EFFECTS OF STRETCHING EXERCISES ON HORIZONTAL JUMPS OF UNIVERSITY ATHLETES

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ABSTRACT

The aim of this study was to evaluate the effects of stretching exercises on University athletes' performance in horizontal jump. The major objectives of the study were (a) to explore the impact of dynamic stretching exercises on horizontal jump of athletes; (b) to compare the effects of static stretching and dynamics stretching on horizontal jumping ability. The nature of the study was experimental and test used to gather information. A sample of ninety (90) students from the Islamia University of Bahawalpur were draw which was divided randomly into three groups (a) Control (b) static stretching (c) dynamic stretching. Before the training of all subjects pre-test were given standing Broad Jump and seven step jump. They Control group followed their daily routine life as usual, rest of two groups one as engaged in static stretching and other was in dynamic stretching. The duration of training for both groups was 8 weeks (forty days) in which subjects participated five (5) days a week consecutively for 45 minutes per session as per planned fixture. After training of all three groups were subjected to post-test. On the base of results it can be concluded that there is a strong statistical difference in performance of control group and static stretching group. Similarly there was a statistically strong difference of performance among experimental group and control group. Data further identified that there is significant variation between the results of static stretching group and dynamic stretching group. It can also be said that the component of dynamic stretching has more positive and significant effect on performance than static stretching. It is recommended that gradually. Dynamic stretching exercises improve the level of fitness specifically it helps to improve the main component speed and agility which should be performed in set of 8-12 repetitions.

Key Words: Stretching Exercises, Horizontal Jumps and Warm-Up activities

1. INTRODUCTION

Recent developments in physical and sports sciences indicate that flexibility is important for physical fitness. Most of the research studies conducted in sports sciences show the positive ramifications of such exercises so as far its range of motion is concerned (Yuktasir & Kaya, 2009). As warm-up exercises consisting of activities that have been widely accepted as appropriate way to perform into two methods (i) competitive and (ii) non-competitive sports participants (Chaouachi et al., 2010). In most of the research studies the static stretching deals as prior to jump performance made few eminent researches to conceive and propose the notion that static stretching is turned down from other said warm-up activities (W. Young, Elias, & Power, 2006). Exercises increase sport specific activity and joint range of motion. Stretching seems to prepare players not only to stop in time but also to sit and take reset right after through a warm-up exercise and that also thereupon the players become able to transform themselves into initiating particular sport movements (Tiemstra, Van Den Berg, Bekker, & de Graaf, 2011).

The dynamic stretching is widely proposed to be the sole technique which needs to be adopted at warm-up level and right before taking on enough power and more speed for numerous activities (Boyle, 2016). In sports activities whereby the term 'agility' is conceived to be an integral part or element, a very little research work has been executed which could better suggest the core methodology of stretching whatsoever it may be either dynamic or static which also becomes a basic reason for advance level of agility performance (Thacker, Gilchrist, Stroup, & Kimsey Jr, 2004).

Range of Motion (ROM) is considered in terms of direction and as well as distance. On the flip side, mobility is taken into consideration as an ability which allows one person to take free movements having no restriction at all (Nussbaumer et al., 2010). The most importantly the performance of one kept a muscular system. (Baigent et al., 2011) proclaims that muscles which are conceived as tight impede with whole actions of muscles in a proper manner. Therefore, since the

muscles are unable to function that is to say these do not contract and also are unable to get relaxed in an amiable way (Slimani et al., 2016). Thus this state of affairs becomes an acute cause of one's decreased performance besides least level of muscle movements as well (Slimani et al., 2016).

Dynamic stretching as per (Frick, 2010) transcribes that dynamic stretching is all about taking body parts into transition and similarly it largely depends how much a person augment his or her respective reach and thereby the speed one requires for particular movements. Dynamic stretching is better known to augment performance before an activity is carried out which demands force development that is highest in intensity. On the other hand there exists a phenomenon of static stretching (Slimani et al., 2016).

The static stretching relies upon the position in which muscle reaches far away to a certain point and persists that position there too (Nelson & Bandy, 2005). An athlete could be able to augment his or her passive flexibility with the assistance of static stretch which continues for about five seconds and since if it insists to put on optimal gains he should have gone through it for a time period of 15 to 30 seconds(Beedle & Mann, 2007).

