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THE EFFECT OF "THE FIFA 11+" WARM-UP TRAINING ON BALANCE AND PROPRIOCEPTION IN ADOLESCENT FUTSAL PLAYERS

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ABSTACT

Back ground and purpose: The purpose of this study was to determine the effects of the "FIFA11+" warm up program in neuromuscular performance on ankle joint position sense (JPS) and center of pressure (CoP) during standing in youth futsal players.

Participants: Adolescent futsal players from Nakhonpathom sports school, Nakhonpathom age between 15-18 years. 11 subjects in control group (age 16.46 ± 0.29, height 168.69 ± 1.96, weight 59.46 ± 2.75 and BMI 20.86 ± 0.84) and 10 subjects in trained group (age 16.20 ± 0.25, height 170.80 ± 2.14, weight 57.00 ± 2.45 and BMI 19.43 ± 0.42).

Methods: Ankle absolute mean errors of JPS were measured from joint position sense instrument (Institute of Molecular Bioscience (MB), Mahidol University) with reliability at p=0.835 and center of pressure Cop parameters were measured from Kistler force platform, calculated by bioware software while the subjects performed single leg stance position with eyes closed and eyes opened conditions.

Design: Experimental design.

Setting: Field laboratory.

Main Outcome Measures: JPS absolute mean errors ware measured at neutral (N) 0º, dorsiflexion (DF) 10º, and plantarflexion (PF) 15º. CoP parameters on CoP RANGE, SD, RMS, and peak velocity in anterior/posterior (AP) and medial/lateral (ML) directions were also measured.

Results: There were significant difference decreased for CoP parameter in AP direction and tendency decreased in absolute mean errors in plantar flexion (PF) at 15º.

Conclusions: The FIFA11+ program could improve and develop neuromuscular balance control without visual condition and increased cognition in body control which correlated with the prevention and reduction of lower extremity injuries in futsal players.

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KEYWORDS: Center of Pressure (CoP), FIFA11+, Futsal, Joint Position Sense (JPS), Proprioception

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INTRODUCTION

Futsal (Indoor Soccer) is a sport that has attracted more and more followers all over the world. In Brazil, it is one of the most popular sports, played by more than twelve million Brazilian people, according to the Futsal Brazilian Confederation (CBFS)[1]. Currently the Federation Internationale de Football Association (FIFA) unifies 203 national associations and represents about 200 million active players, of which about 40 million are women. The incidence of football injuries is estimated to be 10-35 per 1,000 game hours. One athlete plays on average 100 hours of football per years (from 50 hours per player of a local team) every player will have a minimum of one performance-limiting injury per year but the incidence of injuries in futsal is higher [1, 2]. Lateral ankle sprains are the most common injuries affecting athletes up to 25% of all time lost from participation in sports and it occurs 85% of all ankle injuries[3, 4].

Futsal is different from football in many aspects. Futsal is played on a smaller pitch and usually indoors, with six players including a goal keeper on each side and the ball can be played directly off the wall that surrounds the playing field. Futsal is growing in many countries and played by over a million people worldwide. It started in South America in 1930 and the first World Futsal Championship was held 1982 in Brazil. Since 1989, a Futsal World Cup is organized by the Federation Internationale de Football Association[5, 6].

“The 11” injury prevention program was developed by FIFA’s medical research centre (the FIFA Medical and Research Centre: F-MARC) to help reduce the risk of injury in football players aged 14 years and over[7]. The revised program (“The 11+”) included key exercise routines and additional exercises to provide variation and progression. It also included a new set of structured running exercises that make it better suited as a comprehensive warm-up program for training and matches [8]. The “11+” is a complete warm-up to prevent injuries, combines the exercise training listed above to provide you with general protections from injuries if performed prior to every training session start at age 14. In a scientific study with almost 2,000 female youth players, teams performing “11+” at least twice a week had 30-50 per cent fewer injured players than teams who warmed up as usual [6].

Rehabilitation programs emphasizing coordination, balance, and strength training have been recommended for improving ankle stability and postural stability in subjects with both stable and unstable ankles. Ankle rehabilitation exercises are typically performed in a static position rather than a dynamic balance position. Although most coordination and balance training programs have effectively improved postural stability and decreased the incidence of ankle sprains [9], from the sports medicine prospective, the coordination of a movement is mainly the internal organization of optimal control of the motor system and its parts.

