EFFECT OF BALLISTIC AND PNF STRETCHING ON HIP JOINT RANGE OF MOVEMENT AMONG ADOLESCENT BOYS

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Abstract

The aim of the study was to determine the effect of ballistic and PNF stretching on hip joint range of movement among adolescent boys. Forty-five boys from higher secondary school Qaimoh Kulgam in Kashmir were selected randomly and their age ranged from 13 to 18 years. The subjects (N=45) were randomly assigned into three equal groups of fifteen boys each such as experimental group I, experimental group II and control group III. The experimental group I underwent ballistic stretching group (BSG) and experimental group II underwent PNF stretching group (PNFSG) for one hour in morning session. The control group (CG) didn't participate in training programme. The period of training was twelve weeks in a schedule (weekly three alternative days). The data was collected on selected dependent variables before and after the training period. The collected data was statistically analyzed by using analysis of covariance (ANCOVA) to find the significant differences among the groups. The Scheffe's post hoc test was used to find the paired mean difference if any. The level of confidence was fixed at 0.05.Based on the study it was concluded that ballistic stretching training (BS) and PNF stretching training (PNFS) had significantly improved hip joint range of movement among adolescent boys.

Key words: ballistic stretching, PNF stretching, hip joint range of movement.

INTRODUCTION

Stretching exercises are usually a part of warm-up routines before involvement in competitive sports and physical activities. It is believed that their use will enhance subsequent performance, reduce the risk of injury, and alleviate muscle soreness symptoms (Bacurau et al., 2009).

The three most common stretching methods are static, ballistic, and proprioceptive neuromuscular facilitation (PNFstretching.All methods are used for both acute (a single

stretching training) and short-term (repeated stretching training for 3-8 weeks) stretching and are able to increase the range of movement (RoM)[Konrad et al., 2015].Regarding short-term stretching training, the literature suggests that PNF stretching increases RoM the most. This stretching method can furthermore be subdivided into passive and active techniques (contract relax or hold relax), the target muscle is placed into a position of stretch followed by a static contraction. The muscle is then passively moved into a greater position of stretch(Cornelius,1983;Etnyre &Abraham,1986;Hanten &Chandler,1994;Ferber et al.,2002).In the active technique(contract-relax-antagonist-contract),the final passive stretch is exchanged by an active contraction of the antagonist, which stretches the target muscle(Cornelius,1983;Rowlands et al.,2003).

Ballistic stretching, also known as active stretching, uses movement and propulsion to stretch muscle. Ballistic stretching involves a series of rapid movements that become a specific stretching condition (Giroux et al., 2015).In this method, sequential contractions of agonist muscles are used to induce rapid antagonist muscle stretches. Active contraction and muscle stretching is done using gravity. If the force produced by jerking is greater than the stretching of the muscle, it may cause muscle damage. Consistent and severe contractions of agonist muscle that lead to antagonist muscle tension can also cause muscle pain (Nishimoto and Takasaki, 2019).In general, in this technique, repeated agonist muscle contractions are used to elicit antagonist muscles rapidly(De Souza et al.,2016).

Proprioceptive neuromuscular facilitation (PNF) is a form of flexibility exercises used to resolve muscle shortening and strain. The "PNF stretching'' is called " muscle energy techniques'', "active musculature relaxation techniques'', "rapid resistance duction ", "active stretching", and "PNF stretching"depending on the group used or called.

The PNF method is a tensile technique first used by Kabat to treat paralysis patients and then used by other researchers to increase flexibility and diverse groups of athletes (Yuktasir and Kaya,2009).Holt,Travis,Okita,Sadie,Wertman,Blank,and Toni Gawa observed a greater increase in flexibility by combining PNF techniques with active(ballistic and static) techniques(Khamwong et al.,2011).The term PNF stands for Proprioceptive Neuromuscular Facilitation(Ferber et al.,2002).PNF stretching is the method of accelerating or expanding the neuromuscular mechanism by stimulating deep receptors that can relax the muscle. This type of stretching is known to be the fastest and most effective method of improving static and passive flexibility (Krukowska et al., 2016).

