Acute Effect of Static and Dynamic Stretching on Sprint Performance in Adolescent Basketball Players

Rountas P., Manousaridou E., Galazoulas Ch., Bassa E., Karamousalidis G., Giannakos A.
Aristotle University of Thessaloniki
Galazoulas Ch., Giannakos A., Sentelides Th., Bassa E., Gesiou A.
Department of Physical Education and Sport Sciences
Thessaloniki, Greece.

Corresponding author:
Christos Galazoulas Phd
Department of Physical Education and Sports Science,
Aristotle University of Thessaloniki,
Thessaloniki, Greece.
Tel. +302310 9922481
e-mail: galaz@phed.auth.gr

Abstract

The purpose of the present study was to examine the effect of static and dynamic stretching on running velocity in adolescent basketball players. Fifteen adolescent male basketball players (age 14,93±0,25y) volunteered to participate in this study. The dynamic and static protocols were performed randomly in different days, a week apart. The programs included stretching exercises for knee extensors, knee flexors and plantar flexors. Three 15-second sets of each exercise were performed till the limit of the muscle pain and a 15-second rest was allowed between exercises. Then the 30m-sprint (3x10m) was performed in the basketball court using an electronic chronometer, whistle for indoor use, tape measure and adhesive tape. The joint mobility of the low limbs improved after both stretching protocols. Statistical analysis revealed a shorter time of 30 meter sprint after the dynamic stretching program compared to the static one ($p<.05$). Thus, it can be concluded that coaches should not use static stretching exercises because, according to the present results, they cause a reduction of running velocity. As it is not well documented which factors negatively affect speed production, further research is needed in order the responsible mechanisms to be determined.

Key words: static stretching, dynamic stretching, sprint, basketball.

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 (11). The ‘‘active’’ component of a warm-up, designed to increase core temperature, blood flow, and prepare the body for exercise, has been shown to benefit performance (6, 7, 19, 26).

Flexibility (joint range of motion) is promoted as an important component of physical fitness (23). It is widely conjectured that increasing flexibility will promote better performances (increasing joint range of motion) (26, 27). Consequently, stretching exercises designed to enhance flexibility are regularly included in training programs and pre-event warm-up activities of many athletes (17, 32).

Particularly, stretching during warm-up has become a traditional practice in preparing for exercise (10) and athletic events (4). It is believed that increasing flexibility will also reduce (26) or prevent the risk of injury resulting from tight musculature and rehabilitation after injury (18). Although there have been reports referring to injury reduction due to stretching (15), Herbert and Gabriel (20) in their review, concluded that stretching is unlikely to prevent injury.

Numerous investigations indicate the advantages and disadvantages of dynamic and static stretching. Joke Kokkonen et al. (20) made an interventionist program that lasted 10 weeks, and applied static stretching exercises on the low limbs of athletes. Flexibility and power (20-meter sprint) was measured before and after the program. The results showed an improvement ($p<0.05$) of both flexibility (18,1%)and 20 m sprint time (1,3%).

Recent research has highlighted that far from helping athletes, passive stretching may inhibit performance by reducing power output (1, 5, 8, 14, 20, 25, 30, 34). Nelson et al. (22) conducted an intervention program in track and field athletes Division I NCAA. 20 meters sprint was evaluated before and after 4 different static protocols. Three of the four static stretching protocols resulted in a significant increase (~0,04s) in time over 20 meters. A similar study (Winchester et al. 32) showed that the application of static stretching would reduce the sprinters' performance.

Vetter (29) studied 6 different protocols for warm-up performance in sprint and jump and showed that a warm-up including static stretching exercises can have negative impacts on jump performance but not on sprint performance. The research of Young et al. indicates that static stretching exercises had a negative influence on explosive power and performance in jumping. Cramer et al. (9), showed that the maximum torque decreased after static stretching exercises over 60^o and 240^o degrees and concluded that static stretching exercises can actually weaken the maximum power output resulting in a reduction of sprint performance.

