VARIABLES USED FOR TALENT IDENTIFICATION AND DEVELOPMENT IN SOCCER: A SCOPING REVIEW

Valmir O. Silvino[1,2], Cirley P. Ferreira[1,2], Pedro Figueiredo[3,4], Luciano S. Prado[5], Bruno P. Couto[6], Guilherme A. Pussieldi[7], Sandro S. Almeida[8,9,10], Danilo M. L. Prado[11,12], and Marcos A. P. Santos[1,2]

[1]Department of Biophysics and Physiology, Nucleus of Study in Physiology Applied to Performance and Health (NEFADS), Federal University of Piaui, Teresina, Piauí, Brazil
[2]Rede Nordeste de Biotecnologia (RENORBIO), Federal University of Piauí, Teresina, Piauí, Brazil
[3]Physical Education Department, College of Education, United Arab Emirates University, Al Ain, Abu Dhabi, United Arab Emirates
[4]Research Center in Sports Sciences, Health Sciences and Human Development, CIDESD, Covilhã, Portugal
[5]Federal University of Minas Gerais, Belo Horizonte, Minas Gerais, Brazil
[6]University of the Sunshine Coast, Sippy Downs, Queensland, Australia
[7]Federal University of Viçosa, Viçosa, Minas Gerais, Brazil
[8]Department of Obstetrics, Escola Paulista de Medicina, Universidade Federal de São Paulo (UNIFESP), São Paulo, SP, Brazil
[9]Hospital Israelita Albert Einstein, São Paulo, SP, Brazil
[10]Faculdade Anhanguera de Guarulhos, Guarulhos, SP, Brazil
[11]School of Medicine, University of São Paulo, São Paulo, Brazil
[12]Ultra Sports Laboratory, São Paulo, Brazil

Review
DOI 10.26582/k.56.2.9

Abstract:

Talent identification and development in youth soccer are complex and multidimensional processes. This scoping review aimed to explore the current literature regarding the variables used in the talent identification and development process in soccer. This study was developed referring to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Scoping Reviews (PRISMA-ScR) guidelines. Pubmed, Web of Science and Scopus databases were searched from September to October 2023. Only peer-reviewed journal articles published in English were included, with no limitation regarding the publication year. Through the initial search 774 records were identified and 190 articles met the inclusion criteria. The main finding was that most studies assessed speed (52.1%), maturity (42.1%), lower limbs strength (40.5%), aerobic capacity (35.8%), agility (32.6%), technical skills (16.8%), and tactical skills (14.2%). Male athletes were investigated in 162 studies (85.3%), whereas seven studies (3.7%) were conducted with females only, and seven articles (3.7%) with males and females. Fourteen studies (7.4%) did not specify the sex of the participants. In conclusion, findings indicate that physical performance and maturity factors are the most investigated variables regarding talent identification and development in soccer. This review highlights the importance of considering physical performance tests and technical/tactical skills, along with maturity status assessment, as key tools in talent identification programs. Current talent identification practices in soccer may benefit from a more balanced approach that includes physical, technical, tactical, maturational, and psychological assessments to capture a broader range of player potential.

Key words: *young athletes, football, talent, youth development*

Introduction

Talent is regarded as a natural and exceptional ability that may lead to outstanding results, and talent identification in soccer has been defined as the recognition process of individuals with the potential to become first class players (Williams & Reilly, 2000). In soccer, talent is often understood as a multifaceted concept involving various qualities that influence performance, such as physical, physiological, technical, and tactical skills, alongside psychological and social factors (Larkin & O'Connor, 2017). Talent identification process is the recognition of young players with the potential to join a development programme involving coaching, support, training, and match-play (Vaeyens, Güllich, Warr & Philippaerts, 2009). This is a multifactorial and complex process designed to assist coaches and researchers in sports academies in finding young athletes with the potential to achieve elite status (Bergkamp, Frencken, Niessen, Meijer & den Hartigh, 2021). Talent identification and development allow for the inclusion of players from outside the game with the potential to advance in development programmes (Williams & Reilly, 2000). It has been suggested that a multidisciplinary approach should be explored to identify talented youth players by measuring some predictor variables, including physical, technical-tactical, maturity, and psychological factors (Williams, Ford, & Drust, 2020).

Soccer is considered the world's leading sport in terms of participation, licenses, spectatorship, financial resources, and revenues (Bourke, 2003). Therefore, millions of youth players participate in systematic selection programmes in professional soccer academies worldwide (Ford, et al., 2020). Detecting young talent for soccer has become an issue in recent years (Bergkamp, Niessen, den Hartigh, Frencken & Meijer, 2019). Recruitment at an early stage in a soccer academy is crucial for the long-term development of a player (Ford, et al., 2020). Soccer scouts are constantly looking for talented young players to develop elite players. This has led to a growing number of evaluation tools for talent identification and development in soccer (Pino-Ortega, Rojas-Valverde, Gómez-Carmona & Rico-González, 2021).

Many reviews have been written on talent identification in soccer (Fernández-Rio & Méndez-Giménez, 2014; Focan, Paraschiv & Zamfir, 2018; Sarmento, Anguera, Pereira & Araújo, 2018; Williams, 2020; Williams & Reilly, 2000). However, there are gaps in the literature regarding the main variables assessed by researchers and exercise scientists in investigations related to the talent identification and development process in soccer. The rationale for conducting this scoping review lies in the increasing recognition of the complex and multifactorial nature of talent in soccer, where physical, technical, tactical, psychological, and sociological factors all play critical roles in player's success. As youth soccer talent identification becomes more central to the development of elite players, understanding which variables are most frequently assessed becomes essential. Therefore, this scoping review aims to identify the main variables assessed in studies regarding talent identification and development in soccer.

Methods

Search strategy

This scoping review has been previously registered at OSF Registries (https://osf.io/beqyh/). A systematic literature search was carried out on PubMed (n = 201), Web of Science (n = 235), and Scopus (n = 338) databases from September to October 2023 by two authors (VOS and CPF). Gray literature was considered via Google Scholar. We searched for additional records through cross-referencing to avoid missing any possible relevant source. The search strategy was performed following the Preferred Reporting Items for Systematic review and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) Checklist (Tricco, et al., 2018), including the PICO strategy: P (participants) (e.g., student, adolescent, child, young); I (intervention) (programme, intervention); C (comparators) (e.g., football, soccer, "sport context"); O (outcomes) (e.g., identification, detection, selection, development). The complete strategy used for searching databases previously mentioned is shown in Supplementary File 1.

Inclusion and exclusion criteria

The primary data from the articles, including title, authors, date, and database, was extracted and organized in a Microsoft Excel spreadsheet (Microsoft Excel, Microsoft, Redmond, WA, USA). Following the removal of duplicate records, two authors (VOS and CPF) screened the search results independently and blindly, considering the inclusion/exclusion criteria established using the Rayyan website (Ouzzani, Hammady, Fedorowicz & Elmagarmid, 2016). Any disagreements between the reviewers were resolved by consensus or arbitration through the third reviewer (MAPS). References that could not be eliminated by title or abstract alone were retrieved for further evaluation. In case of disagreements on the final inclusion-exclusion status, the two authors responsible for the screening discussed and decided against its inclusion or exclusion. Only peer-reviewed journal articles published in English were included, regardless the publication year. Only studies involving soccer athletes, regardless of sex, were included. Studies in which the participants were older than 18 years were excluded. Abstracts, conference papers from

annual meetings, and case studies were not included due to the need for additional information for the systematization process. Moreover, review articles, meta-analyses, pilot studies, clinical trials, association studies, and studies conducted with animal models were excluded.