This type of stretch is a combination of passive stretching and isometric stretching to achieve maximum static flexibility. Most PNF tensile movements agree with isometric contraction of the muscles(Espejo-Antunez et al.,2016).However, some PNF stretching techniques are performed with the contraction of the opposing muscles that have been stretched(Feland et al.,2001).In all of these, the essential thing is to stretch the muscle for 20 seconds before the next stretch and relax. The most common PNF stretching methods are a combination of agonist and antagonist contraction or stretching and relaxation (Khodayari and Dehghani, 2012.

Methodology: The aim of this study was to determine the effect of ballistic and PNF stretching on hip joint range of movement among adolescent boys. Forty-five boys from higher secondary school Qaimoh Kulgam in Kashmir were selected randomly and their age ranged from 13 to 18 years. The selected subjects were medically examined by a qualified physician and certified that they were medically and physically fit to undergo the selected training programme.

The selected subjects were randomly assigned into three equal groups of fifteen boys each such as experimental group I, experimental group II and control group. The experimental group I underwent ballistic stretching training and experimental group II underwent PNF stretching training for one hour in the morning session. The control group (CG) didn't participate in any training programme. The period of training was twelve weeks in a schedule (weekly three alternative days i.e., Monday, Wednesday and Friday). Data was collected prior to and after experimentation from ballistic stretching group (BSG), PNF stretching group (PNFSG) and control group (CG).

Statistical Analysis

Paired "T" test was applied to find out the changes within groups from pretest to post test on selected dependent variables. To find out the significant differences between the groups, Analysis of Covariance (ANCOVA) was applied. When the f-ratio of adjusted post test mean was found to be significant, Scheffe's post hoc test was employed to find out paired mean differences. The level of confidence was fixed, at 0.05 level of significance.

Results

Analysis of hip flexion

The descriptive analysis showing mean, percentage of improvement and't' ratio of the collected data on hip flexion among experimental and control groups are presented in table-1.

Table-1

Descriptive Analysis of the Data on Hip flexion

Variable	Groups	Pre-Test	Post-Test	M.D	%change	T-ratio	Sig.(2 tailed)
Hip flexion	BSG	107.80	108.94	1.14	1.05	8.95*	0.00
	PNFSG	107.87	109.99	2.12	1.96	20.62*	0.00
	CG	107.80	107.94	0.14	0.12	1.96	0.07

**Significant at 0.05 level for the df of 1 &14 is 2.14*

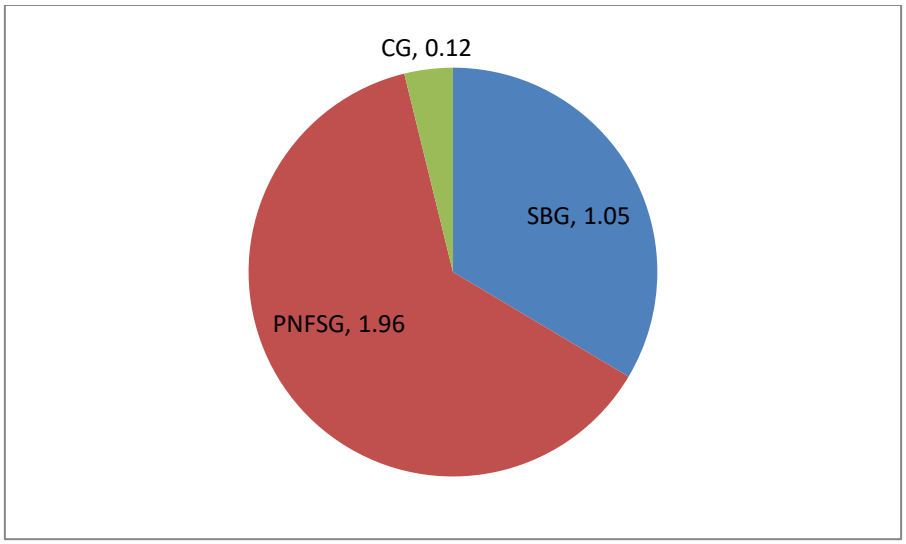
It is clear from the table-1,that there were significant differences between pre-test and post-test on hip flexion of ballistic stretching group, PNF stretching group because obtained t-ratio of 8.95 and 20.62 are greater than the required table value of 2.14 at 0.5 level of significance for df of 1&14.But the control group 't'ratio was 1.96, lesser than the required table value of 2.14 at 0.05 level of significance for 14 degrees of freedom. So it was found to be insignificant.

