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The Effect Of Preventive Exercises During Deceleration On The Anterior Cruciate Ligament (ACL) In Preventing Sudden Injuries In Young Football Players

[1]M.s. Nawwar Muthanna Subhi*

***Corresponding Author:** Subhi, Nawwar Muthanna e-mail: **Bluebird1432.hm@gmail.com**

[1]Ministry Of Education, Al-Athar Intermediate School For Girls

Abstract

Objectives. This study aimed (1) to develop preventive exercises that target sudden movements during deceleration and rotation in youth football, and (2) to examine the effects of these exercises on selected performance and biochemical indicators linked to knee-joint injury risk.

Materials and Methods. A single-group pretest-posttest experimental design was used. Participants were six youth football players from Al-Furat Sports Club. The program was implemented from March 22 to May 22, 2025 (24 sessions; 3 sessions/week; 25–35 minutes/session; intensity 55–80%). Pretests were conducted on March 18, 2025, and posttests on May 24, 2025. Outcomes included lower-limb explosive power assessed via the standing broad jump and serum creatine phosphokinase (CPK) activity (U/L). Paired-sample t-tests were used with $\alpha = 0.05$.

Results. Significant improvements were observed after the intervention. Explosive power (standing broad jump distance) increased from 2.20 ± 0.29 m to 3.05 ± 0.92 m ($t = 8.057$; $p < 0.001$). CPK changed from 293.50 ± 43.79 U/L to 366.17 ± 47.89 U/L ($t = 12.507$; $p < 0.001$).

Conclusions. Preventive exercises focusing on controlled deceleration and rotation were associated with meaningful improvements in lower-limb explosive power and significant changes in CPK response. These findings support integrating structured preventive exercise components into youth football training, alongside periodic monitoring of musculoskeletal and

biochemical indicators.

Keywords: Anterior Cruciate Ligament; Deceleration; Injury Prevention; Youth Football; Neuromuscular Training; Creatine Kinase

Introduction

In football, many non-contact knee injuries occur during high-demand actions such as rapid deceleration, cutting, and rotational changes of direction. Emerging evidence highlights deceleration ability and braking as key performance qualities that are also relevant to injury-risk management. Deceleration-focused training strategies that improve braking control and movement quality may help reduce exposure to hazardous knee loading in match-relevant scenarios (Harper et al., 2025). Recent injury-mechanism syntheses further show that sport-specific demands influence ACL injury mechanisms and should inform prevention planning (Sundberg et al., 2025).

Neuromuscular and warm-up based injury prevention programs have demonstrated consistent reductions in lower-limb injury rates when implemented with adequate adherence and coaching quality (Stergiou et al., 2025). In children, FIFA 11+ Kids has been associated with meaningful reductions in overall and serious injury risk (Ramos et al., 2024). In addition, integrated neuromuscular training interventions can improve landing mechanics and indicators linked to ACL injury risk (Marwat et al., 2025).

Despite this progress, many teams still lack structured content that specifically targets the moments of slowing down and rotation that commonly precede injury situations. Therefore, this study developed a preventive exercise set emphasizing controlled deceleration and rotation, and evaluated its effects on lower-limb explosive power and a biochemical marker associated with exercise-induced muscle stress. The study hypothesized that post-intervention results would be superior to pre-intervention results for the selected variables.

Materials and Methods

Study Participants.

The research population comprised youth football players from Al-Furat Sports Club. A purposive sample of six players participated in the experimental group (100% of the selected players), and three additional players were used for a pilot study. Sample homogeneity was examined using descriptive statistics and skewness for height, body mass, and chronological age.

Table 1. Descriptive Characteristics Of Participants (n = 6)

Variable	Unit	Mean	SD	Skewness
Height	cm	178.5	0.600	0.832
Body Mass	kg	63.6	0.454	-0.766
Chronological Age	years	17.3	0.895	0.867

Study Organization.

Pretests were administered on March 18, 2025 at 16:00, following standardized procedures. The preventive exercise program was implemented from March 22 to May 22, 2025 (24 sessions total). Training load parameters were structured as follows: 10–15 repetitions per exercise, 1–2 sets, 200 seconds rest between sets, and intensity progressing between 55% and 80% according to session objectives. Each training unit lasted approximately 25–35 minutes. Posttests were conducted on Saturday, May 24, 2025 using the same procedures as the pretests. The primary performance test was the standing broad jump, used to assess lower-limb explosive power. Biochemical assessment included serum creatine phosphokinase (CPK) activity (U/L) as an indicator of exercise-related muscle stress and recovery dynamics (Radišić Biljak et al., 2025). Equipment used during implementation included a fitness gym setting, a medical scale, resistance bands, braces/straps, cones/stakes, medicine balls (1–2 kg), and timing devices.

Statistical Analysis.

Descriptive statistics (mean and standard deviation) were calculated for all variables. Pre- and post-intervention differences were tested using paired-sample t-tests with $\alpha = 0.05$ and 5 degrees of freedom. Statistical processing was performed using the Statistical Package for the Arabian (SPA).

Results

Table 2 presents pre- and post-test descriptive statistics and paired t-test results. Significant differences were observed in both outcomes, favoring the post-test measurements.

Table 2. Pre–Post Changes In Physical And Biochemical Variables (n = 6)

Variable	Unit	Pre Mean	Pre SD	Post Mean	Post SD	t	p
Lower-Limb Explosive Power (Standing Broad Jump)	m	2.20	0.291	3.05	0.92	8.057	<0.001
Creatine Phosphokinase (CPK)	U/L	293.50	43.79	366.17	47.89	12.507	<0.001

Discussion

The findings indicate that the preventive exercise program was associated with significant improvements in lower-limb explosive power. This is consistent with broader evidence that neuromuscular training and structured warm-up interventions can enhance physical performance qualities while reducing lower-limb injury risk in football settings (Stergiou et al., 2025; Ramos et al., 2024). Because deceleration and rotation are common precursors to non-contact ACL injury scenarios, emphasizing braking control and movement quality may provide a practical pathway for coaches to integrate prevention into routine training (Harper et al., 2025). A significant change was also observed in serum CPK activity. Creatine kinase responses are known to show substantial inter-individual variability and are influenced by training intensity, muscle mass, and exercise modality, particularly when eccentric actions such as deceleration are emphasized (Radišić Biljak et al., 2025). Accordingly, CPK monitoring should be interpreted alongside training load and symptom reports, rather than as a stand-alone marker. This study has limitations, including the small sample size, the lack of a control group, and the use of a single club setting, which restrict generalizability. Future work should incorporate controlled designs, larger cohorts, and direct biomechanical assessments (e.g., cutting and deceleration kinematics) to better clarify how the program influences knee-loading patterns (Della Villa et al., 2024).

Conclusions

Preventive exercises emphasizing controlled deceleration and rotational actions were associated with significant improvements in lower-limb explosive power and significant changes in CPK response in youth football players. Coaches may consider integrating structured preventive components into training, supported by periodic musculoskeletal screening and cautious interpretation of biochemical monitoring.

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Conflict of Interest

The author declares no conflict of interest.

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