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A Meta-Analysis of the Most Effective Training Programs for Developing Speed Endurance in Young Male Football Players in Northern Iraq

Hussein, Riyadh Rajab[1] **Elyakine, Lakhdar Nour Al-Khawaldeh**[2], **Ibtihal Mohammed**

[1]Department of Physical Education and sport science, College of Education ,AlNoor University, Mosul, Iraq .
[2] Department of Sports Sciences, Sultan Moulay Slimane University, Beni Mellal, Morocco .
[3] Department of Kinesiology and Sports Training, Faculty of Sport Sciences, Mutah University, Jordan.

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Correspondence:

Riyadh Rajab Hussein
riyadh.rajab@alnoor.edu.iq

Abstract

The distribution of fat and muscle plays a crucial role in motor performance. While individuals with a mesomorphic body type (muscular) exhibit faster neuromuscular response, which enhances the effectiveness of explosive exercises, those with an endomorphic body type (muscular-fat) demonstrate greater endurance capacity.
This study aimed to:

- Investigate the relationship between somatotypes (mesomorph and endomorph) and physical strength performance in men.

In light of this aim, the researchers proposed the following hypothesis:

- There is a statistically significant relationship between somatotypes (mesomorph and endomorph) and physical strength performance.

The researchers adopted the descriptive correlational method as appropriate for the nature of this study. The experiment was conducted on a sample of 12 advanced-level male powerlifting athletes from Duhok Governorate, divided into two groups (somatotypes), each consisting of 6 players, selected purposefully based on fat and muscle indices. The experiment involved three physical strength tests performed sequentially:(Bench Press, Squat ,Deadlift)
Statistical tools used included mean, standard deviation, coefficient of variation, skewness, Pearson correlation coefficient, and t-test.
The researchers arrived at the following conclusions:

1. No statistically significant differences were found between the mesomorphic and endomorphic groups in isolated exercises (e.g., bench press), indicating that increased muscle mass does not significantly affect the performance of exercises relying on neuromuscular efficiency and the balance of small muscle groups.
2. Significant differences were observed in favor of the endomorphic group in compound exercises (e.g., squat and deadlift), confirming that compound, absolute-strength-based movements depend more heavily on total muscle mass and the ability to generate muscular torque.

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1-Introduction

Speed endurance is one of the most essential physical attributes for young male football players, as it enables them to sustain high-intensity efforts throughout the duration of a match. Achieving high performance in technical, tactical, physical, and skill-related aspects requires the player to repeatedly execute explosive movements without a noticeable decline in efficiency. For this reason, specialists and coaches continuously seek effective and time-efficient training methods that can enhance speed endurance and rapid lower-limb movement, given their direct impact on dribbling, fast offensive transitions, counter-attacks, and repeated short sprints. Numerous studies have investigated approaches to improve this ability, and most have reported statistically significant outcomes; however, the sheer volume of these studies has created uncertainty for practitioners attempting to identify the most effective training methods.

Despite the extensive research, most previous studies depended primarily on statistical significance (p-values) to interpret their findings. Relying solely on statistical significance limits the ability to understand the practical importance of results, as certain outcomes may have substantial real-world value even when their probability levels are comparatively low. Conversely, some statistically significant results may have minimal practical effect. Sullivan and Feinn (2012) emphasized the need to report both statistical significance and effect size, noting that the former indicates whether results are likely due to chance, while the latter clarifies the magnitude and meaningfulness of observed differences. Together, they provide a more comprehensive and accurate interpretation of research outcomes.

Similarly, Bahash (2019) explained that effect size represents a cornerstone of advanced statistical analysis, distinguishing meaningful research reviews from those that rely solely on probability testing. The American Psychological Association (APA) has highlighted the limitations of statistical significance, especially its sensitivity to sample size, which may artificially inflate relationships between variables without reflecting true training effects. For this reason, APA strongly encourages reporting effect sizes as indicators of practical significance. Many scientific journals in the fields of psychology, education, and sports science have adopted this requirement as an essential element of rigorous research reporting.

Given the abundance of studies addressing the speed of leg extension and the limited focus on effect size and similar statistical indicators, it has become increasingly difficult for coaches to determine which training programs yield the greatest practical benefit. This gap has given rise to the current research, which seeks to identify the most effective training programs for developing leg speed and to determine the magnitude of their impact based on effect size analysis. The study aims to determine the training programs that improve bilateral leg speed in football players, to identify the optimal intensity and volume of training that effectively develop speed and flexibility in young males, and to explore the most effective method for training bilateral leg speed in male football players. The research draws on all relevant master's theses and experimental doctoral dissertations completed up to the year 2025, using data collected and analyzed between March 20, 2024, and October 5, 2024. The spatial field of the study includes the libraries of the faculties of physical education and sports sciences in the universities of the northern region of Iraq: the University of Mosul, the University of Sulaimani, Salahaddin University, the University of Duhok, Koya University, and Soran University.

