Journal of Physical Fitness, Medicine & Treatment in Sports

Juniper Publishers key to the Researchers

Mini Review
Volume 7 Issue 4 - February 2020
DOI: 10.19080/JPFMTS.2020.07.555720

J Phy Fit Treatment & Sports

High Levels of Hamstring Flexibility May Enhance Physical Fitness Performance in Elite Soccer-Players

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Submission: January 30, 2020; **Published:** February 13, 2020

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Abstract

There is growing confusion of whether stretching training (static or dynamic) affect athletes' performance. Studies suggested that acute pre-competition stretching, may diminish maximum speed and muscular explosiveness performance in very short but powerful athletic trails/events. Similarly, studies suggested that by increasing the range of motion, with flexibility training, may negatively influence performance in long-distance runners. However, how safe is for soccer scientists/coaches to generalize results from studies that did not utilize soccer players and without taking into consideration the demands, needs, environment and the nature of soccer as a sport? In this opinion, we will focus specifically on the effect of sit-and-reach flexibility levels on elite young and mature/professional soccer-players' physical fitness performance. Studies from our laboratory observed positive results of the effect of "good" levels of sit-and-reach flexibility on elite soccer players' physical fitness performance.

Keywords: Flexibility training; Physical fitness performance; Elite soccer players

Introduction

Flexibility, which describes the ability to move a joint and its surrounding muscle groups through a full range of motion (ROM), is considered one of the five indispensable elements of a complete physical fitness [1]. Stretching therefore exercises have been considered to be an essential component of daily training programs, during warm-up and cool-down, as well as, prior to official competitions in several sports; since it was suggested to prevent from muscle injuries and minimize post-training/competition muscle soreness [2] and hamstring strain incidences [3]. However, there is a growing confusion with regards to the effect of stretching exercises (static or dynamic) on physical fitness performance in elite athletes. The misperception has arisen perhaps since several studies suggested that acute, hamstring pre-competition/trial stretching, diminished muscle force output [4] and deteriorated the peak force development during isometric contraction [5]. However, in the above studies, an acute stretching protocol was employed for examining the effect of stretching on strength and muscular explosiveness in a single predominantly trial.

The results also are contradictory concerning the effect of regular/chronic flexibility training on exercise performance. Regular flexibility training for example, was suggested to diminish running economy; but inflexibility may improve it by enhancing storage and return of elastic energy minimizing the need for muscle-stabilizing activity in sub-elite runners [6]. Others however, suggested exactly the opposite. Regular stretching/flexibility training was found to enhance optimal running performance by:

a) Increasing peak torque generation [7].

b) Reducing the series of elastic-component stiffness which contributes in enhancing the utilization of elastic strain energy and therefore muscle contraction [8,9].

c) Increasing muscle hypertrophy which, in turn, may donate in enhancing muscular force and contraction velocity [4].

d) Improving hip flexibility, myofascial balance and pelvic symmetry enhancing neuromuscular balance and muscle contraction [10,11].

However, how safe is for soccer-fitness instructors and coaches to generalize and apply the above contradictory results, (which derive from studies that did not use soccer-players and soccer environment) in soccer-training and pre-competition preparation?

Discussion

For examining the effect of flexibility on physical fitness performance of elite soccer-players, three studies, one interventional and two comparatives, were designed from our laboratory. In the intervention one, the effect of specific long-term supplementary static stretching training on various physical fitness components in young high-level soccer players was examined [12]. The study suggested that 4-weeks of specific supplementary application of static stretching-training is effective in improving flexibility, 35m maximum linear speed, neuromuscular explosiveness and agility performance in young high-level soccer-players, without also having any negative effect on players' endurance capacity [12]. These results, related to liner speed, are supported from a recent intervention study [13]. In a subsequent, comparative study from our laboratory, it was examined whether "poor" (sit-and-reach test score <22cm) or "good" (sit-and-reach test score >28cm) levels of lower back and hamstrings' flexibility may influence fitness parameters in elite young soccer-players (n=103: U15, U17, U19 National teams' members) [14]. Supporting the above intervention study, we found that high level of sit-and-reach flexibility contributed in enhancing neuromuscular explosiveness performance in young elite soccer-players without also influencing isokinetic muscle force development and/or diminishing endurance capacity. In a follow-up comparative study (Hadjicharalambous and Christou, unpublished results), we also examined whether "poor" or "good" levels of lower back and hamstrings' flexibility may influence fitness parameters in elite/professional soccer-players (n=94). We interestingly observed that high level of sit-and-reach flexibility (>28cm: mean 31.4cm) contributed in enhancing aerobic capacity in professional soccer players relative to low sit-and-reach flexibility (<22cm: mean 17.4cm) group (Figures 1 & 2). However, in contrast to other studies [5,6], neither high nor low levels of sit-and-reach flexibility should be considered as a limiting factor in maximum speed and muscular explosiveness performance. On the other hand, poor lower back and hamstrings' flexibility might be a limiting factor in achieving high endurance capacity in professional soccer-players.

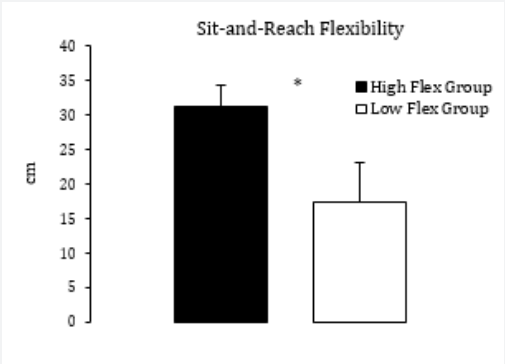

Figure 1 : Sit-and-reach flexibility test scores between High and Low levels of flexibility groups. *Statistical difference between High and Low sit-and-reach flexibility groups (p< 0.05)..