Data extraction

Two authors (VOS and CPF) conducted the selection and information extraction from the studies included. The data extracted include study design, sample, variable evaluated, and evaluation tool. The data were systematized using methodological outcomes and the results of the studies. After independent screening, two researchers (VOS and CPF) discussed any differences and finalized the studies for inclusion in this review. Eventual conflicts of decisions were resolved by consensus or arbitration by the third author (MAPS). The outcomes were summarized, taking into account the author, publication year, sample size, and the evaluation tools employed in the talent identification and development process (see Supplementary File 2).

Quality assessment

We evaluated the quality of the cross-sectional studies using The Joanna Briggs Institute (JBI) Critical Appraisal Checklist for studies reporting prevalence data (Munn, MClinSc, Lisy, Riitano & Tufanaru, 2015), and for longitudinal studies, the assessment was conducted with the Newcastle-Ottawa Quality Assessment Scale (Wells, Shea, O'Connell & Peterson, 2000). Two reviewers assessed the quality of each article (VOS and CPF), with disagreements resolved by consensus or arbitration by the third reviewer (MAPS). The complete scores for the studies in this review are shown in Supplementary File 2.

The JBI Critical Appraisal Checklist comprises eight items, each scored as "Yes", "No", "Unclear", or "Not applicable". This checklist examines the potential for bias in three domains: (I) design, (II) conduct, and (III) analysis. Each article was assessed based on nine specific criteria: (Item 1) Was the sample frame appropriate to address the target population? (Item 2) Were study participants sampled in an appropriate way? (Item 3) Was the sample size adequate? (Item 4) Were the study subjects and the setting described in detail? (Item 5) Was the data analysis conducted with sufficient coverage of the identified sample? (Item 6) Were valid methods used for the identification of the condition? (Item 7) Was the condition measured in a standard, reliable way for all participants? (Item 8) Was there appropriate statistical analysis? (Item 9) Was the response rate adequate, and if not, was the low response rate managed appropriately? The overall appraisal was categorized as 'Include', 'Exclude' and 'Seek further info'.

The Newcastle-Ottawa Quality Assessment Scale consists of eight items grouped into three categories: (i) selection (1. Representativeness of the exposed cohort; 2. Selection of the non-exposed cohort [controls]; 3. Ascertainment of exposure, and 4. Demonstration that outcome of interest was not present at start of study), (ii) comparability (5. Comparability of cohorts on the basis of the design or analysis), and (iii) outcome (6. Assessment of outcome; 7. Was follow-up long enough for outcomes to occur? and 8. Adequacy of follow up of cohorts). For each study, the items from the selection and outcome categories were assessed with one star, and a maximum of two stars was used in the comparability category.

Results

Studies included

A total of 774 articles were initially retrieved from the databases used in this review, out of which 245 were excluded after duplicate removal. Additionally, 104 records were added after consulting the gray literature and through cross-referencing. A total of 529 articles were analyzed by reviewing the title, abstract, and year of publication considering the exclusion and inclusion criteria. Finally, 423 studies were read in their full-text version. Since they did not contemplate the purpose of this review, 233 studies were discarded. Thus, 190 articles were included (Figure 1).

Participants' characteristics

The sample size of the studies ranged from 10 (Zago, et al., 2016) to 68,158 (Höner, Votteler, Schmid, Schultz & Roth, 2015). Considering the studies that described the average age of the participants, the sample included in this review was 13.3±0.8 years old. Although some studies did not specify the average age, they disclosed the minimum and maximum age, which ranged from three to 18 years. Out of the 162 studies on talent identification, 85.3% focused on male athletes, while only 3.7% involved females exclusively, and another 3.7% included both males and females. Additionally, 7.4% of the studies did not specify the participants' sex. Further details can be found in Supplementary File 2.

Studies' characteristics

Out of the 190 articles included in this scoping review, 99 evaluated the sprint performance, 80 investigated the maturity status, 77 evaluated the lower limbs strength, 68 investigated the aerobic capacity, and 62 examined the agility of their participants. In addition, technical skills,

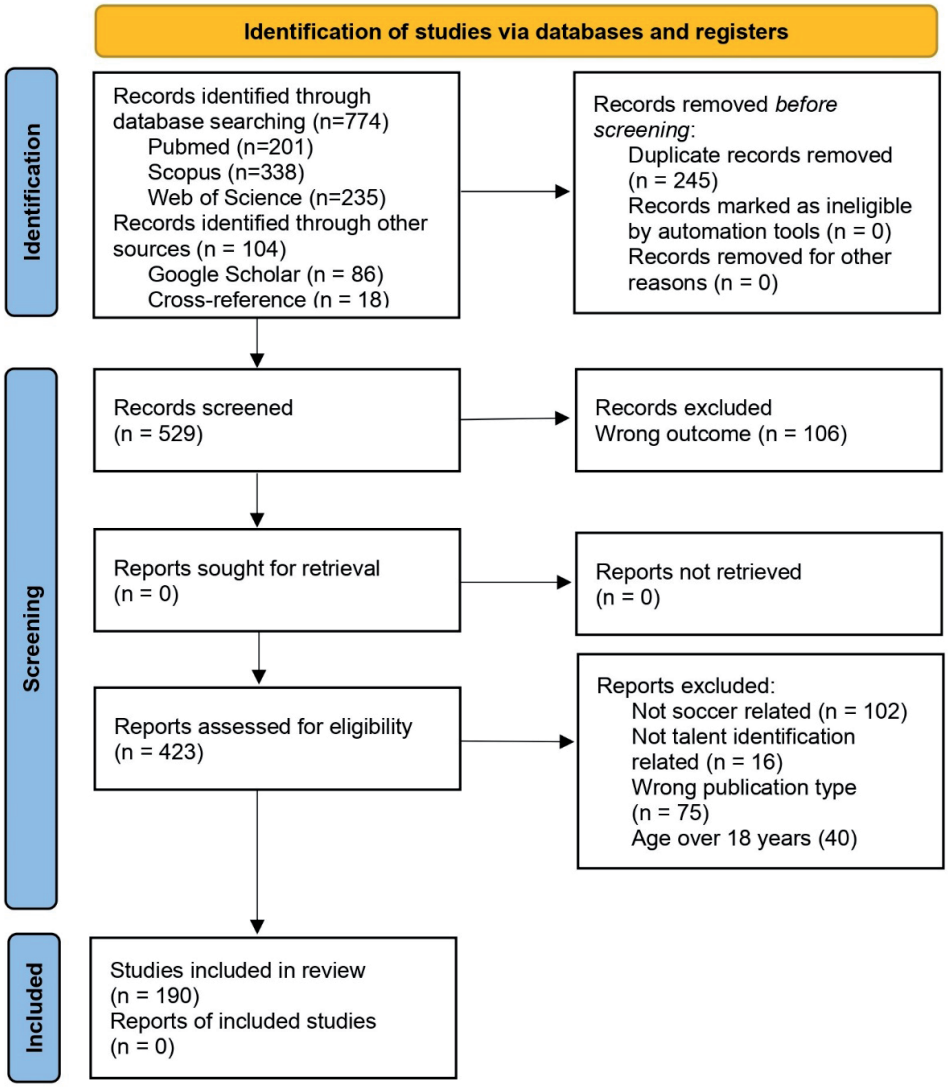

Figure 1. Search strategy flow diagram of the study

including passing, dribbling, controlling, heading, and kicking, were used in 32 studies and tactical skills were evaluated in 27 studies, as seen in Figure 2. A cross-sectional design was employed in 80% of the studies, with the remaining 20% using a longitudinal design. The follow-up period of the longitudinal studies included in this review ranged from six months (Clemente, et al., 2021) to ten years (Craig & Swinton, 2021).