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"Coordination" can be regarded as an umbrella term embracing the concept of optimization for intramuscular and intermuscular coordination and cooperation for a given task, including internal and external feedback mechanisms [10]. Proprioception is the umbrella term for kinesthesia and joint position sense (JPS). JPS refers to the awareness of joint position in space and is mediated through various receptors call mechanoreceptors that are located in the joint capsule, ligaments, menisci, musculotendinous unit, and skin. The deterioration of proprioception results in increased postural sway, decreased balance, increased risk of falls and changes in gait patterns [11]. Proprioceptive training reduces the incidence of ankle sprains in athletes with recurrent ankle sprains to the same level as subjects without any history of ankle sprains[10].

Proprioception is the conscious awareness of limb position and movement, and is a specialized form of the sensory modality of touch that encompasses the sensation of joint movement (kinesthesia) and joint position (joint position sense). It is generally defined as the ability to assess respective limbs's position without the assistance of vision and governed by central and peripheral mechanisms that come mainly from muscular receptors, but also includes tendinous, articular and cutaneous receptors. Joint position sense results feom the afferent input to the central nervous system and is determine by muscle spindle and skin receptor response to stimuli. The respective roles of these various sources of afferent information have been debated, but it is now recognized the muscular receptors have the most important part in the elaboration of limb proprioception. This role for muscular receptors indicated that modifying the functional state of the muscles could affect the precision of position sense [12-14]. The proprioceptive mechanism is essential for proper function of the joint in sports, for activities in daily life, and for some occupational tasks. These contribute to the motor programming for neuromuscular control required for precision movements and also contributes to muscle reflex, providing dynamic stability. Objective quantification of proprioception may improve early detection of proprioceptive loss with injury[15]. Loss of proprioception, resulting in lack of balance and position sense, is considered to be particularly important.

METHODS

The study was experimental design. The CoP independent variable condition (eyes closed (EC) and eyes opened (EO) with single leg static stance) and CoP parameters (Range, SD, RMS, and peak velocity). The JPS independent was the absolute mean errors measure for neutral at 0º, dorsiflexion at 10º, and plantarflexion 15º.

Participants

21 healthy adolescent futsal players of 15-18 years old, control group (n=11) and trained group (n=10) subjects between the ages of 15-18 years (age = 16.29 ± 0.18 yrs) were recruited from Nakhonpathom sports school, Nakhonpathom to participate in this study. They were free from any lower extremity injuries and the following medical conditions: ear infections, neurological disorder, and visual

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disorder. A consent form that described the methods will be explained to all subjects before their informed consents will be given. Participants all read and signed a consent form approved by the Ethics Committee on Human Experimentation of Mahidol University.

Instrumentation

Joint position sense instrument with the bulls-eye surface level to measure ankle joint position sense (Institute of Molecular Bioscience (MB), Mahidol University), reliability at p = 0.835 (SPSS version 18) size 50×50×50 cm. (Figure 1), to investigate the subjects' ankle in various predetermined angles and asked them to reproduce their remembered perception of the angles[12].

Figure 1: Subject positioning in joint position sense instrument

CoP parameters measurement was taken from Kistler force plate (Kistler Instrument Corp., Amherst, NY). The COP ranges were determined by location the most positive and most negative values within the dataset in anterior-posterior (forward and backward) direction and medial-lateral (side to side) direction[16].

Figure 2: Subject standing with static single leg on Kistler force plate.

Joint Position Sense (JPS) Protocol

The subjects were blindfolded to avoid visual perception and affect the results and allowed to sit comfortably on a bench with the knees flexed at 90° with lower leg positioned vertically [17] place their foot on the testing instrument while straps were used to hold the subject's foot to the platform with ankle stating

position at 0º. Four trials were given by passively placed to similar random target positions in every subject without positioning memorizes angle. The subjects were held in that position for 10 seconds, and asked to remember the target angle [18] then returned to the neutral starting position, rest for 15s before the next trial [19]. Subjects were asked to actively reposition their foot as closely to the target angle as possible [20]. The subjects were told their target position and data was recorded by the researcher. The absolute angular error (AAE), the absolute difference between target and perceived angle, was calculated at each test angle [19]. These studies were measure ankle from both sides in difference positions. The test angle were neutral at 0º, dorsiflexion 10º[17, 21, 22], and plantarflexion 15º[20-23].

Center of pressure Protocol (Cop)

Data from the force plate were extracted by bioware software (version 4.0) and acquire data acquisitions were used to capture COP motion for Kistler Data were recorded using sampling frequency 500 Hz, filtered with a cutoff frequency of 5 Hz.[24, 25]. The subject has to maintain the standing position with their hand on their hip while the knee is flexed to 90° and they face straight ahead on single leg stance position to exclude the visual proprioception[18, 26, 27].