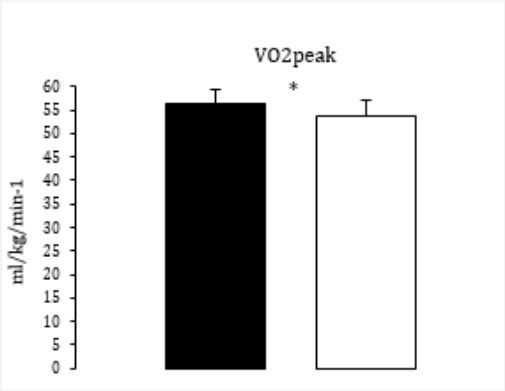

Figure 2 : Peak oxygen consumption ($VO2_{peak}$) between High and Low levels of flexibility groups. *Statistical difference between High and Low sit-and-reach flexibility groups (p< 0.05).

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The mechanical properties of musculoskeletal and tenodious function, as well as the cellular, molecular and neural mechanisms associated with exercise performance were not the purpose of our investigations [12,14] Hadjicharalambous and Christou unpublished results. The mechanism, consequently, associated with the performance parameters improvement observed in our studies, is only speculative. It is possible that the improvement in speed, agility and neuromuscular explosiveness performance observed in our studies, where young elite players were employed, to have been due to the positive effect of regular stretching training in muscle elasticity, motor coordination and anaerobic a-lactic energy production system enabling improvement in lower limbs speeding up mechanism and in muscular power. It was previously suggested for example that regular flexibility training may improve muscular performance by increasing peak torque generation [7] and/or by reducing the series elastic component stiffness which contribute in enhancing the utilization of elastic strain energy and therefore muscle contraction [9]. In addition, regular stretching training was found to improve hip flexibility, myofascial balance and pelvic symmetry which all may contribute in enhancing neuromuscular balance and contraction velocity [10].

However, why in our two above mentioned studies [12,14] where young elite soccer players were evaluated, an improvement in maximum speed and neuromuscular explosiveness were observed, but in the study that elite professional soccer-players were evaluated (Hadjicharalambous and Christou unpublished results), only an improvement in endurance capacity was found? It is plausible that the training background and the biological age, as well as, the "good" level of flexibility (improved due to the 4 weeks of stretching intervention) of the young players used in our two studies, enabled the regular stretching protocol and the high level of flexibility respectively to positively influence agility, speed and legs explosiveness [12,14]. Otherwise, the training background of the participants (mature athletes) used from the other studies [15] contributed to insignificant responses to stretching training treatment. It was observed, for example that biological growth process per se may negatively affect flexibility and technical performance of young soccer players increasing the rate of soccer injuries development [16]. It is therefore possible that the benefit of improving particularly speed and neuromuscular explosiveness, to regular flexibility training is more evident in young than mature athletes due to the correction of the physical but negative-effect of biological growth on flexibility and therefore on neuromuscular skills-related performance such as speed, agility and broad-jump. McNeal and Sands [17] for example, suggested an improvement in neural adaptations following flexibility training rather than an improvement in peripheral tissue responses; and this is more evident in young than in mature soccer-players [16].

In one of our studies (Hadjicharalambous and Christou, unpublished results), endurance capacity and the distance covered (during the bleep-test) were improved in the professional soccer players, who were included the "good" sit-and-reach flexibility group (sit-and-reach test score >28cm); results that were not evident in our studies [12,14] where young soccer-players were evaluated. These results are in contrast with several previous reports which found that less-flexible long-distance runners had greater running economy compared with the more flexible group [6,18]. However, soccer-way of running/moving during the game, is different with long-distance nature of running and technique. Modern soccer demands not only high levels of aerobic and anaerobic capacity but also intermittent and high-speed activities including maximum short-distance sprints, accelerations, decelerations, muscular explosiveness, quickness and agility [19-21]. In addition, in our unpublished yet study, aerobic capacity was evaluated with a bleep-test, in a soccer grass-pitch, imitating therefore as much as possible the real soccer environment. Consequently, since increased ROM was previously found to positively influence the stretch-shortening cycle, which causes the muscle to generate greater force, increases the rate of force development and decreases the ground time, these may contribute in improving muscular performance and running economy (endurance capacity) [22]. A study for example, has shown that rugby players who increased their lower limps ROM with flexibility training, improved their running mechanics when running at 80% of their maximum velocity [23]. It is possible therefore that, the professional players included in the "good" levels of flexibility group, evaluated in our study, to have benefited during the bleep-test when the pace progressively become greater to 80% of their maximum velocity during the bleep-test, contributing to improve their endurance capacity.

Alternately, stretching was found to improve circulation increasing blood flow throughout the body [24,25]. Better therefore, blood circulation will potentially increase the supply of nutrients throughout the body and active muscle particularly and aid with the removal of harmful waste from the body's muscle tissues, which may ultimately accelerate muscle recovery time and delay muscular fatigue [24]. Consequently, based on the above, good flexibility improved blood circulation mechanism delaying muscular fatigue, the group of soccer-players with "good" levels of sit-and-reach flexibility may has the advantage to last longer during a bleep-test on a grass surface compared with the group with "poor" sit-and-reach flexibility levels.

Conclusion

Good levels of sit-and-reach flexibility may contribute:

a) In improving maximum speed, quickness, agility and neuromuscular explosiveness performance in young elite soccer-players without negatively influencing their endurance capacity, and

b) In enhancing aerobic capacity in elite mature soccer players without negatively influencing their maximum speed,

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quickness, agility and power performance. Consequently, regular stretching application is beneficial in both young and mature elite soccer-players.

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