesser improvement, while the largest difference indicates the greatest flexibility improvement. To present these findings, the data collected from the measurements was processed and analyzed using statistical methods. Initially, the data was raw, requiring standardization for further analysis. The analysis was conducted using Statistical Product and Service Solution (SPSS) version 29 to ensure the accuracy of the results. The data from the measurements can be seen in **Table 3**.

Table 2. Descriptive Statistics for Pretest and Posttest MHFAKE Scores

Descriptive Statistics

	N	Range	Minimum	Maximum	Mean	Std. Deviation
Pre-Test Flexibility	12	30	20	50	35.83	9,962
Post-Test Flexibility	12	20	10	30	21.67	8,348
Valid N (listwise)	12					

Based on the provided data, Table 2 presents the updated and accurate Descriptive Statistics for both the Pretest and Posttest results from the MHFAKE (Maximal Hip Flexion Active Knee Extension Test). The data reveals a significant effect of static stretching on the improvement of muscle flexibility in Taekwondo athletes. After conducting the descriptive analysis, the next step is to process the data further in order to test the hypothesis. This will begin with normality and homogeneity tests, which are essential for ensuring the appropriateness of the subsequent statistical tests and to validate the results of the intervention.

Tabel 3. Normality Test *Shapiro-Wilk*

Tests of Normality

		Shapiro-Wilk		
	Class	Statistic	df	Sig.
Result	Pre-Test Flexibility	,895	12	,137
	Pos-Test Flexibility	,802	12	,010

Based on Table 3, it is shown that the initial and final test data changes are normally distributed, as the significance value is greater than 0.05 (5%). The result of this normality test will determine the choice of statistical test to use, whether parametric or non-parametric. If the data is normally distributed or the significance value is greater than 0.05, the next step is to use a paired samples t-test. If the data is not normally distributed or the significance value is less than 0.05, the next step is to use the Wilcoxon test or Mann-Whitney test. From the normality test results as presented in the data above, the significance value for the pretest flexibility is 0.137, which is greater than 0.05, indicating normal distribution. However, the posttest flexibility has a significance value of 0.010, which is less than 0.05, indicating non-normal distribution. Therefore, a **Wilcoxon test** and **Mann-Whitney test** will be used for further analysis.

Tabel 4. Test Homogeneity

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Result	Based on Mean	,435	1	22	,516
	Based on Median	,103	1	22	,752
	Based on Median and with adjusted df	,103	1	18,941	,752
	Based on trimmed mean	,405	1	22	,531

Based on the table above, the result of the Levene's Test for Equality of Variances shows a significance value of 0.531, which is greater than 0.05. This indicates that the variance of both the initial test and the final test (MHFAKE - Maximal Hip Flexion Active Knee Extension Test) is homogeneous, meaning that the data for both tests come from the same variance. The significance test for the effect of static stretching on the improvement of muscle flexibility in taekwondo athletes was conducted using the Wilcoxon Signed-Rank Test because the normality test showed that the posttest flexibility data was not normally distributed. The results of the Wilcoxon Signed-Rank Test are as follows:

Tabel 5. Result Test Wilcoxon

	Posttest -Pretest
Z	-3.153[b]
Asymp. Sig. (2-tailed)	,002

Based on Table 4.6, the results of the Wilcoxon Signed-Rank Test show that the calculated Z-value is -3.153 and the significance value (sig) is 0.002. Since the p-value (2-tailed) is 0.002, which is less than 0.05, we can reject the (H_0) and accept the (H_a). Therefore, it can be concluded that there is a significant effect of static stretching on the improvement of muscle flexibility in taekwondo athletes.

DISCUSSION

Based on the data analysis results using the Wilcoxon test, an improvement in muscle flexibility was observed in taekwondo athletes. Static stretching works by elongating muscle fibers and connective tissues such as tendons and ligaments. This process allows the muscles to move through a wider range of motion. When muscles are stretched, microscopic changes occur in the muscle fibers and connective tissues, enhancing muscle elasticity. In the long term, muscles that are frequently stretched become more elastic and have a greater capacity to stretch. This increase in flexibility not only enhances the range of motion but also helps in preventing injuries by reducing muscle stiffness and improving overall muscle function. Regular static stretching can thus play a crucial role in optimizing athletic performance and maintaining joint health, especially in sports like taekwondo, where flexibility is essential for executing high kicks and other dynamic movements. One of the main benefits of static stretching is its ability to reduce muscle soreness, which often occurs after heavy physical activity. Muscle stiffness can hinder mobility and increase the risk of injury. Through regular stretching, muscle tightness can be minimized, contributing to improved flexibility. Several studies have been conducted to measure the impact of static stretching on muscle flexibility. One such study by Warneke et al (2022) showed that static stretching could reduce muscle tension after physical activity and improve muscle flexibility. This research also noted that static stretching could enhance the ability of muscles to perform over a longer period without injury. By regularly engaging in static stretching, athletes and individuals can maintain or increase their muscle flexibility, which not only improves performance but also contributes to better recovery post-exercise and a reduced risk of long-term injuries.

