PROPHYLACTIC WARM-UP ENHANCES FUNCTIONAL MOVEMENT SCREEN IN YOUNG FEMALE BASKETBALL PLAYERS

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This study investigated effects of a prophylactic warm-up programme on functional movement screen (FMS) in young basketball players. Twenty-four female players in a high school basketball league were recruited and assigned to two groups. The experimental group performed prophylactic warm-up and the control group performed regular warm-up for 15 minutes per day, five days per week for 12 weeks. Seven measurements in FMS were collected before and after training. A 2-way analysis of variance (group by time) with repeated measures on the second factor was used to analyze data. There were group by time interactions in deep squat, hurdle step, in-line lunge, active straight-leg raise and total scores of FMS. There were significant group differences in deep squat, hurdle step, in-line lunge, active straight-leg raise, rotary stability and total scores of FMS. There were significant differences in deep squat, hurdle step, trunk stability push-up, rotary stability and total scores of FMS in experimental group before and after training ($p < .05$). The 12-week prophylactic warm-up programme enhanced FMS scores in young female basketball players.

KEYWORDS: deep squat, straight leg raise, hurdle step.

INTRODUCTION: Functional movement screen (FMS) has been found to improve the overall scope of performance and management of sports injury risk in individuals. It is a systematic way of assessing movement patterns to identify movement dysfunction. Previous studies indicated that athletes had four times higher risk of injury to lower limbs when their FMS total score was 14 or lower.(Kiesel, Plisky, & Voight, 2007) 62 professional American football players with FMS scores below 14 pre-season suffered sports injuries after the end of the season and their probability of occurrence was significantly higher than subjects with a FMS score greater than 14 (Kiesel et al., 2007). The FMS does not provide discriminatory prediction of musculoskeletal injury, overall injury, or severe injury in national collegiate athletic association division II athletes (Dorrel, Long, Shaffer, & Myer, 2018). However, the application in young female adolescents is not well explored. FMS scores can be improved through training programs (Stanek, Dodd, Kelly, Wolfe, & Swenson, 2017). Lower extremity injury prevention training programmes such as FIFA+11 have been developed to reduce injury in soccer players. Adolescent female basketball players have a high risk of sustaining anterior cruciate ligament injuries and therefore it is recommended that a prophylactic warm-up programme should be designed, with a special focus on improving the asymmetrical movement pattern, enhancing the sports performance and reduce injury risks. Therefore, the purpose of this study was to investigate the effects of prophylactic warm-up programme on the FMS in young basketball players.

METHODS: Twenty-four female high school basketball league players were recruited in this study and randomly assigned to an experimental group (n=12, mean ± SD of age 16.9 ±. 8 yrs, height 163.5 ± 4.5 cm, mass 55.8 ± 4.3 kg) and a control group (n=12, mean ± SD of age 16.7 ± .9 yrs, 163.9 ± 3.4 cm, 59.3 ± 5.1 kg). The experimental group performed prophylactic warm-up (Table 1) and the control group performed regular warm-up for 15 minutes per day, five days per week for 12 weeks respectively. Regular warm-up included 7-minute jogging and 8-minute stretching for major muscle groups. Before and after training, the FMS measurements including deep squat, hurdle step, in-line lunge, shoulder mobility, active straight-leg raise, trunk stability push-up, rotary stability were collected (Teyhen et al., 2012).

A 2-way analysis of variance (group by time) with repeated measures on the second factor was used to analyze the data to identify if there was differences among variables.

Table 1: Prophylactic warm-up programme

Training	distances/reps	Time
Coordination training (4 minutes)		10 s rest in between
Skip with hip external rotation	28 m	50 s
Skip with clapping	28 m	40 s
Skip with hip external rotation	28 m	50 s
Skip with clapping	28 m	40 s
Cross step	28 m	40 s
Africa dance	28 m	60 s
Balance and strength training (5 minutes)		10 s rest in between
One-legged side jump	28 m	60 s
Swing and balance	28 m	70 s
Side step	28 m	70 s
Gluteus medius stretching during marching	14 m	60 s
Comprehensive training(6 minutes)		20 s rest in between
Lunge walking	14 m	80 s
Lunge jump	30 reps	60 s
Squat jump	30 reps	60 s
Burpee	15 reps	80 s

RESULTS: Almost all the variables (except shoulder mobility) in experimental group were improved after training (Table 2). There were group by time interaction in deep squat, hurdle step, in-line lunge, active straight-leg raise and total scores of FMS (Table 2). Significant group differences were found in deep squat, hurdle step, in-line lunge, active straight-leg raise, rotary stability and total scores of FMS. There were significant differences in deep squat, hurdle step, trunk stability push-up, rotary stability and total scores of FMS in experimental group before and after training ($p<.05$).

