

WARM UP STATIC STRETCH VERSUS WARM UP DYNAMIC STRETCH ON SPRINT PERFORMANCE IN FOOTBALL PLAYERS

Abdelrazek Youssef Ibrahim Bayomi

Assistant professor of Physical education, Department of Rehabilitation
Prince Sattam bin Abdul-Aziz University (Formerly Salman bin Abdul-Aziz University),
Alkharj, Saudi Arabia,

a.bayomi@psau.edu.sa
Mobile: +966540435859

Abstract— Background: Sprinting is the act of running over a short distance at (or near) top speed. It is used in many sports that incorporate running, typically as a way of quickly reaching a target or goal, or avoiding or catching an opponent.

Objectives: The aim of this study was to investigate the effects of static stretch versus dynamic stretch protocols on sprint performance in football players.

Method: 45 male football players were randomly classified into 3 groups. First group was Active Static Stretch group (ASS) (n=15), second group was Passive Static Stretch group (PSS) (n=15) and third group was Active Dynamic Stretch group (ADS) (n=15). The three groups performed a standard 10-min. jogging warm-up, followed by two 20-m sprints. The 20-m sprints were repeated after subjects performed the two stretch protocols.

Results: The ASS and PSS groups had a significant increase in sprint period ($P < 0.05$), while the ADS group had a significant decrease in sprint period ($P > 0.05$).

Conclusions: It was concluded that dynamic stretching as part of a warm-up seems to increase short sprint performance, but static stretching (active & passive) as part of a warm-up may decrease sprint performance.

Index terms- Static, Dynamic, Stretch, Sprint Performance, Football.

I. INTRODUCTION

Traditionally, athletes have achieved peak performance goals through long-term structured training schedules. Investigations have observed a variety of methods for optimizing training protocols, from increasing strength to improving aerobic endurance. However, until recently, little work has been done on one of the most fundamental parts of training, the stretch component of warm up [1].

The 'active' component of a warm up, designed to increase core temperature, blood flow and prepare the body for exercise, has long been shown to benefit performance [2,3,4,5]. However, less is known about the traditional western warm up model, and particularly the passive stretches used as part of the warm up process [1].

Recent research has highlighted that, far from helping athletes, passive stretching may inhibit performance by reducing power output [6, 7,8,9,10,11,12,13]. The most widely held rationale for this reduction in performance is that passive stretching causes the musculotendinous unit (MTU) to become more compliant, reducing force development by decreasing MTU stiffness [9,10]. This reduction in MTU stiffness leads to acute neural inhibition and a decrease in the neural drive to muscles, resulting in a reduction in power output [6, 9,14,15].

These results have lead, not surprisingly to a great deal of interest from coaches, athletes and sport scientists. However, there appear to be some issues with much of this research when its ecological validity, in terms of practical sports application, is examined. The length that stretches are held for, (ranging from 90 sec per muscle [8,16] up to 1 hr [9] are unlikely to be used by athletes in preparation for competition (where typical stretch routines last no more than 10-15 sec. per muscle group) [1].

The methods of determining power output in studies investigating this area have usually involved maximum voluntary contraction of isolated muscle groups, including maximum knee flexion / extension [8,11,16] or plantar flexion [9,16]. However, the ability of tests of muscular function to reflect changes in performance are severely limited. It is recommended that the effect of interventions or training should be based on changes in performance rather than changes in test scores of muscle function [17]. Therefore, is the apparent decrease in power output reported in these studies applicable to the multi-joint, coordinated actions that many athletes perform as part of their sports [17].

Despite the obvious difficulties of applying much of the research on passive stretching and its effect on sport preparation strategies, many athletes have moved away from the static passive approach to stretching in the warm up in favor of dynamic stretching, (defined by this author as a controlled movement through the active range of motion for each joint). This should not be confused with ballistic stretching (repeated small bounces at the end range of movement), which is linked to muscle damage and shortening [18]. However, despite its increasing popularity, very little research has been done on the effects of dynamic stretching as part of a warm up prior to performance [1].

Purpose of the study: The aim of this study was to investigate the effect of static stretch versus dynamic stretch protocols on the performance of a sport specific action (20m sprint running performance) in trained football players.

II. SUBJECTS AND METHODS:

A. Subjects

This study was conducted in Prince Sattam bin Abdul Aziz University. 45 football players in university football teams were selected between October 2015 and January 2016 with (mean + SD) 18.4 ± 0.43 years, 173.58 ± 4.46 cm and 70.8 ± 3.32 kg. Players were randomly classified into three groups; (Group A) Active Static Stretch (ASS) (n=15), (Group B) Passive Static Stretch (PSS) (n=15) and (Group C) Active Dynamic Stretch (ADS) (n=15). All players gave their informed consent before enrolment in the study.

