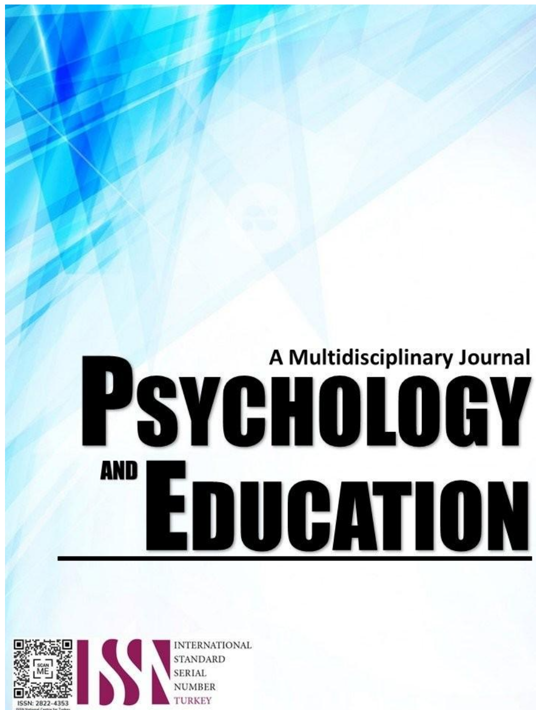
EFFECTIVENESS OF LEG-FOCUSED STATIC AND DYNAMIC STRETCHING IN ENHANCING THE STUDENTS' LOWER BODY FLEXIBILITY PERFORMANCE



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Research Article

Effectiveness of Leg-Focused Static and Dynamic Stretching in Enhancing the Students' Lower Body Flexibility Performance

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Abstract

Flexibility, particularly in the lower extremities, is essential for optimal physical performance, injury prevention, and daily functional movement. Despite its importance, lower body flexibility is often neglected in physical education settings. To address this gap, a quasi-experimental study was conducted involving 60 Grade 12 students from a private school in Cagayan de Oro City during the Academic Year 2024–2025. Participants were grouped into leg-focused static stretching (lunge, butterfly stretch, and seated forward bend) and leg-focused dynamic stretching (high knees, walking lunges, and leg swings). The study used the Modified Sit-and-Reach Test to measure flexibility, and data were analyzed using descriptive statistics, paired-samples t-tests, and Analysis of Covariance (ANCOVA). The results showed that both groups improved in lower body flexibility, with the static stretching group moving from a "Good" to a higher "Good" range, while the dynamic group improved more significantly to "Very Good." The data revealed that both static and dynamic stretching enhance lower-body flexibility, with dynamic stretching providing the most significant benefits. Flexibility programs may use either method or a combination of the two, depending on the activity's requirements.

Keywords: *leg-focused static stretching, leg-focused dynamic stretching, lower body flexibility performance*

Introduction

Flexibility is crucial to physical performance and injury prevention, particularly in athletic and fitness activities requiring a full range of motion. It is one of the progressive assessments in physical education, designed to inclusively assess learners' health and physical capabilities (Vargas, 2024). As a Physical Education teacher, the researcher has observed how students react to the physical demands of activities, particularly during flexibility tests and strenuous exercises. Many students express discomfort and struggle with the pain associated with stretching beyond their usual range of motion (Chekol, 2017; Shanmugananth et al., 2023). During flexibility assessments, the researcher often notices students wincing or hesitating as they attempt to push their limits, highlighting the challenges they face in mobility and endurance (Rahman & Islam, 2020; Hidayatullah et al., 2022). This prompts the teacher-researcher to improve students' flexibility, specifically lower-body flexibility. The researcher's goal is to investigate the influence of leg-focused static and dynamic stretching on students' lower-body flexibility performance.