Table 2: Comparison of mean values for FMS scores before and after training

Measurements (points)	Experimental group			Control group		
	Pre Mean±SD	Post Mean±SD	change% Mean±SD	Pre Mean±SD	Post Mean±SD	change% Mean±SD
Deep squat	1.83±0.94	2.75±0.45	0.92±0.49	1.67±0.65	1.58±0.67	–0.9±0.02
Hurdle step	2.33±0.49	2.92±0.29	0.59±0.20	2.08±0.51	2.00±0.43	–0.08±0.08
In-line lunge	2.75±0.45	3.00±0.00	0.25±0.45	2.42±0.67	2.33±0.65	–0.09±0.02
Shoulder mobility	2.67±0.49	2.67±0.49	0±0	2.42±0.51	2.50±0.52	0.8±0.01
Active straight-leg raise	2.75±0.45	3.00±0.00	0.25±0.43	2.50±0.52	2.42±0.51	–0.08±0.01
Trunk stability push-up	1.92±0.79	2.33±0.65	0.41±0.14	1.83±0.58	2.00±0.43	0.17±0.15
Rotary stability	2.00±0.43	2.50±0.52	0.50±0.09	1.83±0.39	2.00±0.43	0.17±0.04
Total score	16.25±1.71	19.17±1.03	2.92±0.68	14.75±1.91	14.83±2.04	0.08±0.13

"–" indicated reduction

Table 3: The statistical results of the FMS scores

Measurements	Time		Group		Time X Group	
	F	P	F	P	F	P
Deep squat	11.70	0.002**	6.67	0.02*	16.85	0.000**
Hurdle step	8.61	0.008**	13.65	0.001**	15.30	0.001**
in-line lunge	1.16	2.94	6.44	0.02*	4.63	0.04*
Shoulder mobility	1.00	0.33	1.06	0.31	1.00	0.33
Active straight-leg raise	1.16	0.29	6.96	0.02*	4.63	0.04*
Trunk stability push-up	9.80	.005**	0.77	0.39	1.80	0.19
Rotary stability	12.57	.002**	4.63	0.04*	3.14	0.09
Total score	27.10	.000**	20.81	0.000**	27.18	0.000**

*p<.05 **p<.01

DISCUSSION: Five out of seven movements showed significant improvement after training in experimental group while the control group were slightly decreased in deep squats, hurdle step, in-line lunge, and active straight leg raise. No significant group difference was found in shoulder mobility and trunk stability push-up. Trunk stability and push-ups were significantly improved after training in the experimental group in this study, but not in the control group and no significant difference between groups was found after training.

Significant differences in the total score between groups was found in the current study. Chorba et al., (2010) conducted FMS in 38 female athletes in college football, volleyball and basketball prior to the season and discovered that female college student athletes had a 4 times higher risk of injury to lower limbs when their FMS total score was 14 or lower. Of the players 69% had sports injuries throughout the season, and their FMS scores were all lower than 14 (Chorba, Chorba, Bouillon, Overmyer, & Landis, 2010). In the current study, there were five players in the experimental group with total score less than 14 points before training, and their scores were all improved after training. This indicated that the prophylactic warm-up training of this study has positive effects and FMS scores can be improved through training programs. The results in current study were consistent with previous studies (Cowen, 2010; Kiesel, Plisky, & Butler, 2011).

CONCLUSION: A 12-week prophylactic warm-up programme enhanced FMS performance scores when compared to regular warm-up programme. The research improves the understanding of the training effects of prophylactic warm-up in FMS scores in young female basketball players; however, the cause of these differences and the prolonged injury prevention results requires further research.

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