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RANGE OF MOTION IN THE LOWER EXTREMITY: ELITE VS. NON-ELITE SOCCER PLAYERS

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Abstract The purpose of this study was to describe flexibility characteristics of elite Serbian soccer players, and make comparisons with non-elite counterparts to find a relationship between results from the flexibility tests and competition level. Two male soccer teams participated in the study with Squad A ($n = 30$) competed in the professional First National League while Squad B ($n = 30$) played in the amateur Third Division. Sit-and-reach test and goniometric measurements were done for hip (flexion, extension, abduction, adduction, medial and lateral rotation), knee (flexion, extension, medial and lateral rotation) and ankle (dorsiflexion, plantar flexion) of dominant leg. No statistically significant difference was found between the Squad A and Squad B for passive knee, hip and ankle flexibility ($p > 0.05$). However, we found a significant difference in sit-and-reach test results between groups with a significantly superior range of motion in the non-elite players as compared to their elite counterparts (36.4 ± 5.2 vs. 29.1 ± 4.7 ; $p < 0.05$). It appears that goniometric measurement of hip, knee and ankle range of motion seems to be indiscriminative method of joint flexibility between elite and non-elite soccer players.

Key words: range of motion, competition, goniometry, soccer players

INTRODUCTION

Flexibility may be defined as the range of motion (ROM) at a single joint or a series of joints, and good flexibility is needed in sports where maximum amplitude of movement is required for an optimal execution of technique [17]. Beyond other factors, suboptimal flexibility increases the risk of injuries of locomotor system [8]. Therefore, testing for limitation in the range of motion at a specific joint can be of benefit in screening for injury predisposition.

Several studies have shown that soccer players had flexibility values poorer than non-athlete subjects [5, 15, 21]. Moreover, limited ROM has been noted in Japanese [7] and English [16] soccer players. This poor flexibility may reflect an adaptive response of soft tissue around the joints which improves stability at the specific joint, or lack of attention to flexibility practices in training. Appropriate stretching protocols are thought to increase flexibility, but the optimum level of flexibility to prevent injury is not clear and may vary between muscle groups and different sports.

Previous investigations have evaluated flexibility profile of soccer players vs. non-players although there is a lack of data comparing successful and non-successful soccer players. The lack of optimal flexibility may be one of the key factors that contribute to higher incidence of injuries in professional soccer leagues [14]. Yet, it is difficult to find *specific* flexibility parameter that correlates with injury [15].

The purpose of this study was to describe flexibility characteristics of elite Serbian soccer players, and make comparisons with non-elite counterparts to find a relationship between the results from flexibility tests and competition level. Understanding the flexibility profile of

successful players could give coaches, trainers, and exercise scientist's better working knowledge of this particular group of athletes. This flexibility pattern could give coaches, athletic trainers and team physicians a better working knowledge to help plan prevention and rehabilitation of injuries.

MATERIAL AND METHODS

SUBJECTS

Two male soccer teams participated in the study. One of the teams in the study (Squad A; $n=30$) competed in the professional First National League while the other team (Squad B; $n=30$) played in the amateur Third Division. All of the subjects gave their informed consent and volunteered to participate in the study, which had the approval of the Academy's Ethical Advisory Commission.

All participants were fully informed verbally and in writing about the nature and demands of the study. They completed a health history questionnaire, and were informed that they could withdraw from the study at any time, even after giving their written consent. Flexibility measurements were made of 60 players (all positional roles were equally represented in both teams), during the final week of their preparatory training for competition. All subjects were assessed on the same day, and the tests were performed in the same order.

They were in good health, free from diabetes, heart disease, musculoskeletal dysfunction, cancer, and smoking, participating in consistent training (average of 12 hours per week) for the past five years. In the 24 hours before the experiment, the subjects did not participate in any prolonged exercise.

EXPERIMENTAL PROCEDURES

Subjects reported to the laboratory field at 10 A.M. after an overnight rest of between 10 and 12 hours. Upon entering, subjects completed a soccer-specific warm up (15-min of sprints and individual exercise).

In the sit-and-reach test the subject sits on the floor with the legs extended forward and feet pressed flat against a box that supports the measuring device (Novel Trunk Flex, T-42, Creative Health, USA). With the back of the knees pressed flat against the floor, the subject leans forward and extend fingertips as far as possible. The distance reached is recorded with the median of three measurements used to represent general flexibility.

Goniometric measurements were done for hip (flexion, extension, abduction, adduction, medial and lateral rotation), knee (flexion, extension, medial and lateral rotation) and ankle (dorsiflexion, plantar flexion) of dominant leg. Maximal active joint flexibility was measured using a modified goniometer with spirit level (Goniometer 0054 and 004BB, Creative Health Inc., Plymouth, USA) according to Borms and Van Roy [1]. Measurements were done in the same order by the trained technician on all subjects.

STATISTICAL ANALYSIS

The data are expressed as means \pm SD. Statistical analysis was performed using Student's *t* test with Bonferroni correction for repeated comparisons. *P* values of less than 0.01 were considered to be statistically significant. The data were analyzed using the statistical package SPSS, PC program, version 7.5 (SPSS Inc., USA).

