The effect of FIFA 11+ injury prevention program on dynamic balance and knee Isometric Strength of Female players in soccer super league

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Abstract

Aim: The aim of this study is to survey the effect of FIFA 11+ injury prevention program on dynamic balance and knee isometric strength of female players in soccer super league.

Method: Sample of study included 30 subjects of female players of Shahrdari Bam, super league soccer team. 11+ injury prevention training protocol should be completed within eight weeks, at least two times a week and approximately 20-25 minutes. Lower extremity strength is assessed by using dynamometer device and dynamic balance test was evaluated (in the pre-test and post-test) by star test (SEBT). For data analysis, descriptive statistics of paired t and independent t test at significant level of p<0/05 were used.

Result: Research finding indicates that 11+ injury prevention training program led to a significant increase in flexion and extension strength of knee joint and dynamic balance in the posterior and postero-lateral directions in the experimental group (p≥0/05). There was a non-significant increase in the other directions and the control group P≥ 0.05. Also there was a significant difference between the experimental and control groups in posterior and postero-lateral posterior (p =0/001). But there was no difference in the control and experimental groups in other directions. Also a prominent difference was observed between experimental and control group in flexion and extension strength of knee (0/001).

Conclusion: Because the 11+ injury prevention program includes special soccer movements, plyometric, strength and balance training, it has an effect on muscular strength and dynamic balance in posterior and postero-lateral directions in professional soccer players. It can also be a preventive factor in lower extremity injuries because of increasing knee strength.

Key words: 11+ training, strength, balance, soccer, female

Introduction

We live in an era when sport penetrates the life of people. Among all sports, soccer is one of the most popular sports around the world and has more than 265 million participants of which 21 million are female soccer players, and in near future, soccer will turn into the main female sport all over the world. Because of this increasing popularity of soccer, physicians will encounter more injured females (1). Most of these soccer-related injuries occur in lower limbs (2). Most sport injuries are avoidable, however, if no consideration was taken into account, the occurrence of such injuries would increase and lead to loss of athletes' health and in some cases cause the athletes to permanently quit sport (3,4).

Injury is one of the main concerns of coaches and athletes reducing physical performance, with the main factor a waste of time and it imposes enormous treatment costs on athletes (5). Eggar states that the cost of sports injuries is approximately one billion dollars a year in Australia alone (6).

Damage may occur due to a simple accident or a complex interaction of risk internal factors. Risk of internal factors is an inherent characteristic of an individual that can lead to injury or increase the risk of injury. Lack of enough muscle strength is one of the most important internal risk factors of injury (7).

Many soccer skills such as successful landing after jumping (heading and catching ball in the space), tackling, kicking, and kicking strength require muscle strength to protect against joint injuries. It is possible that a large percentage of the ankle and knee injuries result from strength disabilities. Therefore, the muscle power that can be achieved through strength training is valuable for soccer players. In order to jump, spin and change direction, Quadriceps and hamstring muscle groups should produce much power. Ability of muscles is important to continue strong contraction in balance and body control. Since almost 76% of soccer-related injuries occur in lower limbs, the amount of muscle strength according to the ratio of hamstring to Quadriceps muscle is very important in knee stability and reducing the risk of injuries. Quadriceps femur muscle has a critical role in performance of knee joint. This muscle is effective in all motion and stable performances of knee and also has a key role in absorbing the incoming forces to knee. Quadriceps femur muscle cooperates with PCL in maintenance of knee anteroposterior stability.

The risk of injury in women footballers is high and more than 80% of injuries occur in the lower limbs (8,9). Various internal and external factors cause injury in athletes and one of these cases is the ability to maintain balance. Balance is an integral part of daily activities and it is the determining index in the study of functional ability of athletes (10,11) and it is known as an important factor in many athletic skills such as gymnastics, basketball, volleyball and football and its weakness is related with a number of injuries such as ankle and knee instability or pain, severe osteoarthritis of the knee and ankle sprains. Dynamic balance is defined and measured as a person's ability to maintain balance from dynamic to static state. In various sports such as football and basketball, which need quick reactions, an inherent protection against injury is provided. The results show that the lower limbs are more vulnerable than the other parts of body in football in all positions. Due to the prevalence of ankle and knee injuries because of the shear jumping movements and the role of muscles of the lower limbs to bring the body skeletal status to a balanced state, an effective training program to improve the dynamic balance has major importance (12,13). Grancher et al concluded that the four-week balanced exercise program significantly improves dynamic balance and controls fluctuations in stature (14). Kimberly et al studied the effect of the five-week central stabilization training on the balance dynamic of tennis athletes. The results showed that these exercises improve dynamic balance of athletes (15). Buchner et al did a survey on the effect of strength and endurance training on balance, walking and risk of falling in retired older people and concluded that the exercise program had no effect on balance (16).