Bacurau et al. (2) applied static and ballistic stretching exercises on the lower limbs. The maximum force decreased after static stretching exercises while remaining unchanged after the ballistic stretching. Bazett-Jones et al. (3) applied static stretching exercises for 6 weeks and they found no effect of static stretching on sprint time.

In recent years, many researchers have reported the importance of dynamic stretching as part of warm-up to ensure greater efficiency in power sports. Therefore, there are numerous studies that compare dynamic and static stretching and their effectiveness on sport performance. Fletcher IM et al. (13) found enhanced performance in 20 meters sprint in rugby players after a dynamic stretching protocol. Little et al. (21) studied different stretching protocols during warm-up in professional football players with high-speed capability and reported that static stretching exercises had a negative impact on speed while dynamic stretching protocol during warm-up was more effective in preparing for a performance sprint.

Other studies have shown the effect of the combination of static and dynamic stretching on athletic performance. Fletcher et al. (12) conducted a study on track and field athletes with a combination of static and dynamic stretching protocols on performance at 50 meters sprint. The results indicate that static stretching exercises reduce performance in running velocity.

Faigenbaum AD et al. (11) explored different warm-up protocols in athletic performance in children and the results of the investigation showed that it would be preferable for children to perform moderate or high-intensity dynamic exercises before carrying out activities that require high power output.

Thus, it seems very interesting to examine the effectiveness of different stretching protocols on the running velocity of athletes during developmental ages. Consequently, the purpose of this study was to examine the acute effects of dynamic and static stretching on running velocity in adolescent basketball players.

METHODS

Fifteen adolescent basketball players aged 14,93±0,25y volunteered to participate in the study. All participants agreed to maintain their normal exercise and activity levels throughout the duration of the study. All subjects were healthy, with no history of musculoskeletal or neurological disease. A sport medicine accredited doctor examined each player physically before the beginning of the study, and the nature, purpose and possible risk involved in the study was explained to the subjects before receiving their informed written consent for participation. The study was conducted in accordance to the rules and regulation of the research ethics committee of the Aristotle University of Thessaloniki.

Procedures and stretching protocols

All participants performed two stretching protocols of the knee extensors, knee flexors and plantar flexors in two different days, a week apart.

On both stretching protocol days, the subjects performed three times for 15 sec (3x15s) stretching with a rest period of 15 sec among the stretching repeats. The stretching exercises consisted of dynamic and static lengthening of the muscles, maintained for 15 sec at the position of maximum lengthening. This position of maximum lengthening was a terminal position, which was defined as the point at which participant felt the stretch 'till the limit of muscle pain.

Description of joint mobility

The measurement of joint mobility at the hip, knee and the ankle included hip and knee flexion, and ankle extension. The preferred leg was used on the measurements. Each day, two measurements took place. The first measurement was accomplished before the warm-up, and the second after the application of the stretching protocol. The measurement took place on an adjustable bench from the upright seat with bent knee on flat surface height 40cm. The initial and the final position of movement were passively measured starting from 0 point, as defined by the American Academy of Orthopaedic Surgeons. Maximal flexibility was defined as the point where the joint attained end-range, which was defined as the point at which the examiner felt muscle restriction.

All pre and post test measurements were taken at approximately the same time of the day. No warming-up exercises were performed prior to the initial flexibility measurement, while none of the subjects performed any training program or other type of exercise during the 48 hours prior to the measurements.

The exercises which were performed in the programme were:

Exercise 1: the subjects are at sitting position with arms linked and extended. From this position they shifted their body weight forward by bending the stretching limbs and touching the toes of the feet. The muscle groups stretched during the exercise were the hamstring muscles.

Exercise 2: the subjects were in the upright position with one leg flexed at the knee, near the supporting limb and caught with the hand of the respective arm. The subject flexes the joint of knee until he feels the resistance of the quadriceps muscles. The other hand touched a constant point to ensure the stabilization of the body. The muscle groups stretched were the quadriceps muscles.