RESULTS

All results are shown in Table 1. No statistically significant difference was found between the Squad A and Squad B for passive knee, hip and ankle flexibility ($p > 0.05$). However, we found a significant difference in sit-and-reach test results between groups ($p < 0.05$) with a significantly superior range of motion in the non-elite players as compared to their elite counterparts.

Table 1. Flexibility characteristics of elite (Squad A) and non-elite (Squad B) Serbian soccer players. Values are mean \pm SD

	Squad A (n = 30)	Squad B (n = 30)
Seat-and-reach (cm)	29.1 \pm 4.7*	36.4 \pm 5.2
Hip flexion (degrees)	124.3 \pm 10.8	125.7 \pm 9.5
Hip extension (degrees)	21.5 \pm 2.2	22.4 \pm 1.9
Hip abduction (degrees)	53.6 \pm 5.5	54.1 \pm 5.1
Hip adduction (degrees)	25.8 \pm 3.4	26.0 \pm 3.9
Hip medial (internal) rotation (degrees)	30.9 \pm 3.3	31.8 \pm 2.5
Hip lateral (external) rotation (degrees)	34.1 \pm 3.1	35.7 \pm 2.9
Knee flexion (degrees)	142.5 \pm 12.3	141.6 \pm 11.9
Knee extension (degrees)	174.7 \pm 10.5	175.6 \pm 13.0
Knee medial (internal) rotation (degrees)	36.5 \pm 5.6	37.7 \pm 5.2
Knee lateral (external) rotation (degrees)	28.7 \pm 4.7	29.2 \pm 4.4
Ankle dorsiflexion (degrees)	12.9 \pm 3.9	13.4 \pm 3.7
Ankle plantar flexion (degrees)	52.1 \pm 7.3	51.4 \pm 6.1

* Statistically significant at $p < 0.05$

DISCUSSION

Joint flexibility is an important factor in soccer, particularly in the field of injury predisposition and prevention. The degree of flexibility and sport performance are inter-connected [20] and it seems that optimal flexibility reduces the risk of injuries in team sports and promotes soccer-specific activities [17]. Several investigators found that flexibility of soccer players is sub-optimal as compared to non-athletes [6, 10, 13]. The use of static hamstring stretching was found to be the only training factor that correlated significantly and negatively with hamstring strain rate suggesting that the use of static hamstring stretching is associated with lower hamstring strain rate in soccer players [3]. Hattori and Ohta [7] indicated that Japanese players were less flexible than a reference group in ankle range of motion (inversion, eversion, plantar flexion and dorsiflexion). This may reflect an adaptive response of soft tissue around the articulation, which could improve stability at the joint. Reilly [16] found that soccer players from different codes have similar degree of flexibility. In addition, Dunbar and Power [2] investigated the flexibility of semiprofessional and professional soccer players and found no differences between the groups with the lack of flexibility being attributed to the fact that flexibility is not usually viewed as an important component of fitness for soccer.

In the present study we didn't find any significant difference between flexibility of the main lower extremity joints between elite and non-elite soccer players. On the other side, the degree of general flexibility, assessed by sit-and-reach test, seems to be significantly different with superior flexibility in non-elite soccer players. It appears that goniometric measurement of hip, knee and ankle range of motion seems to be indiscriminative method of joint flexibility between elite and non-elite soccer players. Moreover, specific flexibility of lower extremity isn't a fundamental element of selection for elite soccer. Flexibility is rather a determinant of the current status of locomotive system, influenced by age, gender, body type, training, room temperature and previous warm-up than a factor which could be essential for success in soccer. Different results in the sit-and-reach test could be due to muscle stiffness of elite soccer players and maladaptation to soccer performance but it could also reflect a lack of attention to flexibility practices in training [12, 21]. Although this may not predispose an elite player to increased injury risk in itself, a combination of inadequate range of motion, fatigue and imbalances in muscle strength could lead to acute injury. Range of motion seems to be in optimal range for all the subjects in the present study. However, it is difficult to compare athletes with 'normal' population since few normative data exist for athletic groups [4, 9]. Moreover, the validity of goniometric measurements is limited since the two-dimensional goniometry is only an estimation of the real

flexibility which in fact occurs three-dimensionally [19]. Sit-and-reach test is widely used, simple and low cost, although it remains questionable which joints and muscles are being assessed because of the complexity of movement [11]. It has been suggested that the contribution of hip flexion to sit and reach performance is about 60%, with the remainder being derived primarily from spinal column flexion [18]. Therefore, it could be hypothesized that the difference in the flexibility of the lumbar region could be partially responsible for the results obtained in this study.

CONCLUSION

No statistically significant difference was found between the Squad A and Squad B for passive knee, hip and ankle flexibility ($p > 0.05$). However, we found a significant difference in sit-and-reach test results between groups with a significantly superior range of motion in the non-elite players as compared to their elite counterparts (36.4 ± 5.2 vs. 29.1 ± 4.7 ; $p < 0.05$). It appears that goniometric measurement of hip, knee and ankle range of motion seems to be indiscriminative method of joint flexibility between elite and non-elite soccer players.

PRACTICAL APPLICATION

Goniometric measurement of hip, knee and ankle range of motion seems to be indiscriminative method of joint flexibility between elite and non-elite soccer players. As assessed by sit-and-reach test, elite soccer players are less flexible in lumbar area and hamstrings as compared to their non-elite counterparts. Therefore, it looks reasonable to incorporate more flexibility training in top-level soccer.

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