Therefore strength and balance are important factors for a successful soccer player (14,17,18) which results in better performance of technical and tactical skills in this sport (19). Reduction of injuries prevents early retirement, provides a safe environment for players and minimizes expenses. Hence, the implementation of prevention programs is highly recommended to coaches (20). In 2006, FIFA medical committee provided an injury prevention program called 11+ that aimed at reducing injuries among male and female soccer players. Soligard et al reported that 11+ training program reduces injuries of the lower extremity of amateur female soccer players (21). The finding of Berito et al showed that 11+ training program enhances the strength of Quadriceps femur and hamstring muscles (22). That research has not examined the effect of FIFA 11+ injury prevention program on professional female players and different exercises achieved different results on dynamic balance and there is no survey about +11 injury preventing exercise program of FIFA on the dynamic balance of professional female footballers so the purpose of this study is to survey the effect of FIFA 11+ injury prevention program on balance and knee isometric strength of female players in soccer super league.

Methodology

In this study pretest – posttest were used. The sample of study consisted of 30 players from Shahrdari Bam team in the super league. Then they were randomly assigned into control (N= 15) and experimental (N= 15) groups. Table 1 demonstrates the descriptive characteristics of participants.

The participants had no serious injuries in their lower limbs. To make sure, the participants were chosen by team physician confirmation and by reviewing their medical records.

FIFA injury training program 11+

The training program with body warm up structure was designed by FIFA medical center of research and evaluation in collaboration with Oslo sport injuries research center and Santa Monica sport medicine center and called +11. This program was designed to prevent injuries in soccer players' lower limbs. The required time to perform this program is 20-25 minutes. This program consists of three parts. The first part includes 8 minutes jogging. The second part contains six types of strength training, balance exercise and jumping exercises with time duration of 15 minutes at three elementary, intermediate and advanced levels. The final section includes speed running combined by bounding, planting and cutting movements (speed running with sudden change of direction). This section lasts 2 minutes (23). This program was done 3 times a week for two months in the morning.

Measurement of static or isometric strength:

Maximal isometric strength of the knee extensor and flexor muscles at 90 degrees were measured by using a dynamometer (Model 300kED made in Japan, with credits ICC = 0/92 (24). Subjects sat on a table or bench so that their feet were dangling. Dynamometer was fastened to the top of the ankle and subjects were asked to perform as much maximum contraction as they could do in flexion and extension without using their hands and hold for 5 seconds. After each move, the subjects were given 5 seconds rest (25).

The ability of the dynamic balance of samples was determined by access distance record in eight directions of anterior, internal anterior, internal, internal posterior, posterior, external and external anterior. In this test, eight directions are drawn on the ground like a star with an angle of 45 degrees to each other. Before the start of the test, preferred foot of the subjects is determined and if the right foot is superior, the test is done in the opposite of clockwise direction but if the left foot is superior, the test is done clockwise. Subjects are placed in the center of the star on the superior foot and perform access operation with the other foot in eight directions without errors (errors: The movement of foot from the star Centre, stay on the other foot at the point of contact and person falling). The distance between the contact place of the free foot and the center of the star, is access distance. Each subject does each of them three times and finally the average is calcuated, divided by the foot height in cm, and then multiplied by 100 in order to obtain access distance in terms of a percentage of the length of the foot (26). The star test for 8 weeks training protocol was applied to the experimental group while the control group only began to work normally.

In the present study, descriptive statistics were used to calculate mean and standard deviation of tests. In inferential statistics paired t and independent t tests were used to compare intra- and inter-group changes respectively. The data was analyzed through SPSS software version 19, and the level of significance was considered P≤ 0.05.

Results

Demographic features of 30 players divided into two 15 players groups can be seen in Table 1.