Lower extremity flexibility refers to the ability of the muscles and joints of the hips, knees, and ankles to move through their full range of motion (ROM). This characteristic is crucial for increasing functional mobility, improving athletic performance, and lowering the risk of injury. Adequate flexibility improves the muscle-tendon unit's ability to withstand mechanical stress, reducing the risk of injury and improving posture, balance, and coordination (Cejudo et al., 2020; Overmoyer & Reiser, 2015). On the other side, dynamic stretching (DS) involves a series of exercises performed at low, moderate, or high intensity, engaging both the upper and lower limbs to achieve a stretch (Mocanu & Dobrescu, 2021). Numerous studies suggest dynamic stretching positively impacts strength and agility (Lykesas et al., 2020; Eken & Bayer, 2022).

Based on Deshmukh (2019), the dynamic is often considered the most effective and widely used method. It involves controlled movements of the arms and legs that push the body to the edge of its range of motion. This type of stretching is beneficial in sports and physical education, serving as an excellent warm-up for fitness tests, active games, dancing, and similar activities. Opplert and Babault (2018) suggest that dynamic stretching may offer immediate improvements in flexibility that are comparable to, or even greater than, those of static stretching.

A review of several journal databases revealed mixed findings regarding the effectiveness of static and dynamic stretching (Lee et al., 2021; Rana et al., 2020). Moreover, the literature highlights the need for further investigation into the impact of warm-up strategies on lower-body flexibility (Mehdizadeh Harikandei et al., 2024; Mocanu & Dobrescu, 2021). There is a need to address this issue to bridge this gap in flexibility training, as this study will provide evidence-based insights into the specific benefits and limitations of leg-focused static and dynamic stretching for improving lower-body flexibility. This will allow athletes, coaches, and fitness professionals to tailor their stretching protocols to meet the demands of specific sports or activities.

Additionally, the study may identify optimal conditions, timing, and application of these stretching methods, potentially leading to best practices in flexibility training and enhancing overall performance and safety in athletic and recreational contexts. Furthermore, the study addresses the lack of consensus on optimal stretching protocols for improving lower-body flexibility. While static and dynamic stretching are widely practiced, the literature remains divided on their relative effectiveness, mainly when applied to the legs, which are crucial for running, jumping, and squatting, by utilizing a controlled experimental design. The findings may help fill the evidence gap on the most effective stretching practices for leg flexibility and performance, ultimately improving flexibility training programs across various populations.

Research Questions

This study was centered on key research questions that shape its purpose and direction. These questions provided a focused framework to guide the investigation. The questions were as follows:

1. What is the students' level of lower-body flexibility before and after exposure to a leg-focused static stretching intervention?
2. What is the students' level of lower-body flexibility before and after exposure to a leg-focused dynamic stretching intervention?
3. Is there a significant difference in students' lower-body flexibility performance between the groups of participants before and after the intervention?
4. Is there a significant difference in students' lower-body flexibility performance between groups after the intervention?

Methodology

Research Design

The study utilized a Two-Factor Pretest-Posttest Quasi-Experimental design, in which two independent variables are manipulated to assess their effects on the dependent variable (Creswell, 2017). Participants were measured on the dependent variable both before and after the intervention, allowing the impact of two different interventions to be evaluated (Campbell and Stanley, 1996).

This study used a quasi-experimental methodology to assess the efficacy of two different interventions: static and dynamic stretching in two participant groups. This approach was explicitly chosen to accurately assess the effect of each intervention on participants' lower-body flexibility.

Participants

This study involved healthy senior high school students enrolled in PE 104 during the Academic Year 2024–2025 at a senior high school in Cagayan de Oro City, Philippines. The participants were students directly enrolled in the researcher's PE classes, which ensured better accessibility and consistent monitoring throughout the intervention. The recruitment process began with an orientation conducted by the researcher, during which the purpose, procedures, risks, benefits, and ethical considerations of the study were explained to all enrolled students. Those who expressed willingness to participate were provided with parental consent forms, which they returned signed by their parents or legal guardians.

