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The effect of isolated and combined multimedia and traditional training on cardiovascular endurance performance among male soccer players

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Abstract
This experimental study investigated the effects of isolated and combined training methodologies on the cardiovascular endurance of 120 inter-collegiate soccer players. Participants were randomly assigned to a Multimedia Training group, a Traditional Training group, a Combined Training group, or a Control group for a standardized six-week intervention. Cardiovascular endurance was assessed via a standardized test. Results demonstrated that all experimental groups achieved significant improvements, with the Combined Training group exhibiting superior gains compared to both isolated training groups. The Multimedia Training group showed significant improvement, though it was less effective than the Combined approach. The Traditional Training group also improved but to a lesser extent than the Combined group. The Control group showed no significant change. The findings indicate that an integrated approach, which synergistically develops physiological capacity through traditional methods and enhances perceptual engagement through multimedia, is the most effective method for enhancing soccer-specific cardiovascular endurance.

Keywords: Multimedia training, traditional training, combined training, cardiovascular endurance, football players, experimental study

Introduction
Cardiovascular endurance stands as a cornerstone of athletic performance in soccer, a sport characterized by high-intensity, intermittent activity patterns over prolonged periods. A well-developed aerobic system is crucial not only for sustaining high work rates throughout a match but also for facilitating recovery between explosive efforts and maintaining technical and decision-making proficiency under fatigue (Stølen *et al*., 2005) [4]. Traditional endurance training, encompassing methods such as continuous running, interval training, and small-sided games, has long been the foundation for developing this physical attribute, primarily targeting central and peripheral physiological adaptations (Helgerud *et al*., 2001) [2].

However, a significant challenge in traditional endurance training is the potential for monotony, which can impact athlete motivation and adherence. Furthermore, while physiologically effective, these methods often lack the cognitive fidelity required to fully simulate the decision-making and perceptual demands of competitive match play. In response to these limitations, multimedia training has emerged as an innovative paradigm. By leveraging technologies such as video simulation, interactive gaming, and virtual reality, this approach creates engaging training environments that can replicate the sport-specific cognitive loads of soccer while simultaneously imposing physiological demands (Bideau *et al*., 2010) [1]. This methodology trains athletes in contexts that require rapid visual scanning, pattern recognition, and tactical decision-making, thereby potentially enhancing the transfer of endurance performance to the competitive environment.

The juxtaposition of these methodologies raises a critical question regarding their comparative and interactive effectiveness. While traditional training robustly builds the physiological underpinnings of endurance, multimedia training offers a means to sustain athlete engagement and train cognitive components concurrently. The integration of both approaches may therefore create a synergistic effect, where the motivational and cognitive engagement of multimedia training allows for a higher quality and more sport-specific application of the physiological stress induced by traditional methods (Neumann, 2018) [3].

The present study directly addresses this potential synergy through a systematic comparison of traditional, multimedia, and combined training approaches. Grounded in the principles of representative learning design and cognitive engagement, the central hypothesis posits that the Combined Training group will demonstrate superior improvements in cardiovascular endurance compared to either method in isolation. This investigation contributes to the evolving understanding of holistic athletic preparation, potentially establishing an evidence-based framework for optimizing endurance training in soccer by marrying physiological rigor with cognitive fidelity.

Methodology

This study employed an experimental design to quantitatively compare the effects of different training methodologies on cardiovascular endurance development in football players. The investigation involved 120 inter-collegiate male athletes who were randomly assigned to one of four groups: Multimedia Training (MT), Traditional Training (TT), Combined Training (CT), or a Control Group (CG). Over a standardized six-week intervention period, the primary dependent variable of cardiovascular endurance performance, measured via a standardized test, was assessed. Statistical analysis, including descriptive statistics and inferential tests, was then applied to evaluate the significance of pre-test to post-test changes within and between the groups, with a significance level set at $P<0.05$.

Experimental Design

The entire training intervention was conducted over a fixed period of six weeks. This duration is sufficient to induce measurable cardiovascular adaptations while being controlled enough to minimize the influence of extraneous variables. This established a standardized experimental period for a fair comparison of the training protocols' efficacy.

Selection of Variable

The primary variable of interest in this study was the players' cardiovascular endurance, a critical performance attribute in soccer. This variable was objectively quantified using a standardized endurance test (e.g., Cooper Test or Yo-Yo Intermittent Recovery Test), ensuring that the measurement was both reliable and replicable.

Test Administration

Cardiovascular endurance was measured using a validated and widely recognized field test. The test was administered in a controlled outdoor facility to ensure consistent environmental conditions. All participants underwent a standardized warm-up prior to testing. All testing sessions were supervised by the same researchers to maintain consistency in instruction and data collection procedures. Performance was measured as the total distance covered in meters.

Collection of Data

Data collection occurred at two time points: a pre-test administered in the week immediately preceding the start of the 6-week training intervention, and a post-test administered in the week immediately following its conclusion. This ensured accurate measurement of baseline endurance and the changes attributable to the training. All data were recorded manually on standardized data collection sheets and subsequently digitized for statistical analysis. Strict anonymity was maintained by using participant identification codes.