Exercise 3a: The subjects were in the upright position and support the hands on the wall provided. One leg inflexed at the knee and the other, stretched at the knee to the point that the person feels the resistance of the posterior muscles of the leg. The muscle groups stretched were the triceps surae muscles of the low limb.

Exercise 3b: The subjects were in the upright position and supported the hands on the wall, bringing both low limbs back and the body forward, with knees extended. *The subject* slightly flexes one knee while stretching the other leg (turn right - left) without projection of limbs (continuous contact of the feet with the ground), and the subject feels the resistance of the gastrocnemius muscles. The muscle groups stretched were the triceps surae muscles of the low limb.

Running velocity test

The subjects after the protocol of stretching, accomplished shuttle run velocity test 30m (3x10 meters). The test was carried out on a clean non-slip floor (parquet basketball court). An electronic timer, a whistle indoors, a tape measure, a paper adhesive tape was used. The run was between two parallel lines 5 meters long, and 5 cm width with a distance between of 10 meters. The subjects clocked in shuttle run test individually.

STATISTICAL ANALYSIS

Anova with repeated measurements and a paired t-test was used for the statistical analysis of joint mobility and sprint performance, respectively. Statistical significance level was set at $p<0.05$.

RESULTS

Both static and dynamic stretching programs improved statistically significantly the joint mobility in all measured joints ($p <0.05$).

