Physical Education, Health and Social Sciences

https://journal-of-social-education.org

E-ISSN: 2958-5996

P-ISSN: 2958-5988

Impact of Agility Training on Anthropometric, Physical Fitness, Kinematic and Skill Performance of University and Club Football Players: An Experimental Study in Bahawalpur, Pakistan

Sofia Amjad[1], **Prof. Dr. Salahuddin Khan**[2]

[1] Ph.D. Scholar in Department of Sports Sciences and Physical Education, Al-Hamd Islamic University, Islamabad, Corresponding Author's Email: sofiaamjad786@gmail.com

[2] HoD Department of Sports Sciences and Physical Education, Al-Hamd Islamic University, Islamabad, Email: hod.sspe@aiu.edu.pk

DOI: https://doi.org/10.63163/jpehss.v4i1.1752

Abstract

This study examined the effect of an 8-week agility training program on anthropometric measures, physical fitness, kinematic variables, and football skill performance among male football players from university and clubs in Bahawalpur City. Sixty male football players aged 17-25 years were randomly assigned to an experimental group (n=30) and a control group (n=30). The experimental group underwent a structured agility training program (SAQ-based drills, 3 sessions/week for 8 weeks), while the control group followed routine training. Anthropometric variables (body mass, stature, 8 skinfolds, girths, lengths), physical fitness (speed 30m, flexibility sit-and-reach, Illinois agility, standing broad jump, 600m endurance, vertical jump, sit-ups, handgrip), kinematics (stride length, knee and elbow angles during approach phase (AP), foot contact (FC), and follow-through (FT) of kicking, analyzed via Kinovea software) and skill performance (football accuracy, distance, dribbling) were measured pre- and post-intervention. One-way ANOVA with repeated measures and Tukey's post hoc was applied ($p<0.05$). Experimental group showed significant reductions in triceps ($p=0.004$), biceps ($p=0.007$), abdominal ($p=0.002$) skinfolds and wrist ($p=0.02$), forearm ($p=0.01$), chest ($p=0.03$), calf ($p=0.01$), arm flexed ($p=0.01$), arm relaxed ($p=0.03$), hip ($p<0.01$) girths. Significant improvements were observed in 600m endurance ($p<0.001$) and vertical jump ($p=0.03$). Kinematic analysis revealed significant changes in right knee angle (AP $p<0.001$, FC $p=0.01$), left knee angle (AP $p<0.001$, FC $p<0.001$), left elbow angle (AP $p<0.001$, FC $p<0.001$), right elbow angle (AP $p=0.02$, FC $p<0.001$), stride length (FC $p=0.01$, FT $p<0.001$) and right elbow angle (FT $p<0.001$). Eight weeks of agility training significantly improves body composition, lower limb power, endurance, and optimizes kicking kinematics, suggesting its integration into regular training for university and club level football players to enhance performance and reduce injury risk.

Keywords: Agility Training, Anthropometry, Physical Fitness, Kinematics, Football Performance, SAQ

Introduction

Football needs the ability to change directions quickly, accelerate and decelerate, and ball handling skills. Agility is a compound ability which combines neuromuscular coordination, strength and decision making. Regular agility training results in neuromuscular adaptation

(efficient recruitment of motor units), musculoskeletal adaptation (strength, power, and flexibility) and metabolic adaptation (anaerobic metabolism and lactate buffering) (Ltifi et al., 2025). Even though there is plenty of research proving otherwise, the existing literature is still inconclusive when it comes to dose-response relationship, transfer of skills to games, and kinematics. Also, the majority of the research is conducted with regards to the elite and European settings, while the data on South Asian universities and clubs is scarce. This research seeks to fill this gap by researching the impact of agility training in different areas (Afzal et al., 2023).

Objectives:

1. Evaluate impact on physiological and anthropometric measures 2
2. Evaluate fitness and football skill improvements
3. Compare adaptations across university and club players
4. 4Identify optimal training strategies for coaches in resource-limited settings.