After consent was obtained, a health screening was conducted to determine eligibility. Students completed two forms: the Physical Activity Readiness Questionnaire (PAR-Q) and a Health Appraisal Form. These tools were used to verify the absence of health risks and ensure the participants' physical readiness. The inclusion criteria dictates that the participants must 1) be a Filipino citizen, 2) have completed and submitted the PAR-Q, 3) have completed and submitted the Health Appraisal Form, 4) have no history of leg-related surgeries, injuries, or were not on medications that could affect lower body performance, and 5) be declared fit on the day of the pretest and posttest. Only those who met all these criteria were selected as participants in the study.

This study employed purposive sampling, a non-probability sampling technique in which participants are deliberately selected based on specific characteristics relevant to the research objectives. This method was deemed appropriate because the study required healthy participants capable of performing physical tasks and available for both the pretest and posttest sessions. Mujere (2016) states that purposive sampling allows researchers to "select respondents who are most likely to provide the needed information due to their characteristics and relevance to the subject under investigation." Likewise, Rai and Thapa (2015) stated that purposive sampling is suitable when participants must meet particular criteria to maintain the validity and relevance of the research.

Since the study followed a quasi-experimental design, participants needed to be healthy and available throughout the study period. The researcher, who was also the instructor, personally administered both the pretest and posttest procedures to ensure consistency and reliability of data collection.

Table 1. *Distribution of Student-Respondents*

Grade Level	Section	Number of Participants
Grade 12	PE 104 - A	30
Grade 12	PE 104 - B	30
	Total	60

Table 1 shows that 60 students were selected as the study's respondents.

Instrument

The principal research tool used in this study is the standardized Modified Sit-and-Reach Test (MSRT), which is described in the Department of Education's Revised Physical Fitness Test Manual (DepEd, 2019). This test was chosen to determine the effectiveness of both static and dynamic leg-targeted stretching procedures in enhancing lower-body flexibility. It is an improved version of the standard sit-and-reach test for increasing lower-body flexibility. The MSRT is an upgraded version of the standard sit-and-reach test that accounts for individual variability in arm and leg length, yielding more accurate measurements of hip, lower back, and hamstring flexibility (Wood, 2010). Adherence to the established methods outlined in the Revised Physical Fitness Test Manual (DepEd, 2019) assures that the data collected is reliable and valid. Given its emphasis on muscle groups critical to lower-body flexibility, the MSRT is an effective instrument for evaluating the results of the stretching therapies used in this study.

Convenience sampling was used to select intervention participants based on availability and willingness. Using this method, the researcher readily collected data from students who were present during the study and met the criteria for participation. They were already in Grade 12, so it was easy for them to understand how static and dynamic stretching might improve lower-body flexibility. Due to time and resource constraints, convenience sampling was appropriate for attaining the study's objectives.

Scoring Procedure

To record the farthest distance between the two trials to the nearest 0.1 centimeters.

Table 2. *Lower-Body Flexibility Performance Scoring Procedure*

Score	*Standard*	*Interpretation*
5	61 cm. and above	Excellent
4	46 - 60.9 cm.	Very Good
3	31 - 45.9 cm.	Good
2	16 - 30.9 cm.	Fair
1	0 - 15.9 cm.	Needs Improvement

Procedure

To assure the study's integrity and ethical conduct, the researcher followed the criteria described in the Belmont Report and the Declaration of Helsinki. The entire research methodology was designed to protect the participants' rights, safety, and welfare.

The study lasted 8 weeks, from the first week of March to the end of April 2025. Before initiating any research activities, the researcher submitted the study protocol to the Liceo de Cagayan University Research Ethics Board (LREB). The committee reviewed the proposal to ensure scientific merit and ethical compliance in the involvement of human participants. Upon receiving ethical clearance, the researcher submitted a letter of approval to the Office of the Dean of the School of Teacher Education, where the researcher is under supervision, and a formal request to the school administration of the participating school for permission to conduct the study within the senior high school's PE 104 classes. The letter outlined the study's objectives, procedures, and assurances of confidentiality and ethical safeguards.

Once approval from the school administration was secured, the researcher conducted an orientation session for all PE 104 students. During this session, the researcher explained the study's objectives, procedures, potential benefits, and risks. The voluntary nature of participation was emphasized, along with a clear assurance that students' academic standing would not be affected by their decision to join or withdraw from the study.