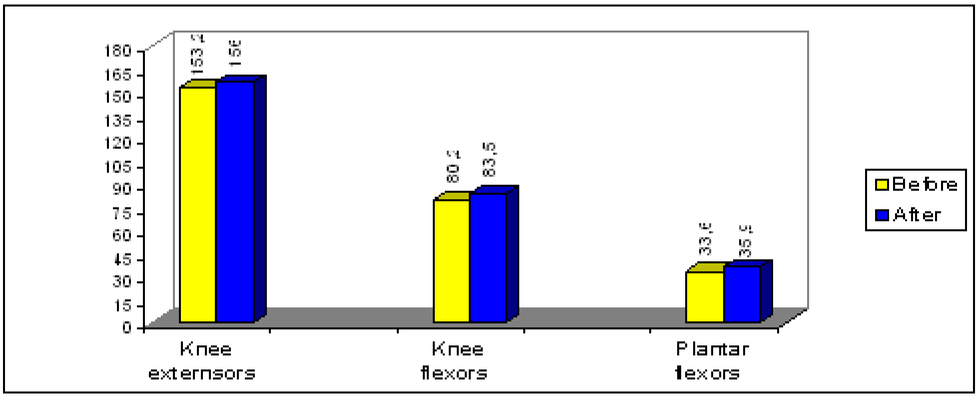


Fig 1: The joint mobility after the implementation of static stretching

Fig 2: The joint mobility after the implementation of dynamic stretching

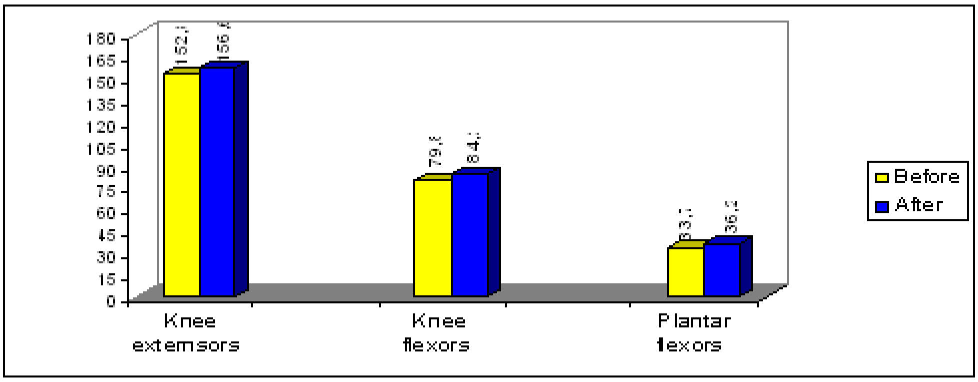
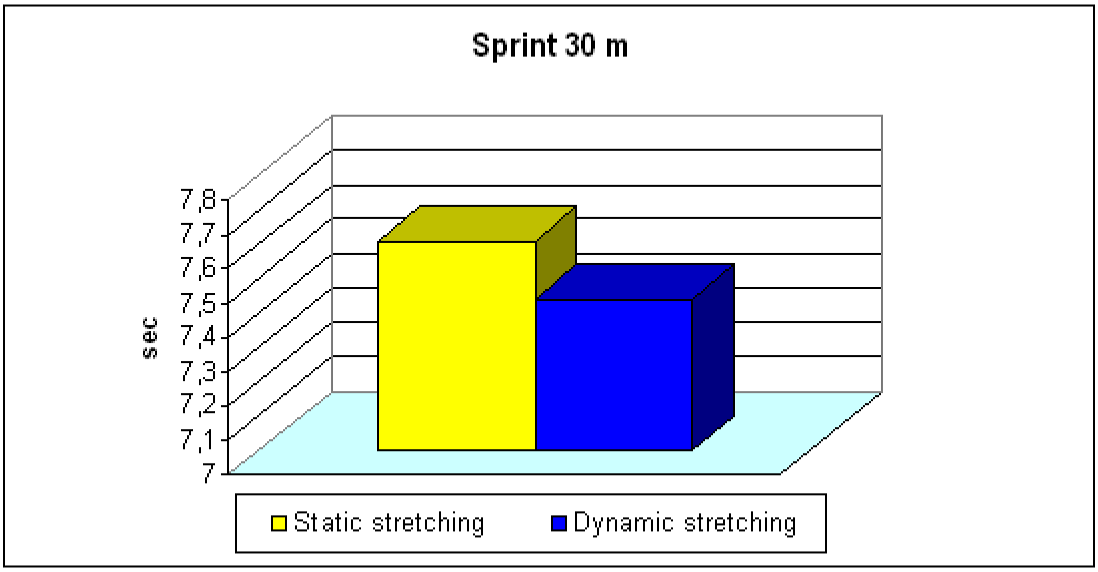


Fig 3. Statistically significant better running performance ($p < 0.05$) on 30 meters sprint after the implementation of dynamic stretching (7,446 ± 0,468) compared to the running performance after static stretching (7,617 ± 0,398).



DISCUSSION

The findings of the present study showed that both static and dynamic 15 s stretch, repeated three times, can improve the joint mobility on hip flexors, knee extensors and plantar flexors. Furthermore, the findings of the present study showed that the 15s dynamic stretch, repeated three times, improved statistically significantly the

30 meters sprint performance in adolescent basketball players. On the other hand, 15s static stretch, repeated three times, does not differentiate statistically significantly the 30 meters sprint performance.

According to the literature review, the application of passive stretching, especially when prolonged, result in significant reduction of the power of the following maximal force activities, when performed immediately after stretching. The decrease in performance with the use of static passive stretching provides supporting evidence for a number of studies (1, 5, 8, 14, 20, 25, 30, 34).

On the contrary, the application of dynamic stretching prior to maximal force activities, resulted in enhanced performance. Fletcher and Jones (2005) implemented static and dynamic stretching in rugby athletes and then executed 30 meter sprint. The results of their research demonstrated that implementation of dynamic stretching showed better performance on 30 meter sprint, compared to the static stretching. Similar findings were also reported at the research of Fletcher and Anness (2007) in which the static stretching had negative influence compared to the dynamic. Another study (Little and Williams, 2006) reported no negative effect of static stretching on the running velocity, but it also showed positive effect of dynamic stretching on the running velocity in football players.

