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Effect of maximum strength training on the football skills of elite male players

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Abstract
Purpose: This study sought to explore how maximum strength training affected elite male football players' ability to dribble, trap, pass, and kick, among other essential football skills. It was anticipated that targeted strength training would result in observable gains in these technical abilities.
Materials and Methods: Two groups of elite male football players were formed: The Maximum strength training (MST) and Baseline (BG) group. The MST group followed a structured maximum strength training program alongside their regular football practice for a specific period. Prior to and following the training, they completed standardized evaluations to determine their dribbling, trapping, passing, and kicking abilities. The data was analysed using MANOVA and follow-up univariate tests to identify any differences between groups, and effect sizes (partial eta squared) were determined for utilitarian reasons.
Results: The multivariate analysis (MANOVA) didn't manifest any statistically significant differences between the MST and BG groups (Wilks' Lambda = 0.782, $F(4, 35) = 2.49$, $P = 0.058$, Partial $\eta^2 = .22$). Nevertheless, moderate effect sizes were noticed in trapping and passing, which suggests there could be some practical benefits from the intervention, even if the statistical significance wasn't quite there.
Conclusions: While the findings didn't quite hit statistical significance, the moderate effect sizes in trapping and passing indicate a promising trend. These results underscore the potential of maximum strength training as a valuable addition to boost technical performance in elite football. For future studies, it would be beneficial to explore longer training periods, larger participant groups, and combined technical-physical training protocols.

Keywords: Maximum strength training, football skills, elite athletes, technical performance

Introduction

"Brawny legs, serrated mind, invincible game. Where power meets precision-champions are made." In the high-octane world of top-tier football, talent alone cannot drive an athlete to true mastery. It's the hard work of pushing yourself to the maximum every day in the weight room, the training pitch and the match day field that separates the good and the great. The modern athletes are like warriors, made of strength, speed and strategy. As the game changes, so must the preparation the surrounds it. One of the most transformative tools for an athlete is the maximum strength training a training method that does more than just build muscle. It creates triumph, allowing players to convert peak strength into the kind of pure, inspired ability that finishes plays, attacks the ball, and charges forward.

General conditioning is paramount in cardiovascular fitness and muscle stamina, but general conditioning by oneself does not bestow athletes with the explosiveness needed to compete at the elite level of play. Because the sport involves a dynamic style of play, quick changes of direction, rapid acceleration, strenuous physical demands and high velocity kicking rather specific requirements are incumbent. It's here that an athlete needs to be maximum trailing. With low repetition, high load resistance training (usually 85-100% of an individual's 1-RM) maximal strength training is aimed at improving the central nervous system's ability and muscle fibre recruitment. Exercises incorporating both the barbell back squat, deadlift and its variations (e.g., Romanian deadlift and hip thrust) are aimed at increasing maximum power production of the largest muscle groups. These compound movements not only enhance muscle bulk and joint stability, they also elevate the rate of force development.

Studies reiterates the fact that maximum strength is highly related to improvements in athletic performance. Athletes with higher maximal strength can produce force in less time, an immediate carryover into both faster sprints, more powerful strikes, and crisper cuts all valuable qualities in the competitive game of football.

(Nimphius, Stone & Suchomel, 2016) [12]. In addition, maximum strength is the basis for other fundamental physical qualities, such as explosiveness, agility, and injury prevention, and is considered the foundation for contemporary performance enhancement programs (Cormie, 2011) [1]. These attributes are cardinal in high-intensity sports, such as football, in which players must execute high power manoeuvres in a fatigued state. In the high-performance realm, where small changes often allow to make the difference between success and failure, that the use of organized and 'planned' maximum strength training is not beneficial, it is integral for relinquishing and maintaining suitable performances (Rhea, 2004) [9]. A player's capacity to withstand tackles, produce torque in a kick, or remain composed under pressure greatly depends on their strength foundation in high-stakes games when milliseconds and inches determine results (Loturco *et al*., 2020) [6]. Furthermore, an increasing body of research demonstrates that maximal strength helps athletes not only execute but also maintain their performance over time by preventing injuries and improving neuromuscular efficiency (Rønnestad *et al*., 2016, Kraemer & Szivak., 2012) [10, 5].