The results of the study also produced 1.05% of changes in hip flexion due to ballistic stretching group, 1.96% of changes due to PNF group and 0.12% of changes in control group.

The percentage of changes on hip flexion of ballistic stretching training group, PNF stretching training group, and control group are given in the figure-1.1.

Figure-1.1

Pie Diagram Showing the Percentage of Changes on Hip flexion of Experimental and Control Groups



The data collected from three groups on hip flexion was statistically analyzed by ANCOVA and the results are presented in Table-2.

Table-2

Analysis of Covariance on hip flexion of Experimental and Control Groups

	BSG	PNFSG	CG	SOV	SOS	df	M.S	f-ratio
Pre-test Means	107.80	107.87	107.80	**BG**	0.04	2	0.02	0.01
S.D	1.14	1.12	1.14	**WG**	54.26	42	1.29	
Post-test Means	108.94	109.99	107.94	**BG**	31.42	2	15.71	11.86*
S.D	1.32	1.02	1.07	**WG**	55.62	42	1.32	
Adjusted Post-Test Means	108.96	109.95	107.96	**BG**	29.48	2	14.74	90.59*
				WG	6.67	41	0.16	

***Significant, table value, 2 to 42&2 to 41 is 3.22 &3.23*

Table-2, shows that pre-test mean values on the hip flexion of ballistic stretching group, PNF stretching group, and control group are 107.80, 107.87 and 107.80 respectively. The obtained 'F' ratio of 0.01 pre-test score was lesser than the required table value of 3.22 for df 2 and 42 for significance at 0.05 level of confidence on hip flexion.

The post-test mean values on the hip flexion of ballistic stretching group PNF stretching group, and control group are 108.94, 109.99, and 107.94 respectively. The obtained 'F'ratio value of 11.86 for the post-test score was greater than the required table value of 3.22 for the df of 2 and 42 for significance at 0.05 level of confidence on hip flexion.

The adjusted post-test mean on the hip flexion of ballistic stretching group, PNF stretching group, and control group are 108.96, 109.95, and 107.96 respectively. The obtained 'F' ratio of 90.59 for the adjusted post-test score was greater than the required table value of 3.23 for df 2 and 41 for the significance at 0.05 level of confidence on hip flexion. It was concluded that the differences exist among the adjusted post-test means of ballistic stretching group, PNF stretching group, and control group on hip flexion. Since the 'F'value in the adjusted post-test means was found significant, Scheff's test was applied to assess the paired mean difference and the results are presented in Table-3.

Table-3

Scheffe's test for the Differences between Adjusted Post-test Paired Means on hip flexion.

