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THE EFFECTS OF FIFA 11+ INJURY PREVENTION PROGRAM ON LOWER LIMBS STRENGTH AND BALANCE

The purpose of this study was to evaluate the effect of the injury prevention program FIFA 11+ (level 2) application, on lower limb balance ability and knee muscle strength, as an effective approach to reduce injury risk in male soccer players. Thirty-two players were randomly divided into two subject groups (N = 16 each), one control group (CON group), and one training group (INT group). The INT group followed the FIFA 11+ injury prevention program 3 times per week for 8 weeks. The CON group continued the usual warm-up. Biodex Stability System was used to assess balance ability in both groups at baseline and after completing the FIFA 11+ program. Additional isokinetic knee joint moment measurements (concentric flexors / extensors and eccentric flexors) performed at two different angular velocities, first at 60°/s and then at 180° /s. Beneficial effects were found of the implementation of the FIFA 11+ in total stability index and anterior - posterior index, concentric and eccentric flexors strength and conventional H/Q ratio ($p < .05$). Performing FIFA 11+ injury prevention program for 8 weeks can improve lower limb balance ability and hamstrings muscle strength, elements which are very important for prevention of hamstring muscle strains and lower limb ligament injuries in soccer.

Keywords: soccer, balance, strength, training, injury prevention

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ВЛИЯНИЕ ПРОГРАММЫ ПРЕДОТВРАЩЕНИЯ ТРАВМ НА FIFA 11+ НА ПРОЧНОСТЬ И БАЛАНС НИЖНИХ КОНЕЧНОСТЕЙ

Цель этого исследования состояла в том, чтобы оценить влияние применения программы FIFA 11+ (уровень 2) для профилактики травм на способность балансировать нижние конечности и силу

мышц колена как эффективный подход к снижению риска травм у футболистов-мужчин. Тридцать два игрока были случайным образом разделены на две предметные группы ($N = 16$ каждая), одну контрольную группу (группа CON) и одну тренировочную группу (группа INT). Группа INT следовала программе профилактики травм FIFA 11+ 3 раза в неделю в течение 8 недель. Группа CON продолжила обычную разминку. Система стабильности Biodex использовалась для оценки способности баланса в обеих группах на исходном уровне и после завершения программы FIFA 11+. Дополнительные изокINETические измерения момента в коленном суставе (концентрические сгибатели / разгибатели и эксцентрические сгибатели) проводят при двух разных угловых скоростях, сначала при $60^\circ / \text{с}$, а затем при $180^\circ / \text{с}$. Были обнаружены положительные эффекты применения FIFA 11+ в отношении общего индекса стабильности и передне-заднего индекса, прочности концентрических и эксцентрических сгибателей и обычного отношения H / Q ($p < 0,05$). Выполнение программы FIFA 11+ по предотвращению травм в течение 8 недель может улучшить способность баланса нижних конечностей и силу мышц подколенных сухожилий, элементы, которые очень важны для предотвращения растяжений мышц подколенных сухожилий и травм связок нижних конечностей в футболе.

Ключевые слова: футбол, баланс, сила, тренировка, профилактика травм.

Introduction. Soccer is without doubt the most popular sport in the world. The number of people playing soccer is close to 270 million [1]. Football is a high-intensity intermittent contact sport, where prevail very dynamic and explosive movements [2]. These factors entail increased muscle fatigue and a substantial risk of injury [3]. Fatigue or overload of muscles during a game reflected by the appearance of injuries in the last 15 minutes of each half of the match [4]. The maximum torque of the hamstrings muscles decreased at the end of the first half and rate of torque development decreased significantly after 15-minutes in the first-half and the end of the second half [5].

Indeed, the most frequently injured body parts were the ankle with 19%, generally the lower leg 16% and the head 15% [6]. Also, Eirale, Farooq, Smiley, Tol and Chalabi [7] listed the professional player's injuries for one season and found that more than 1/3 of all injuries were mus-

cular injuries. The hamstrings injuries had the highest rate. In the same respect, Hägglund, Waldén and Ekstrand [8] reported that 30% of all injuries were the posterior thigh muscles. Indeed their injury rate is 0.5 to 1.5 times / 1000 hours of participation in football [9]. These rates of injuries in soccer are not just random. The majority of these injuries occur when running or sprinting and incurred during the eccentric contraction of these muscles to slow down the extent of the knee [10].

