International Journal of Research in Medical Sciences
Hegishte AS et al. Int J Res Med Sci. 2023 May;11(5):1758-1763
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20231350

Original Research Article

Effect of proprioceptive neuromuscular facilitation and dynamic stretching on flexibility, agility, and balance in hamstring tightness among collegiate level badminton players

Atharva S. Hegishte*, Neeraj Kumar

Department of Orthopedic Physiotherapy, Dr. A.P.J. Abdul Kalam College of Physiotherapy, Pravara Institute of Medical Sciences (Deemed to be University), Loni, Ahmednagar, India

Received: 24 March 2023
Revised: 17 April 2023
Accepted: 19 April 2023

***Correspondence:**
Atharva S. Hegishte,
E-mail: atharva.hegishte@gmail.com

ABSTRACT

Background: The development of muscular damage is typically attributed to intrinsic factors, such as muscle tension. Additionally, it has been demonstrated that muscular stiffness is the primary cause of the risk of pathological disorders of the knee and spine. Hamstring tightness leads to high risk of recurrent injury, decreases the performance in athletes, lead to post-exercise soreness and decreases coordination among athletes. Objectives of current study were to find out the effects of PNF and dynamic stretching on flexibility, balance, and agility among collegiate level badminton players having hamstring tightness.
Methods: 110 participants were screened and 68 participants were recruited according to the selection criteria and were randomly allocated to Group A (PNF stretching) (N=34) and Group B (Dynamic Stretching) (N=34). The exercise program underwent training for 30 min, 3 times per week for 4 weeks.
Results: Group A and Group B demonstrated significant improvement in Flexibility, Balance, and Agility ($p<0.0001$). Whereas, no significant difference was seen when intergroup comparison was done ($p>0.005$).
Conclusions: The study concludes that there is significant improvement in the Flexibility, Balance, and Agility after implication of 4 weeks of PNF and Dynamic Stretching in Collegiate Level Badminton players having Hamstring tightness. This evidence substantiates that these exercises do recruit the Hamstring muscles and provides further insight into the role of the Hamstring muscles to keep the body flexible.

Keywords: Flexibility, Agility, Balance, Hamstring tightness

INTRODUCTION

The well-liked sport of badminton is one of the fastest racquet sports. The sport of badminton, in which two or four opposing players hit a shuttlecock over a separating net to score a point, is one of the most popular racquet sports in the world. The overhead technique is one of the three main categories of badminton strokes, which are further divided into the three strokes of drop, clear, and smash. Playing badminton requires a certain amount of physical conditioning in terms of motor and action controls. This sport's primary motor demands include reaction time, foot striding, and static or dynamic balances.[1,2] One of the most used actions in badminton, the lunge step makes up about 15% of all movements during a match. The most important component of technical mastery in badminton contests is footwork. Good lunge step execution is typically correlated with excellent flexibility. The task, therefore, essentially consists of a weight acceptance (braking) and recovery (accelerating)

phase and forms an integral part of the start–stop recover cycle. Players must therefore have high joint ROM, power, and agility.[1] College students typically feel hamstring stiffness as a result of their sedentary lifestyles. Women experience a higher rate than males do. Most people in contemporary society have diminished physical strength as a result of their busy and monotonous daily life and lack of exercise.[3,4] The hamstrings are examples of muscle groups that tend to get shorten. Musculotendinous units in the hamstrings that experience shortening in hamstring tightness have a diminished capacity to extend because of fewer sarcomeres, or a decreased length or elasticity of connective tissues.[4] Proprioceptive neuromuscular facilitation (PNF) techniques make use of proprioceptive stimulation for the strengthening (facilitation) or relaxation (inhibition) of muscle groups. One principle of PNF maintains that voluntary muscular contractions are performed in combination with muscle stretching to reduce the reflexive components of muscular contraction, promote muscular relaxation, and subsequently increase joint range of motion (ROM).[5,6] Dynamic stretching (DS), an alternative to static stretching that involves moving the limb from its neutral position to the end range, when the muscles are at their greatest length, and then bringing the limb back to its starting position, has been recommended to promote muscle flexibility. recent studies have shown that dynamic stretching enhances balance and agility in addition to maximal strength and power performance. This shows that for activities requiring balance and quick changes in running direction, dynamic stretching is preferable.[7-11] Flexibility, Agility and Balance play a crucial role in this sport and these components are all in corelation with the strength and flexibility that the Hamstring muscles provide. If the players get injured due to overuse of hamstring muscles or if there is tightness present, the efficacy rate in their performance levels start decreasing and they are not able to give their 100% in the game. Hence, this study is imperative to compare the effect of PNF and Dynamic Stretching on Flexibility, Agility and Balance in collegiate level badminton players with hamstring tightness so that it can be used by badminton coaches in coming years.