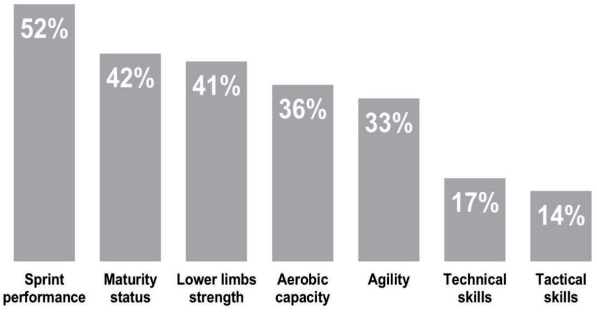

Figure 2. Distribution of variables assessed in talent identification studies included in this review

The cross-sectional studies met 78% to 100% of the quality criteria, with an average of 95%, as assessed by the JBI Critical Appraisal Checklist for Analytical Cross-Sectional Studies. Similarly, the longitudinal studies met 67% to 100% of the quality criteria, with an average of 81%, scoring six to eight stars according to the Newcastle-Ottawa Quality Assessment Scale. All the studies received an overall appraisal of 'include' (Supplementary file 2).

Discussion and conclusions

This study presented a review of the available literature on the talent identification and development of soccer players. The main finding of our study is that the majority of the studies focused on physical performance-related variables in talent identification and development in soccer. Sprint performance emerged as the most frequently evaluated metric, with 52.1% of the studies recognizing its significance. This reflects the widely acknowledged importance of speed in soccer, an attribute

that can significantly influence the effectiveness on the field. Furthermore, maturity status and lower limbs strength were evaluated in 42.1% and 40.5% of the studies, respectively. These variables address fundamental aspects of a player's physical development. Lower limb power is crucial for shooting, tackling, and jumping. Likewise, assessing maturity status acknowledges the potential impact of growth and development trajectories on performance.

Not surprisingly, we observed that maturity status, physical performance, anthropometry, as well as technical and tactical skills were investigated in most of the studies in this review. Considering the specificity of soccer, the majority of the investigations assessed variables that closely replicate the demands of the game, including high-intensity running, agility, and rapid changes of direction.

It is worth mentioning that maturity can significantly impact the other variables considered in this review, particularly in the context of sports and exercise, including soccer (Hunter, et al., 2022). During adolescence, the body undergoes significant changes as it develops from a child to an adult, including increases in height, body mass, and muscle mass, as well as changes in bone density, hormonal levels, and other physiological systems (Malina, et al., 2018). As a result, physical abilities such as strength, speed, and endurance can improve dramatically during this time (Albaladejo-Saura, Vaquero-Cristóbal, González-Gálvez & Esparza-Ros, 2021). Moreover, there can be individual differences in the timing and pace of physical maturation, with some individuals developing faster or slower than others (Albaladejo-Saura, et al., 2021). This can result in players of the same age having noticeably diverse physical characteristics, which, in turn, can affect how they perform in tests.

The predominance of physical performance parameters in talent identification for soccer research reflects several factors related to the sport's demands. Soccer relies heavily on physical abilities such as speed, strength, agility, and endurance, which are essential for performing actions like sprinting, tackling, jumping, and rapid changes of direction (Bidaurrazaga-Letona, Lekue, Amado, Santos-Concejero & Gil, 2015). Moreover, physical performance metrics are relatively straightforward to assess using standardized field-based tests, which are often practical, affordable, and can be conducted with minimal equipment. Finally, the emphasis on physical performance is partly due to its high relevance in competitive play and the need for efficiency in identifying players who can perform well under the physical demands of soccer. However, as this review suggests, a more balanced approach, including technical, tactical, and maturational evaluations, may provide a more comprehensive insight into a player's potential beyond physical abilities.

Sprint performance

Sprint performance was the most evaluated variable in the studies included in this scoping review, present in 99 articles (52.1%). All the studies used practical field-based sprint tests to estimate this parameter. The primary test used for evaluating the sprint performance in the studies included in this review was the 30-m sprint test, used in 31 (31.3%) studies. Sprint ability plays a crucial role in soccer, accounting for around 11% of the total distance covered during a match (Rampinini, Coutts, Castagna, Sassi & Impellizzeri, 2007). In addition, it has been reported that sprint performance can distinguish among youth soccer players of diverse levels of play (Comfort, Stewart, Bloom & Clarkson, 2013). Similarly, it is widely recognized that sprint ability is strongly associated with lower body power in both elite soccer players (Wisløff, Castagna, Helgerud, Jones & Hoff, 2004) and youth soccer athletes (Comfort, Stewart, Bloom & Clarkson, 2014).

Maturity status

It was observed that maturity status was widely evaluated, being investigated in 42.1% of the studies included in this review. Among the methods used to assess the maturity status of the participants, the relative age effect (RAE) and the determination of the age at peak height velocity (PHV) stood out. RAE is a phenomenon that describes an unbalanced distribution of individuals within a group, where those born shortly after the established cut-off date gain certain advantages, while those born later face several disadvantages (Bilgiç & Işın, 2023). For instance, players born from January 1st to December 31st of a given year may be in the same age group. This means a player born in January could be a year older than a player born in December of the same year, which may pose an advantage for their immediate and long-term development in several contexts, including sports and education (Baker, Schorer & Cobley, 2010). The competitive advantage observed in the older athletes in their age group results from the older athletes being more physically and emotionally mature (Helsen, et al., 2012).

PHV, which typically occurs during puberty, a period characterized by significant physical and hormonal changes, refers to the period during growth and development when individuals experience the fastest rate of longitudinal growth (Patel, Nevill, Cloak, Smith & Wyon, 2019). Soccer players are expected to achieve their PHV for around one year between 10.7 and 15.2 years oof age, accelerating their growth rate at approximately 7.5-9.7 cm/year (Philippaerts, et al., 2006). In soccer, biological maturation is regarded as the status, timing, and tempo of progress demanded to achieve maturity (Malina, Eisenmann, Cumming, Ribeiro &

Aroso, 2004). The age at PHV is widely estimated using anthropometric measurements (see Mirwald, Baxter-Jones, Bailey & Beunen, 2002 for more details).

Additionally, it has been reported that anthropometry and performance dimensions alone can contribute to a maturity-selection bias, in which early-maturing players are over-selected (Carling, Le Gall & Malina, 2012). Some professional soccer club confederations, such as the English Premier League, have invested in the development frameworks of athletes considering the influence of maturity status (Ford, et al., 2011). Overall, practitioners and coaches should establish realistic expectations for physical abilities of younger players, considering their biological characteristics rather than relying solely on chronological age-based standards (Deprez, et al., 2013).

Using maturity status in talent identification offers advantages but raises ethical concerns. By accounting for maturity, evaluations can differentiate players based on developmental stage rather than age alone, improving accuracy and reducing bias towards early maturers who may appear more physically capable. This approach supports creating developmentally appropriate training programmes, minimizing injury risks and setting realistic performance expectations. However, labelling players by maturity can lead to bias, where late-maturing athletes may be undervalued, limiting their development opportunities and impacting their self-esteem. To ensure fairness, talent identification must balance these practices to prevent exclusion, provide equal developmental resources, and avoid potential biases, supporting all athletes regardless of their maturity level.

Lower limbs strength

Likewise, we observed that lower limbs strength was also among the most evaluated parameters in the studies included in this review, investigated in 77 (40.5%) articles. Lower limbs strength can be easily estimated by measuring vertical jump height using validated tools such as smartphone applications (Cruvinel-Cabral, et al., 2018) and stride sensors (Santos, et al., 2021). The countermovement jump was the most used test of lower limbs power, present in 59 (76.6%) studies that evaluated the lower limbs strength of their subjects. Lower limbs strength is a crucial aspect of soccer performance as it involves the ability of the muscles in the lower body, particularly the legs, to generate force quickly and explosively. This power is vital for actions like sprinting, jumping, kicking, and changing direction rapidly, all of which are fundamental in soccer (Murtagh et al., 2018). Evidences indicate that jumping ability can distinguish between elite and sub-elite youth soccer players and may be valuable for coaching staff during the athlete selection process (Comfort, et al., 2013). Therefore, soccer academy coaches should consider including sprint ability and lower limbs power as parameters in their talent identification and development programmes.

