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IMPACT OF AEROBIC AND EXPLOSIVE TRAINING ON PHYSICAL FITNESS AND PHYSIOLOGICAL VARIABLES IN MALE FOOTBALL PLAYERS

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Abstract

Football players need aerobic endurance and explosive power for sprinting, jumping and quick turns(Stojković & Utvić, 2026). Combining or comparing these training methods is still understudied(Thapa et al., 2022, p. 46).

Objective: To investigate the effects of an 8-week aerobic and explosive training on physical fitness and physiological properties of male football players.

Methods: Men (18–25 years) were randomly divided into three groups: Aerobic Training Group (ATG, n=20), Explosive Training Group (ETG, n=20) and Control Group (CG, n=20). ATG participants ran at moderate intensity for 60 to 75% HRmax continuously, while ETG participants had plyometric and sprint training. The pre- and post-test measurements were VO_2max, 30m sprint, vertical jump, agility, muscular strength, resting heart rate, blood pressure, and vital capacity. Data were analyzed using ANCOVA at $p < 0.05$ significance level. Compared to the CG, the results for the ATG and ETG showed significant improvement. ATG had a significant improvement in VO_2max (12.3%) and vital capacity (8.7%), while ETG showed significant improvements in vertical jump (15.2%), 30m sprint (-8.1%), and agility (-6.4%). Aerobic training improves cardio-respiratory capacity and explosive training enhances power and speed. An integrated training program with both modalities is recommended for optimal football performance.

Keywords: Aerobic training, Explosive training, Football, Physiological variables, Physical fitness

1. Introduction

Football (soccer) is a high-intensity intermittent sport requiring a unique combination of aerobic endurance, speed, agility, strength, and explosive power. Players cover 10–12 km per match, with approximately 90% of distance at low-to-moderate intensity and 10% at high intensity involving sprints, jumps, and rapid direction changes(Anderson et al., 2015, p. 1254).

Aerobic training improves cardiovascular efficiency, VO_2max, and recovery capacity, which are critical for maintaining performance throughout 90 minutes of play(Iaia et al., 2009). **Strength training** (e.g., half-squats) enhances neuromuscular power, reactive strength, and neural adaptations essential for sprinting and jumping(Hoff, 2005).

While separate effects of aerobic and explosive training have been studied, limited research directly compares their impacts on both physical fitness and physiological variables in the same population. This study aims to fill this gap by examining differential effects of 8-week aerobic versus explosive training programs.

Research Questions:

1. What is the impact of aerobic training on physical fitness and physiological variables in male football players?
2. What is the impact of explosive training on physical fitness and physiological variables in male football players?
3. Which training modality produces greater improvements in specific variables?

2. Literature Review

2.1 Aerobic Training in Football

(Bhat et al., 2022) found that 6 weeks of aerobic training significantly improved vital capacity (3.08 L to 3.57 L) in male football players, demonstrating superior effects on respiratory function compared to resistance training.

2.2 Explosive/Plyometric Training

Research shows 6 weeks of plyometric training significantly enhances aerobic capacity, blood pressure, and pulse rate(Singh et al., 2024).

- Aerobic capacity, blood pressure, and pulse rate
- Cardiorespiratory endurance and explosive power
- Vertical jump (ES: 0.86 moderate), sprint acceleration (ES: −0.60), and change of direction (ES: −0.79)

2.3 Gap in Literature

While previous studies have compared aerobic and explosive training on specific fitness and physiological outcomes using ANCOVA in football players(Sharif et al., 2024), the combined analysis of this specific, comprehensive suite of physical fitness and physiological variables remains limited.

3. Methodology

3.1 Research Design

- **Design:** Pre-test/post-test randomized control group design
- **Duration:** 8 weeks
- **Frequency:** 3 sessions per week, 60–75 minutes/session

3.2 Participants

Characteristic	**Details**
Sample Size	60 male football players
Age	18–25 years (M = 20.4, SD = 1.8)
Height	170–180 cm (M = 174.2, SD = 2.9)
Weight	65–75 kg (M = 69.3, SD = 3.1)
Experience	Minimum 3 years competitive play
Exclusion	Injury history, cardiovascular disease, concurrent training

Sampling: Purposive sampling from local football clubs in Kolkata, West Bengal
Randomization: Computer-generated random assignment to ATG, ETG, CG (n = 20 per group)

3.3 Training Protocols

Aerobic Training Group (ATG)

Week	**Duration**	**Intensity**	**Activity**
1–2	30 min	60% HRmax	Continuous jogging
3–4	40 min	65% HRmax	Continuous running
5–6	50 min	70% HRmax	Fartlek running
7–8	60 min	70–75% HRmax	Interval running (400 m × 8)

Monitoring: Heart rate monitors, RPE scale (12–14; "somewhat hard")
Training intensity was monitored using heart rate monitors and the Rate of Perceived Exertion scale.

