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The effects of the proprioceptive neuromuscular facilitation (PNF) stretching on explosive power and agility

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ABSTRACT

The purpose of this study was to determine the effects of proprioceptive neuromuscular facilitation (PNF) training on feet explosive power and agility among female students. Forty participants (age, 21.9 ± 3.95 yrs; weight, 58.52 ± 10.16 kg; height, 164.6 ± 5.50 cm) selected for this study. The subjects were randomized in two groups included experimental group (N=20) and control group (N=20). Experimental group performed PNF stretching protocol for 8 weeks, 3 times per week and at least 2 minutes after warm up. The control group didn't participate in PNF protocol. The subjects measured in two sessions before and after training sessions. The results of the study revealed that a significantly improvement in PNF Stretching protocol compared to the control group in explosive power. This study was design to ascertain whether survey the effects of PNF Stretching protocol on vertical Jump and T test performances in female students. The finding of the study provide evidence that PNF stretching leads to more explosive power and no significant difference ($p \leq 0.05$) in agility in subjects is detected.

Key Word: Harman formula, Vertical jump, T test, HR.

INTRODUCTION

Warm up before physical activity is a procedure believed to reduce injury and enhance performance[1]. The benefits of warm up are numerous including increasing the temperature of the muscles and connective tissues, increasing the rang of movement, reducing the incidence of injury, decreasing the severity of injury, delaying the onset of muscular fatigue, preventing and alleviating muscle soreness, increasing the level of skill and muscular efficiency, and prolongation of sporting life[2-6].

Stretching is traditionally used as part of a warmup to increase flexibility or pain-free range of motion (ROM) about a joint in an attempt to promote better performances [7, 8]and /or reduce the risk of injury[9, 10].Kurtzstates the goals of a warm up are to increase awareness, improve coordination, improve elasticity and contractibility of muscles, and increase efficiency of the respiratory and cardiovascular system[11].

Recent research has indicated that stretching prior to athletic or sporting movements may have a detrimental effect on performance[12, 13, and14].Unick et al found no significant reduction in countermovement or drop jump performance following ballistic stretching in trained women[14]. In contrast, Nelson and Kokkinen found that maximal strength during knee flexion and extension decreased substantially after ballistic stretching [15]. Therefore, further research is needed to determine the effect of different methods of stretching on the performance of athletic movements.

Another form of stretching commonly used is proprioceptive neuromuscular facilitation (PNF). While research on the acute effects of PNF on muscle performance is limited, interesting results have been obtained from a few recent studies. Acute bouts of either PNF or static stretching caused similar deficits in knee extension power, measured by isokinetic dynamometry [16]. There have been numerous studies examining the effects of different warm up on agility and vertical jump performances. Young and Elliot studied the effects of static stretching, (PNF), and maximum voluntary contraction on explosive force production and jump performance. The result of the study showed a significant reduction in drop jump performance following static stretching compared to the other warm up procedures. The other modes of stretching had no significant influence on the concentric performance during the squat jump procedure[1].Church et al concluded that PNF was the only group that showed a decrease in vertical jump performance. They used women in their study comparing PNF and static stretching[12].

A recent investigation by Little and Williams discovered that the best agility performance observed during testing was seen following the dynamic warm up compared to both the static stretch warm up and no warm up,[17] the existence of this initial effect would benefit speed and agility performance conditions[18].McMillian, et all's study was designed to assess total body power and agility measures, thusthe warm-up protocols in the study included calisthenics (dynamic warm up) and full body stretches (static stretching warm up)[19]. Compared to the control condition, the dynamic warm up protocol increased power (medicine ball throw and five-step jump) and agility (T-drill) performance. For tasks requiring power and agility, the results suggested that dynamic stretching might offer performance benefits not found with static stretching or with no pre-participation routine. Dynamic or ballistic stretching has been shown to enhance performance in agility [18, 19] and vertical jump height [20].

A review by Bishop showed dynamic warm up routines positively influence power, agility and other performance measures[21]. It is valuable for coaches, athletic trainers, and athletes alike to recognize the established acute improvements in strength, power, and agility associated with dynamic warm up[22, 23].

