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Efficacy of metabolic based sports specific skill training on selected physiological variables of school level boys soccer players

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Abstract
Soccer is one of the most attractive and pleasant sports, attracting children of all ages to participate. However, at the initial stages, many young players experience fear of injury and frustration due to improper techniques or a lack of fundamental skills (Sharma *et al*., 2007). In light of this, the present study intended to observe the effect of incorporating metabolic based sports specific skill training (MBSSST) on selected physiological variables among soccer players. A total of 30 soccer players from the various academy in Coimbatore district and aged between 14 to18 years, were selected as participants. The subjects were randomly assigned to two equal groups (n = 15): Group I underwent metabolic based sports specific skill training (MBSSST), while Group II served as the control group (CG). The experimental group participated in the training program three days per week over a period of 8 weeks, whereas the control group maintained their routine daily activities without additional training. Data were analyzed using the paired sample t-test, with the significance level set at 0.05. The findings demonstrated that the MBSSST intervention led to notable improvements in vo2 max and vital capacity performance among the school level boys soccer players. These results suggest that integrating metabolic based spots specific skill training can significantly enhance specific physiological abilities at the school level players. The study was conducted while considering factors such as diet, climate, lifestyle, and prior training experience as limitations. Overall, the findings align with previous research, supporting the conclusion that metabolic based spots specific skill training effectively develops vo2 max and vital capacity in soccer players.

Keywords: Metabolic based sports specific skill training, Vo2 Max, vital capacity, physiological and school level soccer players

Introduction

Soccer is one of the trendiest sports in the world in terms of spectator sports and players participation. It's presto, quick aggressive and seductive. It is considered a emphatic game because the game demands a high degree of fitness as well as intelligence and alertness of mind, speed, strength, capability, balance and inflexibility are the introductory rates for all the elite players (Moud Musher Rink, 1987).

Metabolic-based sport-specific skill training has become an essential component of modern football conditioning, as the sport requires continuous, intermittent, and high-intensity activity that places significant demands on both aerobic and anaerobic energy systems. Football players must repeatedly perform explosive actions—such as sprinting, tackling, accelerating, decelerating, and rapid changes of direction—while also maintaining technical proficiency under fatigue. Because match performance relies heavily on energy availability, particularly glycogen stores and oxygen delivery to working muscles, metabolic conditioning directly influences players' technical, tactical, and physical efficiency throughout a match (Stølen *et al*., 2005).

Elite footballers typically sustain high metabolic stress during competition, operating at approximately 75–80% of VO_2 max and spending 5–15% of total match time in high-intensity actions (Mohr *et al*., 2003) [7]. As fatigue accumulates, reductions in sprint frequency, running velocity, and technical precision often occur, largely due to glycogen depletion and increased lactate accumulation (Bangsbo, 2014). Integrating metabolic-specific training with football-specific skills such as dribbling, passing, pressing, and shooting—prepares players to perform these actions effectively under physiological fatigue, thereby improving match realism and performance transfer. Research demonstrates that well-structured metabolic training enhances aerobic capacity, anaerobic power, lactate threshold, and recovery ability, all of which contribute to improved match running performance and technical output (Iaia et., 2010). Therefore, metabolic-based skill training is considered a critical component of football fitness development, enabling players to sustain high-intensity technical actions, improve tactical responsiveness, and maintain performance consistency across the full duration of the match.

Methodology

The study drawn in thirty school level football players whose ages ranged from 14 to 18 years were selected from various academy in the Coimbatore District to take part in the study, and all participants provided valid data for assessing the effect of metabolic based sports Specific skill training (MBSSST).The participants were randomly assigned into two equal groups: the MBSSST training group

(n = 15) and the Control Group (CG) (n = 15). The experimental group participated in the MBSSST intervention three times a week (on Monday, Wednesday, and Friday) over a period of 8 weeks, while the control group did not undergo any additional training apart from their regular daily activities.
The study evaluated the following physiological variables

1	VO_2 max Max (Kg/Litres): measured using the Cooper Vo2 Max Test
2	Vital Capacity (Litres): assessed through the Wet Spirometer Test

Both pre-test and post-test assessments were conducted to evaluate changes after 8 weeks of intervention. The training intensity for the experimental group was gradually increased every two weeks according to the participants' progress and adaptability.

Preparation Programme
The training program was showed for duration of 8 weeks, with sessions held three times per week on Monday, Wednesday, and Friday. Each session lasted for 90 minutes, consisting of a 10-minute warm-up, 60-70 minutes of (Metabolic Based Sports Specific Skill Training), and a 10-minute cool-down period. The schedule was designed to ensure consistent participation and metabolic based sports specific skill training intensity across all sessions throughout the intervention period.