Muscle flexibility is a crucial factor in taekwondo, which relies on various high kick techniques, body rotations, and explosive movements that require a wide range of motion. **Static stretching** has long been used as a method to improve muscle flexibility,

involving holding a stretch position for a certain duration without active movement. This technique aims to lengthen muscle fibers, increase joint range of motion, and reduce muscle stiffness, allowing athletes to perform movements with greater flexibility without increasing the risk of injury (Sulowska-Daszyk and Skiba 2022). By incorporating static stretching into training, taekwondo athletes can enhance their performance, particularly in executing high kicks and other dynamic actions that demand superior flexibility and mobility.

Several studies have shown that static stretching can improve muscle flexibility in the long term. Mehraban Jahromi, Vlček, and Grünerová Lippertová (2024) found that when muscle fibers are subjected to static stretching, structural adjustments occur that reduce the resistance of muscle and tendon tissues. This adaptation allows for a significant increase in range of motion when performed regularly over several weeks. These findings highlight the effectiveness of static stretching as a method to improve flexibility, especially for athletes who require a broad range of motion for their sports performance. By regularly engaging in static stretching, individuals can experience lasting improvements in flexibility and overall muscle function. In the context of taekwondo, better flexibility is crucial for executing higher and faster kicks. For instance, kicks such as dollyo chagi (roundhouse kick) and bandal chagi (axe kick) require high flexibility in the hamstring, adductor muscles, and hip flexors. If muscle flexibility is not optimal, athletes may experience limited movement, which can hinder the performance of their techniques. Adequate flexibility allows taekwondo athletes to perform these dynamic and complex movements with greater precision and fluidity, ultimately enhancing their overall performance and reducing the risk of injury. Regular stretching, particularly static stretching, can be a key component in improving the flexibility necessary for executing these advanced techniques effectively.

CONCLUSION

Based on the results of the study, it can be concluded that static stretching effectively improves hamstring muscle flexibility in Taekwondo athletes with an average age of 19 years. The average pre-test hamstring flexibility score was 35.83°, and the post-test average score was 21.66°, representing a 50% improvement. This indicates that static stretching has a significant impact on increasing muscle flexibility in Taekwondo athletes.

Enhanced muscle flexibility is crucial in Taekwondo as it allows athletes to perform kicks with a greater range of motion, improves movement efficiency, and reduces the risk of injury. Several studies have demonstrated that static stretching provides benefits through the following primary mechanisms: 1) The reduction of muscle and connective tissue stiffness, which allows muscles to stretch further with minimal resistance, 2) Neuromuscular adjustments that decrease stretch reflex activity and allow for a greater range of motion, and 3) Structural adaptations of muscles, as increased muscle fiber length results from consistent stretching exercises. These mechanisms collectively contribute to improved muscle flexibility, enhancing athletic performance and reducing the risk of injury, particularly in sports like Taekwondo, where flexibility is essential for executing high and explosive kicks.

However, although static stretching is effective in improving flexibility, its implementation in Taekwondo training programs should be tailored to the specific needs of the athletes. Static stretching is most beneficial when performed after training as part of the cool-down process, as it promotes long-term flexibility improvements and accelerates muscle recovery. Conversely, dynamic stretching is more recommended as a warm-up before training or competitions because it enhances blood flow and prepares muscles for activity without compromising strength and explosiveness. By incorporating both static and dynamic stretching appropriately within their training routines, Taekwondo athletes can optimize flexibility while maintaining their performance during high-intensity activities.

REFERENCES

Almansoof, Haifa Saleh, Shibili Nuhmani, and Qassim Muaidi. 2023. “Role of Kinetic Chain in Sports Performance and Injury Risk: A Narrative Review.” *Journal of Medicine and Life* 16(11):1591–96. doi: 10.25122/jml-2023-0087.

Daneshjoo, Abdolhamid, Elham Hosseini, Safoura Heshmati, Mansour Sahebozamani, and David George Behm. 2024. “Effects of Slow Dynamic, Fast Dynamic, and Static Stretching on Recovery of Performance, Range of Motion, Balance, and Joint Position Sense in Healthy Adults.” *BMC Sports Science, Medicine and Rehabilitation* 16(1):1–11. doi: 10.1186/s13102-024-00841-5.

