

Assessment of Linear Speed and Change of Direction Ability in Elite Male Soccer: A Systematic Review of Test Protocols Used in Scientific Literature

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Abstract

Linear sprinting and turning actions are frequently performed in a soccer game, linked with crucial game moments. A comprehensive and systematic search in linear speed and change of direction (COD) ability assessment procedures in elite soccer is needed. The aims of the systematic review are (1) to identify the tests and outcome variables used to assess linear speed and COD ability of elite male soccer players, (2) to provide normative values for the most common tests of linear speed and COD ability, and (3) to report the reliability values of the identified linear speed and COD tests. For linear speed testing, sprint distances ranged from 5-50 m, with 10 m (72 studies), 20 m (54 studies), 5 m (46 studies), and 30 m (46 studies) being the most frequently assessed. For COD testing, the zig-zag test (14 studies), the agility T-test (11 studies), and the 505 COD test (8 studies) represented the most frequently performed tests. Distances shorter than 30 m prevailed in linear speed testing. COD tests employed a wide range of distances, modes of travel, angles, and number of turns, with no gold-standard protocol being evident. Standardized methods are imperative for accurate benchmarking and transferability of the results.

Introduction

Speed represents an integral physical quality to achieve a high level of performance during competitive soccer. Soccer players competing at the elite level have been reported to cover sprint distances (> 25.2 km/h) of ~ 300 m during a game, depending on playing position and tactical formation (39). In addition, the volume and frequency of high-intensity actions at the elite level are increasing over time (17,34), further highlighting the importance of developing players robust enough to meet the physiological demands of the modern game. However, the unpredictable nature of soccer match-play and the presence of opponents typically demand players to alter their movement pattern every 4-6 seconds (180). Previous research has demonstrated that players are required to perform a multitude of directional changes (i.e., 727 ± 203) during a soccer match (27). As such, an appropriate amount of emphasis should be placed by practitioners on the enhancement of linear speed and change of direction (COD) ability.

Linear speed, consisting of the acceleration and maximum speed phases, describes an athlete's ability to cover a straight-line distance in the shortest possible time (108). Within the context of a soccer match, straight-line sprinting is the most frequent action preceding goal scoring (64,128). A recent study that examined the sprint patterns in the English Premier League showed that 85% of sprints are executed in a curvilinear form (36). During an elite soccer match, the average duration of a sprint is between 2-4 seconds, with the majority of sprints having a distance shorter than 20 m (189). Nevertheless, the importance of sprints longer than 20 m should not be overlooked, especially for certain playing positions and tactical scenarios (147,148). On the other hand, COD ability has been defined as "the ability to decelerate, reverse or change movement direction and accelerate again" (93,142). Several authors have further distinguished the perceptual component of multi-directional speed using the term "agility", while the term "change of direction" (COD) ability is utilized when only referring to the physical, mechanical, and pre-planned aspects of multidirectional speed (93,142,157,173).

A reliable and efficient assessment of linear speed and COD ability is of paramount importance for practitioners to enable confidence in the continued use of collected data and to facilitate decision-making for training prescription. Linear speed assessments typically involve the use of various distances (0-40 m) with split times to enable the simultaneous assessment of acceleration and maximum speed ability (21,78). Various equipment methods have been implemented, such as hand-held timing devices, radar guns and laser devices, photocell systems, and fully automated camera systems (78). Although the latter represents the gold-standard equipment method, it is costly and impractical to use in an applied setting. The challenges related to fitness testing in elite soccer settings have led to an “integrated” speed testing approach at the end of warm ups and during speed sessions, using global positioning systems (GPS) for the assessment of maximum velocity (19). However, this approach does not provide information on a player’s acceleration ability. Additionally, the use of sprint force-velocity-power profiles has been proposed to obtain deeper and more comprehensive insights into the mechanical components of sprint performance. Consequently, it is believed that this enables a more individualized approach to planning and programming for a player’s speed development (92).

In contrast, greater complexity seems to be evident surrounding the assessment of COD ability since the various implemented COD tests differ in duration, entry velocities, turning angles, and number of changes of directions (142). Deweese and Nimphius (51) have previously classified COD tests in two categories: 1) “COD speed” tests, referring to those involving a “cutting” movement, and 2) “maneuverability” tests, referring to those without a clear “plant” step and/or involving a change in the mode of travel to and from transitional movements (i.e., side shuffle or backpedaling). With these definitions in mind, there appears to be no single COD test that can assess all relevant components. Most COD tests encompass a considerable amount of linear sprinting, and it has been found that linear speed can significantly influence the end outcome by compensating for a poor turning ability (142). The use of alternative approaches that focus more on turning actions, such as

kinetic and kinematic analysis, as well as measures of center of mass (COM) velocities, has therefore been suggested (130,142).