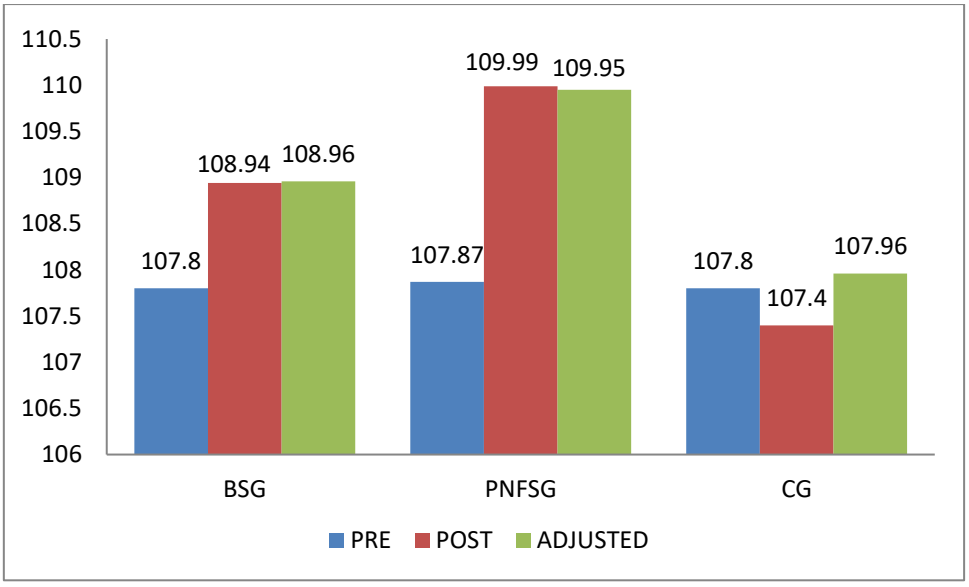
BSG	PNFSG	CG	M.D	C.I
108.96	109.95	-	0.99*	0.36
108.96	-	107.96	1.00*	
-	109.95	107.96	1.99*	

From table 3, it was imperative that both the experimental groups differed significantly from the control group on hip flexion. A significant difference was found between ballistic stretching group and PNF stretching group in improving hip flexion among adolescent boys. Therefore, twelve weeks of PNF stretching showed greater improvement than ballistic stretching among adolescent boys. The findings of the study imply that both the

groups improved but PNF stretching was significantly better in improving hip flexion than the other two groups in this study. The changes in hip flexion are presented in figure-1.2.

Figure-1.2

The Pre, Post, and Adjusted Post test Means of Experimental and Control Groups on hip flexion



Analysis of hip extension

The descriptive analysis showing mean, percentage of improvement and't' ratio of the collected data on hip extension among experimental and control groups are presented in table-4.

Table-4

Descriptive Analysis of the Data on Hip extension

Variable	Groups	Pre-Test	Post-Test	M.D	%change	T-ratio	Sig.(2 tailed)
Hip extension	**BSG**	11.00	11.80	0.80	7.27	4.51*	0.00
	PNFSG	11.20	12.67	1.47	13.12	6.72*	0.00

	CG	11.13	11.20	0.07	0.62	0.28	0.81

**Significant at 0.05 level for the df of 1 &14 is 2.14*

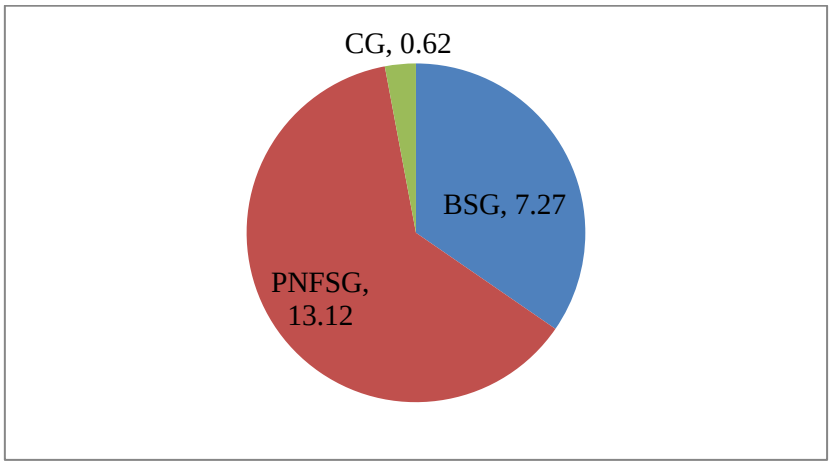
It is clear from the table-4,that there were significant differences between pre-test and post-test on hip extension of ballistic stretching group, PNF stretching group because obtained t-ratio of 7.27 and 13.12 are greater than the required table value of 2.14 at 0.5 level of significance for df of 1&14.But the control group 't'ratio was 1.96, lesser than the required table value of 2.14 at 0.05 level of significance for 14 degrees of freedom. So it was found to be insignificant.