Statistical Analysis

The data were analyzed by SPSS (SPSS Inc., IBM Corporation) for windows version18. The levels of statistical significant were set at 0.05. for all analyses. Shapiro-Wilk test was performed to determine a normal distribution of the data. Two-way repeated measures ANOVA were performed to determine the differences in absolute mean errors and CoP parameters.

RESULT

Subject characteristics and outcome measures for each group are reported in Table1. Eleven control subjects were matched by height, weight, BMI tested to 10 subjects (Table 1). There were no significant group by interactions or main effect in dominant legs, eyes closed and eyes open conditions in both group.

Joint position sense

There were no significant difference decreased degree errors between control and trained groups but in trained group on the right ankle was found tendency to be decreased.

Center of pressure (CoP in EC)

There were no significant difference in both groups but within trained group were found significant difference decreased in CoP $Range_{AP}$, CoP SD_{AP}, CoP RMS_{AP} in anterior/posterior direction with EC on the left leg and CoP RMS_{AP} on the left and right legs with EO condition.

Center of pressure (CoP in EO)

There were no significant differences in both groups and within group.

Table 1. Characteristic of subjects

	Control (n=11) Mean ± SD	Trained (n=10) Mean ± SD	P-value
Age (years)	16.46 ± 0.29	16.20 ± 0.25	0.438
Weight (kg)	59.46 ± 2.75	57.00 ± 2.45	0.779
Height (cm)	168.69 ± 1.96	170.80 ± 2.14	0.319
BMI	20.86 ± 0.84	19.43 ± 0.42	0.215
Futsal training (d/wk)	5.19 ± 0.04	5.26 ± 0.22	0.316
FIFA11+ training (d/wk)	3.96 ± 0.25	0	

Test by independent T-test

Table 2. Outcome Measures

Outcome Measure	Control (n=11) Mean ± SD	Trained (n=10) Mean ± SD	P-value
Joint position sense (degree)			
Left N 0º	4.28º ± 1.04º	2.71º ± 0.86º	0.259
Right N 0º	2.63º ± 0.84º	3.13º ± 1.03º	0.717
Left DF 10º	2.17º ± 0.35º	2.17º ± 0.37º	0.988
Right DF 10º	1.52º ± 0.14º	1.65º ± 0.15º	0.516
Left PF 15º	2.10º ± 0.35º	2.16º ± 0.36º	0.906
Right PF 15º	2.38º ± 0.34º	2.39º ± 0.35º	0.979
Center of pressure (cm)			
$Left_{AP}$ EC	4.74 ± 0.42	4.45 ± 0.35	0.603
$Right_{AP}$ EC	4.29 ± 0.40	4.92 ± 0.33	0.250
$Left_{ML}$ EC	3.78 ± 0.40	3.50 ± 0.33	0.599
$Right_{ML}$ EC	3.32 ± 0.20	3.35 ± 0.16	0.891
$Left_{AP}$ EO	2.50 ± 0.20	2.76 ± 0.17	0.332
$Right_{AP}$ EO	2.56 ± 0.22	3.03 ± 0.18	0.124
$Left_{ML}$ EO	2.09 ± 0.14	2.15 ± 0.12	0.731
$Right_{ML}$ EO	2.09 ± 0.11	2.17 ± 0.09	0.594