The benefits of warm-up are known for the preparation and the protection of athletes' body before participating in sports [11]. The International Federation of Association Football (FIFA), through the Medical Assessment and Research Centre has developed a comprehensive soccer warm-up program, the FIFA 11+, to reduce the incidence of soccer injuries [12]. It is a complete warm-up package that can replace the typical soccer warm-up before the training [13]. The main objective of this program is the training of neuromuscular control, proper posture and control of the body during the exercises [14]. According to a recent survey, the participation of young players in the injury prevention program FIFA 11+ for six months and a frequency of 2 times / week resulted in a reduction in total injuries to 41% and a reduction in overall injuries of the lower limbs up to 48% [15].

The purpose of this study was to evaluate the effect of the injury prevention program FIFA 11+ (level 2) application, on lower limb balance ability and knee muscle strength, as an effective approach to reduce injury risk in Greek male soccer players.

Participants. The study was conducted on 32 young male soccer players (age 19 ± 1 years; body mass 72 ± 6 kg; body height 178 ± 6 cm; mean \pm SD) participating in the young championship of the first Greek division. The participants were free of injuries in the lower limbs for the past 3 years. The experimental procedures complied with the Helsinki declaration of 1975 and were approved by the Ethical Committee of the Democritus University of Thrace. The participants were randomly divided into two subject groups (n=16 each), one control group (CON group), and one intervention group (INT group) that performed FIFA 11+ injury prevention program.

Interventions. Control Group performed traditional warm up which involved a combination of running, stretching, technical exercises with the ball and small sided games. The total duration was about 20-25 minutes.

Intervention group performed the warm-up program FIFA 11+ (level 2), three times per week for eight weeks substituting their normal

warm-up routine. The “level 2” is the second level of difficulty of the program FIFA 11+ (www.f-marc.com/11plus). The mean duration of the protocol was about 20-25 minutes.

Measurements. Isokinetic Measurement.

The testing equipment, that was selected to evaluate the two groups, was an isokinetic machine (Isoforce, TUR GmbH, Berlin, Germany). Concentric peak torque (PT) of knee extensors and flexors were measured. Testing included one session of three maximal knee extension/flexion repetitions at each tested speed (60°/s and 180°/s) in a random order, separated by one minute rest intervals. Also, eccentric measurements of knee flexors muscles consisted of three maximal contractions at 60°/s.

Balance assessment. Balance ability was assessed in all subjects at baseline and after the completion of the 8-week intervention program. The balance ability assessment was performed with the Biodex Stability System (Biodex Medical Systems, USA). The participants maintained single-limb stance for 20 seconds, with the Biodex platform set to freely move by up to 20° from level in any direction. From the variance of the platform displacement in the antero-posterior and medio-lateral directions from level during the test, the Biodex system computed three different indices; the total stability index (SI), anterior-posterior index (API) and the medial-lateral index index (MLI) Three test trials were carried out and the one with the lowest SI (best performance) was further processed.

Statistical Analysis. Two-way repeated measures ANOVA (2x2) was used to test for differences in (a) isokinetic performance at the velocities examined, and (b) balance ability, between pre-training and post-training and between groups. The level of statistical significance was set at $p < 0.05$.

Results. There were no differences between groups in all dependent variables examined at baseline.

Balance. The means of Balance measurements in pre-test and post-test of the groups are presented in Table 1. Two Way Repeated Measures Analysis for Total SI variable found statistically significant interaction between the factors time and group ($F_{(1, 30)} = 4.772$, $p = 0.037$) in the dominant and ($F_{(1, 30)} = 13.751$, $p = 0.001$) non-dominant limb.

