

Coaching Sciences
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**THE EFFECTS OF THE FIFA 11+ WARM UP PROGRAM ON RESTING POSTURAL SWAY,
REACTION TIME, MOVEMENT TIME AND SPEED OF FINGER TAPPING IN ADOLESCENT FUTSAL
PLAYERS**

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ABSTRACT

Objectives - The purposes of this study were to determine the FIFA 11+ warm up training program on postural sway, reaction time, movement time and speed of finger tapping in adolescent futsal players.

Methods - Twenty nine healthy adolescent futsal players (age = 16.48 ± 0.22 yrs, weight = 59.59 ± 2.06 kg, height = 168.90 ± 1.58 cm, play experience = 6.03 ± 0.06 yrs, age of puberty = 14.30 ± 0.32 yrs, game playing = 2.75 hr/time) were randomly assigned to either trained or control groups. The intervention group participated in 10 weeks of the FIFA11+ training protocol at least 3 times a week through the training period. The control group did not participate in the FIFA11+ training.

Results - Postural sway test found sway area decreased after training. Reaction time found significant decreased on the left hand and tendency decreased on the right hand and left leg in trained group after 10 weeks but in control group found only significant decreased on right leg. Movement time test found significant decrease in trained group on the right hand at 0° and 90° and tendency decreased on the right hand at 180° and 270° , both left and right legs at 90° , 180° , and 270° but in control group found significant decreased at 0° on the right hand and tendency decreased at 90° on the left leg. Tapping speed test in trained group found significant increased on the right hand and on the left hand also found tendency of increase after 5 weeks and 10 weeks.

Conclusion - The results of this study indicate that the FIFA 11+ training program could have improvement of balance, and neuromuscular development in adolescent futsal players. These factors imply the advantage to athletes (good balance, good agility, and good co-ordination) and correlated with injury rate decrease in athletes.

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Key Words - Postural sway, Reaction time, Movement time, Tapping speed, FIFA 11+, Futsal

INTRODUCTION

Soccer is the most popular sports; in many countries the environment does not permit for playing or competition such as the winter season when snowing. Then they have developed futsal by decrease players in each team, size of ball size of the pitch and change of the rule. Futsal is regulated by the Federation International de Football Association (FIFA). Now a day futsal is increasingly popular worldwide because of it was indoor sports and can be played every season, funny sports due to variety of skill such as balance, agility which have impact on often injury [1]. Sports injury in futsal was more than 70% in lower extremity especially contactsports more than 80% in ankle joint injury [2-4]. The study of Sekir they found inversion of ankle joint injury was more than 85% with lateral ligament [3]. It was reported that re-injury will have sensory motor of functional ankle instability damage, range of motion decrease and to results in functional ankle instability (5).

Ankle injury was related to proprioception damage and weak of peroneal muscle. The work of neuromuscular system was important for work of joint such as stance, walking, sitting or running, especially on athletes; they will have to move the body fast as to gain advantage of sports. Prevention of sports injury is important for coach, doctor those concern with groups and athletes. Variety of program for training is suitable for each sports such as star excursion training[5] wobble board training[6] and disk training[7] for ankle stability and strength. When there was ankle sprain or functional ankle instability [6]. Performance of balance and agility may be increased in some sports with reduce rate of sports injury. Now a day warm up program of many exercises are suitable for used with all sports. Especially they used worldwide in soccer and to be used as warm up program before the game. Sifen [8] reported that the FIFA11+ could have reduce the injury rate on adolescent female football players to conformed with the numerous studies have documented the FIFA 11+ program could have prevention of sports injuries [9-14] while the study of Moriera reported that the FIFA11+ warm up program could have improvement of reaction time on peroneal longus after training 6 weeks in young soccer players [15].

METHODS

Participants

Twenty-nine adolescent futsal players of Nakhonpathom Sports School, Nakhonpathom Province. All subjects had age range between 15-18 year old no history of lower extremity injury or surgery in the past 3 months before training, no vigorous sports or physical activities during the period of laboratory study. Any subjects who had smoking, taking alcohol or caffeine within 24 hours before the testing day, slept less than 8 hours, to be absents more than 5 % of total training, had injury or pain during training or test were excluded from the study. The 14 subjects in trained group (age 16.50 ± 0.20 yr., weight 61.18 ± 2.23 kg., height 168.69

± 1.63 cm., BMI 19.43 ± 0.42 play experience 6.13 ± 0.06 yr., age of puberty 14.43 ± 0.39 yr., game playing 2.63 ± 0.24 hr/time) and the 15 subjects in control group (age 16.47 ± 0.25 yr., weight was 56.00 ± 1.89 kg., height 169.11 ± 1.54 cm., BMI 20.86 ± 0.84 , play experience 5.94 ± 0.06 yr., age of puberty 14.18 ± 0.25 yr., game playing 2.88 ± 0.23 hr/time). The study was approved by the local Ethics Committee on Human Experimentation of Mahidol University, and all subjects read and signed an informed consent before beginning the study.

