Effect of specific coordination training on the performance of young football players: a systematic review

Efecto del entrenamiento específico de la coordinación en el rendimiento de jóvenes futbolistas: una revisión sistemática

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Abstract

Introduction: Football is a complex and dynamic sport in which motor coordination plays a fundamental role in player development, contributing to the acquisition of technical skills, movement efficiency, and adaptability to dynamic game environments.
Objective: This systematic review aimed to analyze the effects of specific coordination training on the performance of youth football players.
Methodology: A systematic search was conducted in PubMed, Scopus, Web of Science, and SPORTDiscus following the PRISMA 2020 guidelines. Studies were selected if they included youth football players (6–18 years old) and involved interventions specifically aimed at developing coordination. Methodological quality and the participants' competitive level were assessed using the Downs and Black (1998) scale and the DeWeese et al. (2015) classification framework, respectively.
Results: Specific coordination training improved technical skills, agility, balance, and general motor coordination in young players. The four included studies scored between 20 and 23 points (good quality). The most frequently used instruments were standardized tools (MABC-2, KTK) and ball-specific coordination tasks.
Discussion: The results are consistent with the literature regarding the positive effects of coordinative training; however, the heterogeneity in protocols and assessment methods limits direct comparison between studies. The competitive level of the participants was identified as a relevant moderating factor.
Conclusions: Coordination-focused interventions appear to be effective in improving performance variables in youth football players. It is recommended to standardize assessment protocols, consider the competitive level when interpreting results, and explore the long-term effects of coordination-based training programs.

Keywords

Children; football; motor coordination; performance; youth.

Resumen

Introducción: El fútbol es un deporte complejo y dinámico en el que la coordinación motora desempeña un papel fundamental en el desarrollo del jugador, contribuyendo al desarrollo de habilidades técnicas, eficiencia del movimiento y adaptabilidad a entornos de juego dinámicos.
Objetivo: Esta revisión sistemática tuvo como objetivo analizar los efectos del entrenamiento específico de la coordinación en el rendimiento de jóvenes futbolistas.
Metodología: Se realizó una búsqueda sistemática en PubMed, Scopus, Web of Science y SPORTDiscus siguiendo las directrices PRISMA 2020. Se seleccionaron estudios que incluyeran jóvenes futbolistas (6–18 años) con intervenciones dirigidas específicamente al desarrollo de la coordinación. La calidad metodológica y el nivel competitivo de los participantes se evaluaron mediante la escala de Downs y Black (1998) y el marco de clasificación de DeWeese et al. (2015), respectivamente.
Resultados: El entrenamiento específico de la coordinación mejoró las habilidades técnicas, la agilidad, el equilibrio y la coordinación motora general en jugadores jóvenes. Los cuatro estudios incluidos obtuvieron entre 20 y 23 puntos (calidad buena). Los instrumentos más utilizados fueron herramientas estandarizadas (MABC-2, KTK) y tareas de coordinación específicas con balón.
Discusión: Los resultados son coherentes con la literatura sobre los efectos positivos del entrenamiento coordinativo; sin embargo, la heterogeneidad en protocolos y métodos de evaluación limita la comparación directa entre estudios. El nivel competitivo de los participantes fue identificado como un factor moderador relevante.
Conclusiones: Las intervenciones centradas en la coordinación parecen efectivas para mejorar variables de rendimiento en jóvenes futbolistas. Se recomienda estandarizar los protocolos de evaluación, considerar el nivel competitivo al interpretar los resultados y explorar los efectos a largo plazo de los programas de entrenamiento basados en la coordinación.

Palabras clave

Coordinación motora; fútbol; jóvenes; niños; rendimiento.