METHODS

The type of study was a randomised control trial. The study took place in Pravara institute of medical sciences, Loni, from 1 August, 2022 until 15 February, 2023. All the Participants were selected based on the inclusion and exclusion criteria. The inclusion criteria were badminton players in the age group between 18 to 25 years, players having Hamstring muscle tightness, players who were willing to participate and qualified PAR-Q. Exclusion criteria were players who underwent any recent injury or trauma, having any musculoskeletal disorders especially in lower extremities, and are suffering from neurological, cardiovascular or any other medical conditions. Informed consent was obtained from the participants regarding the procedure prior to the study. Demographic Data was recorded and Baseline information of dependant variables was taken at the beginning of study on day one, for flexibility with sit and reach test, for agility with 20-meter shuttle run test and for balance with computerised balance board. The software tool used to calculate the sample size was Openepi. 110 Participants were screened for the eligibility criteria out of which 68 participants were selected for the study and further were randomised into 2 groups that is Group A (PNF stretching) (N=34) and Group B (Dynamic Stretching) (N=34). Group A was administered with PNF Stretching Exercise while Group B was administered with dynamic stretching exercises that is, standing hamstring stretch, standing roll downs, lying single leg stretch, seated hamstring stretch. All the instructions were given verbally, provided demonstration, and guided through a single practice trail. The participants were given exercise regimen and administered to perform for 25-30 minutes per day for 3 days in a week for 4 weeks. Flexibility, Agility and Balance were measured using Sit and Reach Test, 20-meter shuttle run and computerised balance board post completion of intervention.

RESULTS

The objective of the study was to find out the effects of PNF and dynamic stretching on flexibility, balance and agility in collegiate level badminton players having hamstring tightness.

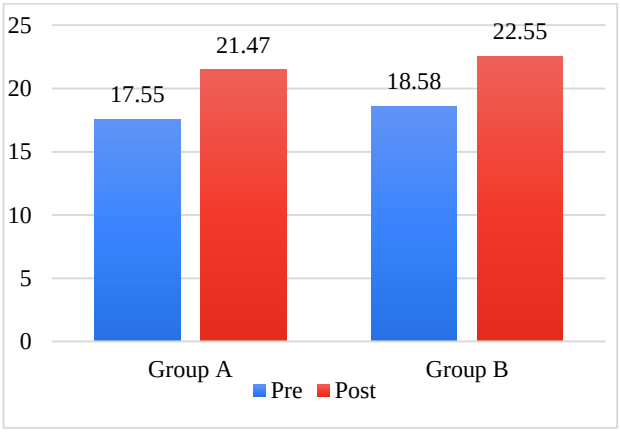

Figure 1: Comparison between pre and post flexibility scores within group A and group B, showing increase in Flexibility in Group A and Group B which is statistically significant p<0.001.

Table 1: Demographic data.

Parameters	Mean±SD
Age	21.44±1.36
Height	167.01±8.08
Weight	62.05±11.82
BMI	22.18±3.71

The study was conducted in Pravara institute of medical sciences (DU), Loni. Demographic Data was recorded and Baseline information of dependant variables was taken at the beginning of study on day one.

Table 2: Comparison of pre and post flexibility scores within group A and group B.

Group	Pre -treatment (Mean±SD)	Post-treatment (Mean±SD)	T value	P value	Significance
Group A	17.558±4.439	21.470±4.315	14.069	<0.0001	Highly Significant
Group B	18.588±5.592	22.558±5.489	6.162	<0.0001	Highly Significant

Table 3: Comparison of pre- and post- balance scores within Group A and Group B.