PROCEDURE

The subjects were trained the FIFA 11+ warm up program with a total of 15 exercises. It has three parts; part one the running exercises at a slow speed combined with active stretching and controlled partner contacts (8 minutes), part two exercises focusing on core and leg strength, balance and plyometrics and agility. Each with three levels of increasing difficulty is begin, moderate and advance (10 minute), part three includes running exercises at moderate / high speed combined with planting / cutting movement (2 minutes). The subjects of the control group performed normal program (weight training program) 20 minutes five times per week. We collected the data on week-0, week-5 and week-10.

Table 1. Subjects characteristics, trained (n = 14) and control (n = 15) group (mean \pm SEM)

Parameters	Trained group	Control group
Age (years)	16.50 ± 0.20	16.47 ± 0.25
Weight (kg)	61.18 ± 2.23	56.00 ± 1.89
Height (cm)	168.69 ± 1.63	169.11 ± 1.54
BMI	19.43 ± 0.42	20.86 ± 0.84
Play experience (years)	6.13 ± 0.60	5.94 ± 0.06
Age of puberty (years)	14.43 ± 0.39	14.18 ± 0.25
Game playing time (hr/time)	2.63 ± 0.24	2.88 ± 0.23

Postural sway Assessment

Postural sway was measured by Kistler force platform (type9286BA, Switzerland; sampling frequency 500 Hz). Subjects performing barefoot while on the force platform (Figure 1) prior to testing, subjects were allowed six practice trials with right eyes open and closed, left eyes open and closed, double leg stance eye open and closed. These trials were done by each subjects performing repeated eye open and closed. Trials duration was 20 second [16]. The area of postural sway (Figure 1) was determined from the posturogram; anterior / posterior and medial / lateral directions [17].

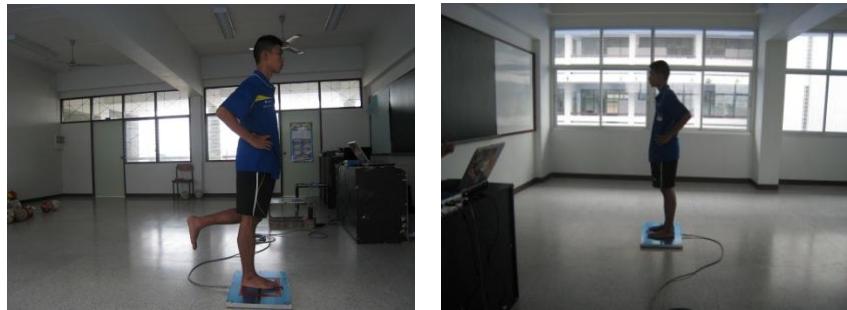


Figure 1 Single leg stance on force platform

Reaction time Assessment

Reaction timer is an instrument of measuring reaction time. The subjects were asked to sit on the chair for reaction time tests of hands and legs when the light signal was on they must press on switch as fast as possible. They performed all right and left of hands and legs. The time which recorded in the digital watch was the reaction time [18].

Movement time Assessment

Movement time was measured by reaction timer. The movement time assessment was done under 4 conditions; the directions of 0° (forward), 90° (leftward), 180° (backward), and 270° (rightward). We used the distance from the start point of 30 cm for hand and 50 cm for leg. The subjects performed 3 times all right and left of each trial and the recorded in the digital watch

(Figure2).