Aerobic capacity

Aerobic capacity is well-known for its importance in excellency in soccer and incorporating aerobic conditioning and endurance training into a soccer players' regimen is essential for success on the field. It has been reported that elite soccer players usually cover up to 12km during a competitive official match at an average intensity of around 70% of their maximal oxygen consumption (Stølen, Chamari, Castagna & Wisløff, 2005). Aerobic training postpones fatigue onset; thus, coaches employ soccer fitness drills and activities related to developing aerobic fitness.

Aerobic fitness is paramount in soccer performance as it enables the players to sustain high-intensity efforts throughout a match. In matches that frequently extend beyond 90 minutes, players with high aerobic condition, depending on their playing position, demonstrate improved endurance that enables them to sustain peak performance, make critical decisions, and execute skills effectively, even in the final stages of the game (Deprez, et al., 2015). Moreover, a well-conditioned aerobic system facilitates rapid recovery between sprints, reducing the risk of fatigue-induced errors and injuries (Roe & Malone, 2016). Endurance capacity also enables players to cover more ground, contributing both offensively and defensively. Additionally, aerobic fitness provides adaptability to different styles of play, making it an indispensable factor of a successful soccer player. Moreover, it has been reported that aerobic fitness, a key factor for soccer performance, increases by age- and maturity-status-driven morphological changes (Armstrong & Welsman, 2019).

Out of the 68 studies included in this review, which assessed the aerobic performance of the participants, 46 (67.6%) used the Yo-Yo intermittent recovery test level 1. The test provides an estimate of an individual's maximal aerobic speed and his/her ability to recover from high-intensity efforts. It is a valuable tool for coaches and athletes to monitor and evaluate aerobic fitness, especially in sports where repeated bouts of high-intensity efforts are common.

Agility

Agility, also regarded as an essential skill in soccer, was largely investigated in 62 (32.6%) studies included in this review. Agility is recognized as a vital physical ability in competitive team sports, including soccer., as it empowers players to quickly change direction, evade opponents, and react swiftly to the dynamic demands of the

game (Krolo, et al., 2020). In soccer, where decisions and sudden shifts in movements are widely common, agile players gain a technical advantage by outmaneuvering opponents and creating scoring opportunities. Whether executing precise dribbles, defending against attacking runs, or transitioning from offense to defense, agility is a crucial ability to maintain control and effectiveness considering the fast-paced and dynamic nature of soccer. Additionally, it has been demonstrated that neuromuscular training significantly improves agility performance of elite soccer players (Wojtys, Huston, Taylor & Bastian, 1996), which is associated with lower incidence of injuries (Mijatovic, Krivokapic, Versic, Dimitric & Zenic, 2022). Thus, agility stands as a cornerstone of a players' holistic skill set, enabling them to excel in the complex and multifaceted demands of high-level soccer.

Technical skills

Proficiency in technical skills, investigated in 32 (16.8%) studies included in this review, plays a pivotal role in optimal performance in the sport. Dribbling, the art of controlling the ball in motion, empowers players to navigate through intricate defensive formations, affording them a strategic advantage and enabling fluid offensive plays. Accurate passing, a cornerstone of effective teamwork, facilitates ball circulation, cohesive team dynamics, and the execution of strategic maneuvers. Juggling, while displaying a players' exceptional ball-controlling dexterity, refines their touch and spatial awareness, enhancing their versatility on the field. Shooting, the combination of precision, power, and technique, holds the potential to change the score of the game. Finally, heading, a specialized skill, endows players with a distinct advantage in aerial duels, both in attack and defense. Collectively, these technical skills serve as the foundational elements that not only distinguish elite players but also catalyze the orchestration of cohesive, dynamic, and tactically astute gameplay (Esposito & Raiola, 2020). In our review, we observed that dribbling, passing, touching, juggling, shooting, and heading skills were assessed in the majority of the studies. Mastery of these skills, as well as other factors such as teamwork, strategy, and mental toughness, can help players to succeed in the sport at all levels, from amateur to professional (Focan, Paraschiv & Zamfir, 2018).

Tactical skills

In our scoping review, we found that tactical characteristics were assessed in 27 studies (14.2%). Among these, five studies employed the Tactical Skills Inventory for Sports (TACSIS), a self-assessment questionnaire, developed by Elferink-Gemser, Visscher, Richart & Lemmink (2004). In team sports, tactical skills involve a player's ability to execute the appropriate action at the right moment and swiftly adjust to changes in the play and the movement of the ball (Elferink-Gemser, et al., 2004). These skills encompass key elements such as positioning and decision-making, understanding ball dynamics, awareness of other players, and adaptability in changing situations (Abarghoueinejad, et al., 2021). Tactical skills like behavior in one-on-one offensive and defensive situations, anticipation, decision-making, and game intelligence are critical for reaching elite performance in soccer (Roca, Williams & Ford, 2012). Therefore, coaches should consider including tactical skills tests in their talent identification programmes because such a comprehensive evaluation helps ensure that the selected players have the potential to perform well under pressure, contribute to team success, and develop into top-level athletes.

Psychological characteristics

Psychological skills were each assessed in 22 (11.6%) of the studies included in this scoping review. Sports psychology is a field within psychology that focuses on the scientific study of individuals and their behavior in the context of sports or physical activity. One of its key aims is to understand emotional stabilization, making the exploration of both positive and negative emotions its central area of interest (Martinent, Ledos, Ferrand, Campo & Nicolas, 2015). In the realm of sports, emotions such as stress, pressure, tension, competition anxiety, nervousness, concern, and fright have garnered significant experimental interest. In sports psychology, these emotions are often classified as different forms of anxiety. They are a major focus of study, as they involve unpleasant sensations that can impact performance in either positive or negative ways, and are frequently debated and analyzed by psychologists (Burton & Naylor, 1997). Regarding the optimization of talent identification and development in sports, the importance of developing psychosocial characteristics in younger athletes was highlighted, noting that these traits may not yet be fully developed but could be crucial for future success (Till & Baker, 2020). Given the significant impact of emotions like anxiety on athletic performance, coaches should consider incorporating tests related to psychological characteristics into their talent identification programmes.

Motor coordination and motion-video analysis

Our scoping review also identified 15 studies (7.9%) that evaluated motor coordination and 17 studies (8.9%) that conducted motion tracking analysis using footage or global positioning system (GPS) tracking. Motor coordination skills play a crucial role in soccer, as they directly impact players' ability to perform various movements and techniques on the field (Archer, Drysdale &

Bradley, 2016). Players can improve their motor coordination skills through soccer participation as it enhances lower limb coordination and reduces motor lateralization. Additionally, utilizing foot motor performance measurements for talent identification in soccer could be advantageous for selecting less lateralized players from the beginning (Akpinar, 2022). The Körperkoordinationstest für Kinder prominently surfaced as the most frequently utilized evaluation instrument within the scope of our study, present in 10 studies. The specific components of the test may vary, but common elements often include tasks regarding balance, agility, spatial awareness, and fine motor skills. Results from this test can provide valuable insights into a child's physical development, motor proficiency, and potential areas for improvement (Novak, et al., 2017).

Likewise, motion tracking analysis in soccer involves using technology to capture and analyze movements of players and the ball during a match. This sophisticated technique provides valuable data that can be used for several purposes in soccer, including tactical analysis (Bastida-Castillo, Gómez-Carmona, De La Cruz Sánchez & Pino-Ortega, 2019) and performance improvement (Reinhardt, Schwesig, Lauenroth, Schulze & Kurz, 2019). The majority of the studies included in this scoping review used game footage and GPS tracking for motion analysis in their investigations.