A recent survey has identified the tests employed by practitioners in applied elite soccer settings to evaluate linear speed and COD ability (11). In addition, the previous work of Altmann et al. (5) provided valuable information on the validity and reliability of linear speed and COD ability tests in adult soccer players. Nevertheless, the focus of the latter was on the psychometric properties of the tests, resulting in the exclusion of the studies that did not report reliability and/or validity data. As such, a systematic review that permits the broader inclusion of linear speed and COD assessments in a specific population (i.e., elite soccer players), along with reporting of normative values for the main tests, can serve as a valuable resource for practitioners and researchers seeking to inform their testing practices. Consequently, the aims of this systematic review were to (1) identify the tests and outcome variables used to assess linear speed and COD ability of elite male soccer players, (2) provide normative values for the most common tests, and (3) report the reliability values of the identified testing methods.

Methods

A systematic review following the Preferred Reporting Items of Systematic Reviews and Meta-Analyses (PRISMA) guidelines (152) was conducted using MEDLINE, CINAHL, SPORTDiscus, Web of Science, and OVID databases to identify peer-reviewed studies assessing linear speed and/or COD ability in elite male soccer players (≥ 17 years). For normative values, the mean of each group (i.e., senior professionals vs. elite youth) was recorded. To contextualize normative values, players were categorized into two groups: a) senior professionals, defined as regular first-team players or national team members, and b) elite youth, comprising players over 17 years old who were part of a professional club's youth department or a junior national team squad. To eliminate intervention bias, only baseline values were recorded from intervention studies. In repeated-measures studies with no

intervention, the most recent testing point was used to capture current performance, unless influenced by fixture congestion or detraining. Detailed methodology, including the experimental approach, search strategy, eligibility criteria, quality assessment and data extraction processes, is provided in Supplemental Digital Content (SDC) 1.

Results

Identification and Selection of Articles

Figure 1 illustrates the flowchart of the selection process. The initial search of databases identified 3522 articles. After removing the duplicates (1098 articles), the titles and the abstracts of 2424 articles were screened. A total of 140 articles were retained for eligibility assessment through full-text review. An additional 9 studies were identified through reference lists for full-text eligibility assessment. Following full-text screening, 123 were included for the aim of identifying the tests and outcome variables used to assess linear speed and COD in elite male soccer. In addition, 87 of those were included for the purpose of reporting normative values for the most common linear speed and COD tests, while 38 reported reliability data.

Characteristics of Included Studies

The quality assessment of the included studies, with scores ranging from 4 to 10 across 11 items, and a summary of study characteristics, including sample sizes ranging from 12 to 939 (median: 24 participants), are detailed in SDC 2. A total of 63 studies included senior professionals as participants, 50 included elite youth, while 10 studies involved a group of both. The age range of the samples involved in the studies was 17.0-28.3 years, with a median age of 20.6. In terms of study design, 46 (37.4%) studies used a cross-sectional design, 45 (36.6%) were intervention studies, 28 (22.8%) used a repeated-measures design, 3 (2.5%) were reliability studies, and 1 (1%) was a validity study. The

studies took place in 27 different countries, with Brazil (14.9%), Spain (14.9%), England (9.6%), Norway (7.9%), and Portugal (5.3%) being the most frequently identified countries.

Tests and Outcome Variables Used to Assess Linear Speed

Linear speed was assessed in 119 studies (96.6%) (Table 1). A total of 25 different tests were used to evaluate linear speed, demonstrating the multitude of different assessment methods available. The investigated distances ranged from 5-50 m, with the vast majority of the studies using distances shorter than 30 m. Specifically, the most frequent tests were: 1) 10 m sprint (72 studies), 2) 20 m sprint (54 studies), 3) 30 m sprint (46 studies), and 4) 5 m sprint (46 studies). In these tests, time (in seconds) was the most commonly assessed outcome variable, reported in 60 studies using the 10 m sprint, 46 studies using the 20 m sprint, 43 studies using the 30 m sprint, and 37 studies using the 5 m sprint.

Tests and Outcome Variables Used to Assess COD Ability

COD ability was assessed in 53 studies (43.1%) (Table 2). In total, 28 different tests were used to assess COD ability, employing various distances, modes of travel, angle of direction changes, and number of direction changes. The three most frequent tests used were: 1) zig-zag test (14 studies), 2) agility T-test (11 studies), and 3) 505 COD test (10 studies). Velocity (m/s) (7 studies) and time in seconds (6 studies) were the most frequently assessed outcome variables in the zig-zag test. Similarly, for both Agility T-test and 505 COD test, time was the most commonly assessed outcome variable, reported in 10 and 8 studies, respectively.