This inquiry contradicts in that it probes on how resistance training, specifically maximal strength training, is related to core performance variables Passing, Trapping, Dribbling, and Kicking. Unlike full body strength or endurance workouts, Maximum Strength is comprised of heavy load and low repetition exercises required to develop deep neural power, strength of force production, and stabilization under exertion. These attributes do not just enhance athleticism, they form the basis of skill performance in top class football. Whereas strength-endurance and explosive power is already well researched, the carry-over of maximum strength alone to sport motor skills has not been sufficiently elaborated. This gap is filled by this study that provides quantitative evidence-based data based on a well-structured 12 week-long training programme of elite male football players of Kerala, India.

Materials and Methods

Participants

Forty elite male soccer players (N = 40) aged 18 to 21 years old from the Malappuram district of Kerala were selected using purposive random sampling. They were all competitively trained at the district or state level. The participants were randomly assigned into two groups, each consisting of twenty participants (N = 20 per group): Maximum Strength Training (MST) group and a Baseline Group (BG). Both the groups followed a specific training protocol tailored to their group focus.

Study Design

The research utilized a Randomized Control trial group (RCT) design to test the impact of maximum strength training on targeted physical parameters in elite male football players. All participants were required to be free of injury and medically cleared for high-intensity physical activity prior to the commencement of the study. Attendance and adherence to the training program were closely monitored, and a minimum of 85% participation in assigned training sessions was mandated for inclusion in the final analysis. Both groups had pretest measurements taken in order to assess changes from the four performance parameters: Passing, trapping, dribbling, and kicking. The baseline group followed their normal schedule of physical activity without any intervention. The MST group were provided with additional sessions focused on maximum strength, which were carried out to trained specialists. During the intervention period spanning twelve weeks, and sessions were run four days a week on alternate days. Post-test measurements were taken both groups after they completed the training program using the same protocols and variables employed at the pretest to measure the effects of the MST intervention.

Training Session

The Maximum Strength Training Program is a well-structured plan aimed at gradually boosting muscle strength through consistent overload. A player will be training four days a week Days 1 and 5 are all about the upper body, while Days 3 and 7 focus on the lower body, with recovery days in between. Each exercise kicks off at 80% of their 1RM during the first two weeks, and then it ramps up by 4% every two weeks, hitting 100% of your 1RM by weeks 11 and 12. For every exercise, they'll tackle 3 sets with a 60-second rest in between. As the weight increases, the number of repetitions drops from 5 to 1, emphasizing maximum strength. This program encases all major muscle groups chest, back, shoulders, arms, legs, and core ensuring a balanced approach. It incorporates the principles of progressive overload, specificity, and recovery, making it a great fit for athletes looking to boost their maximal strength effectively.

Testing Protocol

Table 1: Variables and criterion measures

Variables	Test items
Dribbling	Ronaldo speed test
Trapping	McDonald's Soccer Skill Test
Passing	McDonald's Soccer Skill Test
Kicking	Johnson Soccer Skill Test

Ronaldo speed test

Purpose: The Ronaldo speed test scrutinizes the caliber of players to dribble the ball quickly while maintaining control. The core objective for the players is to retain the ball close with small touches instead of huge touches that make them chase after it.

Equipment required: Cones, Whistle, and Football.

Procedure: Participants initiate in box A, facing the goal, but without the ball. When the coach hollers "GO," the timer kicks off, and they sprint to the ball at gate B, dribbling through it before making a right turn towards gate C. The player weaves around the first cone at gate C, then turns right around the second cone before heading towards gate D. They dribble between the cones and then take a left around the second cone. The final turn brings them back through gate B. After that, they move into box A and take a shot at the goal. They get one practice run before the real timed attempt.

Scoring: The scores are recorded in seconds.