Subsequently, informed consent forms were distributed to the participants' parents or legal guardians, and assent was obtained from the students themselves, as they were minors. The recruitment process followed purposive sampling, targeting students directly under the researcher's instruction to ensure consistent monitoring and implementation of the intervention.

Participants were selected based on the following inclusion criteria: 1) Filipino citizenship; 2) Current enrollment in PE 104; 3) Submission of a completed Physical Activity Readiness Questionnaire (PAR-Q) and Health Appraisal Form; 4) No history of surgeries, injuries, or current medication affecting the lower extremities; and 5) Physically fit on the scheduled dates of the pretest and posttest. On the other hand, exclusion criteria applied to students who: 1) Had medical conditions posing potential risks during physical activity; 2) Failed to submit the necessary health clearance forms; 3) Withdrew consent or demonstrated irregular attendance; and 4) Were not medically fit on test days.

All participants were informed of their right to withdraw from the study at any time, with no academic consequences. This pledge was repeated throughout the research period and was always respected.

Apparently, all participant data was managed in compliance with the Data Privacy Act of 2012 (RA 10173). Each student was assigned a participant code to ensure anonymity. Physical records, such as consent forms and health documentation, were stored in a locked cabinet, while electronic files were stored on a password-protected computer accessible only to the researcher. All data be retained securely for one year before being permanently deleted or destroyed.

Following this, each participant remained engaged throughout the eight-week program, which was integrated into their regular PE class schedule. The initial week involved health screening through the submission and review of the PAR-Q and Health Appraisal Forms. Only those cleared through this screening proceeded to the pretest, which measured lower-body flexibility using the Modified Sit-and-Reach Test (MSRT).

The intervention phase began the following week. Students wore their PE uniforms during sessions for comfort and safety. Each session started with a 10-minute warm-up, followed by the researcher demonstrating the stretching exercises. Instructions focused on proper technique and safety precautions. Students performed the stretches under close supervision to ensure consistency and prevent injury.

At the end of the eight-week intervention, the Modified Sit-and-Reach Test (MSRT) was repeated to assess changes in flexibility. The test was administered precisely as indicated in the Department of Education's Revised Physical Fitness Test Manual (DepEd, 2019). The MSRT was chosen over the classic sit-and-reach test because it is more accurate at accounting for limb-length changes, resulting in a more reliable assessment of hip, hamstring, and lower back flexibility (Wood, 2010). According to the standardized protocol outlined in the manual, participants were instructed to sit on the floor with their back, head, and shoulders against the wall, and their feet 12 inches apart. With thumbs interlocked and fingertips touching the floor while elbows remained extended, the partner placed the zero point of the measuring device at the tip of the middle fingers. From this position, the participant was required to slide the hands forward slowly and in a controlled manner, attempting to reach the maximum distance possible without bending the knees. Bouncing or jerking motions were not permitted. Each participant performed two trials, and the best score was recorded as the test result.

Overall, the study was conducted with complete transparency. From the outset, participants were thoroughly informed of all procedures, objectives, and expectations. Notably, no deceptive practices were employed at any stage of the research. Participants were expected to experience improved lower-body flexibility, increased knowledge of proper stretching techniques, and enhanced physical well-being. Although minimal, potential risks such as mild discomfort or muscle soreness were identified; however, these were effectively mitigated through appropriate warm-up routines and continuous safety monitoring.

Moreover, there were no costs incurred by the participants. To support their involvement, the researcher provided light refreshments during longer sessions and reimbursed minor transportation or study materials expenses when necessary. Also, the researcher declared no conflict of interest. The entire study was carried out solely for academic purposes, without external sponsorship or commercial involvement.

Finally, the intervention was designed not only to benefit individual participants but also to contribute to the school's health and fitness culture. The results of the study will be shared with the SHS PE Department, providing valuable insights for future program development. Throughout the process, the researcher ensured the study caused no disruption to regular school operations and worked closely with school officials to maintain a respectful, collaborative environment.