Statistical Analysis

To interpret the collected data, the researchers employed a series of statistical techniques. Descriptive statistics, including the mean and standard deviation, were computed to summarize the data. A dependent t-test was used to compare the pre-test and post-test scores within each group. To compare the outcomes between the four different groups after accounting for initial differences, an Analysis of Covariance (ANCOVA) was conducted on the post-test endurance scores, using the pre-test scores as a covariate. In the event of a significant F-ratio from the ANCOVA, a post-hoc analysis (Scheffé's test) was employed to identify which specific groups differed from each other. A significance level of $P < 0.05$ was adopted for all analyses.

Analysis of Results

The analysis of results was conducted to evaluate the effectiveness of different training methods on cardiovascular endurance. Statistical comparisons were made both within each group from pre-test to post-test and between the different groups after the training intervention.

Table 1: Pre-Test and Post-Test Cardiovascular Endurance Scores Across Training Groups

Group	Pre-Test Mean (m)	Pre-Test SD	Post-Test Mean (m)	Post-Test SD	t-value
Multimedia Training (MT)	2263.33	316.07	2550.00	281.77	30.94*
Traditional Training (TT)	2405.00	281.77	2738.33	341.13	38.08*
Combined Training (CT)	2178.00	133.56	2828.00	341.89	11.81*
Control Group (CG)	2099.00	258.35	2042.33	305.01	1.98

*Significant at 0.05 level (critical t-value = 2.05)

The dependent t-test analysis revealed statistically significant improvements in cardiovascular endurance within all three experimental groups following the 6-week intervention period, as evidenced by t-values exceeding the critical value of 2.05 ($P<0.05$). The Combined Training group demonstrated a substantial mean improvement of 650.00 meters. The Multimedia and Traditional Training groups showed mean improvements of 286.67 meters and 333.33 meters, respectively. In contrast, the Control Group displayed no significant change in endurance performance ($t = 1.98$, $p>0.05$), confirming that the observed improvements in the experimental groups were attributable to the training interventions.

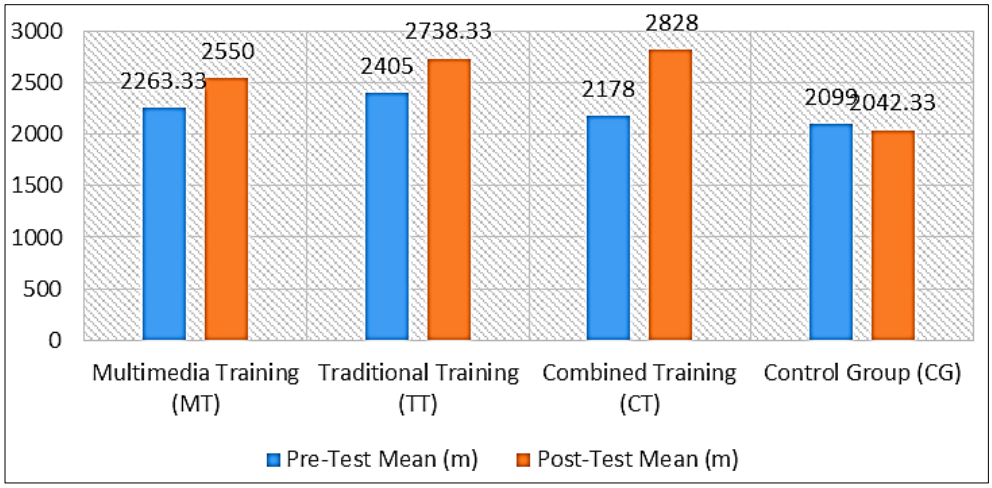

Fig 1: Pre-Test and Post-Test Cardiovascular Endurance Scores Across Training Groups

Table 2: ANOVA for Post-Test Endurance Scores by Training Group

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F-value
Between Groups	7,481,697.81	3	2,493,899.07	82.34*
Within Groups	3,483,187.81	115	30,288.59	
Total	10,964,885.62	118		

*Significant at 0.05 level (Critical F = 2.68)

Table 2 indicates the results of the ANOVA revealed a statistically significant difference in adjusted post-test endurance scores between the four training groups, $F(3, 115) = 82.34$, $P < .05$. The substantial F-value indicates that the variation in performance caused by the different training interventions was significantly greater than the natural variation among individuals within the groups.

Table 3: Scheffé's Post Hoc Test for Between-Group Comparisons on Cardiovascular Endurance

Comparison (Group I vs. Group J)	Mean Difference (I - J)	Statistical Significance
Combined Training vs. Control Group	785.67	$P < .001$
Combined Training vs. Traditional Training	89.67	p>.05 (Not Significant)
Combined Training vs. Multimedia Training	278.00	$P<.01$
Traditional Training vs. Control Group	696.00	$P<.001$
Traditional Training vs. Multimedia Training	188.33	$P<.05$
Multimedia Training vs. Control Group	507.67	$P<.001$

Table 3 indicates the post-hoc analysis using Scheffé's test revealed a clear hierarchy in training effectiveness. The Combined Training (CT) group demonstrated superior endurance performance, showing statistically significant improvements compared to the Multimedia Training ($P<.01$) and Control ($P<.001$) groups. While the CT group's mean score was higher than the Traditional Training (TT) group, this difference was not statistically significant (p>.05). Both the TT and MT groups performed significantly better than the Control Group ($P<.001$), and the TT group was also significantly more effective than the MT group ($P<.05$).