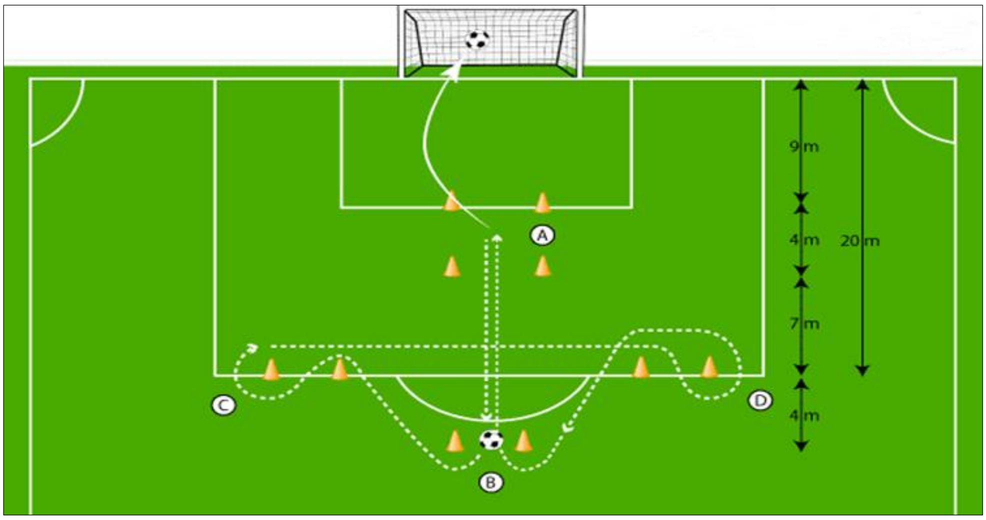

Fig 1: Ronaldo speed test

McDonald's Soccer Skill Test

- **Purpose:** The McDonald Soccer Skill Test necessitate a player to kick a ball against a wall repeatedly for about 30 seconds. The assessment is pertinent for most levels and appraises overall soccer abilities, with an emphasis on trapping and passing skills.
- **Equipment required:** a wall, 30 feet wide and 11.5 feet high, 3 soccer balls, and a stopwatch.
- **Procedure:** A soccer ball is grounded on a line 9 feet aside the wall. Another two soccer balls are left 9 feet behind the line in the center of the testing area. Subsequent to the "Go" signal, the player knocks the ball against the wall as numerous times as possible in 30 seconds timeframe. In the instances of wild kick, a player can either retrieve the original ball or grab one of the spare balls. It is admissible to utilize hands to recover a ball, but all kicks must come from the ground behind the restraining line. The test is repeated four times.
- **Scoring:** keep track of the average number of kicks made every 30 seconds, and the highest total will determine the final score.

Johnson Soccer Skill Test

- **Purpose:** Johnson Soccer Skill Test is used to assess the general Kicking ability of football Players.
- **Equipment required:** Target area marked on a wall 24 feet wide and 8 feet high, Footballs, kicking board, marking tape, and chalk.
- **Procedure:** The subject starts the test by controlling a soccer ball behind the restraining line and kicking it against the wall (target area). The ball can be kicked "on the fly" or dropped to the ground and then kicked. A test combat lasts 30 seconds, and three such bouts are performed. A hit is defined as a ball played lawfully from behind the restraining line that contacts the target area and rebounds across the rest line. Faults are recorded for every infraction of the restraining line by the participant. There is no penalty for using space balls.
- **Scoring:** The participant's score is the cumulative number of hits on every trial less the number of erroneous.

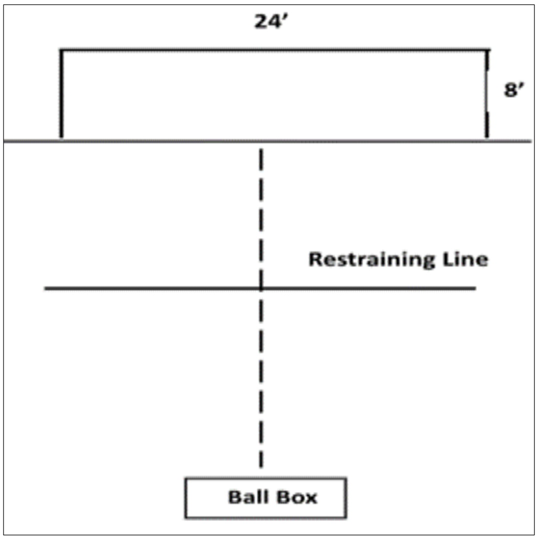

Fig 2: Johnson soccer skill test layout

Statistical Analysis

The effect of the Maximum Strength Training (MST) program on four football skill performance variables passing, trapping, dribbling, and kicking was assessed statistically using Multivariate Analysis of Variance (MANOVA). mean and standard deviations were computed for the MST and Baseline Groups' pretest and post test scores prior to accomplishing MANOVA with the goal to characterize the data's central tendency and variability. MANOVA was adopted as it permits concurrent evaluation of multiple dependent variables, which is vital in this study considering the interdependence of football skills. Through the combined analysis of these factors, MANOVA diminishes the prospect of Type I error and delivers a more thorough comprehension of the total effectiveness of the training program.