Introduction

Football is known for its fast-paced and intensive professional activities, which certainly contribute to a higher risk of injuries during the season (Martins et al., 2022). In this context, training and high-performance practices pose ever-changing and demanding challenges, particularly regarding training according to ideas and playing styles that allow for the materialisation of these same ideas (Stølen, Chamari, Castagna, & Wisløff, 2005). It becomes pertinent to study and investigate football in its various aspects, to identify and manipulate the constraints that promote or hinder the progress of players, teams, and the game itself (Teoldo et al., 2015). The demand for frequent changes in the type of movements (e.g., walking, running, sprinting, jumping, tackling), speed (e.g., acceleration and deceleration), direction, and specific technical skills characterise football as an activity profile of an intermittent nature (Di Salvo et al., 2007; Bradley et al., 2009). High-intensity running and sprint activities are considered crucial for successful performances in this sport (Bangsbo, Mohr, & Krustrup, 2006). Previous studies show that football players cover average distances between 10 and 13 km during matches, of which 8% to 12% correspond to high-intensity runs or sprints, with differences between players of different positions (Bianchi et al., 2019; Teoldo, Garganta, & Mesquita, 2015). Based on the multifaceted nature of physical requirements in football, various methods have been developed to improve players' physical fitness parameters, such as endurance, strength, power, and speed (Bianchi et al., 2019). Despite the fundamental importance of physical fitness, players do not develop solely through it, as there are other factors that will influence their development and performance, including motor coordination (Malina & Bouchard, 2004; Boraczyński et al., 2019). In addition to physical capacities, such as aerobic and muscular endurance, the literature emphasises the importance of prescribing training programmes aimed at improving neuromuscular coordinative and athletic performance in younger football players, particularly for those in the categories of 6–8 and 8–10 years of age (Boraczyński et al., 2019; Ferreira et al., 2023).

Motor coordination consists of a complex and multidimensional ability in which various systems (sensory-neuro-muscular) interact harmoniously to ensure efficient and precise motor responses in a dynamic environment in constant change (Malina & Bouchard, 2004). Coordination is thus one of the most important abilities in sports performance (Koksal et al., 2021), which is subdivided into two types: gross/general motor coordination and fine motor coordination (Malina & Bouchard, 2004; Lyakh & Vitkovsky, 2010). Gross motor coordination refers to the ability to control and coordinate the muscular and nervous systems to perform movements using the large muscle groups of the body (Henderson, Sugden, & Barnett, 2007; Galgon & Shewokis, 2016). Fine motor coordination refers to the ability to control and coordinate movements that require small muscles, relating to precision, dexterity, and manipulation of objects (Koksal et al., 2021). In addition to the subdivision of coordination into gross and fine, it can be understood as a broader term that encompasses various coordinative abilities (Hirtz, 1985; Šimonek, 2014), including spatial orientation, differentiation, rhythm, balance, reaction time, and combination (Laróvere, 2015). All these coordinative abilities as well as the sensorimotor system will be important for the training and professional life of all athletes, including football players (Ljac et al., 2012).

Football is a complex and dynamic sport that requires players to continuously adapt to variable and unpredictable situations. It involves frequent changes in movement type, intensity, and direction, together with the execution of specific technical skills such as passing, dribbling, and shooting, which characterise football as an intermittent activity (Stølen et al., 2005). Motor coordination, a key factor in this adaptability, is commonly assessed using standardised and validated instruments such as the Movement Assessment Battery for Children-2 (MABC-2), the Körperkoordinationstest für Kinder (KTK), or field-based protocols like the Y-Balance Test and ball-coordination tasks (Henderson, Sugden, & Barnett, 2007; Lima et al., 2024; Luz Lacaps et al., 2023).

Motor coordination influences footballers' performances at various levels, notably their agility (Malina & Bouchard, 2004). The practitioner needs to coordinate the various segments of their body to adjust posture throughout the game, i.e., with adjusted force and direction, to perform braking, acceleration, and changes of direction. Therefore, there is a correlation between motor coordination, agility, and strength, which can justify the increase in execution speed (Malina & Bouchard, 2004). After 10 weeks of specific coordination training, significant increases in lower limb segment speeds were observed, as

well as increases in hip and knee joint range of motion (Davids et al., 2000). Plyometric training, considered as training for the development of muscle shortening and lengthening cycle and agility, has been suggested as a coordinative training capable of improving footballer performance and reducing injury risks in this population group (Sanudo et al., 2019). It is therefore understood that there are different coordination training methodologies, which should be explored to improve not only football performance but also injury prevention. Indeed, one of the most common criticisms of standard youth football training is the lack of integration of coordinative training, which can irreversibly delay the development of these capacities and other technical skills in young football players (Boraczyński et al., 2019; Ferreira et al., 2023; Lima et al., 2024).

Despite the importance of motor coordination training in improving various physical aspects of the player, such as speed, agility, or the ability to readjust to unforeseen situations, as well as in injury prevention, we have not identified systematic reviews addressing this specific topic. Therefore, this study aims to investigate and synthesise the effect of motor coordination training on the performance of young football players.

Method

This systematic review was performed following Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 (Page et al., 2021) and the review protocol was registered in PROSPERO (International Register of Systematic Reviews) with the ID Number CRD42023392298.