Normative Values for Linear Speed in Elite Male Soccer Players

Table 3 presents the normative values for the most commonly administered linear speed tests, while detailed information, including timing technology, starting procedures, gate heights, and running surfaces, are available in SDC 3. Timing gates, either single-beam or dual-beam, were used in almost all studies reporting normative values. Among the various brands identified, Brower Timing and Witty Microgate systems were the two most prevalent. The starting distances varied, with 30 cm (18 studies), 50 cm (15 studies), and 1 m (10 studies) being the most common. The sprints were conducted on different surfaces, including artificial grass, natural grass, indoor courts, and running track. No consistency was observed regarding the location of testing, with both indoor and outdoor settings being utilized.

For the 10m sprint test, senior professionals recorded times ranging from 1.51 to 2.27 seconds across 31 studies, while elite youth posted times between 1.54 to 2.15 seconds in 24 studies. The 20m sprint test revealed times from 2.77 to 3.44 seconds for senior professionals in 24 studies and 2.84 to 3.36 seconds for elite youth across 16 studies. In the 5m sprint test, senior professionals' times spanned from 0.86 to 1.44 seconds in 18 studies, with elite youth showing times of 0.95 to 1.43 seconds in 16 studies. Lastly, the 30m sprint test times for senior professionals ranged from 3.93 to 4.70 seconds in 23 studies, with elite youth achieving times between 3.94 to 4.43 seconds in 19 studies.

Normative Values for COD Ability in Elite Male Soccer Players

Table 4 shows the normative values for the most commonly used COD speed tests. In terms of the zig-zag test velocity, the only study identified in senior professionals reported a value of 3.58 ± 0.11 m/s. In elite youth, the zig-zag test velocity ranged from 3.42 to 3.61 m/s (3 studies). Zig-zag test time in senior professionals ranged from 5.34 to 7.07 s (5 studies), where the only identified study in elite youth reported a time of 5.06 ± 0.15 . Agility T-test time ranged from 8.50 to 10.1 s (4 studies) in senior professionals, while in elite youth, agility T-test time ranged from 8.12 to 9.50 s (5 studies).

Lastly, the 505 COD test time was reported in only one study in senior professionals with a reported value of 2.31 ± 0.15 s, whereas in elite youth, the 505 COD test time ranged from 2.20 to 2.50 s (6 studies).

Reliability Data

Reliability statistics for the linear speed and COD tests can be found in SDC 4. For linear speed tests, reliability statistics were reported in 37 studies (30.6%). All studies reported intraday reliability, whereas only one reported inter-day reliability data. In terms of specific reliability metrics, the reported measures were ICC (30 studies), CV (26 studies), SEM (5 studies), Cronbach's Alpha (3 studies), and Pearson's r (1 study). Ten m sprint (18 studies), 30 m sprint (17 studies), 20 m sprint (16 studies), and 5 m sprint (11 studies) were the tests with the most reported reliability values. ICC values for time ranged from 0.61 to 0.96 in the 10 m sprint, from 0.81 to 0.99 in the 20 m sprint, from 0.81 to 0.98 in the 30 m sprint, and from 0.69 to 0.99 in the 5 m sprint. CV values for time ranged from 0.7 to 5.2% in the 10 m sprint, from 0.9 to 4.7% in the 20 m sprint, from 0.6 to 4.5% in the 30 m sprint, and from 0.9 to 2.9% in the 5 m sprint. SEM for time in the 30 m sprint was reported to be from 0.02 to 0.06 s, 0.02 s in the 20 m sprint, 0.03 s in the 30 m sprint, and from 0.01 to 0.02 s in the 5 m sprint.

For COD tests, reliability values were reported in 18 studies (34%). Similar to linear speed, only intraday reliability values were reported, with ICC (16 studies) and CV (14 studies) representing the most reported metrics. Apart from that, SEM (4 studies), Cronbach's Alpha (2 studies), Pearson's r (1 study), and average intertrial correlation coefficient (AVR) (1 study) were also reported. The zig-zag test (4 studies), agility T-test (4 studies), and 505 COD test (4 studies) were the tests where the most reliability data were provided. ICC values ranged from 0.84 to 0.96 for the zig-zag test, from 0.92 to 0.95 for the Agility T-test, and from 0.71 to 0.88 for the 505 COD test. CV values ranged from

0.9 to 3.7% for the zig-zag test, from 2 to 3.3% for the Agility T-test, and from 0.9 to 2% for the 505 COD test. SEM for the zig-zag test was reported to be 0.09 s, while for the 505 COD test was 0.03 s.

Discussion

This systematic review aimed to provide a comprehensive overview of linear speed and COD ability testing procedures in elite male soccer by 1) identifying the tests and outcome variables used to assess linear speed and COD ability, 2) reporting normative values on the most frequently used tests, and 3) presenting reliability data for the identified tests and outcome variables. A total of 123 studies from 27 different countries were identified as meeting the inclusion criteria. Notably, a considerably greater percentage of studies (i.e., 96.6% vs. 43.1%) investigated linear speed assessment compared to COD ability. This is in line with the results of a recent survey (11), where elite soccer practitioners assessed linear speed to a greater extent than COD ability (71% vs. 52%). This could possibly be attributed to the well-established role of linear speed as an important aspect of soccer physical performance (64,128), as well as the increased familiarity and relative simplicity of linear speed testing. Moreover, this could possibly imply the more prevalent role of linear speed in the player profiling, benchmarking, and talent identification processes.