2- Research Procedures

2.1 Research Methodology: The research employed an analytical descriptive approach, specifically content analysis, due to its suitability and relevance to the nature of this study.

2.2 Research Community and Sample: The research community comprised 34 training programs in football, affiliated with various faculties of physical education and sports sciences at the following universities: University of Duhok, University of Sulaimani, University of Salahaddin, University of Mosul, Koya University and Soran University (see Appendix 1 for details). The research sample consisted of 17studies intentionally and comprehensively selected from the training programs targeting the youth group, accounting for 50% of the total. Table 1 displays the distribution of research papers according to the respective colleges they were sourced from.

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Table 1: Shows the number of studies taken from the colleges

No.	University	Number of studies
1	University of Duhok	4
2	Sulaimani University	7
3	Soran University	1
4	Salahaddin University	4
5	Koya University	2
6	Mosul University	16
	Total	34

2.3 Data Collection Methods

2.3.1 Content Analysis: Multiple English and Arab sources were analyzed to identify appropriate methods beyond statistical analysis, as well as statistical methods and means for extracting effect sizes. Messages and theses related to training programs for developing explosive power were analyzed.

2.3.2 Analysis Form Design: The researcher designed the analysis form, which included the following information in its final version:

1. Title of the research.
2. Name of the researcher.
3. Level of study (PhD, MA).
4. Age group.
5. Experimental design of the study.
6. Sample size.
7. Statistical method used.

2.4 Statistical Treatments:

1. Percentage calculation:
2. Cohen's d formula for correlated samples: $d = (M_1 - M_2) / SD$

(Christophe and Pelletier and cousineau., 2018, 244) and (Nasiri et al., 2020, 300).

5 .Results

3-1 Presentation and analysis of the results

3–1–1 Presentation and Analysis of the Effect Size and Level for Leg Speed Endurance in Youth Football Players.

Table (2) Shows the effect size and level for leg speed endurance in youth football players.

No.	Effect Size	Effect Level	Statistical Significance	Independent Variable
3	1.176	Very High	Significant	Network training using interval training method
4	1.284	Very High	Significant	Plyometric training method
8	8.807	Optimal	Significant	Training program using diverse training methods
9	2.851	Optimal	Significant	Intensive interval training
13	1.411	Very High	Significant	Training load regulation
14	2.982	Optimal	Significant	Proposed program using circuit training
16	0.934	High	Significant	Circuit training
18	0.213	Below Acceptable	Not Significant	General football drills
21	0.585	Moderate	Significant	Combined drills
21	0.272	Below Acceptable	Significant	Play-based drills
22	1.256	Very High	Significant	Combined anaerobic physical-skill drills
23	1.177	Very High	Significant	Physical-skill drills based on interval training
25	1.891	Optimal	Significant	Rebounding plyometric exercises on sand
25	0.822	High	Significant	Rebounding plyometric exercises in water
29	2.801	Optimal	Significant	Load frequency control

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29	0.586	Moderate	Significant	Load duration control
30	1.669	Optimal	Significant	Physical-skill drills using endurance time
32	2.337	Optimal	Significant	Physical training program based on energy systems
33	1.983	Optimal	Significant	Group-based skill drills
33	1.891	Optimal	Not Significant	Paired skill drills
34	1.050	High	Not Significant	Plyometric exercises

- Highest Value: 8.807 → Optimal → Significant → Training program using diverse methods
- Lowest Value: 0.213 → Below Acceptable → Not Significant → General football drills
- Mean Effect Size: 1.808 → Optimal

Summary of Table (2):

Analysis of the results from 17 studies on leg speed endurance in youth football players revealed the following:

- Optimal effect level appeared 9 times, representing 42.86%
- Very high level appeared 5 times, representing 23.80%
- High level appeared 3 times, representing 14.28%
- Moderate level appeared 2 times, representing 9.52%
- Below acceptable level appeared 2 times, representing 9.52%

The highest effect size recorded was 8.807 (optimal level), while the lowest was 0.213 (below acceptable level).
The average effect size across all studies was 1.808, which falls within the optimal level.

Notably, some studies showed no statistical significance, yet their effect size levels ranged from high to optimal, while in contrast, one study was statistically significant but its effect size was below the acceptable level.