B. Method

Three different stretch protocols; active static, passive static and active dynamic, were performed. Times over 20m were recorded in pre- and post-stretch protocols intervention. Each group performed a standard pulse-raising activity followed by two 20m sprints A set stretch protocol was carried out, followed by a repeat of the two 20m sprints.

C. Evaluation

All three groups performed a standard 10min. jogging warm up. This was followed by two sprints over 20m through. A timed recovery between sprints was set at two minutes. All sprints were performed from a standing start. This procedure was repeated after the stretch intervention, with the same starting technique occupied.

D. Stretch Interventions

Stretch interventions were supervised by a qualified Sports Therapist. The ASS group performed active stretches (an active contraction of the agonist muscle to its full inner range, stretching the antagonist's outer range) [18]. Stretches were held at a point of mild discomfort for 20sec per muscle group. The PSS group carried out passive stretches (slowly applied stretch torque to a muscle maintaining the muscle in a lengthened position) [19] of the lower body (gluteals, hamstrings, quadriceps, adductors, hip flexors, gastrocnemius and soleus). Stretches were the same as those performed by the ASS group, held for 20 sec per muscle group. The ADS group carried out a series of lower body dynamic stretches (controlled movement

through the active range of motion for each joint). Exercises were designed to stretch the same muscles as those in the PSS group, namely high knees (gluteals and hamstrings), flick backs (quadriceps), hip rolls (adductors), running cycles (hip flexors, gluteals, hamstrings and quadriceps) and straight leg skipping (gastrocnemius and soleus). Twenty repetitions were performed on each leg independently, with a walk back recovery.

E. Statistical Analysis:

Descriptive statistics was done in the form of mean and standard deviation. Inferential statistics assessed changes in (The two pre- and two post-sprint times) using ANOVA to assess interactions between groups and differences between pre- and post-intervention scores. Analysis was done using SPSS version 17. Significance was set at p-value ($p < 0.05$).

III. RESULTS

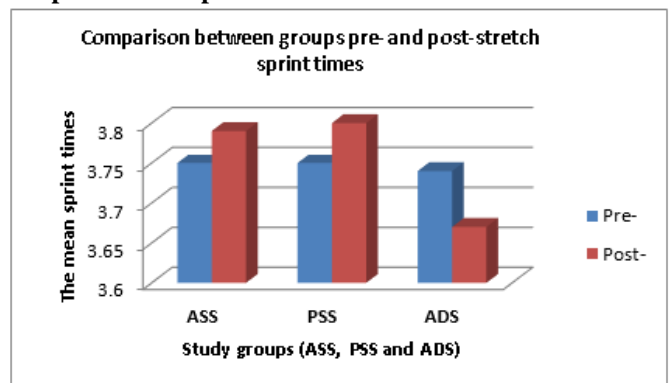
Table 1 and Figure 1 show the mean sprint times, pre- and post-stretch, and the mean difference in sprint times for each group. When the pre- and post-stretch data was analyzed (using a factorial ANOVA) the ASS and PSS groups showed a significant increase ($p < 0.05$) in sprint time after the active and passive static stretch intervention, while the ADS group showed a significant decrease ($P < 0.05$) in sprint time after the active dynamic stretch intervention.

Table 1:- (Mean + SD) pre- and post-stretch sprint times.

Group	Mean+SD pre-stretch (sec)	Mean+SD post-stretch (sec)	Mean Difference (sec)
ASS	3.75 ± 0.16	3.79 ± 0.44	*0.04
PSS	3.75 ± 0.22	3.81 ± 0.21	*0.05
ADS	3.74 ± 0.92	3.67 ± 0.75	*-0.07

* Significant differences before and after stretch intervention ($p < 0.05$).

Figure 1:- Comparison between the three groups pre- and post-stretch sprint times.



IV. DISCUSSION:

The main results of this study was a significantly faster sprint time when active dynamic stretching was incorporated into a warm up, with significantly slower sprint times observed for subjects employing active and passive static stretching protocols.

In agreement with current study, Yasser et al., 2012 [1] studied the effect of different warm up stretch protocols on 20m-sprint performance in trained soccer players. That study included that static stretching as part of a warm-up may decrease short sprint

performance, while active dynamic stretching seems to increase 20-m sprint performance.

The decrease in performance with the use of static stretching provides supporting evidence for a number of studies [1,6,7,8,9,10,11,12,13]. Knudson et al., 2001^[14] hypothesized that the decrease in vertical jump performance they saw, was the result of a decrease in neural transmission, as they found no change in the kinematics of the movement.