Overall, a large variety of testing protocols used in terms of both linear speed and COD ability was observed, with clear trends and preferences. More specifically, 10m sprint, 20m sprint, 5m sprint, and 30m sprint tests were by far the most frequently used among 25 different identified linear speed tests. In terms of COD testing, the zig-zag test, agility T-test, and 505 COD test were the three most commonly used tests among the 29 different identified.

Testing Methods and Outcome Variables

Linear Speed Assessment

The distances in the literature used to assess linear speed range between 5 and 50 m, with a marked predominance of distances shorter than 30 m (i.e., 5 m, 10 m, 20 m, 30 m). These results are in line with the guidelines of previously recommended testing batteries for soccer players (184,188), which advocate the use of distances that include both the acceleration phase (i.e., 10 m) and the maximum speed phase (i.e., 30 m). Acceleration and maximum speed represent distinct physical qualities (108) with different kinematic and kinetic characteristics. In particular, the acceleration phase is characterized by a greater degree of forward body lean (50) to promote the generation of the required high amounts of horizontal propulsive forces (96). In contrast, a more upright position (190) is observed during the maximum speed phase, accompanied by a greater reliance on vertical force production (141).

The 10m sprint test was the most commonly used test in elite soccer, with 72 studies reporting its use. This finding is in agreement with the results of a recent survey investigating the fitness testing practices of elite male soccer practitioners (11), where the 10m sprint represented the most favored option of practitioners in linear speed assessment. The distance of 10 m aligns with many in-game situations, such as closing down an opponent or accelerating quickly into space (31,148). Furthermore, a distance of 10 m may be perceived as a “safer” and less fatiguing option for testing linear speed in elite soccer players, who are subjected to significant hamstring loading owing to high-intensity demands of the contemporary game and training (2,127). The 20m sprint test was the second most frequently used linear speed test in this systematic review, reported in 54 studies. Collectively, the predominance of the 10 m and 20 m may be attributed to their relevance with the game demands since a previous analysis of the activity profile of elite soccer players has shown that the vast majority of sprints are shorter than 20 m (189).

The 5m sprint and 30m sprint tests have also been identified as other frequently used distances. The 30m sprint test performance can provide insights into an athlete’s maximum speed since it potentially represents a distance that is long enough to enable team sport athletes to enter

their maximum speed phase, serving as maximum speed proxy (198). Nevertheless, timing gates, typically used in linear speed assessment provide information on certain split times and average speeds, and the only way to truly quantify the maximum speed achieved is by recording instantaneous running speed. This can be accomplished through the use of radar and laser devices, as well as GPS (110). Our systematic review identified one study evaluating the peak velocity during a 40m sprint test using GPS (52) and two studies using a radar device during a 30m sprint test (16) and a 40m sprint test (92).

In terms of the identified outcome variables, time in seconds was the most commonly reported. Previous research has implied that the use of time as the outcome variable of interest may carry certain limitations when it comes to training prescription, as it fails to provide an in-depth insight into the mechanical properties of linear sprint performance (137,170). Consequently, a novel approach has been developed to address this issue using a simple calculation method to determine the force-velocity-power (F-V-P) relationships during linear sprinting (170). It is proposed that F-V-P can generate detailed insights into the athlete's strengths and weaknesses across these components, leading thus to individualized training prescription and targeted interventions (137). Theoretical maximal horizontal force (F_0), theoretical maximum velocity (V_0), and theoretical maximal horizontal power (P_{max}) were found to be sensitive to seasonal changes in elite soccer players (79), with soccer players of a higher playing standard exhibiting better performance in those measures (80). This systematic review identified 6 studies conducted over the last 6 years investigating mechanical properties, which may indicate an emerging research interest in this area. Nevertheless, the practical value and the additional insights offered by sprint force-velocity profiling have recently been criticized (63). The main arguments against it include the lack of significant contribution beyond the existing time-based methods and the unnecessary overcomplication of training prescription.

Lastly, a certain number of studies utilized flying start approaches, such as the flying 10m, 20m, and 30m sprint tests, along with specific interval-based sprints, such as the 10-30m and 20-

30m. Yet, run-up distances must be standardized, as different studies used various distances to execute the same flying test. For instance, run-up distances of 5 m (120), 10 m (135), and 30 m (108) have been employed during the flying 20 m sprint test in elite soccer players.