Previous authors have examined the effects of stretching on maximal strength[24, 15], explosive force production [12, 25, and 1] vertical jump performance [26, 27, 28, and1]. To our knowledge, only 2 previous groups[12, 1] have compared the effects of static and PNF stretching on human performance measures, and they reported conflicting results. For example, one group [12] reported that the vertical jump heights after PNF stretching were lower than after the static stretching and/or control conditions. The other group, however, demonstrated no significant differences in jump performances between the PNF stretching and control conditions but significant decreases as a result of static stretching[1]. Thus, limited and inconclusive data are available regarding the effects of static and PNF stretching on muscle strength and power output. However, many of studies have used small sample sizes.

The effects of acute stretching on muscle power in women have remained relatively unexplored. From the literature review, only 2 previous studies analyzed the effects of acute stretching on a sample of women[12, 29].Therefore,the purpose of this study was to investigate the effects of eight weeks PNF stretching on explosive power and agility.

MATERIALS AND METHODS

Subjects: The present study was designed to investigate the effects of 8weekPNF stretching on explosive power and agility in female students. Forty healthy subjects (age; 21.9±3.95 yrs, weight; 58.52±10.16 kg, height; 164.60±5.50 cm)were recruited from faculty of physical education and sports sciences in undergraduate population. The participants were randomly assigned into two groups; experimental group (N=20) and control group (N=20). They were instructed to carry out normal daily training. The experimental group performed 2 minutes of PNF stretching protocol after warm up. The control group performed routine warm up before begin training. All subjects gave informed written consent their participation.

Data Collections: Each subject was required to attend in two testing sessions: I) pretest performed before begin of training and follow 8 weeks and 3 days per week with PNF stretching protocol for 2 minutes after warm up in each session and , ii) posttest performed after complete of training sessions. Each subject performed 3 vertical jumps and the trail with maximum record was used to calculate[30].A peak power measurement from the Harman formula has been determined[31].They performed once T test from a moving start and was used to calculate for agility[32, 33]. Hold-Relax (H-R) method has chosen in this study. The H-R method involves isometrically contracting the antagonist followed by a relation phase[34]. In the experimental group, each leg was raised in turn with assistance. The assistance pushed the raised extended leg into hip flexion until the subject reported maximum stretch. The subject resisted a force applied by the assistant in attempting to extend the hip. The non-raised leg was kept firmly on the ground by assistant's leg. The leg was slowly lowered to the ground after each stretch period. Three repetitions of stretch were performed with stretch being held for 10 seconds. A 3 second rest was given between

stretches. The validity and reliability of the instruments have been previously described by Bonnar et al[35].All subjects met study inclusion criteria by being injury free to the hip and knee for at least 6 months prior to testing.

Statistical Analysis

Descriptive statistical including means and standard deviations were measured for all variables. Both groups were assessed using unpaired student's t-test. Analysis of variance (ANOVA) was used to evaluate the effect of PNF stretching on the performance of groups and used to calculate paired t-test to compare the means of each variable between two trails. Significant level was set at P≤0.05. All statistical analyses were performed using the software program SPSS, version 15.

Table 1.The explosive power and agility results mean (SD)

Variables	Expimental Group		Control Group	
	Pretest	Posttest	Pretest	Posttest
Vertical jump	5582±419	6046±426	5580±396	5541±605
Agility	11.17±0.63	11.21±0.66	11.24±0.66	11.23±0.68

Table 2. Results of T-test for difference of pre-tests between control and experimental groups

Variables	Mean Difference	S.D. Difference	t	sig
Vertical jump	-1.84	129.02	0.14	0.99
Agility	0.07	0.20	0.33	0.74

Sig. level was P≤0/05.

Table 3. Results of A Paired t-test for differences between Experimental and control groups

Variables	Mean Difference	S.D. Difference	t	sig
Exprimental VJ	464.53	288.93	-7.19	0.001
Control VJ	-38.46	393.81	0.43	0.67
Exprimental Agility	-0.52	1.72	-1.36	0.19
Control Agility	0.02	0.06	1.23	0.23

Sig. level was P≤0/05.

RESULTS

Forty subjects were tested. Average height was 164.6±5.50 centimeters and average weight was 58.52±10.16 kilograms. There were 40 female students in both the control and PNF stretching groups. The means and standard deviations for all variables were reported (Table 1). The marginal means for experimental group in vertical jump increased from pretest (5582±419) to posttest (6046±426). Research question one examined how those with and without PNF stretching training differed on control and experimental groups in vertical jump and agility performances. There were no significant differences between groups of the dependent variables tested at the pretest occasion (Table 2). The results of this study showed that there were no significant differences between pretest and posttest measures for both control groups and the observed for vertical jump (0.67) and agility tests (0.23) were more than P≤ 0.05(Table 3). Paired t-tests revealed increase from pretest to posttest in vertical jump for experimental group.