Data Analysis

To analyze and interpret the data collected in this study, the researcher employed a combination of descriptive and inferential statistical tools. These tools were carefully selected based on the nature of the data and the specific research questions posed in this quasi-experimental design. All statistical analyses were conducted using a significance level of 0.05 to determine the presence of meaningful differences or effects.

To address Statements of the Problem 1 and 2, descriptive statistical tools such as mean, frequency, percentage, and standard deviation were employed to summarize and interpret the participants' performance in both pre-test and post-test. These measures provided a thorough picture of students' lower-body flexibility levels before and after engaging in static and dynamic stretching therapies for the legs. Descriptive statistics are regarded as vital in physical education and sports science research because they enable the unambiguous portrayal of central tendencies, variability, and observable patterns within the data set (Gravetter & Wallnau, 2017).

In problem 3, a paired samples t-test was performed to determine whether there was a statistically significant difference in each group's lower body range of motion (ROM) before and after the stretching intervention. This test was especially relevant considering that the same subjects were measured twice: before and after the intervention. The paired t-test is commonly used in similar exercise-based research to evaluate within-group changes over time (Field, 2018).

For problem 4, the researcher employed an Analysis of Covariance (ANCOVA) to assess the post-test flexibility performance of static and dynamic stretching groups, which were separated based on pre-test results. Similarly, because the groups were separated, this test allowed the researcher to determine if leg-focused static and dynamic stretching had a meaningful effect on students' lower body flexibility after controlling for any differences at the pre-test.

Each statistical tool was deliberately selected to align with the nature of the data and the overall design of the study. The integration of both descriptive and inferential statistical techniques enabled a more comprehensive analysis, providing not only a summary of the participants' performance but also deeper insights into the effectiveness of leg-focused static and dynamic stretching routines in enhancing lower body flexibility among students.

Results and Discussion

What is the students' level of lower body flexibility performance before and after being exposed to leg-focused static stretching?

Leg-focused static stretching was measured in this study as exercises in which students held leg muscle stretches, such as the seated forward bend or butterfly stretch, in a fixed position without movement for at least 20 seconds, aiming to increase muscle fiber length and improve flexibility.

Table 3. *Results of Frequency, Percentage, Mean, and Standard Deviation for the students' level of lower body flexibility performance before and after being exposed to leg-focused static stretching*

Test	*Range*	*f*	*%*	*Mean*	*SD*	*Interpretation*
	16-30.9	5	16. 67	40.80	9.65	Good
Pretest	31-45.9	15	50.00			
	46-60.9	10	33.33			
	Total	30	100.0			
	16.0-30.9	2	6.6	44.03	9.30	Good
	31.0-45.9	15	50.0			
Post test	46.0-60.9	13	43.33			
	Total	30				

Legend: 61.0 and above (Excellent); 46.0–60.9 (Very Good); 31.0–45.9 (Good); 16.0–30.9 (Fair); 1.00–15.9 (Needs Improvement).

Table 3 shows the frequency, percentage, mean, and standard deviation of students' lower-body flexibility performance before and after leg-focused static stretching. As shown in the table, among students who were exposed to static stretching, 50.0% had good lower-body flexibility during their pretest, 33.33% had outstanding performance, and 16.67% had fair performance. The overall mean for the pretest was M=40.80 (SD=9.65), indicating that students in the static stretching group demonstrated good lower body flexibility in the pretest.

On the other hand, their posttest showed that 50.0% had lower body flexibility, 43.33% had excellent flexibility, and 6.6% had fair flexibility.

The overall posttest mean was M=44.03 (SD=9.30), indicating that students in this group had good lower-body flexibility performance.

The findings imply that leg-focused static stretching positively influenced students' lower-body flexibility, as demonstrated by an increase in the overall mean score from 40.80 to 44.03. This improvement suggests enhanced flexibility outcomes accompanied by a reduction in performance variability among the participants.