Group	Pre -treatment (Mean±SD)	Post-treatment (Mean±SD)	T value	P value	Significance
Group A	3.723±0.225	3.544±0.189	7.787	<0.0001	Highly Significant
Group B	3.738±0.270	3.552±0.210	7.404	<0.0001	Highly Significant

Table 4: Comparison of pre- and post- agility scores within group A and group B.

Group	Pre- treatment (Mean±SD)	Post-treatment (Mean±SD)	T value	P value	Significance
Group A	18.926±2.239	18.091±1.921	6.162	<0.0001	Highly Significant
Group B	18.641±2.543	17.964±2.223	8.503	<0.0001	Highly Significant

Table 5: Comparison of mean of post flexibility scores between group A and group B.

Group	Post-treatment (Mean±SD)	Mean Difference	T value	P value	Significance
Group A	21.471±4.315	1.088	0.9088	0.3688	Not Significant
Group B	22.559±5.489				

Table 6: Comparison of mean of post balance scores between group A and group B.

Group	Post-treatment (Mean±SD)	Mean Difference	T value	P value	Significance
Group A	3.544±0.1894	0.008	0.1816	0.8564	Not Significant
Group B	3.553±0.2107				

Table 7: Comparison of mean of post agility scores between group A and group B.

Group	Post-treatment (Mean±SD)	Mean Difference	T value	P value	Significance
Group A	18.091±1.921	0.126	0.251	0.8026	Not Significant
Group B	17.965±2.223				

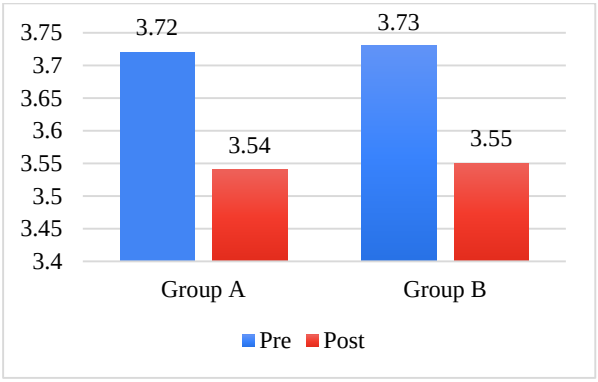

Figure 2: Comparison between Pre- and Post- Balance scores within Group A and Group B, showing increase in balance in Group A and Group B which is statistically significant p<0.001.

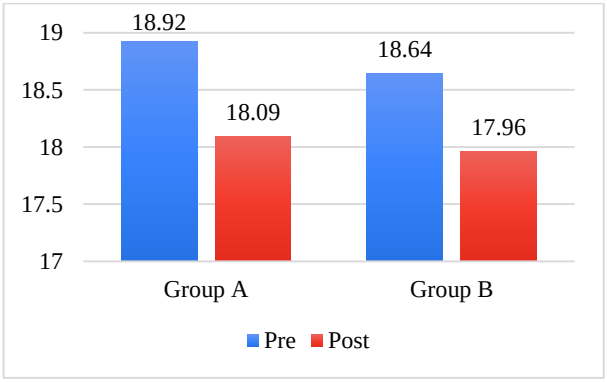

Figure 3: Comparison between pre- and post- agility scores within group A and group B, showing increase in agility in group A and group B which is statistically significant p<0.001.

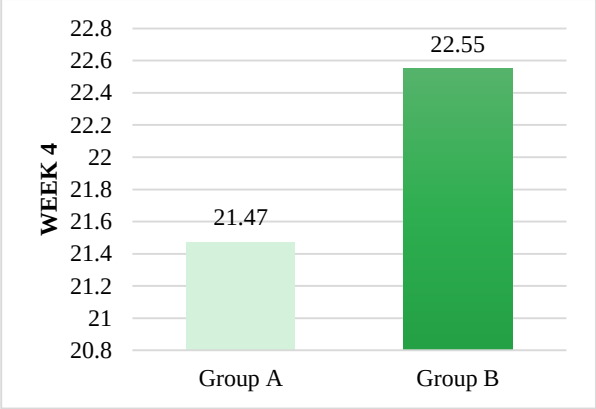

Figure 4: Comparison of Mean of post Flexibility score between Group A and Group B shows a decrease in Flexibility in Group A as compared to Group B which is not significant p>0.05.