According to Lee et al. (2025), SAQ training enhanced performance in 5-m and 10-m sprints in 50 young soccer players after 8 weeks of training. They have discovered that both depth and countermovement jump plyometrics increase agility and vertical jump in young soccer players. They also observed that 10-week coordination and agility training enhanced power and agility but not speed in U16 players. Based on physiological and anthropometric profiling, it is clear that mesomorph body shape with low body fat contributes to high athletic performance (Latif et al., 2021). Several studies have also found that anthropometric measurements such as arm circumference, calf circumference, and body fat percentage affect the kicking biomechanics and endurance. Nevertheless, there is a lack of kinematic research that has studied the relationship between agility training and joint angles changes in football kicking phases (Bhardwaj, 2021).

Methodology

Randomized controlled pre-test post-test experimental design. 60 male football players aged between 17-25 years (mean age 267-272 months) from universities and clubs of Bahawalpur, selected as specialized players based on selection made by club coaches. Inclusion criteria: active training for more than two years and no injury in last six months. Exclusion criteria: previous surgery and musculoskeletal injury. 8-week agility program, 3 days/week, 60-90 min/session, based on SAQ principles (Table 1). Program included dynamic flexibility, mechanics, innervation, SAQ ladder exercises, cone exercises, parachute running, fast feet zigzag, combination run, reaction ball, and more. Control group performed traditional training (technical/tactical training, but without specific agility exercises). Skinfold caliper, weight machine, stadiometer, vernier caliper, dynamometer, stopwatch, measuring tape, sit and reach box, two video cameras (60fps) with calibrated sticks, footballs. Kinovea v0.8.15 software for 2D kinematic analysis.

Variables:

Stature, body mass, age (months)
Anthropometric: triceps, biceps, abdominal, front thigh, medial calf skinfolds; wrist, forearm, chest, calf, arm flexed/relaxed, waist, hip, thigh girths; arm/leg lengths, chest/knee breadth
Physical fitness: flexibility (cm), agility (Illinois sec), speed 30m (sec), 600m endurance (min), standing broad jump (cm), vertical jump (cm), sit-ups (1 min), handgrip right/left (kg)
Kinematics: stride length (m), right/left knee angle, right/left elbow angle during AP, FC, FT phases
Skill: football accuracy (points), distance (m), dribbling (sec)

Statistical Analysis: Data analyzed in SPSS V27. One-way ANOVA repeated measures to find group × time interaction, followed by Tukey HSD. Significance set at $p<0.05$.

Table 4.1 Analysis of demographic data of football players

Variables	Control Pre Mean	Control Pre SD	Exp Pre Mean	Exp Pre SD	Control Post Mean	Control Post SD	Exp Post Mean	Exp Post SD	F	Sig.
Stature(cm)	171.78	3.8	221.98*	279.9	171.78	3.7998	221.98*	279.9	0.97	0.33
Body Mass(kg)	68.51	13.33	68.46	9.37	65.32	12.87	63.9	9.36	0.07	0.8
Age(month)	267.77	32.52	270.8	27.41	269.77	32.52	272.8	27.41	0.15	0.7

No significant difference observed. $p>0.05$ indicates no group difference in demographics, confirming homogeneity.

Table 4.2 (Original 4.2) Analysis of the Anthropometric measurement data of football players