Numerous studies (Holt, Lambourne (2008), Woolstenhulme (2006) et al., Faigenbaum (2006) et al., and Thompsen et al., (2007)) showed improvement of the performance at different jump types after the implementation of dynamic stretching. Additionally, other studies (Mateus et al., (2008), Herda et al., (2008) and Yamaguchi et al., (2005)) reported that dynamic stretching had a better effect on force production compared to static.

No statistically significant differences were found among the two protocols of stretching at the improvement of joint mobility. According to this study, the athletes and coaches who try to improve joint mobility could implement dynamic and static stretching in their activities.

REFERENCES

1. Avela, J., H. Kyrolainen, and P.V. Komi. Altered reflex sensitivity after repeated and prolonged passive muscle stretching. *J. Appl. Physiol.* 86:1283–1291, 1999.
2. Bacurau, R.F.P., Monteiro G.D.A., Ugrinowitsch, C., Tricoli V., Cabral L.F., & Aoki, M.S. Acute effect of a ballistic and static stretching exercise bout on flexibility and maximal strength. *J Strength Cond Res*, 23(1), 304–308, 2009.
3. Bazett-Jones, D.M., Gibson, M.H., & Mcbride J.M. Sprint and vertical jump performances are not affected by six weeks of static hamstring Stretching. *J Strength Cond Res*,1533-4287/22(1), 25–31, 2008.
4. Beaulieu, J.E. Develoing a stretching program. Phys. Sports Med. 9:59-69, 1981.
5. Behm. D.G., D.C. Button, and J.C. Butt. Factors affecting force loss with prolonged stretching. *Can. J. Appl. Physiol.* 26: 262–272. 2001.
6. Bergh, U., and Ekblom B. Physical performance and peak aerobic power at different body temperatures. *J. Appl. Physiol*. 46:885–889. 1979.
7. Blomstrand, E.,. Bergh, V.B., Gustavsson E, and. Ekblom B. The influence of muscle temperature on muscle metabolism during intense dynamic exercise. *Acta Physiol. Scand.*120:229–236. 1984.
8. Cornwell, A., A.G. Nelson, G.D. Heise, and B. Sidaway. Acute effects of passive muscle stretching on vertical jump performance. *J. Hum. Mov. Stud.* 40:307–324. 2001.
9. Cramer, J.T, Housh, TJ, Johnson, G.O, Miller, J.M, Coburn J.W & Beck, T.W. Acute effects of static stretching on peak torque in women. *J Strength Cond Res*, 18(2), 236-41, 2004.
10. DeVries, H.A. The “looseness” factor in speed and O2 consumption of an anaerobic 100-yard dash. *Res. Q.* 34:305-313, 1963.
11. Faigenbaum, A.D., Bellucci, M., Bernieri, A., Bakker, B., & Hoorens, K. Acute effects of different warm-up protocols on fitness performance in children. *J Strength Cond Res*, 19(2), 376-81, 2005.
12. Fletcher, I.M., Anness, R. The acute effects of combined static and dynamic stretch protocols on fifty-meter sprint performance in track-and-field athletes. *J Strength Cond Res*, 21(3), 784-7, 2007.
13. Fletcher, I.M, Jones, B. The effect of different warm-up stretch protocols on 20 meter sprint performance in trained rugby union players. *J Strength Cond Res*, 18(4), 885-8, 2005.
14. Fowels J.R., D.G. Sale, and J.D. Macdougall. Reduced strength after passive stretch of the human plantarflexors. *J. Appl. Physiol*. 89:1179–1188, 2000.