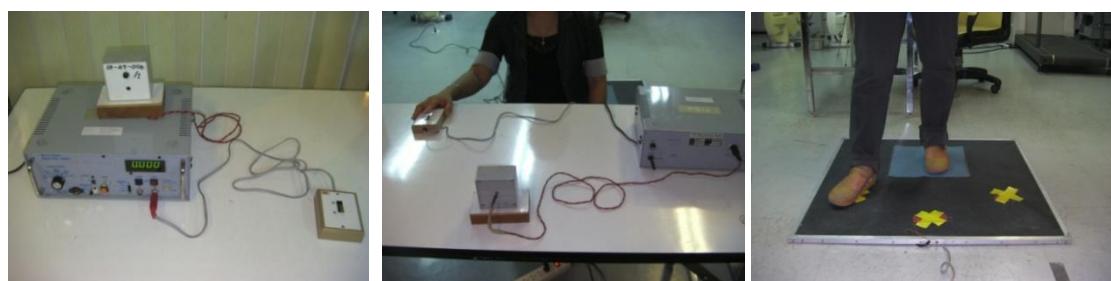


Figure 2 Reaction timers for assessment of reaction time and movement time of arm and legs.

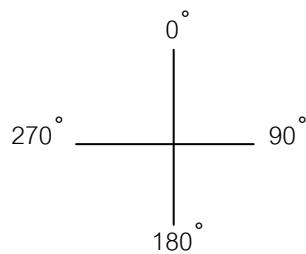


Figure 3 Directions for movement time test.

Speed of finger tapping Assessment

Denominator was the instrument that used for measuring tapping speed. The subjects were asked to sit comfortable on a chair and push the hand on the table. In one minute the subjects was asked use index finger (for hand) or bigtoe (for foot) to press and release (tapping) a knob of the blood counter as fast as possible on switch. The subjects practiced all right and left sides (Figure 3).



Figure 3 Denominator for assessment of index finger-big toe tapping.

Statistical Analysis

Statistical analysis was performed using SPSS®, version 13. A two way analysis of variance (ANOVA) for repeated measures was used to test whether the experimental group and control group on week 0, 5, and 10 weeks of training were different. For comparison between two experimental groups, an unpaired *t*-test was used. A one way ANOVA was performed via a paired *t*-test with a Bonferroni adjustment to compare the mean rectangular area values, reaction time, movement time, and speed of finger tapping within each group. A *P*-value of 0.05 was used as the level of statistical significance.

RESULTS

Postural sway

Postural sway in trained group decreased on week-10 after training while the control group decreased only conditions one-leg stand right open eye and two leg stand close eye on week-10 (Table 2 and 3).

Table 2. Sway area (mm^2): single leg stance eye closed- eye opened condition between trained (n = 14) and control (n = 15) group (mean \pm SEM)

Duration time	Eye Opened (EO)				Eye Closed (EC)			
	Right Leg		Left Leg		Right Leg		Left Leg	
	Trained	Control	Trained	Control	Trained	Control	Trained	Control
Week-0	358.37 \pm 5.11	359.68 \pm 4.98	365.62 \pm 8.12	367.81 \pm 5.82	362.25 \pm 5.98	366.75 \pm 4.20	368.87 \pm 5.32	367.81 \pm 4.36
Week-5	356.31 \pm 6.27	359.00 \pm 4.98	363.12 \pm 6.02	366.93 \pm 6.02	359.62 \pm 6.04	366.31 \pm 4.36	367.62 \pm 5.31	368.25 \pm 7.12
Week-10	350.93* \pm 5.53	358.50* \pm 4.67	361.31* \pm 6.91	366.63 \pm 6.14	358.06* \pm 6.30	365.93 \pm 4.32	364.56* \pm 7.57	368.41 \pm 6.19

* $p < 0.05$ significant difference between group.

Table 3. Sway area (mm^2) :double leg stance eye closed- eye opened condition between train (n = 14) and control (n = 15) group (mean \pm SEM)

Duration time	Eye Opened (EO)		Eye Closed (EC)	
	Trained	Control	Trained	Control
Week-0	342.81 \pm 6.87	347.00 \pm 5.25	365.25 \pm 5.24	353.18 \pm 5.86
Week-5	341.68 \pm 6.77	346.75 \pm 5.11	363.12 \pm 7.28	352.62 \pm 6.93
Week-10	334.37* \pm 7.82	345.81 \pm 4.18	346.93 * \pm 7.14	351.87* \pm 5.90

* $p < 0.05$ significant difference between group.

Reaction time

Reaction time was significantly decreased on the left hand and tendency of decrease on the right hand and the left leg in trained group after 10 weeks of training but in the control group found only significantly decreased on the right leg (Table 4).