COD Ability Assessment

This systematic review revealed a wide variety of COD tests employed, including varying distances, modes of travel, angle, and number of turns. Among these, the Zig-zag test was found to be the most commonly used test in elite soccer players, identified in 14 studies. Velocity in m/s and time in s were the most frequently used outcome variables during the zig-zag test. Besides this, the agility T-test and 505 COD test represent the other two most frequently employed tests in elite male soccer, identified in 11 and 10 studies, respectively. Time in seconds was the most prevalent outcome variable in these tests. In fact, the 505 COD test and agility T-test represent the two main choices of practitioners working in applied elite soccer settings to evaluate COD ability (11), illustrating a correspondence between scientific literature and practice. Surprisingly, though, no respondent in the survey reported the use of the zig-zag test.

Overall, testing selection should adhere to the principle of specificity, where the physiological and biomechanical demands of the sport are considered (20,188). Soccer requires proficiency in turning with both limbs across a range of different angles. When considering the angle of turns during a soccer game, the vast majority of them take place at angles smaller than 90° (27,136), although Dos Santos et al. (57) showed that most of the higher intensity turns occur at larger angles (i.e., 120-180°). It is worth noting, though, that COD kinetics and kinematics are angle and velocity dependent, with sharper COD angles being associated with greater braking distances and longer ground contact times during the plant step (54).

The zig-zag test is a maneuverability test consisting of total distance of 20 m, divided into four 5m sections. Athletes are required to perform 100° turns in each section (125). Conversely, the agility T-test has been classified as a COD speed and maneuverability test, as it involves changes in the mode of travel with the alternation of soccer-related movement patterns (i.e., forward running, side-shuffling, and backpedaling) (177). In contrast to the two aforementioned tests, the 505 test is a COD speed test with only one turn of 180°, which is executed after a run-up of 15 m, with the last 5 m being the initiation of time recording. Following the turn, a re-acceleration over 5 m is performed (143). In addition, the 505 COD test can be used to assess the COD of each leg, which can potentially reveal the presence of interlimb asymmetries (12), as well as effectively be used to guide the return-to-play process (111). Lastly, the 180° turn employed during the 505 test may provide insights into an athlete's deceleration ability since it significantly challenges an athlete's high velocity braking capacity (53,55).

Besides the differences in the number and the angle of directional changes, differences also exist in the duration of each test. 505 has a duration of less than 2.5 s (24,179), zig-zag test 5-7 s (135,153), and Agility t-test 8-10 s (74,177). Metabolic limitations may, therefore, be present in the latter, as the duration of the test may require a contribution from anaerobic capacity (142), which may hinder the ability to accurately interpret whether the performance changes are due to improved COD performance or anaerobic capacity. A thorough understanding of the strengths and limitations of each COD test is essential for practitioners.

In terms of outcome variables used, time was the most used outcome variable, providing a simplified overview of COD ability. Yet, this approach, reportedly associated with the limitation that COD ability, is not isolated (142). More specifically, Nimphius et al. (144) demonstrated that only 31% is actually spent changing direction during the 505 test, implying that a faster athlete could compensate for a poor turn. As a result, the use of change direction deficit (CDD) has been suggested to eliminate the influence of linear speed in the final result (143). CDD has been

previously used in various COD angles (47,68,143), and based on the results of this systematic review, CDD was used in 5 studies using the zig-zag test and in 2 studies using the 505 test. However, a previous study investigating the interday reliability of CDD during 505 tests in youth soccer players demonstrated its low to moderate reliability, warranting caution in its use (183). Moreover, the use of 3D motion analysis, force plates, and high-speed cameras has been recommended to obtain additional and different insights into completion time, such as contact time and joint angles (130,142). This can potentially lead to the implementation of targeted technique modification training interventions (56). Nevertheless, our systematic review did not identify any studies of this nature in elite soccer players, which could be due to the limited practicality of these methods in a group of athletes, as well as the time constraints in elite applied soccer environments.

Finally, the recent works by Caldbeck and Dos Santos (36) and Harper et al. (76) on the frequency and importance of curvilinear sprinting and deceleration ability in soccer have led to a significant interest in developing these abilities. For this reason, novel curvilinear sprinting (67) and deceleration testing protocols (77) have been introduced. Nevertheless, within our systematic review, only one test assessing curvilinear sprint ability was noted (69), whereas no deceleration testing was conducted in elite soccer players. The recency of these protocols, coupled with the cut-off time point of this review (i.e., August 2023), may be responsible for this, and more studies in the future may seek to evaluate these characteristics in elite male soccer players.

Normative Values for Linear Speed and COD Tests

The availability of normative data represents a useful resource in the athletic development process, providing a framework for comparisons, which will subsequently inform decision-making on player development (131). Knowledge of normative standards of elite soccer players can facilitate talent identification processes, effective goal-setting, and the development of targeted interventions based

on the identified strengths and weaknesses (113). To the authors' knowledge, no previous work has attempted to collate normative data of linear speed and COD of elite soccer players.