Small-sided games

Small-sided games were also evaluated as a variable related to talent identification and development in soccer, appearing in 14 (7.4%) of the articles included in this scoping review. Small-sided games refer to matches played on a smaller field with fewer players on each team compared to the traditional full-field matches. The number of players, field size, and rules can vary, but they typically involve three to five players per team. This training method is used to develop specific skills, improve fitness, and enhance tactical understanding. It has been reported that the tactical demands of small-sided games reflect those of 11-vs-11 games (Olthof, Frencken & Lemmink, 2019). Small-sided games are played on reduced field areas with fewer players and modified rules, with the capability of replicating the movement requirements, physiological intensity, and technical demands of an actual match play (Hill-Haas, Dawson, Impellizzeri & Coutts, 2011). It has been suggested that small-sided games play a significant role in developing technical skills and tactical awareness (Little, 2009). The popularity of small-sided games as a training modality in soccer is primarily due to their practicability, low cost, and overall similarity with competitive match-play. Coaches could benefit from these advantages in their pursuit of soccer talents. In addition, it is well known that soccer requires a range of skills that are specific to the sport, including technical, tactical, physical, and mental skills.

Strength of the upper body and flexibility

Strength of the upper body and flexibility were evaluated in 11 (5.8%) and 14 (7.4%) studies included in this review, respectively. Although soccer is primarily a sport that involves running, agility, and lower body strength, upper body strength is still important for several aspects of the game, including balance and stability, throw-ins, physical duels and prevention of injury due to falls (Sabag, et al., 2020). The medicine ball throw test was the most commonly used test to measure upper body power and strength. Its objective is to measure the maximum distance an individual can throw a medicine ball (usually weighing 2-5 kg) from a standing or sitting position. Similarly, flexibility is an important component of physical fitness for soccer players as it plays a crucial role in injury prevention, range of motion, agility, and overall athletic performance (Cejudo, et al., 2019). The sit-and-reach test was widely investigated to evaluate flexibility of soccer athletes in the studies included in this scoping review, mostly due to its practicability, efficiency, and reliability.

Other variables

In addition to the commonly assessed variables, this scoping review identified a range of other factors evaluated across a smaller number of studies, which may offer deeper insights into soccer talent development and performance. One such factor is time of match-play, which has been explored for its role in understanding how experience and exposure in game-play affect skill acquisition and performance consistency (Clemente et al., 2021). Hormonal factors were another key area, reflecting an increased focus on how hormonal fluctuations, such as cortisol and testosterone levels, can impact training adaptation, recovery, and mental resilience (Baldari, et al., 2009). This emphasis on hormonal responses underscores their potential influence in predicting player readiness and long-term development (Eskandarifard, Nobari, Sogut, Clemente & Figueiredo, 2022). Finally, this review highlights physiological factors as critical to a holistic approach, including cardiovascular capacity, muscle endurance, and metabolic efficiency (Nobari, et al., 2021; Waldron & Murphy, 2013). Together, these diverse factors highlight the importance of a multi-dimensional framework for assessing soccer talent, integrating physical, biological, and experiential elements to provide a comprehensive understanding of what contributes to a player's potential.

The inclusion of less studied variables like time of match-play, hormonal factors, and physiological factors enhances talent identification in soccer by

addressing essential aspects of a player's development that traditional metrics may overlook. Time of play offers insights into endurance, resilience, and decision-making over extended periods, reflecting a player's capacity to maintain performance under fatigue, which is a key in high-stakes matches (Mohr, Krustrup & Bangsbo, 2003). Hormonal factors provide valuable information on growth, recovery, and adaptation, helping to assess players' readiness for training and competition and identifying those who may be at risk of overtraining or injury due to rapid physical development (Baldari, et al., 2009). Additionally, examining physiological factors like heart rate variability and metabolic efficiency reveals how players manage energy during different intensities, which is crucial for sustaining high performance throughout matches (Nobari, et al., 2021). Together, these variables deliver a comprehensive view of a player's endurance, physical readiness, and adaptability, making talent identification more effective by considering long-term developmental and health aspects essential for reaching elite levels in soccer.

Limitations and future perspectives

A limitation of this literature review is that we included only studies in English from Pubmed, Web of Science, and Scopus databases. Thus, we may have overlooked other relevant studies published in other languages or from other databases. Additionally, we observed that most of the studies in this review addressed the talent identification and development process in male athletes. Given the findings of this scoping review, future research should expand the focus on underrepresented areas in talent identification and development in soccer. Specifically, there is a need for more studies involving female athletes to ensure that the processes and variables assessed are equally applicable across sexes. Additionally, the integration of more sophisticated and objective assessment tools, such as wearable technology and machine learning algorithms, could enhance the accuracy and predictive power of talent identification models. Future investigations should also explore the influence of psychological and social factors, which remain less examined, on the development and progression of young soccer players.

The methodological quality of the studies included in this review was generally robust, with cross-sectional studies meeting an average of 95% of the quality criteria, while longitudinal studies met an average of 81% based on the established appraisal tools. However, variability in study design, sample sizes, and the types of assessment tools used may impact the interpretation of findings, particularly concerning talent identification metrics. Most studies relied on field-based tests, which, while practical and cost-effective, may lack the precision of laboratory assessments for capturing detailed physiological or technical data. Additionally, the predominance of cross-sectional designs limits insights into the developmental trajectories of athletes, which are critical for understanding long-term talent progression. This methodological diversity introduces some inconsistency in data comparability, suggesting a need for standardized assessment protocols to ensure that findings are both reliable and generalizable across different contexts in soccer talent identification.

Our findings highlight the complex relationship between physical performance, technical/tactical skills, and maturity status in talent identification programmes in soccer. While the review highlights the frequent assessment of these factors, it also raises questions about the potential over-reliance on physical attributes at the expense of a more holistic evaluation. Moreover, the limited focus on psychological characteristics suggests a gap in current talent identification frameworks, potentially missing critical elements that contribute to long-term success in sports. Therefore, a more balanced and comprehensive assessment strategy is recommended, which equally values physical, technical, psychological, and maturity-related factors to ensure a more inclusive and effective talent identification process.

Additionally, the findings of this review reveal a significant emphasis on physical performance parameters, such as sprint speed, lower limb strength, and aerobic capacity, in talent identification programmes for youth soccer players. However, overreliance on physical assessments risks overlooking other critical attributes which contribute to long-term player success. This approach may favor early maturing athletes who excel in physical tests, potentially leading to a maturity-selection bias and overlooking players who may develop these capacities later but possess strong technical, tactical, or psychological skills. Therefore, while physical capabilities are essential, a more balanced approach incorporating technical skills, decision-making abilities, and psychological resilience is crucial. This holistic approach could provide a more inclusive pathway for identifying talent, ensuring that players with diverse strengths, beyond physical performance, have the opportunity to progress and maximize their potential in the sport.

Finally, female athletes are underrepresented in talent identification research, with only 7.4% of studies including female participants. This gap limits the understanding of how physiological, psychological, and social factors uniquely impact talent in women's soccer. Female athletes experience different physical development timelines, with factors like hormonal fluctuations and muscle distribution influencing performance metrics differently than in males. Additionally, social and psycholog-

ical motivators, such as a supportive environment, are crucial for sustained engagement in sports for females. Without dedicated research, talent identification programmes risk using biased evaluation criteria that may undervalue the strengths of female athletes, such as agility, endurance, or tactical insight. Addressing this research gap is essential for developing more inclusive talent identification frameworks that reflect the diverse capabilities of female players.