These studies concluded that this was attributable to acute neural inhibition from passive stretching decreasing the neural drive to the muscle [6,9,15]. Kubo et al., 2001^[15] suggests that passive stretching changes tendon structure, in effect making it more compliant leading to a lower rate of force production and a delay in muscle activation. This change in muscle stiffness is important as Kokkonen et al., 1998^[8] argues a stiff MTU allows force generated by muscular contraction to be transmitted more effectively than a compliant MTU. Rosenbaum & Hennig 1995^[6] and Avela et al., 1999^[9] support this argument by demonstrating a decrease in Electromyogram (EMG) excitation with muscle contraction after passive stretching.

However, these studies employed either no or a very slow, eccentric component prior to concentric contraction. When sprint running is analyzed, the need for a rapid switch from eccentric to concentric contraction is paramount. Although no study has looked at running performance, clues to the negative effect of static stretching may be found in the work of Young and Elliot 2001^[13]. They found that there was a decrease in muscle activation, but that this was particularly important in regard to the pre-activation of the MTU (stiffening of the MTU prior to ground impact). This is a vital component in the drop jumps (more commonly known as depth jumps, involving an athlete dropping from a height, landing and jumping vertically as quickly as possible) Young and Elliot 2001^[13] looked at, but just as important for successful sprint performance.

They concluded that passive stretching mainly affects the eccentric phase of movement, reducing the elastic return from the stretch shortening cycle. Cornwell et al., 2001^[12] explains the decreases in performance, caused by passive stretching in the counter-movement jumps they employed, were the result of a decreased ability of the MTU to store elastic energy. Interestingly, the amount of elastic energy that can be stored in the MTU is a function of the units stiffness^[20,21], therefore the more compliant muscle observed after passive stretching^[22] is less able to store elastic energy in its eccentric phase. This may well explain the decrease in performance exhibited in the static stretch groups in this study. The changes in performance shown by the ASS group have not been demonstrated before.

Although active static stretching is considered to be less effective than passive stretching in terms of increasing muscle length^[22], the prolonged isometric contraction could lead to reduced sensitivity of neural pathways, reducing muscle spindle sensitivity. This is because this type of stretch involves an agonistic muscle contracting, while the opposite antagonistic muscle relaxes, decreasing excitatory impulses through the nervous system to the motor units (reciprocal inhibition).

Therefore, in a complex movement pattern (such as sprinting) where muscle pairs need to work in conjunction, one set of

muscles may be in a position of being 'switched off', through a decrease in nervous system stimuli. The reason why active dynamic stretches positively affect performance may be because of a greater increase in core temperature in comparison to other forms of stretching. Increases in core temperature have shown an increase in the sensitivity of nerve receptors and an increase in the speed of nerve impulses, encouraging muscle contractions to be more rapid and forceful^[5]. Core temperature was not recorded in this study. However, all testing was performed on warm summer evenings after a substantial warm up (10min jogging). Any temperature increase was kept to a minimum by the static dynamic stretching being performed in a slow, controlled manner and the active dynamic stretching had built-in walk back recovery. In addition, active static stretches also involve an amount of isometric muscle contraction, which may affect temperature. In this study, whether temperature differences between interventions would have been great enough to cause the performance changes demonstrated is disputable. The other possibility for the positive changes in performance observed in the ADS group may be the performance of movement in a more specific pattern than static stretching. Proprioception is required in sprinting, particularly for pre-activation to help the rapid switch from eccentric to concentric contraction that is required to generate running speed.

It may be that active dynamic stretching helps performance of movement pattern coordination, to allow muscles to be excited early and quickly, producing more power and, therefore, decreasing sprint time. Evidence is available to demonstrate that passive stretching has a negative effect on coordination. Avela et al., 1999^[9] explains the decrease in motor neuron excitability, observed after passive stretching, through the depression of the H-reflex. This leads to a possible reduction in discharge from the muscle spindles because of increased muscle compliance. This may lead to a reduced efficiency in the self-regulation and adaptation to differences in muscle load and length^[23], modifying running mechanics through loss of control and, therefore, affecting optimum power output.

In conclusion the results from the current study suggest that static stretching (active or passive) has a negative effect on 20m running time. This could be due to an increase in MTU compliance; as Yaser et al., 2012^[1] and Cornwell et al., 2001^[12] explain, too much 'slack' has to be taken up in the initial part of the contraction. On the other hand, active dynamic stretching appears to improve 20m running time. The reasons for the positive increase in performance, brought about by active dynamic stretching, are not clear, but could be linked to rehearsal of specific movement patterns which may help increase coordination of subsequent movement. There is a clear need for confirmatory studies, as well as more fundamental research, to investigate the underpinning mechanisms behind the effects of warm up stretch protocols on athletic performance.

V. CONCLUSION:

It was concluded that dynamic stretching as part of a warm-up seems to increase short sprint performance, but active and passive static stretching as part of a warm-up may decrease sprint performance.