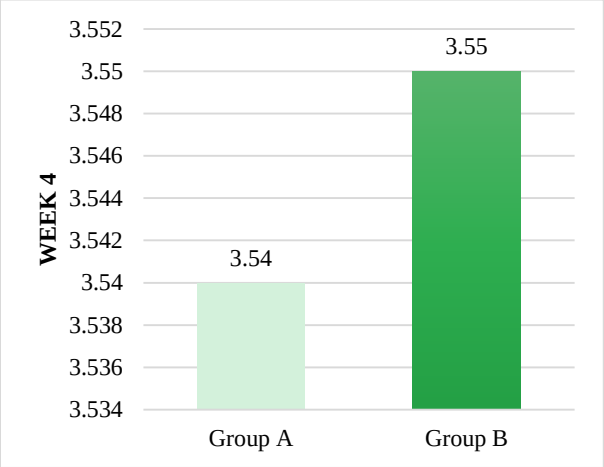

Figure 5: Comparison of mean of post balance score between group A and group B shows a decrease in balance in group A as compared to group B which is not significant p>0.05.

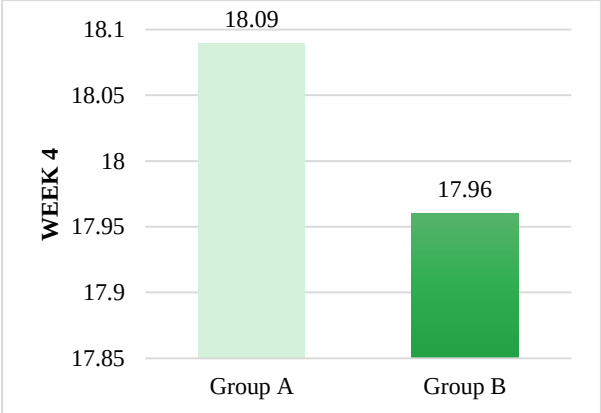

Figure 6: Comparison of mean of post agility score between group A and group B shows a decrease in agility in group A as compared to group B which is not significant p>0.05.

The baseline demographic data is depicted in (Table 1). The result from the statistical analysis of this study supported the alternative hypothesis which stated that there is a beneficial effect to the subjects treated with PNF stretching and dynamic stretching on flexibility, balance, and agility. Paired t-test was done to analyse the effect of PNF stretching on hamstring tightness and showed that there was extremely significant improvement in flexibility, balance, and agility in group A (flexibility-21.470±4.315, t value-14.069, p value<0.0001) (Balance-3.544±0.189, t value-7.787, p value<0.0001) (agility- 18.091±1.921, t value-6.162, p value-<0.0001). Group B showed that there was extremely significant improvement in flexibility, balance, and agility on giving dynamic stretching (Flexibility-22.558±5.489, t value-14.966, p value <0.0001) (Balance-3.552±0.210, t value-7.404, p value <0.0001) (Agility-17.964±2.223, t value-8.503, p value <0.0001), (Figure 1-3). shows the comparison of flexibility, balance, and agility. Comparative analysis was done between Group A and Group B using Unpaired t test to find out the effectiveness of PNF and dynamic stretching on flexibility, balance, and agility. The statistical analysis revealed that there was no significant difference on flexibility, balance, and agility when compared between group A and group B, (Figure 4-6) shows the comparison of mean of flexibility, balance, and agility.