Movement time

Movement time was found to be significantly decreased in the FIFA 11+ trained group on the right hand at directions of 0° , 90° and the left hand at direction of 180° but in the control group found that the movement time was significant decrease on the right by different hand at direction of 0° , 180° and the direction of 270° in both groups were found not significantly different but in the FIFA 11+ trained group had tendency to decrease and the time shorter than to the control group. While the movement time of leg in the FIFA 11+ trained group was found to be not significant to all directions (0° , 90° , 180° , 270°) but the time was shorter than when compared to the control group. The movement time of leg in the control group was found only at the left leg which was significantly decreased at direction of 90° (Table 5).

Speed of finger tapping

Speed of finger tapping in the FIFA 11+ trained group at the right hand was significantly increased after training on week-5 and week-10 but the left hand only had tendency of increase. In the control group was found not significant but on the right hand have tendency to increase while the left hand was not different. Toe tapping of both groups were that not different^{*} (Table 4).

Table 4. Reaction time (sec) and tapping speed (tap/60 sec) of arm and leg between trained and control group (mean \pm SEM)

Variable	Groups	Organ	Week - 0		Week - 5		Week - 10	
			Right	Left	Right	Left	Right	Left
Reaction time	Trained	Arm	0.296 \pm 0.07	0.282 \pm 0.05	0.257 \pm 0.07	0.226 \pm 0.03	0.255 \pm 0.06	0.225 \pm 0.05
		Leg	0.433 \pm 0.02	0.428 \pm 0.02	0.424 \pm 0.03	0.415 \pm 0.02	0.388 \pm 0.03	0.422 \pm 0.02
	Control	Arm	0.282 \pm 0.01	0.286 \pm 0.01	0.262 \pm 0.00	0.256 \pm 0.01	0.285 \pm 0.01	0.274 \pm 0.01
		Leg	0.458 \pm 0.01	0.420 \pm 0.02	0.439 \pm 0.02	0.437 \pm 0.10	0.347* \pm 0.02	0.373 \pm 0.03
Tapping speed	Trained	Arm	264.26 \pm 6.7	246.06 \pm 12.	271.80* \pm 13.	253.53 \pm 12.	294.26* \pm 11.3	249.33 \pm 7.63
		Leg	226.46 \pm 5.5	205.66 \pm 6.0	204.93 \pm 9.95	198.60 \pm 7.2	221.60 \pm 12.8	218.80 \pm 7.20
	Control	Arm	267.73 \pm 8.6	246.40 \pm 7.8	278.86 \pm 12.4	246.26 \pm 10.	277.66 \pm 11.1	246.00 \pm 7.25
		Leg	220.46 \pm 5.27	200.53 \pm 9.95	208.13 \pm 8.67	203.73 \pm 7.77	214.53 \pm 9.20	218.93 \pm 10.71

* $p < 0.05$ significant difference between group.

Table 5. Movement time (sec) of arm and legs (direction of 0° , 90° , 180° , 270°) between trained and control group (mean \pm SEM)