Table 1: Descriptive characteristics of subjects

Experimental group X ± SD	Control group X ± SD	
24.53 ±1.68	24.33±1.44	(year) age
57.10±6.62	52.4±5.74	(kg) weight
161.27±6.96	161.53±5.42	(cm) height

Table 3 shows the results from paired t and independent t test to compare the means of flexion and extension strength of knee joint between experimental and control group. In experimental group there is significant difference in flexion and extension strength of knee joint P≤ 05/0 .

Also prominent difference was observed between experimental and control group in flexion and extension strength of knee 0/001.

In the dynamic balance experimental group, there was a significant increase from pre-test to post-test in the posterior and poster-lateral posterior P≤ 0.05 and a non-significant increase in the other directions and the control group P≥ 0.05. Also there was a significant difference between the experimental and control groups in posterior and postero-lateral posterior (p =0/001). But there is none in the control and experimental groups in other directions.

Table 2: Dependent and independent t-test to compare means of dynamic balance in both experimental and control groups

value P independent	P value paired	X±SD after program	X±SD before program	Direction	Group
0.992	0.152	76.24±10.36	74.56±10.79	frontal	control
	0.092	93.75±12.82	92.08±14.68		experimental
0.560	0.114	78.99±14.17	77.30±12.48	Frontal-interior	control
	0.234	91.65±14.45	90.70±15.52		experimental
0.347	0.826	73.06±11.76	73.20±12.46	interior	control
	0.306	85.63±16.44	84.89±15.27		experimental
0.207	0.061	83.44±13.79	81.27±12.73	Postero-interior	control
	0.345	107.60±11.67	107.2±12.22		experimental
0.001	0.090	87765±12.28	85.51±11.37	posterior	control
	0.001	112.14±15.99	83.58±13.91		experimental
0.001	0.150	91±12.47	89.54±12.08	Postero-lateral	control
	0.001	109.75±13.83	82.78±14.46		experimental
0.835	0.085	91.33±11.19	90±11.20	lateral	control
	0.197	95.49±17.15	94.40±17.68		experimental
0.574	0.106	80.99±11.41	80.15±10.65	Frontal-lateral	control
	0.181	91.49±13.88	89.99±14.40		experimental

Table 3: Result of paired and independent sample t-test

P value independent	P value paired	X±SD after training program	X±SD before training program		
0.001	0.535	7.13±2.53	6.87±2.97	control	Flexion strength of knee
	*0.001	12.07±4.71	7.47±3.42	experimental	
0.001	0.872	7.73±2.05	7.67±2.69	control	Extension strength of knee
	*0.001	14.93±4.43	7.87±3.09	experimental	

P≤ 0.05 *

Discussion

The present study investigated the effect of FIFA 11+ injury prevention program on dynamic balance and knee isometric strength of female players in soccer super league. The results indicated that there is a significant difference in flexion and extension strength of knee joint between experimental and control groups. Moreover, the training program had a significant increase on dynamic balance from the pre-test to post-test only in the posterior and lateral-posterior directions only in the experimental group but in the other directions, they had a non-significant effect in the experimental and control group. There is a significant difference between the mean differences of pre-test and post-test in posterior and lateral-posterior directions in experimental and control groups. But in other directions, there is no significant difference in the control group and the experimental group.

Strength

Results of the present study are in line with Berito et al findings (22). The consistency of the results may be due to the fact that strength is one of the important factors in prevention injury program and the program is structured based on the body warm up. So this factor might be one of the reasons for the positive effects of exercise on strength increase .11+ training program, includes training exercises such as single leg squat, jumping and landing, bounding, plant and cut movements that strengthen the quadriceps muscles (24,27). Therefore, exercises to increase balance, strength and attention to the correct landing could be possible reasons for the effects of +11 training program on strength of knee muscles (22,24,27). Soligard et al reported a preventive effect of the 11+ among female youth soccer players. They reported a reduction in the incidence of knee injuries (21). Also Kirkendall et al noted comprehensive warm-up program is the best type of training for injury prevention (28). A study by Steffen et al, which included female youth soccer players, reported no effects of the 11 training program on strength of knee

joint. They suggested that low compliance with the program explained the lack of effects and this was one of the most important reasons to introduce a modified program (8). The11+ includes a greater diversity of exercises, changing both the type and the intensity during the soccer season. 11+ is a modified program of 11 training program. 11 training program consisted of ten exercises of 15 minutes based on body warm up. 11+ in comparison with 11 is more useful and more effective for improving isometric quadriceps and hamstring strength (23). Performing the FIFA 11+ warm up for an average of 2 months led to enhanced knee strength ratios, as well as agility skills and superior static/dynamic balance in Asian male players (29–31). Stabilization exercises (SE) are one of the aspects FIFA 11+ is following. Previous studies showed poor trunk stability and strength are associated with a higher risk of lower extremity injury (32,33). The warm up programs with SE included, which FIFA 11+ is one such program, have significant effect on the incidence of lower extremity injuries reduction (21,34).