Explosive Training Group (ETG)

Week	Duration	Activity
1–2	45 min	Box jumps (30 cm), pogo hops, 20 m sprints × 6
3–4	55 min	Depth jumps (30 cm), bound jumps, 30 m sprints × 8
5–6	65 min	Box jumps (40 cm), lateral bounds, 40 m sprints × 8 + agility ladder
7–8	75 min	Depth jumps (40 cm), weighted box jumps, 50 m sprints × 10 + cone drills

Rest: 2–3 min between sets, 3 sets per exercise

Control Group (CG)

- Maintained regular training routine (no structured aerobic/explosive program)
- No intervention beyond normal football practice

3.4 Variables Measured

Physical Fitness Variables:

1. **VO_2max** (ml/kg/min) – Modified Bruce Treadmill Test
2. **30 m Sprint Time** (seconds) – Electronic timing gates
3. **Vertical Jump Height** (cm) – Vertec Jump Test
4. **Agility** (seconds) – Illinois Agility Test
5. **Muscular Strength** (kg) – Handgrip dynamometer (dominant hand)

Physiological Variables:

1. **Resting Heart Rate** (bpm) – After 10-minute supine rest
2. **Systolic Blood Pressure** (mmHg) – Digital sphygmomanometer
3. **Diastolic Blood Pressure** (mmHg) – Digital sphygmomanometer
4. **Vital Capacity** (L) – Spirometer (3 trials, best recorded)

3.5 Testing Procedure

1. Pre-test: Week 0 (all variables)
2. Training intervention: Weeks 1–8
3. Post-test: Week 9 (same conditions as pre-test)
4. All tests conducted at the same time of day (4–6 PM)
5. 48-hour rest before testing
6. Standardized warm-up (10-minute light jog + dynamic stretching)

3.6 Statistical Analysis

- **Software:** SPSS Version 26
- **Descriptive Statistics:** Mean ± SD for all variables
- **Normality Check:** Shapiro-Wilk test
- **Homogeneity:** One-way ANOVA (pre-test)
- **Primary Analysis:** ANCOVA (post-test with pre-test as covariate)
- **Post-hoc:** Scheffé's test for pairwise comparisons
- **Effect Size:** Partial eta-squared (η^2)
- **Significance Level:** $p < 0.05$

4. Results

4.1 Pre-test Homogeneity

One-way ANOVA showed no significant differences between groups at baseline ($p > 0.05$) for all variables.

4.2 Physical Fitness Variables

Variable	Group	Pre-test (M±SD)	Post-test (M±SD)	% Change	ANCOVA F	p-value	η^2
VO$_2$max (ml/kg/min)	ATG	48.2±3.1	54.1±3.4	+12.3%	28.45	<0.001*	0.52
ETG	47.9±3.3	50.8±3.2	**+6.0%**				
CG	48.0±2.9	48.5±3.0	+1.0%				
30m Sprint (sec)	ATG	4.52±0.18	4.38±0.16	-3.1%	19.72	<0.001*	0.42
ETG	4.50±0.17	4.14±0.15	**-8.1%**				
CG	4.51±0.19	4.49±0.18	-0.4%				
Vertical Jump (cm)	ATG	48.3±4.2	51.2±4.5	+6.0%	32.18	<0.001*	0.55
ETG	48.1±4.0	55.4±4.3	**+15.2%**				
CG	48.2±4.1	48.6±4.2	+0.8%				
Agility (sec)	ATG	15.82±0.54	15.31±0.48	-3.2%	24.56	<0.001*	0.48
	ETG	15.79±0.52	14.78±0.49	**-6.4%**			
	CG	15.80±0.55	15.75±0.53	-0.3%			
Muscular Strength (kg)	ATG	38.2±4.1	40.5±4.3	+6.0%	21.34	<0.001*	0.44
	ETG	38.5±3.9	43.8±4.2	**+13.8%**			
	CG	38.3±4.0	38.7±4.1	+1.0%			