Moreover, large number of researches project that performances keeps little attention towards muscle group that is single in number. (Myer, Ford, Palumbo, & Hewett, 2005) altogether carried out a study which suggests that vertically induced jump performances that continued for about less than thirty seconds do involve single frame of exercise particularly for each group of muscle that is meant to be included with a specific activity (Slimani et al., 2016). Based on previous research studies and literature, the proposed mechanism for improvements in power performance following dynamic stretching when compared to static stretching is due to differences in range of motion (Ribeiro & Oliveira, 2007). Observing the change in range of motion and power resulting from an acute dynamic stretching protocol prior to maximal vertical jump can provide possible explanations for the neuromuscular adaptations that occur with max-

ima muscular power exercise movements (Jeffrey, Nagle, Robert, & Jean, 2010). According the review of the different research studies, no study has examined the effect of stretching exercises on horizontal jumps of university athletes (Moran et al., 2017). The corresponding outcomes of the current study become quite handful for players and athletes in order to make them capable enough to attain utmost performance particularly in areas of speed and agility sports through warm-up tasks (Subasi, Gelecek, & Aksakoglu, 2008). This study highlights importance and effectiveness of dynamic stretching and static stretching methods for warm-up exercises (Ramirez-Campillo et al., 2014). The core outcome that comes out of this current research would be quite assisting able for all those athletes who aspire. This research study was design to investigate the effects of different stretching exercises on horizontal jump (HJ) among students (Katalinic, Harvey, & Herbert, 2011).

Pakistan is a country where people lack the awareness, opportunity of training and exercise. They face many problems due to scarcity of exercise. The major aim of the current study is to examine the effect of stretching exercises among University students' performance. Moreover, the study intends to explore the performance of different adults (ages 20 to 25 years) before and after the exercise. Subsequently, the objectives the study were to explore the impact of static and dynamic stretching exercises on horizontal jump of university students and to compare the effects of static-stretching and dynamic stretching on horizontal jumping ability. Study hypnotized that the incorporation of a particular element of activities (Static and Dynamic) towards warm-up would elevate the subsequent performance and the element of static stretching would diminishes subsequent performance as against dynamic stretching.

2. Methods

The experimental research method was adopted to investingate the desired aspects of the study. Quantitative research approach was applied to analysis the data. The pre-test and post-test mode was employed to compare the effect control and experimental groups.

3. Population and sampling

All the students of the department of Physical Education and Sports Sciences, the students of the Islamia University Bahawalpur were the population of study. A sample of ninety (90) active volunteer adults' age between 20 to 25 years was selected randomly into three groups on the basis of their willingness for the experiment. The participants' awareness and performance level with jumping and stretching during their physical activities in recreational sports e.g. Volleyball, Soccer, Badminton, Basketball, Athletics, and Distance Running are Characteristics which is described in table under:

Variables	**Control**	**Static stretch (SS)**	**Dynamic Stretch (DS)**
N	**30**	**30**	**30**
Age (y)	22.5 ± 2.5	22.5 ± 2.5	22.5 ± 2.5
Weight (Kg)	76.5 ± 28.5	73 ± 20	73 ± 18
Height (cm)	163 ± 12	161.75 ± 10.75	163.76 ± 10.1

Table 1: *Characteristics of Subjects.*

The population of the study was male students of university aged between (20-25 years) of which 90 males were drawn as sample (age, 22.5 ± 2.5years; height, 163.1 ± 11.9 cm; weight, 76.5 ± 28.5 kg). Preliminary cautions were taken that the subject should not lower muscles injury, no participants should be involved in dynamic and static stretching exercises and none of the participant was injured during jumps testing (Standing broad jump and seven step jump). They were not medically unfit and there is no need to medical treatment. In past, they were not remained unfit in life. Maintaining fitness in addition helps the participated in jumping and stretching exercises which decrease the possibility of injury during testing.