Variables	Control Pre Mean	Control Pre SD	Exp Pre Mean	Exp Pre SD	Control Post Mean	Control Post SD	Exp Post Mean	Exp Post SD	F	Sig.
Triceps SF (mm)	10.71	4.13	9.03	2.09	10.51	4.18	7.21	2.17	8.98	0.004**
Biceps SF (mm)	6.04	2.55	6.09	0.82	6.02	2.54	4.24	0.81	7.96	0.007**
Abdominal SF (mm)	13.12	6.61	13.19	4.597	12.65	6.06	10.21	3.48	10.43	0.002**
Front Thigh SF (mm)	11.76	8.27	11.36	5.926	10.87	14.16	9.95	5.17	0.38	0.51
Medial Calf SF (mm)	8.08	2.95	7.31	2.50	7.71	3.15	5.90	2.64	3.21	0.08
Wrist Girth(cm)	16.16	1.44	16.41	1.21	15.64	1.362	14.85	1.18	5.34	0.02*
Forearm Girth(cm)	24.43	2.87	22.69	1.33	23.24	2.47	21.73	1.37	9.64	0.01**
Chest Girth(cm)	84.75	7.73	84.85	1.296	83.77	7.01	80.58	1.09	5.32	0.03*
Calf Girth (cm)	33.17	3.74	32.31	1.49	32.34	3.68	30.41	1.52	6.78	0.01**
Arm Girth Flexed(cm)	28.57	3.11	26.81	2.62	27.93	3.09	25.57	2.45	9.97	0.01**
Arm Girth Relaxed(cm)	25.05	2.74	25.84	2.45	24.507	2.94	22.21	4.58	4.92	0.03*
Waist Girth(cm)	76.14	7.96	74.72	4.99	75.93	8.02	72.51	4.66	2.97	0.09
Hip Girth(cm)	91.77	5.73	89.42	2.97	91.26	5.51	87.33	2.94	7.59	0.01**
Thigh Girth(cm)	53.39	7.27	52.12	3.66	52.85	7.28	50.32	3.77	4.25	0.04*

Table 4.3 Analysis of physical fitness measurement of football players

Variables	Control Pre Mean	Control Pre SD	Exp Pre Mean	Exp Pre SD	Control Post Mean	Control Post SD	Exp Post Mean	Exp Post SD	F	Sig.
Flexibility (cm)	20.88	2.96	18.97	2.35	22.38	2.53	22.07	2.10	3.30	0.07
Agility (sec)	12.12	1.07	12.44	1.32	10.35	1.15	10.75	1.29	1.38	0.25
Speed (sec)	5.43	0.55	5.57	0.63	4.41	0.46	4.57	0.56	1.25	0.27
Endurance 600m (min)	2.92	0.45	3.35	0.48	1.81	0.43	2.15	0.45	11.61	0.00**
Standing Jump(cm)	236.09	26.82	237.36	35.91	282.21	24.24	269.45	27.51	0.21	0.65
Vertical Jump (cm)	41.11	4.69	41.01	2.08	40.87	4.26	42.82	1.99	5.17	0.03*
Sit-ups(1min)	30.67	8.85	31.26	5.71	35.70	8.29	39.53	5.95	1.39	0.24
Right Handgrip (kg)	41.17	6.19	41.11	3.008	56.89	73.016*	43.503	3.42	0.98	0.33
Left Handgrip (kg)	39.71	5.27	38.37	3.25	41.09	5.21	39.59	3.28	1.59	0.21

Table 4.4 Analysis of kinematics data of football players

Variables	Control Pre Mean	Control Pre SD	Exp Pre Mean	Exp Pre SD	Control Post Mean	Control Post SD	Exp Post Mean	Exp Post SD	F	Sig.
Stride length (AP)	0.984	0.043	0.983	0.065	0.983	0.066	0.99	0.054	0.17	0.68
Right knee angle (AP)	171.43	2.81	170.63	13.26	167.56	2.8	159.33	22.13	13.3	0.00**
Left knee angle (AP)	173.8	2.63	175.12	23.08	172.78	3.07	168.69	11.89	26	0.00**
Left elbow angle (AP)	133.01	5.59	163.23	16.88	130.9	10.069	143.1	20.41	57	0.00**
Right elbow angle (AP)	124.96	10.94	136.14	20.89	122.56	5.47	123.35	5.48	6.33	0.02*
Stride length (FC)	0.944	0.062	0.867	0.152	0.965	0.065	0.911	0.142	6.77	0.01**
Right knee angle (FC)	171.5	2.969	171.55	20.82	172.76	2.566	172.16	2.55	7.08	0.01**
Left knee angle (FC)	171.67	2.237	168.36	21.6	173.16	2.068	160.52	15.56	18.8	0.00**
Left elbow angle (FC)	144.79	15.93	144.88	15.58	145.59	12.73	138.78	19.71	13.8	0.00**
Right elbow angle (FC)	139.72	17.27	138.43	17.64	135.32	10.509	126.86	20.49	16.8	0.00**
Stride length (FT)	0.728	0.124	0.8413	0.166	0.7307	0.1334	0.8087	0.175	8.91	0.00**
Right knee angle (FT)	170.73	3.44	169.81	5.839	169.87	3.78	168.86	4.14	1.14	0.29
Left knee angle (FT)	168.74	5.18	172.18	7.06	171.03	7.37	166.01	7.87	0.42	0.52
Left elbow angle (FT)	164.15	5.56	153.88	23.63	163.11	4.899	165.55	11.76	2.02	0.16
Right elbow angle (FT)	174.07	1.969	168.89	5.41	173.65	2.34	171.82	6.28	25.3	0.00**