SD of center of pressure (cm)			
$Left_{AP}$ EC	0.80 ± 0.05	0.81 ± 0.04	0.935
$Right_{AP}$ EC	0.77 ± 0.05	0.87 ± 0.04	0.151
$Left_{ML}$ EC	0.81 ± 0.11	0.83 ± 0.09	0.878
$Right_{ML}$ EC	0.69 ± 0.05	0.75 ± 0.04	0.321
$Left_{AP}$ EO	0.51 ± 0.04 0.51	0.55 ± 0.03	0.426
$Right_{AP}$ EO	± 0.05	0.60 ± 0.04	0.158
$Left_{ML}$ EO	0.42 ± 0.03	0.42 ± 0.02	0.704
$Right_{ML}$ EO	0.40 ± 0.02	0.43 ± 0.02	0.385
RMS of center of pressure (cm)			
$Left_{AP}$ EC	1.57 ± 0.14	1.32 ± 0.12	0.196
$Right_{AP}$ EC	1.63 ± 0.12	1.39 ± 0.10	0.136
$Left_{ML}$ EC	1.05 ± 0.16	1.19 ± 0.14	0.502
$Right_{ML}$ EC	1.09 ± 0.23	1.53 ± 0.19	0.147
$Left_{AP}$ EO	1.27 ± 0.12	1.17 ± 0.16	0.502
$Right_{AP}$ EO	1.16 ± 0.08	1.19 ± 0.07	0.796
$Left_{ML}$ EO	0.74 ± 0.18	0.96 ± 0.15	0.362
$Right_{ML}$ EO	1.05 ± 0.35	1.57 ± 0.29	0.259
Center of pressure peak velocity (cm/s)			
$Left_{AP}$ EC	6.62 ± 4.18	4.94 ± 3.45	0.517
$Right_{AP}$ EC	4.04 ± 0.59	5.26 ± 0.48	0.126
$Left_{ML}$ EC	4.87 ± 0.99	5.72 ± 0.82	0.849
$Right_{ML}$ EC	4.42 ± 1.10	5.64 ± 0.91	0.407
$Left_{AP}$ EO	2.79 ± 1.12	3.69 ± 0.93	0.546
$Right_{AP}$ EO	2.47 ± 1.12	3.97 ± 0.93	0.316
$Left_{ML}$ EO	2.46 ± 0.77	2.93 ± 0.64	0.644
$Right_{ML}$ EO	2.40 ± 1.23	5.06 ± 1.02	0.114

Abbreviation; N: neutral, DF:dorsiflexion, PF:plantarflexion, AP:anterior-posterior, ML:medial-lateral, EC:eyes closed, EO:eyes opened.

DISCUSSION

The primary finding was the identification of significant decreased in JPS and CoP measurements during EC and EO condition in the FIFA11+ warm up training program in comparison to a control group. When vision was removed, the CoP parameters in AP direction significantly decreased in trained group with eyes closed condition. This indicated that trained group neuromuscular system was

improved and develops in motor learning to detect the movement and maintain the stability body balance control. Overall, the trained group had less time than the control group in the AP direction. These results are consisted with previous finding of single leg stance in soccer players,[28] however, in the current study non-dominant leg had tendency to decreased.

Previously, Barone and Macaluso[28] identified that soccer players had better standing balance in non-dominant one-legged stance among athletes of difference sports and sedentary. Most soccer players prefer to use the dominant leg for kicking the ball to be more accurate and the non-dominant leg to support body weight, many drills performed (shooting, passing, and stopping) are executed in a few seconds whilst standing on leg that normally is not the dominant leg[28]. CoP $Range_{AP}$, CoP SD_{AP}, and CoP RMS_{AP} measures were significantly decreased on the left leg which majorities are right leg dominant. In dominant leg (kicking leg) were changes in the pattern of coordination underlying the movement between hip and knee joints compare to the non- dominant leg[29]. Left leg had more correlated with kicking performance than the right leg (dominant leg) [2, 28, 30] single-leg balance ability can predicted the kicking performance on the other leg, our results found that the FIFA11+ program was significantly improved balance ability on the left leg (non-domint leg) that correlated the development of kicking skill performance in futsal players.

Joint position sense measured by absolute mean errors show the perception ability of joint movement without visual individually. Absolute mean errors were significant decreased on the right ankle plantar flexion in trained group. The present reports shows the effects of FIFA's 11+ significantly decreased the proprioception error, possibly by improving the concentration paid to proprioceptive[31]. Neuromuscular control includes proprioception, muscle strength, muscle reaction time, and postural control. Balance and postural control of the ankle appears to be diminish after lateral ankle sprain but can be restored by training through central nervous mechanism[32]. Our results may explain why there may be reduce risk of lateral ankle sprain in futsal players.

Our study did have a few limitations. It may be affecting sensation and balance such as muscle fatigue which can cause control change and decreased average of CoP movement and joint position sense errors. Our sample of adolescent futsal players from Nakhonpathom Sports School, were homogenous sample, generalizability of our findings to other populations cannot be made without further investigation.

Conclusion

The FIFA11+ warm up training was shown to increase joint position sense slightly to the form of increasing errors angle detection of the right ankle in plantarflexion position at 15º and improve balance without visual perception in anterior/posterior direction in futsal players after 10 weeks training. The results had been shown to improve performance and prevent injuries in football players which may be due to the

characteristic of ball control in anterior/posterior directions, however in the futsal are more in medial/lateral direction this may correlated that FIFA11+ did not show clear positive results in futsal players in this study.

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