Metabolic Based Sports Specific Skill Training Schedule for School Level Boys Football Players

Training week	Name of the Exercises	Sets & Repetition	Intensity
I to II (Phase: 1 - Aerobic Base + Fundamental Skills)	Continuous Jogging Passing Squares (low intensity) Dribbling Cones (long set) Wall Pass Repetitions Technical Ball Mastery Circuit 1v1 Light Shadow Defending	2X5 2x5 2x5 2x5 2x5 2x5	75%
III to IV (Phase – II Aerobic + Technique Conditioning)	Tempo Runs Dribble–Pass–Move Circuit First Touch Ladder Drills Rondo (4v1) Aerobic Small-Sided Game (6v6, large area) Shooting Technique Reps Defensive Footwork Lines	3x6 3x6 3x6 3x6 3x6 3x6 3x6	80 %
V to VI (Phase – III Aerobic-Anaerobic Transition)	Fartlek Runs High-Repetition Passing Gates Dribble Speed Slaloms Rondo (5v2) Crossing & Finishing Circuit Progressive 1v1 Attacking Transition Play (Attack to Defense)	3x7 3x7 3x7 3x7 3x7 3x7 3x7	85%
VII to VIII (Phase IV Competition Simulation + Taper Short Sprint Sets)	Short Sprint Sets Ball Mastery Circuit (high speed, low volume) 7v7 Match Simulation Quick Combination Finishing Light Rondo (4v1) Set-Piece Rehearsal Light Technical Passing	3x6 3x6 3x6 3x6 3x6 3x6 3x6 3x6 3x6	80%

Numerical Analysis
The data collected on vo_2 max and vital capacity as a result of the MBSSST were statistically analyzed using the paired sample "t" test to determine Whether significant differences existed between the pre-test and post-test results. In all analyses, the level of significance was set at 0.05 ($p < 0.05$) to assess the statistical reliability of the findings.

Table 1: Totaling of 'T' Ratio on Vo_2 Max of Football Players on Investigational and Regulator Groups

Group	Test		Mean	Std. Deviation	T ratio
Vo_2 Max	Experimental Group	Pre test	42.52	1.86	15.43*
		Post test	45.64	1.19	
	Control Group	Pre test	42.44	0.84	0.59
		Post test	42.36	0.76	

*significant level 0.05 level (degree of freedom 2.14, 1 and 14)
(Scores in Kg/ml/Lit)

Table I presents the calculated mean, standard deviation, and't' ratio for vo_2 max in the experimental group. The obtained't' value for vo_2 max was 15.43, while the critical table value for the degrees of freedom (DF = 14) at the 0.05 level of significance was 2.14. Since the obtained't' value exceeded the table value, the result was found to be statistically significant, indicating a meaningful improvement in vo_2 max for the experimental group.
In contrast, the control group recorded a't' value of 0.59, which was less than the table value of 2.14, and therefore, the result was found to be statistically insignificant.

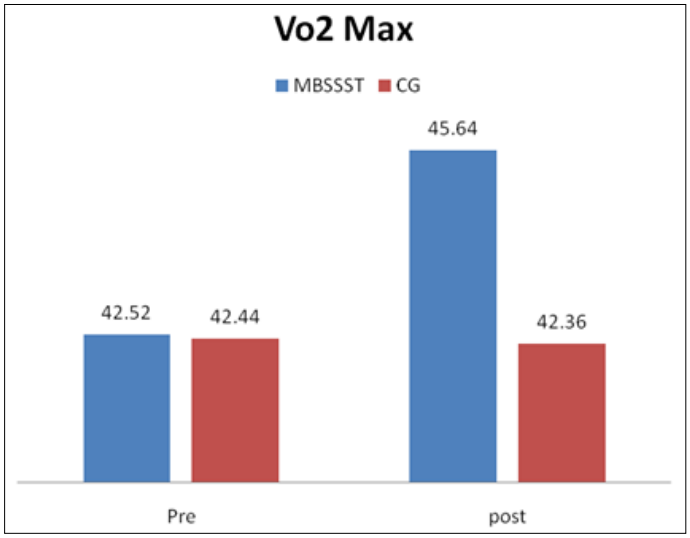

Fig 1: Bar Diagram Showing the Mean Value Vo_2 Max of Football Players On Investigational and Regulator Groups

Table 2: Multiplication of 'T' Ratio on Vital Capacity of Football Players on Investigational and Regulator Groups

Group	Test		Mean	Std. Deviation	T ratio
Vital Capacity	Experimental Group	Pre test	3.35	0.15	10.16*
		Post test	3.61	0.13	
	Control Group	Pre test	3.36	0.10	0.69
		Post test	3.37	0.14	

*significant level 0.05 level (degree of freedom 2.14, 1 and 14)
(Scores in Litres)

Table II displays the computed mean, standard deviation, and't' ratio for vital capacity in the experimental group. The obtained't' value for vital capacity was 10.16, whereas the critical table value for degrees of freedom (DF = 14) at the 0.05 level of significance was 2.14. Since the obtained't' value was substantially greater than the table value, the difference between the pre-test and post-test scores of the experimental group was determined to be statistically significant, signifying a notable improvement in vital capacity development as a result of the intervention.