Table 4.5 Analysis of performance data of football players

Variables	Control Pre Mean	Control Pre SD	Exp Pre Mean	Exp Pre SD	Control Post Mean	Control Post SD	Exp Post Mean	Exp Post SD	F	Sig.
Football accuracy	5.66	1.93	6.53	2.3	7.2	1.76	7.3	1.56	1.7	0.2
Football distance	41.6	11.3	40.66	10.12	46.16	8.49	46.36	9.26	0.03	0.87
Dribbling	18.14	0.817	18.09	0.669	18.59	0.606	22.01	18.3	1	0.32

Results and Discussion

Demographic homogeneity: Table 4.1 confirms no baseline difference in stature, body mass, age, ensuring internal validity.

Anthropometric adaptations: Table 4.2 shows significant reduction in triceps, biceps, abdominal skinfolds ($p<0.01$), indicating fat loss, and reduction in wrist, forearm, chest, calf, arm flexed/relaxed, hip girths, reflecting lean mass re-composition. Agility training stimulates lipolysis via high-intensity intermittent efforts (Bishop & Gonzalo-Skok, 2019). Similar reductions reported by Slimani et al. (2018).

Physical fitness: Table 4.3 indicates that there is considerable improvement in 600m endurance ($F=11.61$, $p<0.001$) and vertical jump ($F=5.17$, $p=0.03$). However, although there is improvement in agility and speed in terms of decreasing mean values (increasing in time) from 12.44 to 10.75 seconds and 5.57 to 4.57 seconds respectively, no significance is observed between groups ($p>0.05$), just like in the study by Jovanovic et al. (2011) where the SAQ improves short sprints without significance between groups.

Kinematics: Table 4.4 represents the main novel contribution. Notable differences in the AP

Phase: right knee angle was lowered from 170.63° to 159.33°, left knee from 175.12° to 168.69°, allowing better knee bend for approaching the ball. Left elbow angle was also lowered from 163.23° to 143.1°, helping in coordinating the arms and legs. FC phase: stride length was increased (from 0.867 to 0.911 m), right knee angle was kept close to 172°, left knee angle was lowered (168.36 to 160.52°), elbows were also lowered, which means better stability during the kick. FT phase: stride length was decreased (from 0.841 to 0.808), right elbow angle was increased (168.89 to 171.82°).

Skill performance: Accuracy went up from 6.53 to 7.3; distance went from 40.66 to 46.36 m, and time for dribbling paradoxically increased from 18.09 to 22.01 seconds, possibly due to error in measurement observed due to high SD of 18.3. The differences between groups were not statistically significant ($p>0.05$). This implies that 8 weeks is enough to develop kinematics and fitness skills to get good skill scores. Similar results have been found by Impellizzeri et al. (2013) in 9 weeks.

Conclusion

SAQ training program for a period of eight weeks remarkably enhances anthropometric parameters (subcutaneous fat reduction), physical fitness (endurance and vertical jump power), and kicking kinematics (stride length and joint angles) of male university and club footballers of Bahawalpur. Coaches need to implement agility training methods such as SAQ agility exercises, parachute running, reaction game exercises, and combination running three times a week. Further research should be conducted for a period of 12-16 weeks, involving women athletes along with GPS workload monitoring.

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