DISCUSSION

The aim of this study investigation was to determine the influence of PNF stretching on vertical jump and agility performances in females. The finding of this study was a significant increase in vertical jump performance for experimental group during PNF stretching (P=0.001). There was increase in time of agility performance, but there was no significant difference in agility performance for experimental group during PNF stretching (P=0.19). There were no significant differences between both control groups in vertical jump (0.67) and agility tests (0.23). The larger decline in vertical jump performance after PNF stretching compare among experimental and control groups could be due to an addition effect of PNF stretching protocol that performed with experimental group. The application of 8 week PNF stretching increased the explosive power.

These results were consistent with previous reports of short term decrease in performance after a bout of stretching [36, 37, 38, 22, 25, 1, and 23].However, in that they observed decreases in muscle strength and power as a result of both the static and PNF stretching exercise. Conflicting evidence exists regarding the effects of PNF stretching on jumping performance[1, 12].Vertical jump heights after PNF stretching were lower than after the static stretching and/or control conditions [12],and the results in studies by[12, 16, 39, and10]supported these finding. Another group demonstrated no significant differences in jump performance between the PNF stretching and control conditions[1]. These conflicting results [12, 1] may be due to differences among stretching protocols and/or the types of jumping

tests performed (vertical jump versus drop jump versus concentric only jump). For example, a contract relax, agonist-contract PNF method involving two 10-second isometric contractions for each of the stretching repetition was used in one study [12], whereas the other used a contract-relax method involving one 5-second isometric contraction followed by a 15-second passive stretch for each stretching repetition[1]. Furthermore, it has been suggested that the magnitude of the performance decrement may be in direct proportion to the magnitude of the stretching exercise [40]. It is possible, therefore, that either the magnitude of the stretching of fatigue may have influenced the vertical jumping abilities after the PNF stretching conducted in these previous studies [12,1]. Nevertheless, results extended the finding of previous studies [12, 1]and suggested that PNF reduce the force- and power-production capabilities of the leg extensors during voluntary maximal concentric isokinetic muscle actions and the results found in these studies were conflict to finding of this study.

A review by Bishop [21] and McMillan et al [19] showed positively influence power, agility and other performance measures, and the results found in these studies were supported to finding of this study.

Kokkonen et al have studied the effect of warm ups on agility, sprinting and jumping performance in trained individual. They also have reported that a significant differences in sprint performance and no significant differences in agility and jumping performance[41]. Holt et al. in their study reported that dynamic warm up group enhanced muscular strength and agility [42]. Mcmillian et al. have studied on dynamic and static stretching warm up on power and agility performances. They indicated that dynamic warm up revealed better performance scores for all 3 performance tests[19]. Fletcher & Jones have studied on different stretching methods onsprint and agility. Their results revealed a significant decrease in agility time[22], little& Williams and O'Brien et al were agreement to this finding. Static stretching did not appear to be detrimental to agility performance when combined with dynamic warm up for professional soccer players. Dynamic stretching during the warm up was most effective as preparation for agility performance, and the results in these studies were conflicting to finding of this study[18, 17], but methods of studying were different with PNF stretching protocol. No sequencing effect of PNF stretching was found in the present study as there was no statistic significant impairment associated with control group. Although, the majority of studies reported that static stretching induced impairments, there are studies that have shown no deficit for jump performance [25, 28, and43]. Nevertheless, ballistic stretch has been reported to enhance performance in agility [18, 19]and vertical jump [20]. Alternatively, other studies have reported no change in maximum volunteer contraction force[36], countermovement and drop jump heights [14] with prior stretching. Hence, the present study is in agreement with some of the studies found in the literature on the effect of prior stretching. The significant increase in vertical jump performance ($P \leq 0.05$) for PNF stretching in experimental group is in keeping with previous literature [44, 45, 46, 42,47, 48, 49, 50, 51, and52]. Deposit the significant differences between control and experimental groups; there was a larger effect size for the experimental group.

CONCLUSION

These results of this study suggest that PNF stretching is particularly effective in improving vertical jump performance, because the vertical jump performance on experimental group showed greater improvements.Further studies are needed to examine the long term effects of PNF stretching in agility.

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