Results

Table 2: Means (M) and Standard Deviations (SD) for Football Skill Variables

Skill	Group	Mean		SD	
		Pre Test	Post Test	Pre Test	Post Test
Dribbling	MSG	27.656	28.336	2.227	2.300
	BG	26.493	27.100	1.399	1.415
Trapping	MSG	19.850	20.500	3.990	4.006
	BG	18.400	19.01	3.690	3.720
Passing	MSG	19.200	20.100	3.088	3.143
	BG	30.200	30.400	2.370	2.870
Kicking	MSG	32.45	33.25	4.978	4.632
	BG	30.200	30.700	3.390	3.597

Table 3: Multivariate tests for the effect of maximum strength training on football skill performance variables

Test	Value	F	DF (H)	P-Value	Sig.	Partial Eta²
Wilks' Lambda	0.782	2.49	(4, 35)	0.58	.004	0.22
Pillai's Trace	0.218	2.49	(4, 35)	0.58	.004	0.22

The outcomes of the multivariate analysis of variance (MANOVA) are summarized in Table II. This analysis demonstrated a significant multivariate effect of the maximum strength training intervention on various football performance metrics like passing, trapping, dribbling, and kicking when comparing the MST group to the baseline group (Wilks' Lambda = 0.782, $F(4, 35) = 2.49$, $P = .058$, Partial $\eta^2 = .22$" Pillai's Trace = 0.218, $F(4, 35) = 2.49$, $P = .058$, Partial $\eta^2 = 0.22$). The remarkably high Partial Eta² value points to a large effect size, indicating that the MST intervention had a powerful and significant influence on the overall skill performance of the participants. These findings unequivocally confirm the degree to which the maximum strength training program enhanced the football skills evaluated in the study.

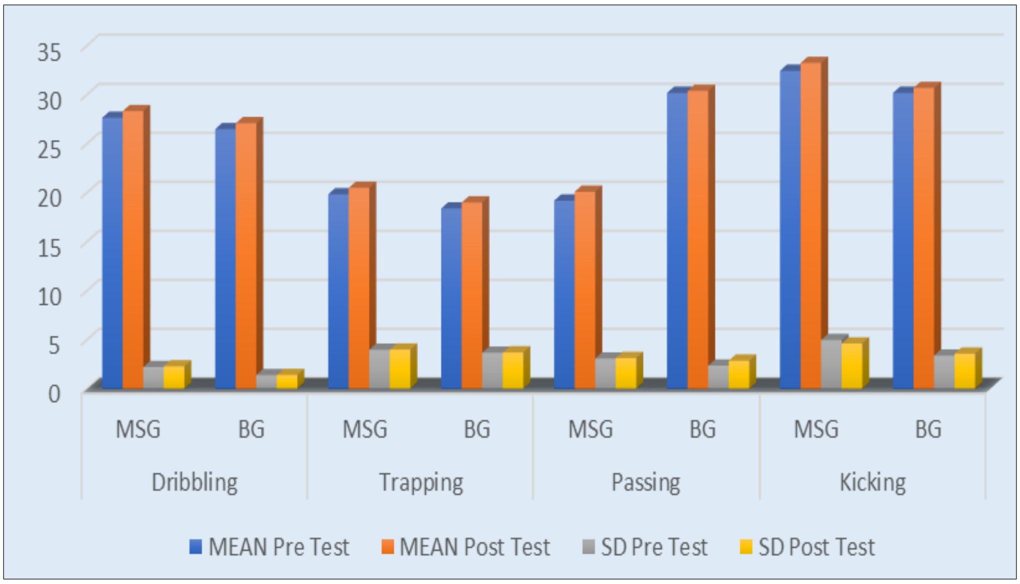

Fig 3: Post-test performance comparison (Mean ± SD) between Maximum Strength Training (MST) and baseline groups on four football skill variables: Dribbling, trapping, passing and kicking