Our study provides a review of the current literature regarding the dimensions of the talent identification and development process in youth soccer, as well as the variables and tests used for these evaluations. From the studies reviewed, we concluded that sprint performance, maturity status, lower limbs power, anthropometric measures, aerobic capacity, and agility were the most evaluated variables in the articles available in literature. Furthermore, most of the tests used to evaluate these variables are affordable and practical. Researchers and practitioners in soccer talent identification should adopt a balanced, multidimensional approach that includes physical, technical, tactical, and psychological variables alongside maturity status to accurately assess player potential. Actionable recommendations include implementing assessments that go beyond physical performance, such as incorporating decision-making and game intelligence tests, which reflect real-game demands. Practitioners should be cautious of over-reliance on maturity-linked physical attributes to avoid bias towards early maturers, ensuring that late-developing players are provided equal opportunities and resources for development. To address the gaps identified in this review, future research should prioritize more comprehensive, longitudinal studies that assess both male and female athletes across a broader range of variables, including technical, tactical, and psychological factors alongside physical attributes.

References

Abarghoueinejad, M., Barreira, D., Dias, C., Guimarães, E., Baxter-Jones, A. D. G., & Maia, J. (2021). Body physique, body composition, physical performance, technical and tactical skills, psychological development, and club characteristics of young male portuguese soccer players: The inex study. *International Journal of Environmental Research and Public Health*, *18*(7). https://doi.org/10.3390/ijerph18073560

Akpinar, S. (2022). Participation of Soccer Training Improves Lower Limb Coordination and Decreases Motor Lateralization. *BioMed Research International*, *2022*. https://doi.org/10.1155/2022/7525262

Albaladejo-Saura, M., Vaquero-Cristóbal, R., González-Gálvez, N., & Esparza-Ros, F. (2021). Relationship between biological maturation, physical fitness, and kinanthropometric variables of young athletes: A systematic review and meta-analysis. *International Journal of Environmental Research and Public Health*, *18*(1), 1–20. https://doi.org/10.3390/ijerph18010328

Archer, D. T., Drysdale, K., & Bradley, E. J. (2016). Differentiating technical skill and motor abilities in selected and non-selected 3-5 year old team-sports players. *Human Movement Science*, *47*, 81–87. https://doi.org/10.1016/j.humov.2016.02.001

Armstrong, N., & Welsman, J. (2019). Clarity and confusion in the development of youth aerobic fitness. *Frontiers in Physiology*, *10*(JUL). https://doi.org/10.3389/fphys.2019.00979

Baker, J., Schorer, J., & Cobley, S. (2010). Relative age effects: An inevitable consequence of elite sport? *Sportwissenschaft*, *40*(1), 26–30. https://doi.org/10.1007/s12662-009-0095-2

Baldari, C., Di Luigi, L., Emerenziani, G. P., Gallotta, M. C., Sgró, P., & Guidetti, L. (2009). Is explosive performance influenced by androgen concentrations in young male soccer players? *British Journal of Sports Medicine*, *43*(3), 191–194. https://doi.org/10.1136/bjsm.2007.040386

Bastida-Castillo, A., Gómez-Carmona, C. D., De La Cruz Sánchez, E., & Pino-Ortega, J. (2019). Comparing accuracy between global positioning systems and ultra-wideband-based position tracking systems used for tactical analyses in soccer. *European Journal of Sport Science*, *19*(9), 1157–1165. https://doi.org/10.1080/17461391.2019.1584248

Bergkamp, T. L. G., Frencken, W. G. P., Niessen, A. S. M., Meijer, R. R., & den Hartigh, R. J. R. (2021). How soccer scouts identify talented players. *European Journal of Sport Science*. https://doi.org/10.1080/17461391.2021.1916081

Bergkamp, T. L. G., Niessen, A. S. M., den Hartigh, R. J. R., Frencken, W. G. P., & Meijer, R. R. (2019). Methodological Issues in Soccer Talent Identification Research. *Sports Medicine*, *49*(9), 1317–1335. https://doi.org/10.1007/s40279-019-01113-w

Bidaurrazaga-Letona, I., Lekue, J. A., Amado, M., Santos-Concejero, J., & Gil, S. M. (2015). Identifying talented young soccer players: Conditional, anthropometrical and physiological characteristics as predictors of performance. *RICYDE: Revista Internacional de Ciencias Del Deporte*, *11*(39), 79–95. https://doi.org/10.5232/ricyde2015.03906

Bilgiç, M., & Işın, A. (2023). Embarking on a journey: a bibliometric analysis of the relative age effect in sport science. *German Journal of Exercise and Sport Research*, *53*(3), 325–332. https://doi.org/10.1007/s12662-021-00792-w

Bourke, A. (2003). The Dream of Being a Professional Soccer Player. *Journal of Sport and Social Issues*, *27*(4), 399–419. https://doi.org/10.1177/0193732503255478

Burton, D., & Naylor, S. (1997). Is anxiety really facilitative? Reaction to the myth that cognitive anxiety always impairs sport performance. *Journal of Applied Sport Psychology*, *9*(2), 295–302. https://doi.org/10.1080/10413209708406488

Carling, C., Le Gall, F., & Malina, R. M. (2012). Body size, skeletal maturity, and functional characteristics of elite academy soccer players on entry between 1992 and 2003. *Journal of Sports Sciences*, *30*(15), 1683–1693. https://doi.org/10.1080/02640414.2011.637950

Cejudo, A., Robles-Palazón, F. J., Ayala, F., De Ste Croix, M., Ortega-Toro, E., Santonja-Medina, F., & De Baranda, P. S. (2019). Age-related differences in flexibility in soccer players 8-19 years old. *PeerJ*, *2019*(1). https://doi.org/10.7717/peerj.6236

Clemente, F. M., Clark, C. C. T., Leão, C., Silva, A. F., Lima, R., Sarmento, H., Figueiredo, A. J., Rosemann, T., & Knechtle, B. (2021). Exploring Relationships Between Anthropometry, Body Composition, Maturation, and Selection for Competition: A Study in Youth Soccer Players. *Frontiers in Physiology*, *12*(January), 1–9. https://doi.org/10.3389/fphys.2021.651735

Comfort, P., Stewart, A., Bloom, L., & Clarkson, B. (2013). A comparison of performance characteristics in elite and sub-elite youth soccer players. *Journal of Strength and Conditioning Research*, *30*(6), 1534–1539. https://doi.org/10.1519/JSC.0000000000001243

Comfort, P., Stewart, A., Bloom, L., & Clarkson, B. (2014). Relationships between strength, sprint, and jump performance in well-trained youth soccer players. *Journal of Strength and Conditioning Research*, *28*(1), 173–177. https://doi.org/10.1519/JSC.0b013e318291b8c7

Craig, T. P., & Swinton, P. (2021). Anthropometric and physical performance profiling does not predict professional contracts awarded in an elite Scottish soccer academy over a 10-year period. *European Journal of Sport Science*, *21*(8), 1101–1110. https://doi.org/10.1080/17461391.2020.1808079

Cruvinel-Cabral, R. M., Oliveira-Silva, I., Medeiros, A. R., Claudino, J. G., Jiménez-reyes, P., & Boullosa, D. A. (2018). The validity and reliability of the " My Jump App " for measuring jump height of the elderly. *PeerJ*, *6*(1), 1–13. https://doi.org/10.7717/peerj.5804

Deprez, D. N., Coutts, A. J., Fransen, J., Deconinck, F., Lenoir, M., Vaeyens, R., & Philippaerts, R. (2013). Relative age, biological maturation and anaerobic characteristics in elite youth soccer players. *International Journal of Sports Medicine*, *34*(10), 897–903. https://doi.org/10.1055/s-0032-1333262

Deprez, D. N., Fransen, J., Boone, J., Lenoir, M., Philippaerts, R., & Vaeyens, R. (2015). Characteristics of high-level youth soccer players: variation by playing position. *Journal of Sports Sciences*, *33*(3), 243–254. https://doi.org/10.1080/02640414.2014.934707

Elferink-Gemser, M. T., Visscher, C., Richart, H., & Lemmink, K. A. P. M. (2004). Development of the Tactical Skills Inventory for Sports. *Perceptual and Motor Skills*, *99*(7), 883. https://doi.org/10.2466/pms.99.7.883-895

Eskandarifard, E., Nobari, H., Sogut, M., Clemente, F. M., & Figueiredo, A. J. (2022). Exploring interactions between maturity status and playing time with fluctuations in physical fitness and hormonal markers in youth soccer players. *Scientific Reports*, *12*(1), 1–8. https://doi.org/10.1038/s41598-022-08567-5

Esposito, G., & Raiola, G. (2020). Monitoring the performance and technique consolidation in youth football players. *Trends in Sport Sciences*, *27*(2), 93–100. https://doi.org/10.23829/TSS.2020.27.2-6

Fernández-Rio, J., & Méndez-Giménez, A. (2014). Talent Detection and Development in Soccer: A Review. *J Sport Health Res*, *6*(1), 7–18.