DISCUSSION

The study was to find out the effects of PNF and dynamic stretching on flexibility, balance and agility in collegiate level badminton players having hamstring tightness. The study was conducted in Pravara institute of medical sciences (DU), Loni. Total number of participants assessed were 110 from which 42 were excluded and 68 participants were included according to the eligibility criteria and randomization was done from which 34 participants were divided in PNF stretching group and 34 in dynamic stretching group. Exercise program which included PNF and Dynamic Stretching was administered for 4 weeks 3 days a week and analysis was done. The result of the present study showed no significant difference in flexibility, balance, and agility between groups post-intervention. Paired t-test was done to analyse the effect of PNF stretching on hamstring tightness and showed that there was extremely significant improvement in flexibility, balance, and agility in group A (flexibility- 21.470±4.315, t value-14.069, p value <0.0001) (Balance 3.544±0.189, t value-7.787, p value<0.0001) (Agility- 18.091±1.921, t value-6.162, p value <0.0001). Group B showed that there was extremely significant improvement in flexibility, balance, and agility on giving dynamic stretching (Flexibility-22.558±5.489, t value- 14.966, p value<0.0001) (Balance-3.552±0.210, t value-7.404, p value<0.0001) (Agility-17.964±2.223, t value- 8.503, p value<0.0001). The comparison of flexibility, balance, and agility (Figure1-3). Comparative analysis was done between group A and group B using unpaired t-test to find out the effectiveness of PNF and dynamic stretching on

flexibility, balance, and agility. The statistical analysis revealed that there was no significant difference on flexibility, balance, and agility when compared between group A and group B. The hamstring muscles are frequently connected to problems with movement in the lower limbs, pelvis, and lumbar spine. Hamstring tightness increases the likelihood of recurrent injury, lowers athletic performance, causes post-exercise pain, and impairs athlete coordination. Muscle tightness is brought on by a decline in the muscle's capacity to deform, which reduces the range of motion at the joint it affects. Hamstring injuries are the most frequent type of injury among athletes and are caused by hamstring tightness. These wounds take a long time to heal, require a lot of medical attention, and lower an athlete's performance level.[4]

Proprioceptive stimulation is used in proprioceptive neuromuscular facilitation (PNF) procedures to either strengthen (facilitate) or relax (inhibit) muscle groups. One PNF tenet states that voluntary muscle contractions should be performed in conjunction with muscle stretching (ROM) in order to reduce the reflexive components of muscle contraction, promote muscular relaxation, and ultimately increase joint range of motion. This would also aid in the improvement of flexibility, balance, and agility. Behroz et al and Dehghani et al conducted research to investigate the mid-term effect of different intensity of PNF stretching on improving hamstring flexibility, and showed that the use of sub-maximal CR PNF training on Hamstring lead to more flexibility.[12]

Amine et al conducted research to investigate the effects of different types of proprioceptive neuromuscular facilitation stretching on dynamic balance control, which showed that CRAC stretching of the quadriceps, hamstrings, anterior tibialis, and calf muscles improved ML dynamic balance. In a previous study Misty et al conducted research to study the effects of proprioceptive neuromuscular facilitation stretching on agility performance among volleyball varsity players, which showed that PNF stretching administered as a post-training flexibility exercise of volleyball varsity players is an effective method in improving agility when compared with the traditional static stretching technique.[13,14] It has been suggested to increase muscle flexibility by using dynamic stretching (DS), an alternative to static stretching that involves moving the limb from its neutral position to the end range, when the muscles are at their greatest length, and then bringing the limb back to its starting position.[8-10] John et al conducted research to investigate that dynamic stretching is effective as static stretching at increasing flexibility, which showed that both dynamic stretching and standard stretching are effective at increasing ROM. In previous study Cem et al and Fırtın et al conducted research comparing the acute effects of static and dynamic stretching exercises on flexibility, agility, and anaerobic performance in professional football players, which showed that aerobic running combined with static or dynamic stretching increased the flexibility more effectively than aerobic running alone.[15,16] The result from the statistical analysis of this study supported the alternative hypothesis which stated that there is a beneficial effect to the subjects treated with PNF stretching and dynamic stretching on flexibility, balance, and agility. Hence, above results showed that subjects treated with PNF and Dynamic Stretching exercises showed significant improvement in flexibility, balance, and agility in collegiate level badminton players having hamstring tightness. The study had several drawbacks, including a limited sample size, a concentration on college-level badminton players, and a lack of gender equality.