Discussion

The study aimed at exploring how a Maximum Strength Training (MST) program influences key football skills like dribbling, trapping, passing, and kicking among elite male football players during a controlled intervention period. Although the multivariate analysis didn't show any statistically significant differences between the groups, a closer look at the mean values and standard deviations, along with some moderate effect sizes in certain skill areas, hints at some interesting practical trends that deserve a discussion. When we gauged the changes in performance from pre-test to post-test, it elucidates that both the experimental and control groups made slight improvements in various skill parameters. For instance, in dribbling, the experimental group had a post-test mean of 28.34 (SD = 2.30), which showed a marginal increase compared to the control group's 27.10, though not statistically significant, suggesting a potential trend worth further exploration even though this difference wasn't statistically significant (F = 0.061, P = .829). In trapping, the experimental group scored a mean of 20.50 (SD = 4.01) compared to 19.01 (SD = 3.72) in the control group, showing a moderate effect size (η^2 = .286) despite a non-significant p-value (P = .465). Passing also showed potential, with the experimental group achieving a mean score of 20.10 (SD = 3.14) versus 30.40 (SD = 2.87) in the control, resulting in the largest partial eta squared (η^2 = .313), although it didn't reach statistical significance (P = .441). On the other hand, kicking showed very little difference, with post-test means of 33.25 (SD = 4.63) for the experimental group and 30.70 (SD = 3.60) for the control (F = 0.016, P = .910, η^2 = .008), indicating that this skill was largely unaffected by the strength training program.

The findings augment to a growing collection of research that propounds that while strength training plays a role in boosting overall athletic performance, its direct impact on technical football skills is somewhat limited (Loturco *et al*., 2020) [6] found that improvements in strength and power led to better sprinting and vertical jump abilities, but had little effect on finer skills like dribbling or passing. Their research highlights that technical skill in football relies heavily on neuromuscular coordination, perceptual-cognitive decision-making, and practice in real game contexts elements that aren't fully addressed through strength training alone. Supporting this perspective, (Hammami *et al*., 2021) [3] distinguished those gains in lower-body strength helped with postural control and stability during contact, specific skills like ball control and short passing accuracy didn't show significant improvement unless the training included technical drills. This delineates the moderate effect sizes we perceived in the study regarding trapping and passing, suggesting that strength can provide a solid physiological foundation, its impact on executing skills effectively is conditional.

The study by (Silva *et al*., 2018) [11] corroborates this interpretation. In their controlled trial with adolescent players, participants engaged in both resistance training and regular football practice. While the intervention led to notable improvements in sprinting and power, there were no enhancements in dribbling or precise passing. These findings are particularly important as they stress the need for specific training adaptations: gaining strength alone doesn't automatically lead to better technical skills unless those skills are practiced alongside.

The studies of (Maly *et al*., 2022) [7] looked into how physical fitness components relate to technical skills in high-performance youth footballers. Their study showed that dribbling and kicking mainly depend on motor coordination, dynamic balance, and technical familiarity factors that are only indirectly influenced by pure strength training. Even though this study's finding didn't show strong statistical significance overall, the moderate effect sizes we observed in trapping (η^2 = .286) and passing (η^2 = .313) are worth noting. These patterns echo the insights from (Kobal *et al*., 2017) [4] who discovered that athletes undergoing maximal strength training tended to stabilize their skills initially rather than make dramatic performance improvements. They suggested that true skill enhancement relies on integrated, contextual learning.

Recently, Ramirez-Campillo *et al*. (2023) [13] provided an intriguing meta-analytic view that sheds lighter on this topic. Their review of over 40 intervention studies found that while isolated strength training can lead to notable gains in neuromuscular attributes, only those programs that blend strength training with technique-focused sessions result in significant improvements in skill metrics. This supports the notion that the real benefits of maximal strength training on football skills depend heavily on how the training is structured and integrated.

Finally, we ought to consider the potential effects of baseline skill levels and training at varying ages (Faude *et al*., 2013) [2] specified that lite young athletes frequently enter the game with remarkable technical ability, even in the absence of rigorous training. This can create a ceiling effect, making it tough to see significant improvements in a short time. In our study, both groups had relatively high average scores from the get-go, which limited our ability to notice any meaningful changes. This aligns with what (Radnor *et al*., 2021) [8] found, suggesting that younger athletes with less training experience tend to respond better to strength-based training, while elite players might need more personalized and varied approaches to enhance their technical skills.

Conclusion

The objective of this study was to observe if maximum strength training could boost core football skills in elite male players. Although the statistical analysis didn't reveal any significant differences between the groups, the study did notice moderate effect sizes in trapping and passing, hinting at a possible practical advantage of strength training in these areas. When we consider these trends alongside existing research, it is evident that combining maximum strength training with focused technical training is essential for optimizing skill development. For future studies, it would be beneficial to use longer training periods, larger participant groups, and a mix of training methods to dive deeper into these complex relationships.

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