REFERENCES

1. Yaser Alikhajeha, Nasser Mohamad Rahimi B., Khadijeh Fazeli C., Hajar Fazeli D. (2012); The effect of different warm up stretch protocols on 20m-sprint performance in trained soccer players. *Procedia - Social and Behavioral Sciences* 46 (2012):2210 – 2214.
2. Karvonen, J.(1978); Warming up and its physiological effects. *Pharmacology and Physiology*. 6 (1978):31-39.
3. Blomstrand, E., Bergh, V., Eseen-Gustavsson, B. & B. Ekblom.(1984); The influence of muscle temperature on muscle metabolism during intense dynamic exercise. *Acta Physiologic Scandinavica*. 120 (1984):229-236.
4. Bergh, U. & B. Ekblom.(1979); Physical performance and peak aerobic power at different body temperatures. *J. of Appl. Physiol*. 46 (1979):885-889.
5. Shellock, F.G. & W.E. Prentice.(1985); Warming up and stretching for improved physical performance and prevention of sports related injuries. *Sp. Med.* 2 (1985):267-278.
6. Rosenbaum, D. & E.M. Hennig.(1995); The influence of stretching and warm up exercises on achilles tendon reflex activity. *J. of Sp. Sci*. 13 (1995):481-490.
7. Watson, A.W.S.(1997); Sports injuries: incidence, causes, prevention. *Physical Therapy Rev.* 2 (1997):135-151.
8. Kokkonen, J., Nelson, A.G. & A. Cornwell.(1998); Acute muscle stretching inhibits maximal strength performance. *Res. Quar. for Ex. and Sp.* 4 (1998):411-415.
9. Avela, J. Kyrolainen, H. & P.V. Komi.(1999); Altered reflex sensitivity after repeated and prolonged passive muscle stretching. *J. of App. Physiol*. 86 (1999):1283-1291.
10. Fowels J.R. Sale. D.G & J.D. Macdougall.(2000); Reduced strength after passive stretch of the human plantar flexors. *J. of App. Physiol*. 89 (2000):1179-1188.
11. Behm. D.G., Button, D.C. & J.C. Butt.(2001); Factors affecting force loss with prolonged stretching. *Canadian. J. of App. Physiol*. 26 (2001):262-272.
12. Cornwell, A., Nelson, A.G. Heise, G.D. & B. Sidaway.(2001); Acute effects of passive muscle stretching on vertical jump performance. *J. of Human Move. St.* 40 (2001):307-324.
13. Young. W. & S. Elliot.(2001); Acute effects of static stretching, proprioceptive neuromuscular facilitation stretching and maximum voluntary contractions on explosive force production and jumping performance. *Res. Quar. for Ex. and Sp.* 3 (2001):273-279.
14. Knudson, D., Bennett, K., Corn, R., Leick, D & C. Smith.(2001); Acute effects of stretching are not evident in the kinematics of the vertical jump. *J. of St. and Cond. Res.* 15 (2001):98-101.
15. Kubo, K., Kanehisa, H., Kawakami, Y. & T. Fukunaga.(2001); Influence of static stretching on viscoelastic properties of human tendon structures in vivo. *J. of App. Physiol*. 90 (2001):520-527.
16. Nelson. A.G. & J. Kokkonen.(2001); Acute ballistic muscle stretching inhibits maximal strength performance. *Res. Quar. for Ex. and Sp.* 72 (2001):415-419.
17. Murphy, A.J, & G.J. Wilson.(1997); The ability of tests of muscle function to reflect training-induced changes in performance. *J. of Sp. Sci*. 15 (1997):191-200.
18. Norris, C.M.(1994); *Flexibility: Principles and Practice*. A & C Black, London.(1994).
19. Mohr, K.J., Pink, M.M, Elsner, C. & R.S. Kvitne.(1998); Electromyographic investigation of stretching: the effect of warm up. *Cl. J. of Sp. Med.* 8 (1998):215-220.
20. Ingen, G.J.(1984); An alternative view of the concept of utilization of elastic energy in human movement. *Human Movement Sci.* 3 (1984):301-336.
21. Shorten, M.R.(1997); Muscle elasticity and human performance. *Med. And Sp. Sci.*25 (1997):1-18. 1987.
22. Wilson, G.J., Wood, G.A. & B.C. Elliot.(1991); The relationship between stiffness of the musculature and static flexibility: an alternative explanation for the occurrence of muscular injury. *Int. J. of Sp. Med.* 12 (1991):403-407.
23. Mcardle, W.D., Katch, F.I. & V.L. Katch.(1996); *Exercise Physiology: Energy Nutrition and Human Performance*. (4th Ed). Williams & Wilkins, London.(1996).
24. Deutsch. M.U., Maw, G.J., Jenkins, D. & P. Reaburn.(1998); Heart rate, blood lactate and kinematic data of elite colts (under 19) rugby union players during competition. *J. of Sp. Sci*. 16 (1998):561-570.