Gupta, Ujjwal, Ankita Sharma, Moattar R. Rizvi, Mazen M. Alqahtani, Fuzail Ahmad, Faizan Z. Kashoo, Mohammad Miraj, Mohammad R. Asad, Shadab Uddin, Waseem M. Ahamed, Saravanakumar Nanjan, Sayed A. Hussain, and Irshad Ahmad. 2023. “Instrument-Assisted Soft Tissue Mobilization Technique versus Static Stretching in Patients with Pronated Dominant Foot: A Comparison in Effectiveness on

Flexibility, Foot Posture, Foot Function Index, and Dynamic Balance." *Healthcare (Switzerland)* 11(6). doi: 10.3390/healthcare11060785.

Mehraban Jahromi, Mostafa, Přemysl Vlček, and Marcela Grünerová Lippertová. 2024. "Stretching Exercises in Managing Spasticity: Effectiveness, Risks, and Adjunct Therapies." *European Journal of Translational Myology*. doi: 10.4081/ejtm.2024.12455.

Podlogar, Tim, and Gareth A. Wallis. 2022. "New Horizons in Carbohydrate Research and Application for Endurance Athletes." *Sports Medicine* 52(s1):5–23. doi: 10.1007/s40279-022-01757-1.

Saputra, Mardepi, Arsil Arsil, Ardo Okilanda, Mario Febrian, Riand Resmana, Andre Igoresky, Yovhandra Ockta, and Rifqi Festiawan. 2025. "The Influence of Leg Muscle Power, Waist Flexibility and Self-Confidence on Soccer Long Passing Ability." *Retos* 62:335–40. doi: 10.47197/retos.v62.109072.

Sari, Yayang Yulia, Ronni Yenes, Yendrizal, Sri Gusti Handayani, and Yovhandra Ockta. 2024. "The Impact of Strength, Flexibility, and Motivation on Student Development in Elementary Education." *Journal of Education, Teaching, and Learning Is* 9(1):154–59.

Sohail, M. Ammar Ahmad, Ramesha Tahir, Ayesha Maqbool, Sana Hanif, and Osama Saeed. 2022. "Comparing the Effectiveness of Static Stretching and Proprioceptive Neuromuscular Facilitation Stretching in Treating Delayed Onset Muscle Soreness in Calf Muscles of Runners." *Anaesthesia, Pain and Intensive Care* 26(1):31–38. doi: 10.35975/apic.v26i1.1763.

Stone, Michael H., W. Guy Hornsby, Satoshi Mizuguchi, Kimitake Sato, Daniel Gahreman, Marco Duca, Kevin M. Carroll, Michael W. Ramsey, Margaret E. Stone, Kyle C. Pierce, and G. Gregory Haff. 2024. "The Use of Free Weight Squats in Sports: A Narrative Review—Terminology and Biomechanics." *Applied Sciences (Switzerland)* 14(5). doi: 10.3390/app14051977.

Sulowska-Daszyk, Iwona, and Agnieszka Skiba. 2022. "The Influence of Self-Myofascial Release on Muscle Flexibility in Long-Distance Runners." *International Journal of Environmental Research and Public Health* 19(1). doi: 10.3390/ijerph19010457.

Wang, Xiangdong, Kezhun Cao, Yang Bai, Shutao Wei, Zongxiang Hu, and Gongbing Shan. 2024. "Unveiling the Biomechanical Insights: Motor Control Shifts Induced by Shoe Friction Adjustments and Their Impact on Defensive Slide, Crossover Dribbling, and Full Approach Jump in Basketball." *Applied Sciences (Switzerland)* 14(7):1–12. doi: 10.3390/app14072869.

Warneke, Konstantin, Anna Brinkmann, Martin Hillebrecht, and Stephan Schiemann. 2022. "Influence of Long-Lasting Static Stretching on Maximal Strength, Muscle Thickness and Flexibility." *Frontiers in Physiology* 13(May):1–13. doi: 10.3389/fphys.2022.878955.

Yearby, Tyler, Shawn Myszka, Andy Grahn, Scott Sievewright, Adam Singer, and Keith Davids. 2024. "Applying an Ecological Dynamics Framework to Mixed Martial Arts Training." *Sports Coaching Review* 00(00):1–28. doi: 10.1080/21640629.2024.2325822.

Zemková, Erika. 2022. "Strength and Power-Related Measures in Assessing Core Muscle Performance in Sport and Rehabilitation." *Frontiers in Physiology* 13(May):1–15. doi: 10.3389/fphys.2022.861582.