The results revealed that students exposed to leg-focused static stretching improved their level of lower body flexibility performance, as reflected in the increase in mean scores from pretest (M = 40.80, SD = 9.65) to posttest (M = 44.03, SD = 9.30), and the shift of more students into the "outstanding" performance category. This finding aligns with Bryant et al. (2023), who found that static stretching significantly increases range of motion (ROM), primarily when performed at higher intensities, by enhancing stretch tolerance and reducing passive stiffness in the musculotendinous unit.

Similarly, Kubo et al. (2018) supported that regular static stretching improves not only ROM but also tendon microarchitecture and stiffness characteristics, indicating that both neural and structural adaptations contribute to improved flexibility. These studies substantiate the observed improvements in lower-body flexibility among students after the intervention.

What is the students' level of lower-body flexibility before and after leg-focused dynamic stretching during the intervention?

Table 4. *Results of Frequency, Percentage, Mean, and Standard Deviation for the students' level of lower body flexibility performance before and after being exposed to leg-focused dynamic stretching*

Test	*Range*	*f*	*%*	*Mean*	*SD*	*Interpretation*
	16-30.9	3	10	40.06	6.42	Good
Pretest	31-45.9	22	50.00			
	46-60.9	16.67	33.33			
	Total	30	100.0			
	16.0-30.9	2	6.6	44.63	1.1	Good
	31.0-45.9	22	50.0			
Post test	46.0-60.9	13	43.33			
	Total	30	100			

Legend: 61.0 and above (Excellent); 46.0–60.9 (Very Good); 31.0–45.9 (Good); 16.0–30.9 (Fair); 1.00–15.9 (Needs Improvement).

In this study, leg-focused dynamic stretching is defined as a series of exercises involving continuous leg movements, including high knees, walking lunges, and leg swings, performed for 30–60 seconds without maintaining a static position. These motions were performed in a controlled, fluid manner, with the goal of directing the muscles and joints through their full range of motion to prepare the body for future physical activity adequately.

Table 4 shows the frequency, percentage, mean, and standard deviation of students' lower-body flexibility performance before and after leg-focused dynamic stretching. As shown in the table, among students who were exposed to dynamic stretching, 50.0% had good lower-body flexibility during their pretest, 43.33% had outstanding performance, and 6.6% had fair performance. The overall pretest mean was M=40.06 (SD=6.42), indicating that students in the dynamic stretching group had good lower-body flexibility before the intervention.

Following the implementation of leg-focused dynamic stretching exercises, their posttest showed that 50.0% had good lower-body flexibility, 43.33% had excellent lower-body flexibility, and 6.6% had fair lower-body flexibility. The overall posttest mean was M=44.63 (SD=9.30), indicating that students in this group had good lower-body flexibility performance, reflecting an overall improvement in flexibility and a tighter distribution of scores, as evidenced by the significantly reduced standard deviation.

These findings are corroborated by Matsuo et al. (2025), who reported in a meta-analysis of 17 studies that dynamic stretching (DS), defined as controlled, active joint motions without holding end positions, provides minor but significant acute increases in flexibility. The study indicated a substantial increase in range of motion (ROM) with an overall effect size of 0.372 ($p < 0.001$). The gains were consistent across ages, sexes, muscle groups, and flexibility measures. This shows that the students' observed gains in lower body flexibility are consistent with previous research on the efficacy of dynamic stretching in improving flexibility across varied populations.

Is there a significant difference in students' lower-body flexibility performance between groups before and after the intervention?

Table 5 presents the results of a paired-samples T-test for the significant difference in students' lower-body flexibility performance between the groups before and after the intervention. As shown in the table, there was a considerable difference between posttest (M=44.03, SD=9.30) and pretest (M=40.80, SD=9.65) scores for the leg-focused static stretching group. The t-value of -10.84 and p-value of.000 ($p < .05$) show a substantial improvement in lower-body flexibility after the intervention. This implies that the investigation rejects the initial null hypothesis.