Focan, G., Paraschiv, C., & Zamfir, C. M. (2018). The Identification of Talent in Soccer a Brief Review. *Revista Romaneasca Pentru Educatie Multidimensionala*, *10*(4), 282–293. https://doi.org/10.18662/rrem/88

Ford, P. R., Bordonau, J. L. D., Bonanno, D., Tavares, J., Groenendijk, C., Fink, C., Gualtieri, D., Gregson, W., Varley, M. C., Weston, M., Lolli, L., Platt, D., & Di Salvo, V. (2020). A survey of talent identification and development processes in the youth academies of professional soccer clubs from around the world. *Journal of Sports Sciences*, *38*(11–12), 1269–1278. https://doi.org/10.1080/02640414.2020.1752440

Ford, P. R., de Ste Croix, M., Lloyd, R., Meyers, R., Moosavi, M., Oliver, J., Till, K., & Williams, C. (2011). The Long-Term Athlete Development model: Physiological evidence and application. *Journal of Sports Sciences*, *29*(4), 389–402. https://doi.org/10.1080/02640414.2010.536849

Helsen, W. F., Baker, J., Michiels, S., Schorer, J., van Winckel, J., & Williams, A. M. (2012). The relative age effect in European professional soccer: Did ten years of research make any difference? *Journal of Sports Sciences*, *30*(15), 1665–1671. https://doi.org/10.1080/02640414.2012.721929

Hill-Haas, S., Dawson, B., Impellizzeri, F., & Coutts, A. (2011). Physiology of Small-Sided Games Training in Football. *Journal of Sports Medicine*, *41*(3), 199–220.

Höner, O., Votteler, A., Schmid, M., Schultz, F., & Roth, K. (2015). Psychometric properties of the motor diagnostics in the German football talent identification and development programme. *Journal of Sports Sciences*, *33*(2), 145–159. https://doi.org/10.1080/02640414.2014.928416

Hunter, A. H., Smith, N. M. A., Camata, T. V., Crowther, M. S., Mather, A., Souza, N. M., Ramos-Silva, L. F., Pazetto, N. F., Moura, F. A., & Wilson, R. S. (2022). Age- and size-corrected kicking speed and accuracy in elite junior soccer players. *Science and Medicine in Football*, *6*(1), 29–39. https://doi.org/10.1080/24733938.2021.1899274

Krolo, A., Gilic, B., Foretic, N., Pojskic, H., Hammami, R., Spasic, M., Uljevic, O., Versic, S., & Sekulic, D. (2020). Agility testing in youth football (Soccer)players; evaluating reliability, validity, and correlates of newly developed testing protocols. *International Journal of Environmental Research and Public Health*, *17*(1). https://doi.org/10.3390/ijerph17010294

Larkin, P., & O'Connor, D. (2017). Talent identification and recruitment in youth soccer: Recruiter's perceptions of the key attributes for player recruitment. *PLoS ONE*, *12*(4), 1–15. https://doi.org/10.1371/journal.pone.0175716

Little, T. (2009). Optimizing the use of soccer drills for physiological development. *Strength and Conditioning Journal*, *31*(3), 67–74. https://doi.org/10.1519/SSC.0b013e3181a5910d

Malina, R. M., Coelho-e-Silva, M. J., Figueiredo, A. J., Philippaerts, R. M., Hirose, N., Peña Reyes, M. E., Gilli, G., Benso, A., Vaeyens, R., Deprez, D., Guglielmo, L. F., & Buranarugsa, R. (2018). Tanner–Whitehouse Skeletal Ages in Male Youth Soccer Players: TW2 or TW3? *Sports Medicine*, *48*(4), 991–1008. https://doi.org/10.1007/s40279-017-0799-7

Malina, R. M., Eisenmann, J. C., Cumming, S. P., Ribeiro, B., & Aroso, J. (2004). Maturity-associated variation in the growth and functional capacities of youth football (soccer) players 13-15 years. *European Journal of Applied Physiology*, *91*(5–6), 555–562. https://doi.org/10.1007/s00421-003-0995-z

Martinent, G., Ledos, S., Ferrand, C., Campo, M., & Nicolas, M. (2015). Athletes' regulation of emotions experienced during competition: A naturalistic video-assisted study. *Sport, Exercise, and Performance Psychology*, *4*(3), 188–205. https://doi.org/10.1037/spy0000037

Mijatovic, D., Krivokapic, D., Versic, S., Dimitric, G., & Zenic, N. (2022). Change of Direction Speed and Reactive Agility in Prediction of Injury in Football; Prospective Analysis over One Half-Season. *Healthcare (Switzerland)*, *10*(3). https://doi.org/10.3390/healthcare10030440

Mirwald, R. L., G. Baxter-Jones, A. D., Bailey, D. A., & Beunen, G. P. (2002). An assessment of maturity from anthropometric measurements. *Medicine & Science in Sports & Exercise*, *34*(4), 689–694. https://doi.org/10.1097/00005768-200204000-00020

Mohr, M., Krustrup, P., & Bangsbo, J. (2003). Match performance of high-standard soccer players with special reference to development of fatigue. *Journal of Sports Sciences*, *21*(7), 519–528. https://doi.org/10.1080/0264041031000071182

Munn, Z., MClinSc, S. M., Lisy, K., Riitano, D., & Tufanaru, C. (2015). Methodological guidance for systematic reviews of observational epidemiological studies reporting prevalence and cumulative incidence data. *International Journal of Evidence-Based Healthcare*, *13*(3), 147–153. https://doi.org/10.1097/XEB.0000000000000054

Murtagh, C. F., Brownlee, T. E., O'Boyle, A., Morgans, R., Drust, B., & Erskine, R. M. (2018). Importance of speed and power in elite youth soccer depends on maturation status. *Journal of Strength and Conditioning Research*, *32*(2), 297–303. https://doi.org/10.1519/JSC.0000000000002367

Nobari, H., Silva, A. F., Clemente, F. M., Siahkouhian, M., García-Gordillo, M. Á., Adsuar, J. C., & Pérez-Gómez, J. (2021). Analysis of Fitness Status Variations of Under-16 Soccer Players Over a Season and Their Relationships With Maturational Status and Training Load. *Frontiers in Physiology*, *11*(February), 1–11. https://doi.org/10.3389/fphys.2020.597697

Novak, A. R., Bennett, K. J. M., Beavan, A., Pion, J., Spiteri, T., Fransen, J., & Lenoir, M. (2017). The applicability of a short form of the Körperkoordinationstest für Kinder for measuring motor competence in children aged 6 to 11 years. *Journal of Motor Learning and Development*, *5*(2), 227–239. https://doi.org/10.1123/jmld.2016-0028