Balance

The results of the present study are consistent with Leavey et al. (2010) (35), Filipa et al (2010) (36), Mattacola et al (37), Kimberly and Samson (2005) (15), Granchar et al (14). Leavey et al (2010) concluded that six weeks of proprioception and strengthening training, middle sciatic exercises or a combination of these two can improve the performance in the star test in healthy subjects (35). Filipa et al (2010) reported the improvement in performance of female soccer players in the star test after eight weeks of training focused on neuromuscular control of the trunk and leg muscle strength (36). Mattacola and Lloyd (1997) concluded that the program of strength training and proprioception improves the ability to maintain balance (37). Kimberly et al (2005) studied the effect of a five-week stabilization dynamic training on the balance of tennis athletes. The results showed that these exercises improve dynamic balance in athletes (15). Granacher et al (2010) in a study also concluded that the four-week exercise program significantly improved dynamic balance and controlled the height fluctuations (14). Because the +11 injury prevention program is a set of strength, balance, plyometric training and also focuses on strengthening core stabilization muscles, neuromuscular control, and maintains the correct direction of the knee and hip joints, (21,24,27) it can represent its consistency with this study. From the possible reasons of the increase in +11 exercises of dynamic balance, proprioceptive receptors, the preparation of motor neurons in a group of muscles and muscle tone can be stated. The program consists of training in eccentric and concentric contraction and coordination of these exercises can also show the improvement of balance (21). Bouchner et al (1997) surveyed the effect of strength and endurance training on balance, walk and risk of falling in older retired people, and concluded that the balance training program is unaffected (16). The discrepancy could be due to differences in the type of exercise, exercise intensity, duration of exercise and type of subjects. Depending on the fact that this test is used to assess the dynamic balance of star test, the following are necessary to be mentioned. During doing the posterior, lateral posterior and external directions, biceps femoral are active and the person must have trunk flexion to do this in order to be able to open the foot backward and in these cases, eccentric hamstring should be contracted to resist hip flexion moment. Surrounding and functional muscle strength on the joints and the contraction to stabilize lower limb joints, deep receptor activity and neuromuscular control in order to achieve balance while performing the star test and get the most distance is of particular importance (38). Another possible reason for the increase in dynamic balance after +11 FIFA program is increasing muscle strength. Strength training, such as squat and Launch, in this program can help to improve the strength of the muscles around the hip, knee and ankle. Brito et al reported that +11 exercises increase strength of the muscles around the knee (22). On the other hand, Hirosmus states that increasing the power of the lower limbs can cause an increase in dynamic balance of athletes (39).

According to the studies, the players who undertook the FIFA 11+ during the season improved their functional balance (34). Neuromuscular control is one of the crucial factors so as to have functional balance efficiency which can be averred. There are studies that showed FIFA 11+ provokes core and hip musculature, and therefore improves neuromuscular control (40). Considering these results of studies, FIFA 11+ can trigger core muscles activation and with that effect, it may improve core stability in individuals. This program can also improve performance with better hamstring/quadriceps strength ratios, jumping and agility skills (41). Bizzini et al stated that physiological responses, performance, and static and dynamic balance were improved immediately after the FIFA 11+ program (42).

So it can be said that the+11 exercises (strength, balance and plyometric) due to the variety it provides for athletes, can cause a significant increase in dynamic balance of athletes.

Conclusion

Finally it can be concluded that the training program 11+ including balance, strength, plyometric, and soccer specific exercises can be effective in increasing the strength of knee joint of professional players. Considering the special muscle strength that athletes require in sport skills and also as an important factor in prevention of sport injuries, these kinds of exercises are recommended as a part of athletes' preparation program at the beginning of each season. In addition, the training program can be effective in increasing the dynamic balance of professional players. Thus, according to the special needs of athletes for dynamic balance in athletic skills as well as an important factor in the prevention of sports injuries, this kind of exercise is considered as a part of the preparation of the athletes at the beginning of the season.

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