15. Hartig, D.E., and J.M Henderson. Increasing hamstring flexibility decreases lower extremity overuse injuries in military basic trainees. *Am. J. Sports Med.* 27:173-179, 1999.
16. Herbert, R.D., and M.Gabriel. Effects of stretching before and after exercising on muscle soreness and risk of injury: systematic review. *Br. Med. J.* 325:468-470, 2002.
17. Holcomb, WR. Stretching and warm-up. In: Baechle TR and Earle RW. (Eds), Essentials of Strength Training and Conditioning (2nded). *Champaign, IL: Human Kinetics*, 2000.
18. Jonhages, S., G. Nemeth, and E. Eriksson. Hamstring injuries in sprinters: the role of concentric hamstring muscle strength and flexibility. *Am. J. Sports Med.* 22:262-266, 1994.
19. Karvonen, J. Warming up and its physiological effects. Pharmacol. Physiol. 6:31–39. 1978.
20. Kokkonen, J., Nelson, A.G., Eldredge, C., & Winchester, J.B). Chronic Static Stretching Improves Exercise Performance. *Med. Sci. Sports Exerc.,* 39, (10) 1825–1831, 2006.
21. Little, L., Williams, A.G.. Effects of differential stretching protocols during warm-ups on high-speed motor capacities in professional soccer players. *J Strength Cond Res*, 20(1), 203-7, 2006.
22. Nelson, A.G., Driscoll, N.M., Landin, M.K., Young, M.A., & Irving c. Schexnayder Acute effects of passive muscle stretching on sprint performance. *J Sports Sc,* 23(5), 449 – 454, 2004.
23. Nelson, A.G., Kokkonen, J., Arnall, D.A.. Acute muscle stretching inhibits muscle strength endurance performance. *J Strength Cond Res*, 19(2), 338-43, 2005.
24. Pollock, ML, Gaesser, GA, Butcher, JD, Despres, JP, Dishman, RK, Franklin, BA, and Garber, CE. ACSM Position Stand on the recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness, and flexibility in healthy adults. *Med Sci Sports Exer* 30: 975–991, 1998.
25. Rosenbaum, D., and E.M. Hennig. The influence of stretching and warm-up exercises on achilles tendon reflex activity. *J. Sports Sci.* 13:481–490. 1995.
26. Safran, M.R., A.V. Seaber, and W.E GArreti. Warm-up and muscle injury prevention: an update. *Sports Med.* 8:239-249, 1989.
27. Shellock, FG and Prentice, WE. Warming up and stretching for improved physical performance and prevention of sports related injuries. *Sports Med* 2: 267–278, 1985.
28. Smith, C.A. The warm-up procedure: to stretch or not to stretch: a brief review, *J. Orthop. Sport Med.* 19:12-17, 1994.
29. Vetter, R.E. Effects of six warm-up protocols on sprint and jump performance. *J Strength Cond Res.*, 21(3), 819-23, 2007.

30. Watson, A.W.S. Sports injuries: incidence, causes, prevention. *Phys. Ther. Rev.* 2:135–151. 1997.

31. Wiemann, K., and K. Hahn. Influences of strength, stretching and circulatory exercises on flexibility parameters of the human hamstrings. *Int. J. Sports Med.* 18:340–346, 1997.

32. Winchester, J.B., Nelson, A.G., Landin, D., Young, M.A., Schexnayder, I.C. Static stretching impairs sprint performance in collegiate track and field athletes. *J Strength Cond Res.*, 22 (1), 13-9, 2008.

33. Woolstenhulme, M.T, Griffiths, C.M, Woolstenhulme, E.M, Parcell, A.C. Ballistic stretching increases flexibility and acute vertical jump height when combined with basketball activity. *J Strength Cond Res.* 20(4):799-803, 2006.

34. Young, W.B., Behm, D.G. Effects of running, static stretching and practice jumps on explosive force production and jumping performance. *J Sports Med Phys Fitness.*, 43(1), 21-7, 2003.

35. Zakas, A. Doganis, G. Galazoulas, C, Vamvakoudis, E, (2006). Effect of Acute Static Stretching Duration on Isokinetic Peak Torque in Pubescent Soccer Players. *Paediatric Exercise Science,* 18, 252-261.