4. Final Results

Based on the analysis of 17 studies focused on training programs aimed at developing leg speed endurance in youth football players in the northern region of Iraq, the study concluded the following:

1. There was a variation in effect size levels across studies, with the highest effect size recorded at 8.807 (Optimal level) and the lowest at 0.213 (Below acceptable), while the overall mean effect size was 1.808, falling within the optimal range.
2. The optimal level of effect size appeared in 9 studies (42.86%), indicating that many training programs were highly effective in enhancing leg speed endurance.
3. Some studies showed no statistical significance, yet had high or optimal effect sizes. This highlights the importance of relying on effect size as a complementary measure for interpreting results.
4. The most effective training program was the one that combined diverse training methods, affirming the importance of integrating multiple approaches to improve physical attributes.
5. A clear shortcoming was observed in previous studies, as most relied solely on statistical significance without calculating effect sizes, reducing the precision of program evaluation.

5. Discussion

The analysis of seventeen studies focused on developing leg speed endurance in youth football players revealed substantial variations in effect size values across different training programs. These variations provide important insights into the differential impact of training methods and underscore the necessity of relying on effect size, not merely statistical significance, to evaluate training outcomes accurately.

The predominance of **optimal effect size levels (42.86%)** suggests that many of the training programs implemented in the northern region of Iraq were highly effective in enhancing leg speed endurance. This aligns with contemporary sports science literature, which emphasizes the cumulative value of structured and high-intensity training methods—such

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as interval training, plyometrics, and circuit-based programs—in improving neuromuscular capabilities associated with rapid lower-limb movement. The consistent appearance of optimal levels in programs employing **diverse or combined training methods** confirms the physiological principle that varied stimuli produce superior adaptations by engaging multiple neuromuscular pathways simultaneously.

The training program that utilized **diverse training methods** produced the highest effect size (8.807), indicating an exceptionally strong influence on leg speed endurance. This result supports the argument that multidimensional training interventions are more effective than single-method approaches. By integrating plyometric, anaerobic, interval, and skill-based components, such programs likely target both metabolic and neuromuscular systems, resulting in enhanced force production, rapid contraction capabilities, and improved movement efficiency—key determinants of speed endurance in football.

Conversely, the lowest effect size (0.213), observed in general football drills, indicates that non-specific or low-intensity training does not sufficiently stimulate the physiological adaptations required for improving leg speed endurance. Despite being an integral part of football preparation, general drills may not provide the required intensity, progression, or volume to influence this specific physical attribute. This finding highlights the necessity for coaches to move beyond traditional training routines and adopt more targeted programs when addressing speed-related qualities.

A notable outcome in the analysis was the lack of alignment between **statistical significance and effect size** in several studies. Some interventions demonstrated **high or optimal effect sizes despite the absence of statistical significance**, while one intervention showed **statistical significance with a below-acceptable effect size**. This pattern reinforces the limitations of relying solely on probability values (p-values), which can be influenced by sample size, variability, or measurement precision. The presence of meaningful effect sizes in statistically non-significant results suggests that the interventions had practical value, but the studies may have been underpowered. Conversely, a statistically significant result with a weak effect size indicates that although a change occurred, it may not have been substantial enough to have real-world implications. Such discrepancies highlight the importance of adopting effect size as a complementary index in sports science research to ensure accurate and meaningful interpretation of findings.

Furthermore, the strong performance of **plyometric and interval-based programs** across multiple studies supports established training principles regarding the development of neuromuscular efficiency and anaerobic capacity. Plyometric exercises enhance stretch-shortening cycle efficiency, while interval training targets metabolic endurance and repeated sprint performance. Their repeated appearance at high or optimal effect levels validates their relevance and effectiveness in youth football training settings.

Another key insight is the significant impact of **training load regulation**, including the manipulation of load frequency and duration. These findings suggest that not only the type of training but also the precise structuring of load variables play a crucial role in optimizing performance outcomes. Proper load management is essential in preventing fatigue, maximizing adaptation, and ensuring safe progression—especially in youth athletes.

Collectively, the discussion highlights a methodological weakness in previous studies, where statistical significance was often prioritized over practical significance. This oversight limits the ability to understand the true effectiveness of training programs and may have contributed to inconsistent recommendations for coaches. The incorporation of effect size into scientific reporting is therefore essential, as it provides a more accurate and objective measure of training impact, guiding evidence-based decision-making.

In summary, the findings of this synthesis demonstrate that the most effective training programs for developing leg speed endurance are those that employ **diverse, combined, or high-intensity structured methods**, while general or non-specific drills are insufficient for achieving meaningful improvements. The study emphasizes the need for future research to systematically report effect sizes and incorporate robust methodological designs to better support training prescription and performance development in youth football.