The results of the study also produced 7.7% of changes in hip extension due to ballistic stretching group, 13.12% of changes due to PNF group and 0.62% of changes in control group.

The percentage of changes on hip extension of ballistic stretching group, PNF stretching group, and control group are given in the figure-1.3.

Figure-1.3

Pie Diagram Showing the Percentage of Changes on Hip extension of Experimental and Control Groups



The data collected from three groups on hip extension was statistically analyzed by ANCOVA and the results are presented in table-5.

Table-5

Analysis of Covariance on hip extension of Experimental and Control Groups

	BSG	PNFSG	CG	SOV	SOS	df	M.S	f-ratio
Pre-test Means	11.00	11.20	11.13	**BG**	0.31	2	0.15	0.03
S.D	1.46	1.37	1.35	**WG**	82.13	42	1.95	
Post-test Means	11.80	12.67	11.20	**BG**	16.44	2	8.22	5.43*
S.D	1.41	1.38	0.77	**WG**	63.59	42	1.51	
Adjusted Post-Test Means	11.88	12.61	11.18	**BG**	15.28	2	7.64	12.38*
				WG	25.30	41	0.61	

***Significant, table value,2 to 42&2 to 41 is 3.22 &3.23*

Table-5, shows that pre-test mean values on the hip extension of ballistic stretching group, PNF stretching group, and control group are 11.00, 11.20 and 11.13 respectively. The obtained 'F' ratio of 0.03 pre-test score was lesser than the required table value of 3.22 for df 2 and 42 for significance at 0.05 level of confidence on hip extension.

The post-test mean values on the hip extension of ballistic stretching group, PNF stretching group, and control group are 11.80, 12.67, and 11.20respectively. The obtained 'F'ratio value of 5.43 for the post-test score was greater than the required table value of 3.22 for the df of 2 and 42 for significance at 0.05 level of confidence on hip extension.

The adjusted post-test mean on the hip extension of ballistic stretching group, PNF stretching group, and control group are 11.88, 12.61, and 11.18 respectively. The obtained 'F' ratio of 12.38 for the adjusted post-test score was greater than the required table value of 3.23 for df 2 and 41 for the significance at 0.05 level of confidence on hip extension. It was concluded that the differences exist among the adjusted post-test means of ballistic stretching group, PNF stretching group, and control group on hip extension. Since the 'F'value in the adjusted post-test means was found significant, Scheff's test was applied to assess the paired mean difference and the results are presented in Table-6.

Table-6

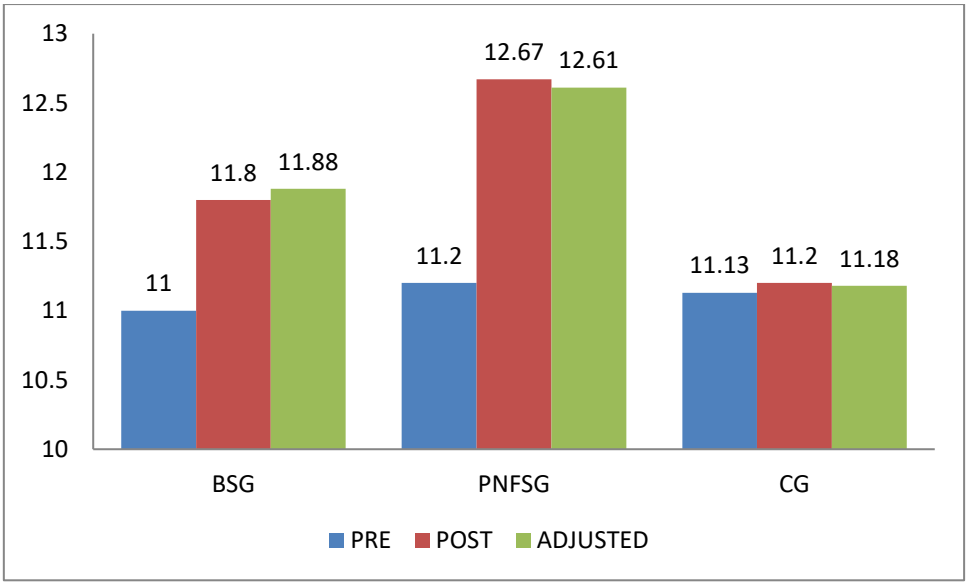
Scheffe's test for the Differences between Adjusted Post-test Paired Means on hip extension.