Knowledge of normative values of elite soccer players can be extremely beneficial for practitioners across different settings. For example, practitioners from different countries can compare the physical performance of their players to those playing at the pinnacle of elite soccer, such as the English Premier League. In addition, practitioners working with developmental soccer players can become aware of the expected physical levels of elite play, which could guide a robust long-term athletic development plan (109). Given the wide range of testing methods identified, normative values were provided only for the most frequently performed tests and outcome variables. However, as observed, the normative values are subject to many limitations, and careful interpretation and application of these results are warranted.

The large range of the normative values reported can be attributed to the different methodologies used across the studies. Specifically, using single-beam versus dual-beam timing gates represents a source of variation, with dual-beam gates having been shown to produce more accurate results (82). Additionally, the height at which the photocells were positioned varied, including 40 cm, 1 m, and 1.20 m. Different heights have been shown to substantially impact the final result (46,197). It has been suggested that photocells should be set at hip height to accurately detect the movements and decrease the possibility of breaking the beam with limbs or the head (197). Another component that has been shown to influence the sprint outcomes is the starting distance (3,192). Altmann et al. (3) have illustrated the differences emerging from different starting distances, as increased starting distances enabled a faster 5m sprint time, possibly due to the higher acceleration reached before triggering the first gate. Furthermore, the different running surfaces reported - including artificial grass, natural grass, and various types of running tracks - combined with different testing environments (indoor vs. outdoor) also contribute to the large variability of the results.

Considering the abovementioned factors, we strongly recommend that practitioners carefully check the methodological procedures reported in the tables prior to the use of normative values and only use them where similarities exist. In addition, this systematic review highlighted a lack of robust methodological reporting in many studies. To enhance the potential comparability and transferability of the results, measurement instruments, starting distances, photocell heights, testing locations, and running surfaces must be reported in detail.

Reliability Data

Reliability represents a fundamental concept in the overall testing process, especially in high-performance sport where success depends on marginal differences. Practitioners must select tests that not only reflect the demands of soccer but are also reliable and sensitive enough to demonstrate that a change in performance has occurred (191). A test with low reliability will not accurately reflect an athlete's true ability. Furthermore, employing tests that have high levels of reliability increases the chances of identifying “real” changes in performance (85). To gain a comprehensive view of a test, both absolute and relative reliability must be established.

Although test reliability is very important, only a relatively small number of studies reported reliability data for linear speed and COD tests. More specifically, 36 studies reported reliability metrics for linear speed testing, whereas 18 did so for COD testing. This can significantly impact the ability to confidently interpret testing results. Notably, we failed to identify any studies reporting inter-day reliability values. This could be attributed to the inclusion and the exclusion criteria, as the reliability values reported are from the tests meeting the inclusion criteria of the first aim. In addition, the difficulties associated with conducting test-retest assessments in elite sports, owing to the particularly demanding training and competitive schedule, may have contributed to the generally lower number of inter-day reliability studies observed in high-performance sports (13). Nevertheless,

inter-day reliability considers the natural biological variation of the athlete, which is crucial in the subsequent interpretation of performance changes.

ICC, indicative of relative reliability, was the most reported for both linear speed and COD testing. Relative reliability refers to the extent to which an individual maintains their ranking over the course of repeated trials. Although what is an acceptable ICC value can be debated, it is generally accepted that an $ICC \geq 0.75$ is considered “good” reliability, with $ICC \geq 0.90$ considered “excellent” (100). As such, the identified linear speed and COD tests possess good to excellent intraday reliability. A limitation of relative reliability, though, is it relies on group homogeneity (86). On the other hand, absolute reliability represents the degree of variation in the scores of an individual over repeated trials (15). Based on the results of this systematic review, CV was the most prevalent absolute reliability metric in linear speed and COD testing. CV, which represents the relative dispersion of the data points around the mean by expressing the SD as a percentage of the mean, can be a more relevant metric for the practice as it is involved in interpreting performance changes (186). Although the scientific community seems to broadly recognize the value of $\leq 10\%$ as an acceptable threshold, this threshold appears to be rather arbitrary (187), and the determination of the sensitivity of an outcome variable will ultimately determine its utility in practice (133).

Overall, greater awareness of the concept of reliability is essential for both researchers and practitioners. Practitioners are also encouraged to establish reliability data within their specific settings to ensure that the testing results represent an accurate reflection of an athlete’s capability, as well as to assist in the interpretation of performance changes. This is of paramount importance, as the characteristics of each setting and its athletes are unique.