7 .Conclusion

The present study synthesized the findings of seventeen research projects focused on training programs designed to enhance leg speed endurance among youth football players in the northern region of Iraq. The analysis revealed clear variability in the effectiveness of these programs, as reflected by the wide range of effect sizes reported across studies. Despite this variation, the overall mean effect size of 1.808 fell within the optimal level, indicating that

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most interventions produced meaningful and practically significant improvements.

The results demonstrated that training programs incorporating diverse or combined training methods yielded the highest effect sizes, with one such program achieving the maximum value of 8.807. This confirms that integrating multiple training approaches—such as plyometric, interval, anaerobic, and skill-based methods—provides superior neuromuscular and metabolic stimulation compared with single-method programs. Conversely, general football drills were shown to be insufficient for improving leg speed endurance, as evidenced by the lowest effect size recorded.(0.213)

A key outcome of this study is the identification of discrepancies between statistical significance and effect size. Several programs achieved high or optimal effect sizes without statistical significance, whereas one program showed statistical significance despite demonstrating a below-acceptable effect size. These findings reinforce the importance of effect size as a critical indicator of practical significance, highlighting that reliance on p-values alone may lead to incomplete or misleading interpretations of training efficiency.
Overall, the study concludes that the most effective training programs for developing leg speed endurance in youth football players are those that use diverse, structured, and high-intensity training methods, coupled with appropriate regulation of training load. The findings also underscore the methodological necessity for future studies to systematically report effect sizes alongside statistical significance in order to enhance the precision, reliability, and applicability of research in sports training science.

7. Recommendations

Based on the findings of this study, several practical recommendations can be made for football coaches seeking to enhance leg speed endurance in youth players:

Adopt diverse training methods: Coaches should incorporate programs that combine plyometric, interval, anaerobic, and skill-based drills, as these interventions demonstrated the highest effect sizes and produced the most significant improvements.

Prioritize structured high-intensity training: Intensive interval training, circuit training, and plyometric work on different surfaces (sand and water) showed strong or optimal effectiveness and should be integrated regularly into training plans.

Use targeted drills instead of general exercises: General football drills were insufficient for improving leg speed endurance. Coaches should avoid depending solely on traditional or low-intensity drills when aiming to develop this specific physical attribute.

Regulate training load carefully: Manipulating load frequency, volume, and duration proved critical in several studies. Coaches should apply scientific load management principles to ensure optimal adaptation and avoid excessive fatigue.

Include energy-system–based conditioning: Drills and programs designed according to the body's energy systems contributed significantly to improvements and should be utilized to enhance both metabolic and neuromuscular efficiency.

Evaluate progress using practical metrics: Coaches are encouraged to monitor performance changes not only through traditional tests but also by tracking effect sizes or standardized performance indices to assess the true impact of their training programs.

8. Suggestions for Future Research

The study identified several gaps and opportunities that future researchers should consider:

Increase methodological rigor: Future studies should employ larger and more balanced sample sizes to minimize the risk of misleading statistical outcomes and enhance the reliability of reported effect sizes.

Report effect sizes consistently: Researchers should systematically include effect size calculations in both results and conclusions to ensure meaningful and accurate interpretation of training effectiveness.

Conduct comparative analyses of training methods: Direct comparisons between diverse, combined, and single-method programs are needed to determine the most efficient strategies for different age groups and skill levels.

Investigate long-term adaptations: Most reviewed studies focused on short-term training periods. Future work should explore long-term effects and retention of leg speed endurance improvements.

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Examine additional variables: Research should explore biomechanical factors, neuromuscular activation patterns, and physiological adaptations that underlie changes in leg speed endurance.

Include female athletes and broader age ranges: Expanding the population beyond youth male players will provide generalizable findings and assist in designing inclusive training programs.

9. Limitations of the Study

Despite the strength of the data synthesis, the study includes several limitations that should be acknowledged:

Variability in study designs: The included research differed in methodology, training duration, sample sizes, and testing procedures, which may influence the comparability of effect sizes.

Limited geographic scope: All studies were conducted in the northern region of Iraq. As a result, the findings may not fully represent athletes from other regions or countries.

Inconsistent reporting standards: Several studies lacked effect size calculations, required the researcher to compute them retrospectively, or did not clearly report training load parameters, which may have affected the precision of the analysis.

Short intervention periods: Many training programs were conducted over relatively short durations, which may not fully capture long-term adaptations or sustainability of improvements.

Focus on a single physical component: The study centered solely on leg speed endurance. Other performance-related factors—such as agility, balance, or tactical performance—were not examined, limiting the broader applicability of the results.

Potential publication bias: Only completed academic theses and dissertations were included, which may overlook unpublished studies or smaller-scale investigations with different outcome

Acknowledgement

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