Table 5. *Results of Paired Samples T-test for the significant difference in students' level of lower body flexibility performance in each group of participants before and after the intervention.*

Group	*Test*	*Mean*	*N*	*SD*	*t*	*p*	*Interpretation*
Static Stretching	Pretest	40.80	30	9.65			
	Post test	44.03	30	9.30	-10.84	.000	Significant
Dynamic Stretching	Pretest	40.06	30	6.42	-13.51	.000	Significant
	Post test	44.63	30	7.17			

The negative t-value simply reflects the direction of change (from lower to higher scores), while the very low p-value suggests high confidence that this improvement was not due to chance. This result provides strong evidence that static stretching improved participants' lower-body flexibility during the intervention period.

Similarly, for the group that underwent leg-focused dynamic stretching, the probability value was also lower than the alpha level of 0.05 ($t=-13.51$, $p<.05$).This implied that there was substantial evidence to claim that students' posttest scores (M=44.63, SD=7.17) were significantly higher compared to pretest scores (M=40.06, SD=6.42). This suggests that dynamic stretching had a positive, measurable effect on students' lower-body flexibility. Notably, the higher t-value relative to the static group indicates a larger effect size, and the narrower standard deviations reflect a more consistent response to the intervention.

The paired-samples t-test showed that both static and dynamic stretching therapies resulted in statistically significant improvements in students' lower-body flexibility. While both approaches were beneficial, the dynamic stretching group had a significantly higher mean gain (from 40.06 to 44.63) and a larger t-value than the static stretching group. These data indicate that dynamic stretching may have a greater influence on flexibility performance throughout the intervention period.

Dynamic stretching led to more consistent and slightly faster improvements in flexibility than static stretching, as evidenced by smaller standard deviations. While both are beneficial for flexibility training, dynamic stretching is especially suitable for warm-ups before physical activity.

This result corroborates the findings of Konrad et al. (2021), who concluded that static stretching effectively increases joint range of motion by decreasing passive stiffness and improving stretch tolerance when applied consistently over time. In the same vein, Freitas et al. (2018) reported that four weeks of static stretching led to measurable improvements in flexibility and changes in the mechanical properties of the muscle-tendon unit, thereby promoting long-term adaptations.

The improvements observed in the dynamic stretching group align with the findings of Matsuo et al. (2025), whose meta-analysis reported that dynamic stretching consistently enhances flexibility across diverse populations, irrespective of age or gender. Their analysis emphasized that controlled, rhythmic leg movements facilitate a greater range of motion by stimulating neuromuscular pathways and elevating muscle temperature. Similarly, Behm et al. (2019) highlighted the effectiveness of dynamic stretching for producing immediate gains in range of motion, underscoring its practical relevance in pre-exercise warm-up routines. Supporting this perspective, Opplert and Babault (2018) concluded that dynamic stretching not only improves flexibility but also enhances performance outcomes, while avoiding the potential reduction in muscle strength that may result from prolonged static stretching.

Is there a significant difference in students' lower-body flexibility performance between groups after the intervention?

Table 6 presents the results of ANCOVA for significant differences in students' lower body flexibility performance before and after the intervention across groups. As depicted in the table, the R2 value of .956 indicated that the independent variables, along with the pretest as a covariate, predicted 95.6% of the students' level of lower body flexibility performance.

Table 6. *Results of ANOVA for the significant difference in students' lower-body flexibility performance between groups before and after the intervention.*

Source	*Squares*	*df*	*Square*	*F*	*Sig.*	*Squared*
Corrected Model	3828.9	2	1914.4	618.808	.000	.956
Intercept	42.45	1	42.4	13.724	.000	.194
Pretest	3823.5	1	3823.5	1235.871	.000	.956
Group	26.3	1	26.32	8.508	.005	.130
Error	176.3	57	3.0			
Total	121932.0	60				
Corrected Total	4005.333	59				

Students who participated in dynamic stretching ($F = 8.50$, $p < .05$) achieved a significantly higher mean score ($M = 44.99$) compared to those in the static stretching group ($M = 43.67$). These results provide strong evidence that dynamic stretching is more effective than static stretching at enhancing lower-body flexibility. Consequently, the second null hypothesis of the study is rejected.