BSG	PNFSG	CG	M.D	C.I
11.88	12.61	-	0.73*	0.72
11.88	-	11.18	0.70*	
-	12.61	11.18	1.43*	

From table-6, it was imperative that both the experimental groups differed significantly from the control group on hip extension. A significant difference was found between ballistic stretching group and PNF stretching group in improving hip extension among adolescent boys. Therefore, twelve weeks of PNF stretching showed greater improvement than ballistic stretching among adolescent boys. The findings of the study imply that both the groups improved but PNF stretching was significantly better in improving hip extension than the other two groups in this study. The changes in hip extension are presented in figure-1.4.

Figure-1.4

The Pre, Post, and Adjusted Post test Means of Experimental and Control Groups on hip extension



Discussion and Conclusion:

The purpose of the study was to compare the effect of ballistic and PNF stretching on hip joint range of movement among adolescent boys. There was significant improvement on hip flexion and hip extension among adolescent boys due to ballistic and PNF stretching. The improvement of hip flexion and hip extension was much better than ballistic stretching. The improvement may be due to the nature of the trainings and type of exercises given in the training schedule. The findings of the study are in line with the findings of Beomryong Kim et al., 2021 reported that hip range of motion was increased followed by PNF stretching training in patients with chronic low back pain.Heider et al., 2020, also showed that PNF stretching had a significant effect on the range of motion after sports injury in soccer athletes. Janice M.Moreside and Stuart M.McGill.,2012 also find significant results in the hip joint range of motion followed by three different exercise interventions. Bekir Yuktasir & Fatih Kaya.,2009 also find significant results in the hip joint range of motion due to the long term effects of two different stretching techniques (i.e.4-times a week for 6-weeks).The findings of the study showed that 12-weeks of ballistic and PNF stretching training improved hip joint range of movement among adolescent boys. Hip joint is one of the most important joint in players while running, jumping, kicking and spiking. Adolescent boys require great range of movement of a joint. Consequently the flexion and extension are important in the hip joint range of movement. We should pay much attention to these joints during trainings.

Acknowledgement:

I am obliged to Annamalai University for allowing us to conduct this study, and I would like to express my gratitude especially to subjects and physical trainers who all participated and supported us in completing this study.

References:

Bacurau, R. F. P., Monteiro, G. A., Ugrinowitsch, C., Tricoli, V., Cabral, L. F., & Aoki, M. S. (2009). Acute effect of a ballistic and a static stretching exercise bout on flexibility and maximal strength. *The Journal of Strength & Conditioning Research*, *23*(1), 304-308.

Konrad, A., Gad, M., & Tilp, M. J. S. J. (2015). Effect of PNF stretching training on the properties of human muscle and tendon structures. *Scandinavian Journal of Medicine & Science in Sports*, *25*(3), 346-355.

Cornelius WL. Stretch evoked EMG activity by isometric contraction and submaximal concentric contraction. Athl Train 1983: 18: 106–109.

Etnyre BR, Abraham LD. Gains in range of ankle dorsiflexion using three popular stretching techniques. Am J Phys Med 1986: 65: 189–196.

Hanten WP, Chandler SA. Effects of myofascial release leg pull and sagittal plane isometric contract-relax techniques on passive straight-leg raise angle. J Orthop Sports Phys Ther 1994: 20 (3): 138–144.