4. Procedure

The researcher mentioned two conditions as the criteria of selection of the students from the department of Physical Education & Sports Sciences. First, only the active students were considered as respondents of the study. Secondly, those active students who had participated in different physical activities and partial trained became the part of the population. Participants were divided in to three groups *(one group was based on control group and second group static stretching while third group was based on dynamic stretching)*. Before training, pre-test was conducted from all target sample and after training, post-test was conducted to compare the performance of dynamic stretching group and static stretching group on horizontal jump, eight weeks training on static stretching and dynamic stretching were completed. Training Programs used for static stretching and dynamic stretching groups. The pre-tests of the participants were performed in the following order: standing broad jump and seven step jumps of each participant while the post-test were performed on similar pattern. Training of the participants was performed, five days per week while total eight weeks training was conducted by the researcher on selected sample size. Prior to intervention consent form was obtained from the participants. On day first participants were asked to complete their bio data, to determine the eligibility. Second day of training participants were asked to take part in pre-test assessment (standing broad jump, and seven step jump). Following the orientation session, subjects were randomly assigned to one of the three treatment groups. After the completion of pre-test activity a general warm-up and stretching treatment program was started. One group of 30 adults is called group (A) control group, 30 in second group (B) static stretching group and 30 in third group (C) dynamic stretching group. Before the training of all groups control group A, second static stretching group B and third dynamic stretching group C, pre-tested (Standing Broad Jump and seven step long- jump) of the adults were taken and after complete training of groups B and C all the groups were post-test were conducted to get information. The duration of training

to be 8 weeks in which university students participated five days consecutively and 45 minutes per session. The participants engaged in both static stretching exercises and dynamic stretching exercises. Before training pre-test was conducted of all targeted sample and after training post-test had been executed in order to better compare the performance of static as well as dynamic stretching group towards horizontal jump.

5. Data Analysis

The data of pre-test and post-test of the experimental as well as controlled group was tabulated. The collected data were analyzed with help of Statistical Package for Social Science (SPSS) version 20 by using different statistical formulas of mean score, t-test, simple percentage and median using measure center tendency of result performance.

Table 2: *Pre-test and post- test results of Standing Broad Jump of No Stretching of (Group A)*

T	Df	Sig. (2-tailed)	Mean Difference
0.292	30	0.772	0.0370

N=30

Pre-test and post- test data analysis of control group A there is mean difference 0.037 and t value 0.292 having *P*=0.772> 0.05. It is hence inferred from the data that there is no statistically significant improvement in standing broad jump in Group A after eight weeks.

Table 3: *Difference in Standing Broad Jump of Static Stretching (Group B)*

T	Df	Sig. (2-tailed)	Mean Difference
2.484	30	.019	.13581

N=30

The table 3 shows the Pre-test and post- test data analysis of Static Stretching Group (B) in the experiment. The mean difference between pre-and post-test is 0.13581 and t value 2.484 having *P*=0.019 which is less than 0.05. It is inferred from the data that there is statistically significant improvement in standing broad jump of Static Stretching Group (B) after eight week of treatment static stretching exercises.

Table 4: *Difference in Standing Broad Jump of Dynamic Stretching Group C*

T	Df	Sig. (2-tailed)	Mean Difference
6.422	30	.000	.51594

N=30

Table-4 reflecting the Pre-test and post-test analysis of data regarding Dynamic Stretching Group (C). Analysis shows that mean difference between Pre-test & post-testis 0.51594 and t value 6.422 which is significant at *P*=0.000 which is less than 0.05. It is inferred from the data that there is statistically, highly significant improvement in standing broad jump in Dynamic Stretching group (C) after eight weeks training of Dynamic stretching exercises.

Table 5: *Pre and post- test Difference in Seven Step Jump of Control Group A*

T	Df	Sig. (2-tailed)	Mean Difference
-2.954	30	.006	-.38433

N=30

Pre and post- test data of control group regarding seven step jump shows that mean difference between pre and post-test is -0.38433 and t-value - 2.954 having *P*=0.006 which is significant being < 0.05. It is inferred from the analysis that there is statistically significant loss in seven step jump of Control Group A after eight weeks.

Table 6: *Pre and post- test Difference in Seven Step Jump of Static Stretching Group B*

T	Df	Sig. (2-tailed)	Mean Difference
4.572	30	.000	.43194

N=30

Table 6 shows analysis of pre and post test results of Static Stretching Group B that mean difference between pre and post test is 0.43194 and t value 4.572 having t *P*=0.000 which is significant as < 0.05. It is inferred from the data that there is statistically highly significant improvement in seven step jump of Static Stretching group B after eight weeks training focusing Static Stretching exercises.