Limitations and Directions for Future Research

Although this systematic review provided a comprehensive picture of linear speed and COD testing in elite soccer, there are several limitations that should be acknowledged. To begin with, the terms “elite” and “professional” are often used interchangeably across the literature. It is likely, though, that these terms may be used differently in different geographic regions and leagues. This can be considered as a limitation, as well as reflection of the existing soccer literature, highlighting the need for a standardized terminology for “elite” and “professional”. The variability in testing conditions is another challenge in the establishment of normative standards, complicating the direct translation of these findings into practice. Lastly, due to the heterogeneity of testing methods identified in the present literature review, it was not possible to carry out a meta-analysis.

Several areas requiring further investigation were identified in this systematic review. Consistent and standardized methodology in linear speed and COD ability testing would assist in the creation of robust normative values. The current landscape in COD testing seems to be mainly focused on the use of completion time. The development of time-efficient testing protocols and advanced technologies that provide kinematic and kinetic insights seamlessly would greatly benefit the holistic assessment of COD. The increased interest in deceleration and curvilinear sprinting ability in soccer highlights the need to evaluate the reliability and validity of these testing protocols in elite populations. Furthermore, establishment of reliability values in each unique setting for the employed linear speed and COD tests is recommended. Alongside this, determining the longitudinal sensitivity of these tests and outcome variables will remove the reliance on arbitrary reliability threshold (i.e., $CV \leq 10\%$), thus informing their utility in practice. This could ensure the optimal use of resources (e.g., time, staff, finances) and the generation of high-quality data that lay the foundation for evidence-informed decision making. A standardized data analysis process should also be adopted, as there is no consensus on the optimal approach to analyze linear speed and COD testing results (i.e., best trial vs average of trials). Future studies should, therefore, examine the ramifications of each approach.

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447 **Practical Applications**

448 The current systematic review provides a comprehensive overview of all tests and outcome variables
449 used in elite male soccer to assess linear speed and COD ability (as shown in the infographic in Figure
450 2). Practitioners can use the findings of this study to inform their testing practices in their applied
451 environment. Regarding linear speed testing, there is a clear preference in the literature using
452 distances shorter than 30 m, with the 10m sprint test being the most widely used. Time in seconds
453 was the most frequently used outcome variable. In COD testing, the identified COD tests included
454 various distances, modes of travel, angles, and number of turns. Zig-zag test, agility T-test, and 505
455 COD test were the most frequently performed. Velocity in m/s and time in s were the most
456 frequently reported outcome variables in the zig-zag test, whereas time in s was the most frequently
457 reported outcome in the agility T-test and 505 COD test. Although the normative values presented
458 increase the practical utility of this review, careful interpretation and implementation of those values
459 is warranted due to differences in testing conditions. Future research should aim to establish
460 standardized linear speed and COD testing procedures grounded in the concepts of ecological
461 validity, reliability, and sensitivity to enable the creation of universal normative values and
462 transferability of the results.

463

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981

Figure 1. Flow of selection process of eligible studies for qualitative and quantitative synthesis