Table 1

Balance Measurement

Values	Dominant		Non-dominant	
	Pre	Post	Pre	Post
FIFA 11+				
TOTAL SI	4.03±1.44	3.36±1.15***	4.66±1.92	3.59±1.57***
AP SI	3.52±1.40	2.83±1.44***	4.11 ±1.79	3.47±1.67***
ML SI	2.16±0.65	2.08±0.61	2.45±0.83	2.44±0.97
CONTROL				
TOTAL SI	3.66±1.17	3.58±0.99	3.99±1.42	4.05±1.35
AP SI	3.08±1.15	3.01±0.90	3.45±1.39	3.31±1.20
ML SI	2.16±0.62	2.25±0.59	2.49±0.98	2.36±0.81

*p< .05; **p< .01; ***p< .001

Isokinetic Measurement. The means of isokinetic assessments in pre-test and post-test of the groups are presented in Table 2. The results showed significant interaction between time with group at CON 60°/s in the dominant ($F(1, 30) = 8.511$, $p = 0.007$) and significant main effect between the time in non-dominant limb ($F(1, 30) = 7.163$, $p = 0.012$). The Sidak test showed that the peak torque (PT) of hamstrings were significantly increased in INT by 15% ($p = 0.00006$) and 8% ($p = 0.004$), respectively. No statistically significant differences was observed for both knee extensors at 60°/s and 180°/s, and for the knee flexors at 180°/s in both groups.

Table 2

Isokinetic Measurement

Values	Dominant		Non-dominant	
	Pre	Post	Pre	Post
FIFA 11+				
Extensors 60°/s	224.6±34.9	224.4±34.6	230.0±31.9	231.3±31.7
Extensors 180°/s	155.3±29.0	158.7±30.4	156.7±24.3	156.7±21.4
Flexors 60°/s	136.9±29.8	156.9±27.2***	130.8±25.0	140.8±26.9**
Flexors 180°/s	104.3±36.7	115.1±28.7	120.5±26.2	112.1±23.4
Eccentric Flexors 60°/s	196.1±41.3	210.9±41.6*	194.3±37.9	206.3±34.0*
CONTROL				
Extensors 60°/s	212.8±44.1	209.3±32.7	223.0±50.3	223.6±40.1

Values	Dominant		Non-dominant	
	Pre	Post	Pre	Post
Extensors 180°/s	146.7±35.6	151.3±30.7	155.3±33.3	146.7±35.6
Flexors 60°/s	127.4±23.8	129.5±27.0	112.6±17.2	114.7±15.2
Flexors 180°/s	93.2±22.6	96.5±23.2	86.4±23.7	92.5±17.7
Eccentric Flexors 60°/s	182.4±38.2	173.3±35.8	168.4±32.4	166.3±40.9

*p< .05; **p< .01; ***p< .001

Discussion. The present study evaluated the effect of the program FIFA 11+ injury prevention in the balance and strength of lower limbs on players. Specifically, evaluated the impact of this program in balance indicators, concentric strength of anterior and posterior thigh muscles and eccentric strength of hamstrings muscles. According to the results, the team participated in the FIFA 11+ program showed statistically significant differences in both total stability indexes (SI) and the anterior -posterior index (AP). Also, statistically significant differences were observed in concentric strength of the rear thigh muscles and conventional H/Q ratios of both lower limbs for players who participated in FIFA 11+ program.

More specifically, the implementation of this program for 8 weeks resulted in statistically significant improvement of the total stability index (SI) and anterior-posterior index (AP) for the dominant and non-dominant leg, respectively. The results of this study agree with those of Steffen et al. (16) which saw that participation in this program and particularly the increased participation has resulted in improved functional balance of young soccer athletes. Also, the surveys of Impellizzeri al. [17] and Bizzini et al. [13] showed that the use of the FIFA 11+ resulted in improved dynamic balance of players.

The implementation of the FIFA 11+ program in the intervention group had resulted in significant increase the eccentric strength of the rear thigh muscles. Especially, eccentric muscle strength was significantly increased by 8% in dominant and by 6% in non-dominant limb. These results are contrary to those of Daneshjoo et al. [18], which found no statistically significant changes in eccentric strength of the rear eccentric thigh muscles at an angular velocity 120°/s. However, Brito et al. [19] found a statistically significant increase of the eccentric strength of specific muscles of the non-dominant limb at 30°/s. Also, Impellizzeri et al. [17] in their research found an average change of 5.9% of the eccentric strength of

the rear thigh muscles of players participating in the FIFA 11+, but these results are not clear.

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