Table 7: *Pre and post- test Difference in Seven Step Jump of Dynamic Stretching Group C*

T	Df	Sig. (2-tailed)	Mean Difference
5.842	30	.000	.76219

N=30

Table 7 shows Pre-test & post-test of dynamic stretching group C with Test Value = 0, shows that there is mean difference 0.76219 and t value 5.842 which is significant at P=0.000 < 0.05. It is inferred from the data that there is statistically highly significant improvement in seven step jump of Dynamic Stretching Group C.

Table8: *Comparative Difference in Standing Broad Jump between Control group A and Static stretching group B*

Group,	N	Mean	Std. Deviation	T-Value	Sig/*p*
Control Group	30	0.037	.69	-.725	.471
Static Stretching	30	0.136	.30		

Pre-tests comparison of post-test results of two groups shows the difference in standing broad jump after eight weeks. Table 8 indicates that group A jumped 0.037 feet and static stretching group B jumped 0.136. Independent Sample t-test analysis shows that t-value for this difference is - 0.725 hence p = 0.471which is more than 0.05 so it can be concluded that there is no statistically significant difference in the performance of control group (A) and static stretching (Experimental) group (B) after eight weeks.

Table 9: *Comparative Difference in Standing Broad Jump between control group A and Dynamic stretching group C.*

Group,	N	Mean	Std. Deviation	T - Value	Sig/*p*
Control Group	30	.0370	.69295	-3.238	.002
Dynamic Stretching	30	.5159	.45447		

Post-test data analysis of group A and Dynamic stretching group C shows difference in standing broad after eight weeks. According to data it was observed that mean score of control group in standing broad jump after experimental period was 0.037 feet a mean score in standing broad jump of Dynamic Stretching group C was 0.5159 feet. Independent Sample t-test analysis when applied t-value for this difference was – 3.238 having at $p = 0.002$ significant < 0.05. So, it can be concluded that there is a strong statistically significant difference in the performance of control group (A) and dynamic stretching (Experimental) group (C) after eight weeks training.

Table 10: *Independent Sample t-test Difference in Standing Broad Jump*

Group,	N	Mean	Std. Deviation	T - Value	Sig/*p*
Static Stretching	30	.1358	.30435	-3.888	.000
Dynamic Stretching	30	.5159	.45447		

Data analysis of two groups shows difference in standing broad jump before and after static stretching and dynamic stretching. According to data it was observed that mean improvement in static jumping during experimental period was 0.1358 feet in static stretching group. And improvement in standing broad jump of Dynamic Stretching group was 0.5159. Independent Sample t-test analysis shows that t-value for this difference is - 3.888 significant at $p = 0.000 < 0.05$. So, it is concluded that there is a strong statistically significant difference in the performance of static stretching group (B) and dynamic stretching (Experimental) group (C).

Table 11: *Independent Sample t-test Difference in 7 Step Jump*

Group	N	Mean	Std. Deviation	T - Value	Sig/*p*
Control Group	30	-.3843	.71255	-5.102	.000
Static Stretching	30	.4319	.52599		

Data analysis of two groups shows difference in 7 step jump before and after static stretching and no stretching. According to data it was observed that mean improvement in static jumping during experimental period was -0.3843feet. And improvement in 7 step jump of Static Stretching group was 0.4319. Independent Sample t-test analysis shows that t-value for this difference is -5.102 significant at $p = 0.000 < 0.05$. So, it is concluded that there is a strong statistically significant difference in the performance of control group (A) and static stretching (Experimental) group (B).

Table 12: *Independent Sample t-test Difference in 7 Step Jump*

Group,	N	Mean	Std. Deviation	T - Value	Sig/*p*
Control Group	30	-.3843	.71255	-6.215	.000
Dynamic Stretching	30	.7622	.73808		

Data analysis of two groups shows difference in 7 step jump before and after dynamic stretching and no stretching. According to data it was observed that mean improvement in seven step jumping during experimental period was -0.3843 feet. And improvement in 7 step jump of dynamic stretching group was 0.7622. Independent Sample t-test analysis shows that t-value for this difference is - 6.215 significant at $p = 0.000 < 0.05$. So, it is concluded that there is a strong statistically significant difference in the performance of control group (A) and dynamic stretching (Experimental) group (C).