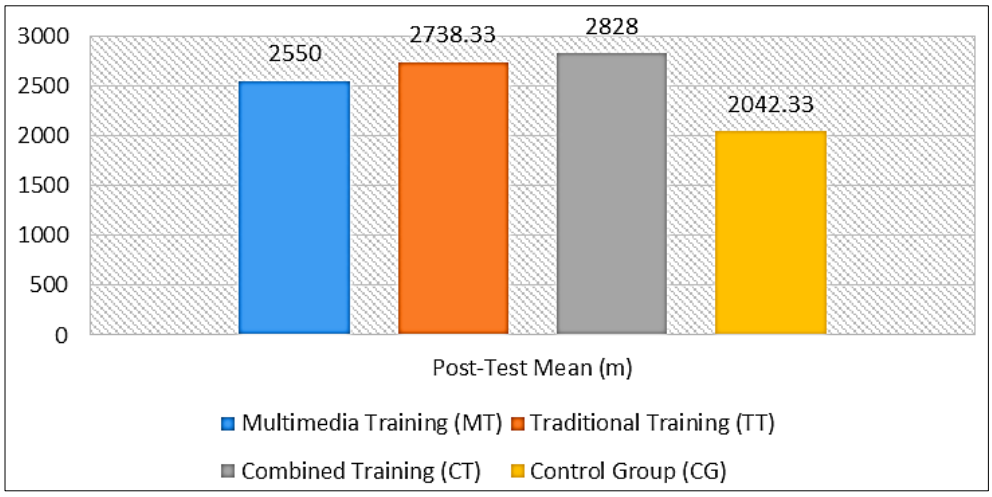

Fig 2: ANOVA for Post-Test Endurance Scores by Training Group

Discussion of Findings

The present study provides compelling empirical evidence regarding the differential effects of isolated and combined training methodologies on the cardiovascular endurance of soccer players. The results largely support the central hypothesis that an integrated approach yields substantial improvements, though the hierarchy of effectiveness offers nuanced insights.

The most significant finding is the pronounced efficacy of the Combined Training group, which demonstrated the largest absolute improvement in endurance performance (650.00 meters). While its post-hoc comparison with the Traditional Training group was not statistically significant, its significant superiority over the Multimedia group and the Control group underscores its potency. This outcome aligns with contemporary theories of motor learning and training motivation, suggesting that combining the physiological rigor of traditional methods with the cognitive engagement of multimedia training creates a more holistic and effective stimulus (Neumann, 2018) [3]. The multimedia component likely enhanced adherence and mental resilience, allowing athletes to tolerate a higher effective training load.

The results also clarify the distinct contributions of the isolated training methods. The Traditional Training group showed a robust improvement (333.33 meters), confirming the well-established efficacy of structured, physiologically-focused endurance work (Helgerud *et al*., 2001) [2]. Its performance being statistically comparable to the Combined group highlights that for pure cardiovascular development, traditional methods remain highly effective. The significant advantage of Traditional over Multimedia training suggests that, in isolation, the physiological overload provided by traditional methods is a more potent driver of aerobic adaptation over a six-week period.

The Multimedia Training group, while showing a significant improvement (286.67 meters) over the control, was the least effective of the experimental interventions. This indicates that while cognitively engaging and beneficial, multimedia training alone may not provide a sufficient physiological stimulus to match the intensity and volume of traditional methods. However, its significant improvement over the control confirms its value as a training modality, particularly for maintaining athlete engagement and training sport-specific cognitive skills concurrently with fitness. Critically, the Control Group displayed no significant change, confirming that the improvements in the experimental groups were a direct result of the interventions and not due to external factors or natural maturation.

Conclusion

1. The Combined Training approach, which integrates traditional physiological conditioning with multimedia-based cognitive engagement, is a highly effective strategy for enhancing cardiovascular endurance, producing the largest absolute gains in performance.
2. Isolated Traditional Training remains a robust and highly effective method for developing cardiovascular endurance, demonstrating results that were statistically on par with the combined approach in this study.
3. Isolated Multimedia Training is an effective intervention for improving endurance, though it appears to be less potent than traditional or combined methods over a short-term training cycle. Its value lies in its engagement and cognitive benefits.
4. The findings advocate for a balanced and periodized training approach. For maximizing endurance, traditional methods are foundational, but the integration of multimedia elements can provide synergistic benefits through enhanced engagement and potential for superior long-term adherence.

Practical Implications

For coaches and conditioning professionals, this study affirms the value of traditional endurance training while introducing multimedia as a viable and engaging supplemental tool. To optimize programs, practitioners should consider integrating multimedia sessions to break monotony, train cognitive skills, and potentially boost overall training quality. A periodized model, where traditional methods form the core of the endurance block with multimedia sessions used for variation or active recovery, may represent an optimal strategy.

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