Eligibility Criteria

The review was performed following the PICOS acronym: P – population corresponded to football players in the youth development stages from 6 to 18 years old, whether affiliated or not; I – intervention was defined as specific intervention programmes for the development of motor coordination; C – comparison included pre- versus post-intervention comparisons and experimental group versus control group comparisons; O – outcomes included results related to motor coordination (e.g., MABC-2, Henderson et al., 2007), performance-related outcomes (Lamb & Bartlett, 2017), and health-related outcomes (e.g., injuries); S – study design was defined as intervention studies with the need for a control group.

The studies included in the present systematic review had the following inclusion criteria: (i) studies involving children and young football players, affiliated or not, aged 6 to 18 years old; (ii) intervention programmes involving specific training for motor coordination; (iii) studies with pre- and post-intervention assessment of motor coordination and performance. To make the search comprehensive, no language or time limitations were defined (Mercê et al., 2021).

The methodological quality and participant level of the included studies were classified according to the framework proposed by DeWeese, Hornsby, Stone, and Stone (2015), which defines performance tiers based on competitive calibre and training experience.

Search Strategy and Databases

A systematic search of three databases (PubMed, EBSCO, Web of Science) was conducted. The following keywords were used: (football OR soccer) AND (coordinat* OR co-ordinat*) AND (youth OR child). Only English words were used in the search; however, systematic reviews in other languages were not restricted. The search was conducted up to December 10, 2022.

Study Selection

The study selection was performed using Zotero reference management software (version 6.0.23). All relevant articles were entered into the software and duplicates were removed. After removing duplicates, one researcher screened the titles, and subsequently two independent reviewers screened the abstracts and full articles according to the eligibility criteria (Bergmann et al., 2021). Disagreements were solved through discussion and, when necessary, with the assistance of a third reviewer (Mercê et al., 2021).

Data Extraction

The following data were extracted from the selected articles: author(s) and year of publication; description and characteristics of the participants; study design; intervention programme (duration, training characteristics, exercises, weekly frequency, intensity); assessment time points; results obtained related to motor coordination and performance; and conclusions drawn from the study.

Quality Assessment

The quality assessment was carried out using the Downs and Black scale by two researchers independently (Downs & Black, 1998). This scale is reliable for assessing both randomised and non-randomised studies and incorporates internal and external quality assessment. The scale consists of 27 items, divided into 5 sections assessing: (i) presentation of results; (ii) internal validity; (iii) external validity; (iv) bias; and (v) confounding factors and study power. Higher scores imply higher quality. The following cut-off values were used to categorise studies:

Table 1.

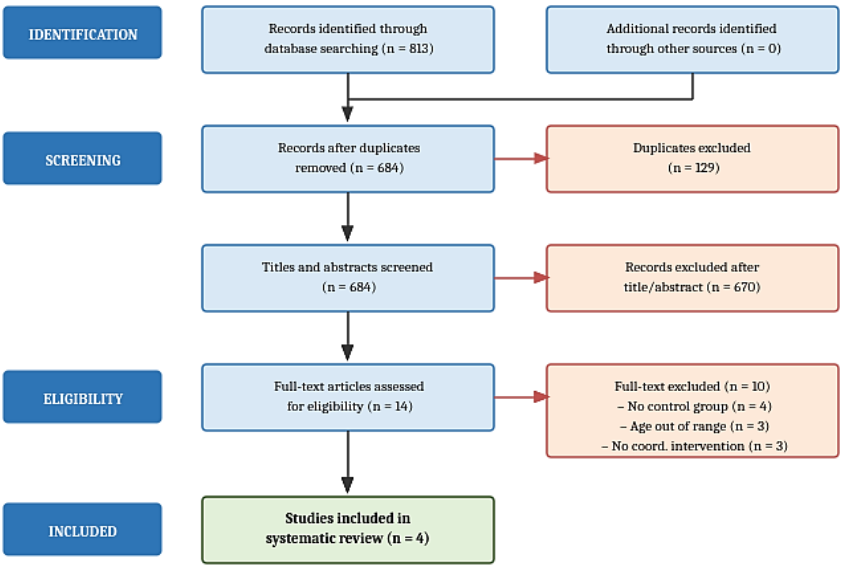
Tier	Score Range	Interpretation
Excellent	26-28	Very high methodological rigour
Good	20-25	Appropriate design, minor limitations
Fair	15-19	Acceptable, several methodological limitations
Poor	<15	Insufficient rigour

Results

Study Selection

A total of 813 articles were found among the different databases. After screening the titles and abstracts, 14 articles were read in full, of which only 4 met the eligibility criteria and were included in this review (Figure 1).