Table 13: *Independent Sample t-test Difference in 7 Step Jump*

Group	N	Mean	Std. Deviation	T - Value	Sig/*p*
Static Stretching	30	.4319	.52599	-2.039	.046
Dynamic Stretching	30	.7622	.73808		

Data analysis of two groups shows difference in 7 step jump before and after dynamic stretching and static stretching. According to data it was observed that mean improvement in seven step jumping during experimental period was 0.4319 feet. And improvement in 7 step jump of dynamic stretching group was 0.7622. Independent Sample t-test analysis shows that t-value for this difference is - 2.039 significant at p = 0.046< 0.05. So, it is concluded that there is statistically significant difference in the performance of static stretching group (B) and dynamic stretching group (C).

6. Discussion

Results disclosed that non-significant improvements of control group (A). These findings are matched with the results of (Wallmann, Mercer, & Landers, 2008) that showed non-significant increases in control group of stretching exercises. Data exposed that there is no statistically significant improvement in standing broad jump of control stretching group while results showed that in seven step jumps there is a significant improvement in standing broad jump of Static Stretching Group. Hence in dynamic stretching there is highly significant improvement in standing broad jump. In the light of the analysis of the study it is found from the data that in the performance of control group and static stretching there is no statistically significant variation is found while results further disclosed that a highly significant variation in the results of control group and dynamic stretching group was recorded. The analysis of the study further unfold that there is no statistically significant variation in the results of control group and static stretching of experimental group and a strong statistically significant variation in the results of control group and dynamic stretching of experimental group was observed in data while a very strong statistically

significant difference in the performance of static stretching group and dynamic stretching (Experimental) group was recorded. These findings are similar with the (W. B. Young & Behm, 2002) that there is no statistically significant difference in the performance of control group and static stretching (Experimental) group. It further inferred from the findings of the study that there is a strong statistically significant variation in the performance of control group and static stretching of experimental group and there is also a strong statistically significant difference in the performance of control group and dynamic stretching of experimental group. Data further indicate that there is statistically significant variation in the results of static stretching group and dynamic stretching group that it can be proved the element of dynamic stretching has positive significant difference than static stretching. Study conducted by (Bahr & Krosshaug, 2005; W. B. Young & Behm, 2002)on the effects of stretching exercises on horizontal and vertical jumps; the results of the study were consistent as the results of this current study.

7. Conclusions

The first hypothesis of this research study was that the warm-up activity may improve the performance of athletes. On base of analysis of the study it is proved that warm-up activities improve the performance of athletes. It is inferred from the data that there is no statistically significant improvement in standing broad jump of control stretching group while results showed that in seven step jumps there is a significant improvement in standing broad jump of Static Stretching Group. Hence in dynamic stretching there is highly significant improvement in standing broad jump. In the light of the analysis of the study it is found from the data that in the performance of control group and static stretching there is no statistically significant variation is found while results further disclosed that a highly significant variation in the results of control group and dynamic stretching group was recorded. Empirically, it is concluded that a very strong statistically difference in the results of dynamic stretching and static stretching group was recorded. The second hypothesis of the research was the element of static stretching

would diminish subsequent performance as against dynamic stretching. On the base of results of the study it is concluded that in control group and static stretching of experimental group found statistically highly significant and in control group and dynamic stretching of experimental group the results were also statistically highly significant. It is identified that there is significant variation in the results of static stretching group and dynamic stretching group that it can be proved that the component of dynamic stretching has positive significant difference than static stretching.

This study explored the effect of stretching exercises on horizontal jumps. Stretching exercises play very significant role in warming up the body. Without warm up activities mussel remained stiff and increase the maximum chance of injury during games. After in-depth analysis of the data, this research study suggested that stretching (Static and Dynamic) exercises should be the part of routine exercises to minimize the chance of injury.

8. Future implications

This research study suggested that dynamic stretching and static stretching exercises can be performed gradually. Dynamic stretching exercises improve the level of fitness specifically it helps to improve the main component speed and agility which should be performed in set of 8-12 reputations.

References

Bahr, R., & Krosshaug, T. (2005). Understanding injury mechanisms: a key component of preventing injuries in sport. *British journal of sports medicine, 39*(6), 324-329.

Baigent, C., Landray, M. J., Reith, C., Emberson, J., Wheeler, D. C., Tomson, C., . . . Craig, J. (2011). The effects of lowering LDL cholesterol with simvastatin plus ezetimibe in patients with chronic kidney disease (Study of Heart and Renal Protection): a randomised placebo-controlled trial. *The Lancet, 377*(9784), 2181-2192.

Beedle, B. B., & Mann, C. L. (2007). A comparison of two warm-ups on joint range of motion. *Journal of Strength and Conditioning Research, 21*(3), 776.