In terms of effect size, the partial eta squared value of .130 ($p<.05$) indicated a large and significant effect of the interventions on students' lower-body flexibility performance. In practical terms, this means that the stretching method accounts for approximately 13% of the variation in posttest scores after adjusting for pre-intervention differences. Moreover, this result complements earlier t-test findings by not only confirming significant within-group improvements but also statistically verifying the superior effectiveness of dynamic stretching in a controlled comparison. This further reinforces the reliability of dynamic stretching as a more impactful intervention for enhancing flexibility, even after accounting for baseline abilities.

Additionally, the findings align with previous studies such as George (2024), who observed greater improvements in power output following dynamic stretching without the performance drawbacks often associated with static protocols. Sople and Wilcox III (2024) similarly advocate for dynamic warm-ups, citing their comprehensive benefits to physiological systems and enhanced readiness for physical activity.

These ANCOVA results therefore validate the growing preference for dynamic stretching in athletic and physical education contexts, providing both statistical and practical justification for its implementation.

Conclusions

This section presents a summary and essential discussions of each central part of the study. It includes key findings that address the problems stated in the research's introductory paragraph, which serve as the basis for the conclusions. The recommendations are carefully provided to improve outcomes and provide helpful guidance for future actions or studies related to this topic.

The findings of this study demonstrated that both leg-focused static and dynamic stretching therapies effectively improved lower-body flexibility in senior high school students. The observed gains from pretest to posttest within each group show that consistent, targeted stretching, whether static or dynamic, is effective at enhancing range of motion and muscle flexibility. Within-group statistical analyses further confirmed that the interventions produced measurable gains in flexibility, thereby supporting the application of these methods in physical education and athletic training contexts. These outcomes also reinforce the theoretical foundation of the Neuromuscular and Muscle Activation Theory, which suggests that stretching optimizes muscle performance and coordination by enhancing neuromuscular activation and reducing stiffness.

The results also led to the rejection of the null hypotheses that claimed no significant differences before and after the intervention and between the two groups. Instead, the study supports the conclusion that leg-focused stretching—both static and dynamic—has a statistically significant and positive effect on students' flexibility. These findings underscore the importance of integrating structured stretching routines into physical education programs to promote physical readiness, injury prevention, and overall movement efficiency.

Based on the findings presented, the following recommendations are proposed to support further application of the results of the study:

Given that participants who performed static stretching showed significant improvements in lower-body flexibility, it is recommended that static stretching be incorporated into the cool-down routines of PE classes, fitness programs, and sports training. Educators and coaches may emphasize exercises such as the butterfly stretch, seated forward bend, and lunge to help improve muscle elasticity and promote recovery. These exercises are efficient when held for 20–60 seconds and can be beneficial for students or athletes with limited flexibility or stiffness.

Since dynamic stretching led to significant gains in flexibility and enhanced muscle readiness, it is recommended to include it during warm-up sessions before physical activities. Exercises like high knees, walking lunges, and leg swings help prepare the body for vigorous movement by increasing blood flow and activating the nervous system. Physical education teachers, coaches, and trainers may prioritize dynamic routines to improve not just flexibility but also performance and injury prevention. Because both static and dynamic stretching groups demonstrated significant increases, stretching therapies should be used consistently over a lengthy period (e.g., 6-8 weeks or longer) to achieve meaningful results. School programs should include an organized stretching regimen tailored to the needs of the pupils. Teachers should also supervise and help students properly execute stretches to ensure efficacy and safety.

With both static and dynamic stretching proving effective, and dynamic stretching offering added benefits such as muscle activation and balance, it is recommended to educate students, athletes, and fitness professionals on the purpose and proper application of each stretching type. Seminars, in-service training (INSET), or class modules may be developed to highlight when and how to apply each method appropriately. For example, dynamic stretching is ideal for pre-activity warm-ups, while static stretching is best for post-activity recovery and flexibility development.

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