Olthof, S. B. H., Frencken, W. G. P., & Lemmink, K. A. P. M. (2019). A match-derived relative pitch area facilitates the tactical representativeness of small-sided games for the official soccer match. *Journal of Strength and Conditioning Research*, *33*(2), 523–530. https://doi.org/10.1519/JSC.0000000000002978

Ouzzani, M., Hammady, H., Fedorowicz, Z., & Elmagarmid, A. (2016). Rayyan — a web and mobile app for systematic reviews. *Syst Rev*, *5*(210). https://doi.org/10.1186/s13643-016-0384-4

Patel, R., Nevill, A., Cloak, R., Smith, T., & Wyon, M. (2019). Relative age, maturation, anthropometry and physical performance characteristics of players within an Elite Youth Football Academy. *International Journal of Sports Science and Coaching*, *14*(6), 714–725. https://doi.org/10.1177/1747954119879348

Philippaerts, R. M., Vaeyens, R., Janssens, M., Van Renterghem, B., Matthys, D., Craen, R., Bourgois, J., Vrijens, J., Beunen, G., & Malina, R. M. (2006). The relationship between peak height velocity and physical performance in youth soccer players. *Journal of Sports Sciences*, *24*(3), 221–230. https://doi.org/10.1080/02640410500189371

Pino-Ortega, J., Rojas-Valverde, D., Gómez-Carmona, C. D., & Rico-González, M. (2021). Training design, performance analysis and talent identification—a systematic review about the most relevant variables through the principal component analysis in soccer, basketball and rugby. *International Journal of Environmental Research and Public Health*, *18*(5), 1–18. https://doi.org/10.3390/ijerph18052642

Rampinini, E., Coutts, A. J., Castagna, C., Sassi, R., & Impellizzeri, F. M. (2007). Variation in top level soccer match performance. *International Journal of Sports Medicine*, *28*(12), 1018–1024. https://doi.org/10.1055/s-2007-965158

Reinhardt, L., Schwesig, R., Lauenroth, A., Schulze, S., & Kurz, E. (2019). Enhanced sprint performance analysis in soccer: New insights from a GPS-based tracking system. *PLoS ONE*, *14*(5). https://doi.org/10.1371/journal.pone.0217782

Roca, A., Williams, A. M., & Ford, P. R. (2012). Developmental activities and the acquisition of superior anticipation and decision making in soccer players. *Journal of Sports Sciences*, *30*(15), 1643–1652. https://doi.org/10.1080/02640414.2012.701761

Roe, M., & Malone, S. (2016). Yo-Yo Intermittent Recovery Test Performance in Subelite Gaelic Football Players from under Thirteen to Senior Age Groups. *Journal of Strength and Conditioning Research*, *30*(11), 3187–3193. https://doi.org/10.1519/JSC.0000000000001417

Sabag, A., Lovell, R., Walsh, N. P., Grantham, N., Lacome, M., & Buchheit, M. (2020). Upper-Body Resistance Training Following Soccer Match Play: Compatible, Complementary, or Contraindicated? *International Journal of Sports Physiology and Performance*, *16*(2), 1–11. https://doi.org/10.1123/ijspp.2020-0762

Santos, M. A. P. dos, Cabido, C. E. T., Silvino, V. O., Mesquita, A. R. de, Nascimento, F. L. S. do, Neto, S. L. de A., Goulart, K. N. de, Szmuchrowski, L. A., Pena, B. C., Albuquerque-Neto, S. L. de, Goulart, K. N. de, Szmuchrowski, L. A., & Pena, B. C. (2021). Validity of the Polar V800 to measure vertical jump performance in taekwondo athletes. *IDO MOVEMENT FOR CULTURE. Journal of Martial Arts Anthropology*, *21*(1), 1–10. https://doi.org/10.14589/ido.21.1.3

Sarmento, H., Anguera, M. T., Pereira, A., & Araújo, D. (2018). Talent Identification and Development in Male Football: A Systematic Review. *Sports Medicine*, *48*(4), 907–931. https://doi.org/10.1007/s40279-017-0851-7

Stølen, T., Chamari, K., Castagna, C., & Wisløff, U. (2005). Physiology of Soccer: An Update. *Sports Medicine*, *35*(6), 501–536. https://doi.org/10.2165/00007256-200535060-00004

Till, K., & Baker, J. (2020). Challenges and [Possible] Solutions to Optimizing Talent Identification and Development in Sport. *Frontiers in Psychology*, *11*. https://doi.org/10.3389/fpsyg.2020.00664

Tricco, A. C., Lillie, E., Zarin, W., O'Brien, K. K., Colquhoun, H., Levac, D., Moher, D., Peters, M. D. J., Horsley, T., & Weeks, L. (2018). PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med*, *169*(7), 467–473. https://doi.org/10.7326/M18-0850

Vaeyens, R., Güllich, A., Warr, C. R., & Philippaerts, R. (2009). Talent identification and promotion programmes of olympic athletes. *Journal of Sports Sciences*, *27*(13), 1367–1380. https://doi.org/10.1080/02640410903110974

Waldron, M., & Murphy, A. (2013). A comparison of physical abilities and match performance characteristics among elite and subelite under-14 soccer players. *Pediatric Exercise Science*, *25*(3), 423–434. https://doi.org/10.1123/pes.25.3.423

Wells, G., Shea, B., O'Connell, D., & Peterson, J. (2000). The Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses. *Ottawa, ON: Ottawa Hospital Research Institute*. http://www.ohri.ca/programs/clinical_epidemiology/oxford.asp

Williams, A. M. (2020). Talent identification and development in soccer: An update and contemporary perspectives. *Journal of Sports Sciences*, *38*(11–12), 1197–1198. https://doi.org/10.1080/02640414.2020.1773075

Williams, A. M., Ford, P. R., & Drust, B. (2020). Talent identification and development in soccer since the millennium. *Journal of Sports Sciences*, *38*(11–12), 1199–1210. https://doi.org/10.1080/02640414.2020.1766647

Williams, A. M., & Reilly, T. (2000). Talent identification and development in soccer. *J Sport Sci*, *18*(9), 657–667.

Wisløff, U., Castagna, C., Helgerud, J., Jones, R., & Hoff, J. (2004). Strong correlation of maximal squat strength with sprint performance and vertical jump height in elite soccer players. *British Journal of Sports Medicine*, *38*(3), 285–288. https://doi.org/10.1136/bjsm.2002.002071

Wojtys, E. M., Huston, L. J., Taylor, P. D., & Bastian, S. D. (1996). Neuromuscular adaptations in isokinetic, isotonic, and agility training programs. *American Journal of Sports Medicine*, *24*(2), 187–192. https://doi.org/10.1177/036354659602400212

Zago, M., Piovan, A. G., Annoni, I., Ciprandi, D., Iaia, F. M., & Sforza, C. (2016). Dribbling determinants in sub-elite youth soccer players. *Journal of Sports Sciences*, *34*(5), 411–419. https://doi.org/10.1080/02640414.2015.1057210

Submitted: January 23, 2024
Accepted: October 31, 2024
Published Online First: December 11, 2024

Correspondence to:
Valmir Oliveira Silvino
Department of Biophysics and Physiology, Federal University of Piauí
Teresina, Piauí, Brazil
Phone number: +55 86 3215-5696
E-mail address: valmirsilvino@live.com

Abbreviations

GPS, global positioning system; JBI, Joanna Briggs Institute; PHV, peak height velocity; PRISMA-ScR, Preferred Reporting Items for Systematic Review and Meta-Analyses Extension for Scoping Reviews; RAE, relative age effect.

Availability of data and material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Acknowledgments

The authors would like to thank Fundação de Amparo à Pesquisa e ao Desenvolvimento Científico e Tecnológico do Maranhão (FAPEMA BD-02488/21) for supporting this study.