Groups	Organ	Direction	Week-0		Week-5		Week-10	
			Right	Left	Right	Left	Right	Left
Trained n = 14	Arm	0°	0.545 \pm 0.01	0.518 \pm 0.13	0.405 \pm 0.01	0.406 \pm 0.02	0.452 \pm 0.02	0.467 \pm 0.02
		90°	0.476 \pm 0.01	0.460 \pm 0.01	0.413 \pm 0.01	0.445 \pm 0.02	0.454 \pm 0.01	0.432 \pm 0.01
		180°	0.501 \pm 0.03	0.487 \pm 0.02	0.450 \pm 0.02	0.421 \pm 0.01	0.442 \pm 0.01	0.406 \pm 0.0
		270°	0.531 \pm 0.03	0.514 \pm 0.01	0.444 \pm 0.02	0.456 \pm 0.01	0.452 \pm 0.01	0.499 \pm 0.02
	Leg	0°	0.523 \pm 0.01	0.519 \pm 0.01	0.461 \pm 0.02	0.462 \pm 0.01	0.473 \pm 0.02	0.471 \pm 0.01
		90°	0.491 \pm 0.01	0.490 \pm 0.02	0.477 \pm 0.02	0.475 \pm 0.03	0.483 \pm 0.03	0.467 \pm 0.06
		180°	0.564 \pm 0.04	0.594 \pm 0.04	0.518 \pm 0.02	0.528 \pm 0.02	0.482 \pm 0.03	0.505 \pm 0.03
		270°	0.595 \pm 0.02	0.580 \pm 0.02	0.561 \pm 0.02	0.515 \pm 0.03	0.504 \pm 0.02	0.553 \pm 0.02
Control n = 15	Arm	0°	0.489 \pm 0.02	0.480 \pm 0.02	0.455 \pm 0.01	0.462 \pm 0.01	0.478 \pm 0.01	0.490 \pm 0.01
		90°	0.408 \pm 0.02	0.496 \pm 0.01	0.464 \pm 0.02	0.447 \pm 0.02	0.477 \pm 0.01	0.464 \pm 0.01
		180°	0.521 \pm 0.02	0.490 \pm 0.02	0.445 \pm 0.02	0.456 \pm 0.02	0.441 \pm 0.02	0.467 \pm 0.02
		270°	0.531 \pm 0.02	0.519 \pm 0.01	0.464 \pm 0.01	0.483 \pm 0.02	0.467 \pm 0.01	0.512 \pm 0.02
	Leg	0°	0.514 \pm 0.02	0.538 \pm 0.02	0.497 \pm 0.02	0.523 \pm 0.01	0.486 \pm 0.01	0.530 \pm 0.02
		90°	0.496 \pm 0.02	0.533 \pm 0.01	0.517 \pm 0.03	0.512 \pm 0.01	0.495 \pm 0.02	0.479 \pm 0.02
		180°	0.592 \pm 0.02	0.573 \pm 0.02	0.548 \pm 0.01	0.550 \pm 0.01	0.537 \pm 0.03	0.560 \pm 0.03
		270°	0.605 \pm 0.02	0.609 \pm 0.02	0.600 \pm 0.01	0.580 \pm 0.01	0.507 \pm 0.02	0.562 \pm 0.03

* $p < 0.05$ significant difference between group.

DISCUSSION

This study found that the sway area was significantly decreased with eyes closed and eyes open conditions, this showed the development of neuromuscular and motor learning of movement and balance control. This indicated that the FIFA 11+ warm up training program could increase strength, balance, plyometrics, and co-ordination agility. These results consisted with previous findings that the 11+ training program could prevent sports injuries [11, 12, 19]. Many researchers could support the present results which improved performance by plyometric and strengthening in the 11+ training program after 5 weeks of training period. Furthermore, the study of Stefen reported that the 11+ warm up program could decrease re-injuries rate in female football players. The capacity of balance was dependent on many factors those those control it [20]. They were visual

system, vestibular system, and somatosensory system which were intrinsic factors and the influences of extrinsic factors such as; age [21-24], disease [5, 16, 21] and training programs [6, 25, 26].

The RT and MT values are related closely the structure and functions of the nervous and the neuromuscular systems which mostly shorter in physical well trained athletes [18,24, 27]. Furthermore the performance of RT, MT and speed of finger tapping to depend on age [28], gender [29, 30], disease [31], and types of sports [32]. In this study we found the reaction time of hand and leg in trained group had tendency to decrease and the time was shorter than when compare control group. The study of Moreira showed that the 11+ warm up program which was applied during 6 weeks, three times a week and the more difficult levels were introduced every two weeks with 14 athletes, they found that the 11+ could have promotes changes in the peroneal reaction time [15]. While the study of Spierer reported that response time in male athletes was faster as compared to female athletes [33], types of sports in the study of Chentaneze they found types of sports had different response time [32], and pathology or disease in the study of Prigatano and Wong reported that speed of finger tapping and grip strength were bilateral by lower after an acute unilateral cerebral vascular accident [34], using different types of stimuli on study of Senel and Eroglu found that auditory reaction time were significantly better than their visual reaction time [35]. Movement time of arm and leg found that time of the trained group had less than the control groups. Tapping speed test of the right finger was significantly increase in the trained group while the big toe tapping was not significantly change in all both groups. Our results found that the FIFA 11+ warm up training program significantly improve the balance, movement time of leg that correlated with the development of physical performance in futsal players.

CONCLUSION

The results of this study indicate that the FIFA11+ training program could have improvement of balance, reaction time, movement time, and speed of finger tapping in adolescent futsal players. These factors imply the advantage in sports (good balance, good agility, and good co-ordination) especially in football and futsal players in the ball control in the game. Furthermore it is correlated with injury rate decrease and re-injuries in athletes.

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