Figure 1. PRISMA 2020 flowchart of the systematic review process.



Across the reviewed studies, motor coordination was assessed using standardised and validated tests such as the Movement Assessment Battery for Children-2 (MABC-2), the Körperkoordinationstest für Kinder (KTK), or sport-specific coordination protocols involving ball-control, balance, and reaction tasks, depending on the participants' age and context (Henderson, Sugden, & Barnett, 2007; Galgon & Shewokis, 2016; Lima et al., 2024).

Studies Characteristics

The sample of articles selected for this systematic review included 4 articles published between 2015 and 2021. The studies covered young football players and included motor coordination intervention programmes conducted on the pitch during regular training sessions (Turkey, Spain, Italy and Poland). All four studies scored between 20 and 23 points on the Downs and Black scale, corresponding to Good methodological quality. The characteristics of the articles included in the systematic review are presented in Table 2.

Table 2. Characteristics of the studies and quality assessment.

Author / Year	Country Quality	Sample	Intervention	Instruments / Variables	Conclusions
Trecroci et al. (2015)	Italy | 21 pts (Good)	TS=24 (11.3±0.70 yrs); CG=12; EG=12	JR training, 8 weeks, 3 days/week; 10 min warm-up + 15 min JP per session (120 min total). 3 exercises: rope jump (3×1 min), HCT (3×2 min), YBT-LQ (3×1 min).	Body composition; MC and JR. EG: significant ↓ in HCT performance time ($p<0.01$). CG: no differences ($p>0.05$).	JR protocol at start of training sessions improved MC and body balance in young soccer players.
Koksal et al. (2021)	Turkey | 23 pts (Good)	TS=45; CG1=15 (11.83±1.06); CG2=15 (12.13±1.01); EG=15 (11.94±1.08)	10-week coordination training, 3 sessions/week, 30 min/session. Dribbling, passing, shooting, ball bouncing, wall-volley (3 sets × 4 reps).	Body composition; dribbling, passing, shooting, jumping. EG: significant ↑ in all skills ($p<0.001$). CG1: ↑ in passing, shooting, wall-volley only. CG2: no improvements.	Coordination exercises combined with structured football training effectively improved general football ability in 10–13 yr male players.
Padron-Cabo et al. (2020)	Spain | 20 pts (Good)	TS=45; CG1=15 (11.83±1.06); CG2=15 (12.13±1.01); EG=15 (11.94±1.08)	6-week ALE program, 3 days/week; 10 min warm-up (SS + jogging + sprints). Tests: 10 & 20 m sprint, DS, agility, slalom dribbling.	Body composition; coordination drills on ladder. Within-group: ↑ in 10 & 20 m sprint for EG and CG ($p<0.005$). No significant differences in DS, agility, slalom ($p>0.005$). No between-group differences.	ALE does not appear effective for improving physical fitness or dribbling, though findings offer useful programming guidance.
Boraczynski et al. (2019)	Poland | 20 pts (Good)	TS=53; EG=26 (10.1–11.8); CG=27 (10.3–11.8); CG2=22 (10.3–11.9)	12-month P-C training, 90 min, 3 days/week; 24 multimodal P-C exercises replacing small-sided games. Intensity adjusted every 8–9 weeks.	Body composition; MC and fitness. EG: significant ↑ in rhythm, motor adaptation, spatial orientation, balance ($p<0.005$). CG: no significant MC gains. Group×time interaction in balance test ($p=0.0204$).	Performance tests can be integrated into field test batteries to monitor training progress in young soccer players.

Note: TS=Total sample; EG=Experimental Group; CG=Control Group; JR=Jumping Rope; HCT=Harre Circuit Test; YBT-LQ=Lower Quarter Y Balance Test; BMI=Body Mass Index; MC=Motor Coordination; ALE=Agility Ladder Exercises; SS=Static Stretching; SP=Sprint Performance; DS=Dribbling Skills; P-C=Proprioceptive-Coordinative.

Discussion

This systematic review aimed to analyse and systematise the characteristics of motor coordination training programmes and their effects on the performance of young football players. In the studies analysed, significant values were found for at least one of the evaluated parameters in all studies: (i) motor coordination; (ii) specific motor skills (e.g., dribbling, passing, shooting, ball bouncing and wall-volley); (iii) balance (Boraczynski et al., 2019; Padron-Cabo et al., 2020; Koksal et al., 2021). These results are in line with other authors who claim that different training modalities, particularly those focusing on coordination, have a positive impact on young football players' motor skills, balance, and performance (Lockie et al., 2016; Trecroci et al., 2015; Michailidis et al., 2013).