CONCLUSION

The study concludes that there is significant improvement in the flexibility, balance, and agility after implication of 4 weeks of PNF and dynamic stretching in collegiate level badminton players having hamstring tightness. However, there was no significant improvement seen between groups. This evidence substantiates that these exercises do recruit the hamstring muscles and provides further insight into the role of the hamstring muscles to keep the body flexible.

ACKNOWLEDGEMENTS

Authors would like to thank Pravara institute of medical sciences and Dr. APJ Abdul Kalam college of physiotherapy, Loni for supporting the current study.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Lin WC, Lee CL, Chang NJ. Acute effects of dynamic stretching followed by vibration foam rolling on sports performance of badminton athletes. J Sports Sci Med. 2020;19(2):420.
2. Hassan IH. The effect of core stability training on dynamic balance and smash stroke performance in badminton players. Int J Sports Sci Physical Edu. 2017;2(3):44-52.
3. Shaikh SM, Moharkar AC. Effect of core stability exercises versus Surya Namaskar on hamstring tightness in healthy adults using active knee extension test at the end of 6 weeks: A comparative study. IJAR. 2020;6(3):386-90.
4. Koli BK, Anap DB. Prevalence and severity of hamstring tightness among college student: A cross sectional study. Int J Clin Biomed Res. 2018;15:65-8.
5. Jang HS, Kim D, Park J. Immediate effects of different types of stretching exercises on badminton jump smash. J Sports Med Physical Fitness. 2017; 58(7-8):1014-20.
6. Waseem M, Nuhmani S, Ram C. Efficacy of muscle energy technique on hamstring muscles flexibility in

normal Indian collegiate males. Calicut Med J. 2009; 7:4.
7. Fletcher IM, Anness R. The acute effects of combined static and dynamic stretch protocols on fifty-meter sprint performance in track-and-field athletes. J Strength Condition Res. 2007;21(3):784-7.
8. Victoria GD, Carmen EV, Alexandru S, Antoanela O, Florin C, Daniel D. The PNF stretching technique- a brief review. Ovidius Univ Annals. 2013;2:13.
9. Marek SM, Cramer JT, Fincher AL, Massey LL, Dangelmaier SM, Purkayastha S, et al. Acute effects of static and proprioceptive neuromuscular facilitation stretching on muscle strength and power output. J Athletic Training. 2005;40(2):23-8.
10. McNair P, Dombroski E, Hewson D, Stanley S. Stretching at the ankle joint: viscoelastic responses to holds and continuous passive motion. Med Sci Sports Exerc. 2000;33:354-8.
11. Holt BW, Lambourne K. The impact of different warm-up protocols on vertical jump performance in male collegiate athletes. J Strength Condition Res. 2008;22(1):226-9.
12. Yamaguchi T, Ishii K, Yamanaka M, Yasuda K. Acute effects of dynamic stretching exercise on power output during concentric dynamic constant external resistance leg extension. J Strength Condition Res. 2007;21(4):1238-44.
13. Ghram A, Yahia A, Damak M, Safaei Motlagh A, Jribi S, Costa PB. Effects of different types of proprioceptive neuromuscular facilitation stretching on dynamic balance control. Sport Sci Health. 2020; 16(3):451-8.
14. Khodayari B, Dehghani Y. The investigation of mid-term effect of different intensity of PNF stretching on improve hamstring flexibility. Procedia Social Behav Sci. 2012;46:5741-4.
15. Rees SS, Murphy AJ, Watsford ML, McLachlan KA, Coutts AJ. Effects of proprioceptive neuromuscular facilitation stretching on stiffness and force-producing characteristics of the ankle in active women. J Strength Condition Res. 2007;21(2):572-7.
16. Coons JM, Gould CE, Kim JK, Farley RS, Caputo JL. Dynamic stretching is effective as static stretching at increasing flexibility. J Human Sport Exer. 2017;12(4):1153-61.

Cite this article as: Hegishte AS, Kumar N. Effect of proprioceptive neuromuscular facilitation and dynamic stretching on flexibility, agility, and balance in hamstring tightness among collegiate level badminton players. Int J Res Med Sci 2023;11:1758-63.