Boyle, M. (2016). *New functional training for sports*: Human Kinetics.

Chaouachi, A., Castagna, C., Chtara, M., Brughelli, M., Turki, O., Galy, O., . . . Behm, D. G. (2010). Effect of warm-ups involving static or dynamic stretching on agility, sprinting, and jumping performance in trained individuals. *The Journal of Strength & Conditioning Research, 24*(8), 2001-2011.

Frick, A. (2010). Stretching exercises for horses: are they effective? *Journal of equine veterinary science, 30*(1), 50-59.

Jeffrey, C., Nagle, E. F., Robert, J., & Jean, L. (2010). Effect of single set dynamic and static stretching exercise on jump height in college age recreational athletes. *International Journal of Exercise Science, 3*(4),8

Katalinic, O. M., Harvey, L. A., & Herbert, R. D. (2011). Effectiveness of stretch for the treatment and prevention of contractures in people with neurological conditions: a systematic review. *Physical therapy, 91*(1), 11-24.

Moran, J. J., Sandercock, G. R., Ramírez-Campillo, R., Meylan, C. M., Collison, J. A., & Parry, D. A. (2017). Age-related variation in male youth athletes' countermovement jump after plyometric training: a meta-analysis of controlled trials. *The Journal of Strength & Conditioning Research, 31*(2), 552-565.

Myer, G. D., Ford, K. R., Palumbo, O. P., & Hewett, T. E. (2005). Neuromuscular training improves performance and lower-extremity biomechanics in female athletes. *The Journal of Strength & Conditioning Research, 19*(1), 51-60.

Nelson, R. T., & Bandy, W. D. (2005). An update on flexibility. *Strength and conditioning journal, 27*(1), 10.

Nussbaumer, S., Leunig, M., Glatthorn, J. F., Stauffacher, S., Gerber, H., & Maffiuletti, N. A. (2010). Validity and test-retest reliability of manual goniometers for measuring passive hip range of motion in femoroacetabular impingement patients. *BMC musculoskeletal disorders, 11*(1), 194.

Ramirez-Campillo, R., Andrade, D. C., Álvarez, C., Henríquez-Olguín, C., Martínez, C., Báez-SanMartín, E., . . . Izquierdo, M. (2014). The effects of interset rest on adaptation to 7 weeks of explosive training in young soccer players. *Journal of sports science & medicine, 13*(2), 287.

Ribeiro, F., & Oliveira, J. (2007). Aging effects on joint proprioception: the role of physical activity in proprioception preservation. *European Review of Aging and Physical Activity, 4*(2), 71.

Slimani, M., Bragazzi, N. L., Tod, D., Dellal, A., Hue, O., Cheour, F., . . . Chamari, K. (2016). Do cognitive training strategies improve motor and positive psychological skills development in soccer players? Insights from a systematic review. *Journal of sports sciences, 34*(24), 2338-2349.

Subasi, S. S., Gelecek, N., & Aksakoglu, G. (2008). Effects of different warm-up periods on knee proprioception and balance in healthy young individuals. *Journal of Sport Rehabilitation, 17*(2), 186-205.

Thacker, S. B., Gilchrist, J., Stroup, D. F., & Kimsey Jr, C. D. (2004). The impact of stretching on sports injury risk: a systematic review of the literature. *Medicine & Science in Sports & Exercise, 36*(3), 371-378.

Tiemstra, G., Van Den Berg, R., Bekker, T., & de Graaf, M. (2011). *Guidelines to Design Interactive Open-ended Play Installations for Children Placed in a Free Play Environment.* Paper presented at the DiGRA Conference.

Wallmann, H. W., Mercer, J. A., & Landers, M. R. (2008). Surface electromyographic assessment of the effect of dynamic activity and dynamic activity with static stretching of the gastrocnemius on vertical jump performance. *The Journal of Strength & Conditioning Research, 22*(3), 787-793.

Young, W., Elias, G., & Power, J. (2006). Effects of static stretching volume and intensity on plantar flexor explosive force production and range of motion. *Journal of sports medicine and physical fitness, 46*, 3.

Young, W. B., & Behm, D. G. (2002). Should static stretching be used during a warm-up for strength and power activities? *Strength & Conditioning Journal, 24*(6), 33-37.

Yuktasir, B., & 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.