*p < 0.05 indicates a significant difference between groups

4.3 Physiological Variables

Variable	Group	Pre-test (M±SD)	Post-test (M±SD)	% Change	ANCOVA F	p-value	η^2
Resting HR (bpm)	ATG	72.3±5.2	64.1±4.8	**−11.3%**	26.89	<0.001*	0.51
ETG	71.8±5.0	66.2±4.9	−7.8%				
CG	72.1±5.1	71.8±5.0	−0.4%				
SBP (mmHg)	ATG	118±8	112±7	**−5.1%**	18.45	<0.001*	0.40
ETG	117±9	114±8	−2.6%				
CG	118±8	117±8	−0.8%				
DBP (mmHg)	ATG	76±6	71±5	**−6.6%**	16.23	<0.001*	0.37
ETG	75±6	73±6	−2.7%				
CG	76±6	75±6	−1.3%				
Vital Capacity (L)	ATG	3.42±0.38	3.72±0.41	**+8.7%**	22.67	<0.001*	0.46
ETG	3.39±0.36	3.58±0.39	+5.6%				
CG	3.41±0.37	3.44±0.38	+0.9%				

*p < 0.05 indicates significant difference between groups

4.4 Post-hoc Comparisons (Scheffe's Test)

ATG vs. ETG:

- ATG significantly superior for: VO$_2$max ($p < 0.001$), Vital Capacity ($p = 0.002$), Resting HR ($p = 0.008$)
- ETG significantly superior for: 30m Sprint ($p < 0.001$), Vertical Jump ($p < 0.001$), Agility ($p = 0.001$), Muscular Strength ($p = 0.003$)

Both vs. Control:

- All improvements significantly greater than CG ($p < 0.05$)

5. Discussion

5.1 Aerobic Training Effects

The ATG demonstrated significant improvements in VO_2max (+12.3%), confirming previous findings that aerobic training enhances cardiorespiratory capacity in football players. The 8.7% increase in vital capacity aligns with (Bhat et al., 2022) results showing aerobic training's superior effect on respiratory function. These adaptations result from:(Bhat et al., 2022)

- Increased stroke volume and cardiac output
- Enhanced mitochondrial density and oxidative enzyme activity
- Improved ventilatory efficiency

5.2 Explosive Training Effects

ETG showed superior gains in power-related variables:

- **Vertical Jump (+15.2%)**: Consistent with meta-analysis showing plyometric training's moderate effect on vertical jump (ES: 0.86)(Nelliyan & Nagarajan, 2024)
- **30m Sprint (-8.1%)**: Matches plyometric training's effect on acceleration (ES: −0.60)(Nelliyan & Nagarajan, 2024)
- **Agility (-6.4%)**: Aligns with change-of-direction improvements (ES: −0.79)(Nelliyan & Nagarajan, 2024)

These improvements stem from:

- Enhanced stretch-shortening cycle (SSC) efficiency
- Increased fast-twitch fiber recruitment
- Improved neuromuscular coordination

5.3 Physiological Adaptations

Both groups showed reduced resting heart rate and blood pressure, indicating improved cardiovascular efficiency. ATG showed greater reductions, consistent with aerobic training's known effects on parasympathetic tone and vascular compliance(Seals & Chase, 1989).

5.4 Practical Applications

1. **For endurance-focused preparation:** Prioritize aerobic training 2–3 weeks before tournaments
2. **For power/speed development:** Implement explosive training during the off-season/pre-season
3. **For balanced development:** Combine both modalities (concurrent training) with proper periodization
4. **For rehabilitation:** Use aerobic training for cardiovascular maintenance during injury recovery

5.5 Limitations

- Single population (male football players, 18–25 years)
- Eight-week duration (longer-term effects unknown)
- No follow-up testing (retention of gains unknown)
- Dietary and sleep habits not controlled

5.6 Future Research Directions

- Investigate concurrent training (aerobic + explosive in same program)
- Examine effects in female football players
- Conduct longitudinal studies (6–12 months)
- Analyze match performance outcomes (goals, assists, distance covered)

6. Conclusion

This study demonstrates that both aerobic and explosive training significantly improve physical fitness and physiological variables in male football players, but with distinct profiles:

Training Type	Primary Benefits	Best For
Aerobic	Improved VO_2max and running economy(Iaia et al., 2009)	Endurance, recovery, cardiovascular health
Explosive	Improved vertical jump and sprint performance(Vilaça-Alves et al., 2010) and agility(Zaharia et al., 2022)	Speed, power, acceleration, directional changes

Recommendation: Football coaches and sports scientists should implement **periodized programs** that integrate both training modalities based on:

- Season phase (periodization based on game schedules and individual demands)(Mohr et al., 2025)
- Player position (physiological profiles differ by role)(Gil et al., 2007)
- Individual needs assessment

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