Ferber R, Gravelle DC, Osternig LR. Effect of proprioceptive neuromuscular facilitation stretch techniques on trained and untrained older adults. J Aging Phys Act 2002: 10: 132–142

Rowlands AV, Marginson V, Lee J. Chronic flexibility gains: effect of isometric contraction duration during proprioceptive neuromuscular facilitation stretching techniques. Res Q Exerc Sport 2003: 74 (1): 47–52.

Giroux, C., Guilhem, G., Couturier, A., Chollet, D., and Rabita, G. (2015). Is muscle coordination affected by loading condition in ballistic movements? Journal of Electromyography and Kinesiology, 25(1): 69-76.

Nishimoto, K., and Takasaki, H. (2019). Jack-knife stretching and active knee extension stretching equally improve the relative flexibility of the hamstring muscles between the low back: A randomized controlled trial. Physical Therapy in Sport, 38: 139-145.

De Souza, L. M. L, Paz, G. A., Eloi, I. L., Dias, R., and Lima, V. P. (2016). Vertical jump performance after passive static stretching of knee flexors muscles. Apunts. Medicina de l'Esport, 51(192): 131- 136.

Konrad A, Stafilidis S, Tilp M. Effects of acute static, ballistic, and PNF stretching exercise on the muscle and tendon tissue properties. Scand J Med Sci sports. 2017;27:1070-80.

Ryu BH. The effect of joint mobilization with PNF stretch exercise on ankle joint range of motion, plantar pressure, and balance in patients with stroke. J Int Acad Phys Ther Res. 2018;9:1642-50.

Kim, B., Kang, T., & Kim, D. (2021). Effect of Proprioceptive Neuromuscular Facilitation Stretching on Pain, Hip Joint Range of Motion, and Functional Disability in Patients with Chronic Low Back Pain. *Physical Therapy Rehabilitation Science*, *10*(2), 225-234.

Yuktasir, B., and Kaya, F. (2009). Investigation into the long-term effects of static and PNF stretching exercises on range of motion and jump performance. Journal of Bodywork and Movement Therapies, 13(1): 11-21.

Khamwong, P., Pirunsan, U., and Paungmali, A. (2011). A prophylactic effect of proprioceptive neuromuscular facilitation (PNF) stretching on symptoms of muscle damage induced by eccentric exercise of the wrist extensors. Journal of Bodywork and Movement Therapies, 15(4): 507-516.

Ferber R., Osternig, L. R., and Gravelle, D. C. (2002). Effect of PNF stretch techniques on knee flexor muscle EMG activity in older adults. Journal of Electromyography and Kinesiology, 12(5): 391-397.

Krukowska, J., Bugajski, M., Sienkiewicz, M., and Czernicki, J. (2016). The influence of NDT-Bobath and PNF methods on the field support and total path length measure foot pressure (COP) in patients after stroke. Neurologia i Neurochirurgia Polska, 50(6): 449-454.

Espejo-Antúnez, L., López-Miñarro, P. A., Albornoz-Cabello, M., Garrido-Ardila, E. M. (2016). Acute effect of electrical muscle elongation and static stretching in hamstring muscle extensibility. Science and Sports, 31(1): e1-e7.

Feland, J. B., Myrer, J. W., and Merrill, R. M. (2001). Acute changes in hamstring flexibility: PNF versus static stretch in senior athletes. Physical Therapy in Sport, 2(4): 186-193.

Khodayari, B., and Dehghani, Y. (2012). The investigation of mid-term effect of different intensity of PNF stretching on improve hamstring flexibility. Procedia - Social and Behavioral Sciences, 46: 5741-5744.

Sajedi, H., Bayram, M., & Bilgiç, M. (2020). Effect of PNF, Ballistic and Static Stretching on the Range of Motion after Sports Injury Surgery in Football Athletes. *African Educational Research Journal*, *8*(1), 105-109.

Moreside, J. M., & McGill, S. M. (2012). Hip joint range of motion improvements using three different interventions. *The Journal of Strength & Conditioning Research*, *26*(5), 1265-1273.