Conversely, the control group achieved a't' value of 0.69, which was lower than the table value (2.14), indicating that there was no significant difference in personality scores for participants who did not undergo the MBSSST program.

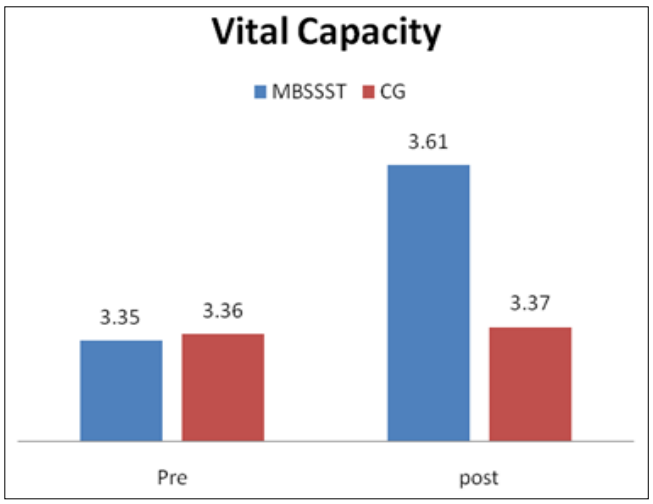

Fig 2: Tablet Figure Display the Mean Value on Vital Capacity of Football Players On Investigational and Regulator Groups

Discussion on Findings

Football performance is influenced by a wide range of factors, with technical proficiency and endurance capacity being two of the most critical for success during matches. If these two components can be trained simultaneously through metabolic based soccer-specific drills or games, it would allow for a more efficient use of training time and physiological effort.

Working muscle oxygen deficiency is believed to regulate the metabolic adjustments that contribute to the depletion of muscle glycogen stores and the reduction in glycolytic enzyme activity. These changes are considered major factors responsible for the decline in performance efficiency and the onset of muscular fatigue (Gabrys *et al*., 2020) [2]. Elite soccer players typically demonstrate VO_2 max values between 50 and 75mL/kg/min, with some exceeding 70mL/kg/min (Edwards *et al*., 2012) [3].

During official matches, professional players generally perform at 80–90% of their maximum heart rate, equivalent to approximately 75–80% of VO_2max (Åstrand *et al*., 2013). Enhancing VO_2 max has been shown to improve players' tactical and technical output by roughly 7%, leading to more effective ball interactions and an increased number of longer sprints—factors that raise the probability of scoring (Angoorani *et al*., 2021) [5]. Research also indicates that top-ranked football teams possess higher VO_2 max levels than lower-performing teams (Redkva *et al*., 2018) [6], highlighting cardio respiratory efficiency as a key component of physical preparedness (Guglielmo *et al*., 2005).

Match running performance (MRP) has drawn considerable scientific attention in recent years (Mohr *et al*., 2003) [7]. Professional players typically cover 9–14 km per match,

with 5–15% of that distance completed at high intensity (Modric *et al*., 2023) [9]. Energy expenditure during a game is influenced by two main factors: locomotion patterns and ball-control actions. Forward running demands less energy compared to backward or lateral movements (Stølen *et al*., 2005). As matches progress, players commonly experience decreases in running speed, sprint frequency, and distance covered at maximal velocity, particularly in the latter stages (Lattier *et al*., 2004) [12].

This decline has been linked to substantial reductions in muscle glycogen levels as the game advances, a finding supported by elevated blood lactate concentrations observed late in matches (Stanula *et al*., 2013) [13]. Efficient lactate clearance becomes increasingly important because it influences how rapidly fatigue develops (Tønnessen *et al*., 2013). Muscle oxygen deficiency appears to play a regulatory role in these metabolic disturbances by accelerating glycogen depletion and suppressing glycolytic enzyme activity. A higher lactate threshold allows players to sustain greater intensities without excessive lactate buildup, thereby delaying fatigue (Stanula *et al*., 2013) [13].

The findings of the present study are consistent with these earlier works, revealing that Metabolic based sports specific skill Training resulted in greater improvements in vo2 max and vital capacity performance. These outcomes support the notion that integrating both training models provides a comprehensive approach to developing both technical precision and dynamic control in football performance.

Conclusions

Within the confines and delimitations of the present study, and based on the results obtained,

It was concluded that an eight weeks of Metabolic Based Sports Specific Skill Training (MBSSST) program twisted significant improvements in selected Physiological variables specifically changes on Vo2 Max and Vital Capacity among football players when compared with the control group.

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