Coordination results from the interaction between the system (i.e., the individual and the context in which they find themselves, through sensory-motor coupling) and the objectives of the task (Sommer et al., 2018). This interaction involves the integration of the nervous, muscular, and sensory systems, allowing adjustments to the purpose of the movement to perform a specific motor action (Boraczyński et al., 2019). Football demands the ability to perform a variety of complex, dynamic movements with the ball (e.g., passing, kicking, dribbling, heading) and without the ball (e.g., changing direction, accelerating, decelerating, jumping) in response to highly unpredictable environments (Padron-Cabo et al., 2020), reinforcing the fundamental importance of coordination in football performance. To develop

this ability effectively, Koksal et al. (2021) proposes a progressive approach, beginning with simple movements and gradually advancing to more complex motor actions.

The findings of this systematic review reinforce the importance of designing coordination training programmes that are both age-appropriate and context-specific to maximise their impact on young football players (Boraczynski et al., 2019; Padron-Cabo et al., 2020; Koksal et al., 2021). Although some interventions demonstrated clear improvements in motor coordination and football-specific skills, the variability in results across studies highlights the influence of factors such as intervention duration, training intensity, age, and maturation status (Padron-Cabo et al., 2020). For example, Padron-Cabo et al. (2020) reported no significant improvements in dribbling ability after six weeks of agility ladder training, possibly reflecting an inadequate intervention period to elicit measurable gains in coordination-dependent tasks (Venturelli et al., 2008). Longer interventions, such as the 12-month proprioceptive-coordinative programme (Boraczynski et al., 2019), produced significant improvements across multiple coordination dimensions, underscoring the need for sustained and progressively challenging training. An additional aspect to consider is the competitive tier of the participants. Training interventions that improve coordination in young or lower-tier athletes may have limited effectiveness in populations with higher performance levels, who already present more refined motor skills and neuromuscular adaptations (DeWeese et al., 2015).

Furthermore, closed skill activities (e.g., sprinting, jumping and ladder drills) provide a controlled environment to build foundational motor patterns. Nonetheless, incorporating open skill activities that simulate the unpredictable nature of football, such as reactive balance tasks and proprioceptive drills, may better prepare players for real-game scenarios (Trecroci et al., 2015; Boraczyński et al., 2019). These findings align with ecological dynamics theory, which emphasises the importance of task constraints and environmental variability in shaping motor behaviour (Davids et al., 2000). It is also important to understand that maturation impacts motor coordination: rapid growth during adolescence can temporarily disrupt coordination due to changes in limb length, muscle strength, and balance, potentially masking the benefits of training interventions (Beunen & Malina, 1988; Boraczyński et al., 2019).

In summary, while all studies emphasised the importance of motor coordination for young football players, they differed in their approaches and methodologies. Trecroci et al. (2015) focused on jump rope training to improve balance and coordination; Koksal et al. (2021) implemented a broader football training regimen with coordination drills; Padron-Cabo et al. (2020) highlighted agility ladder training for improving coordination and speed; and Boraczynski et al. (2019) took a more proprioceptive and multidimensional approach. Each study underscores the significance of coordination in developing essential football skills, though training methods and target attributes varied.

Limitations

All the studies included in this review were of good quality, ranging from 20 to 23 points on the Downs and Black (1998) scale (maximum 27 points), which strengthens the review's internal validity. Although no linguistic exclusion criteria were defined, the search was carried out using keywords in English only, which may have limited the number of articles included (Mercê et al., 2021). The scarcity of scientific evidence on this specific subject, as well as the heterogeneity of intervention and coordination assessment methodologies, limits the possibility of comparing studies and drawing firm conclusions. More research on coordination training in footballers is recommended so that more appropriate training recommendations can be made for these athletes.

Conclusions

The findings of this systematic review suggest that coordination training programmes offer significant benefits to young football players, enhancing their technical skills and overall performance. Nevertheless, the variability in results across studies emphasises the need for interventions that consider the age, development stage, and specific needs of the players. Through the analysed studies, the inclusion of coordination exercises appears to promote significant improvement in sports performance.

Given the crucial role of coaches in skill development, it is recommended that they consider specific training strategies to improve coordination skills by carrying out appropriate and progressive exercises. The competitive tier of the sample should also be considered when applying these findings, as coordination-focused training may yield different outcomes depending on the athletes' performance level (DeWeese et al., 2015). Future research should explore long-term effects of coordination-based training programmes and standardise both assessment protocols and intervention designs to allow cross-study comparisons.

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