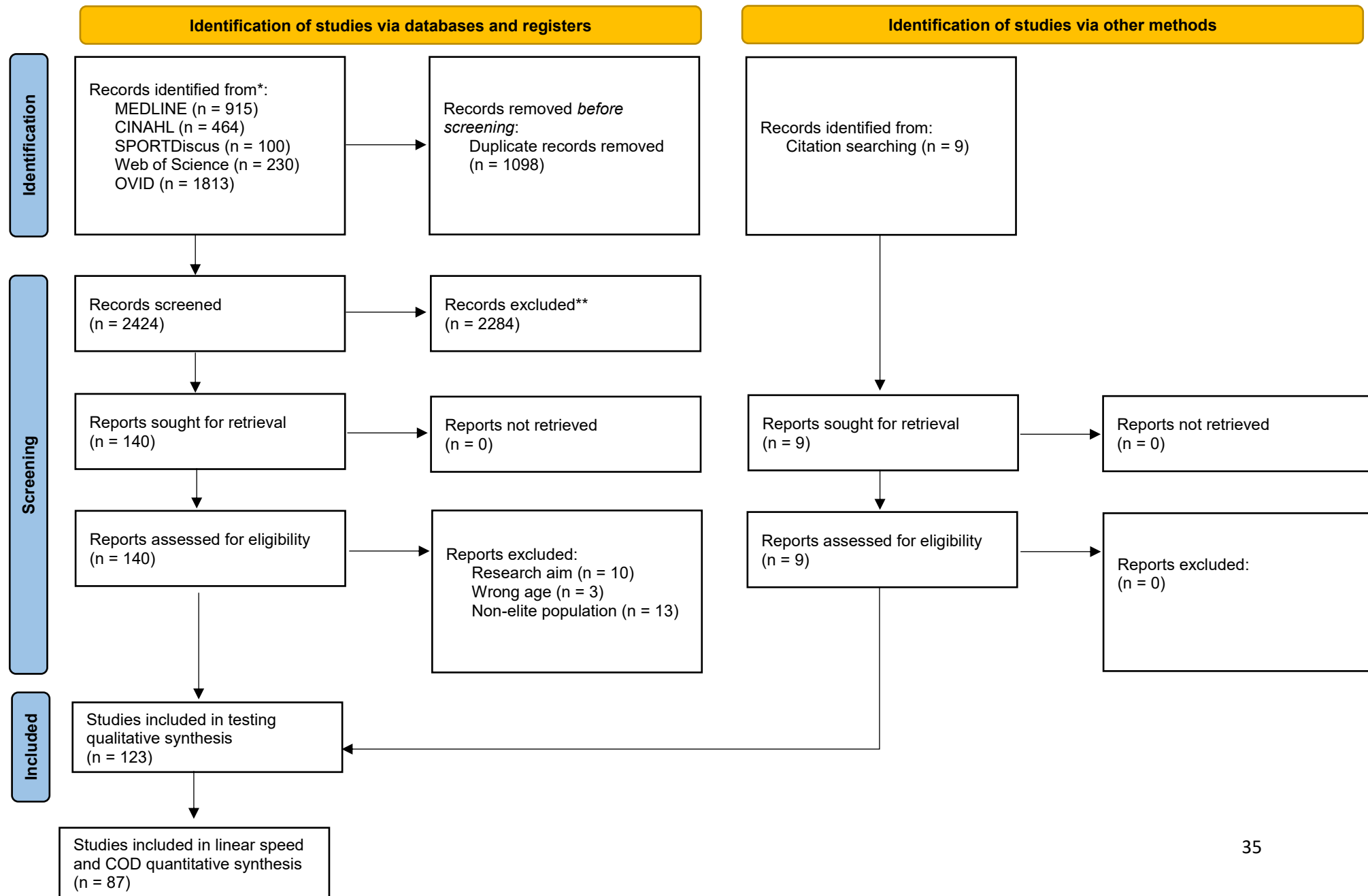


Table 1. Linear speed tests and outcome variables

Test	Outcome Variable	Reference
5m sprint	Time (s)	(24), (193), (154), (30), (16), (181), (132), (112), (174), (22), (25), (38), (87), (7), (29), (104), (146), (161), (61), (18), (116), (71), (37), (105), (196), (129), (72), (8), (9), (134), (162), (175), (41), (176), (94), (178), (151)
	Velocity (km/h)	(171)
	Velocity (m/s)	(69), (118), (125), (117), (120), (123), (124), (121), (119)
	Acceleration (m/s ²)	(118), (117), (121)
	Sprint momentum (kg*m/s)	(117)
Reaction 5m sprint	Time (s)	(28)
5-10m sprint	Acceleration (m/s ²)	(118), (121)
Reaction 5-10m sprint	Time (s)	(28)
7.32m sprint	Time (s)	(95)
10m sprint	Time (s)	(35), (24), (16), (181), (132), (80), (112), (26), (174), (169), (25), (159), (38), (73), (104), (179), (160), (87), (23), (146), (61), (18), (43), (182), (71), (37), (149), (1), (105), (49), (66), (99), (62), (72), (60), (75), (101), (102), (89), (134), (81), (41), (94), (84), (44), (195), (114), (185), (178), (32), (107), (95), (167), (135), (108), (40), (194), (151), (83), (42)
	Velocity (km/h)	(171)
	Velocity (m/s)	(69), (166), (118), (125), (117), (120), (98), (124), (123), (121), (119), (122), (44)
	Sprint momentum (kg*m/s)	(117)
	Acceleration (m/s ²)	(122)
10yd sprint	Time (s)	(45)
Flying 10m sprint	Time (s)	(126)
10-20m sprint	Acceleration (m/s ²)	(118), (121), (122)
	Time (s)	(149), (49), (81), (114)
	Velocity (m/s)	(44)
10-30m sprint	Time (s)	(114)
15m sprint	Velocity (km/h)	(171)
	Time (s)	(16), (174), (7), (116), (71), (163), (196), (129), (72), (8), (9), (70), (164)
	Velocity (m/s)	(10), (139), (140)
17m sprint	Velocity (m/s)	(69)

20m sprint	Time (s)	(24), (193), (154), (97), (16), (172), (181), (132), (174), (169), (22), (25), (38), (153), (125), (73), (87), (146), (18), (71), (61), (37), (79), (149), (1), (49), (99), (165), (72), (119), (88), (33), (75), (101), (102), (89), (134), (48), (94), (84), (44), (114), (185), (178), (194), (151)
	Velocity (km/h)	(171)
	Velocity (m/s)	(118), (117), (98), (124), (123), (121), (122)
	Sprint momentum (kg*m/s)	(117)
Flying 20m sprint	Time (s)	(135), (108)
	Velocity (m/s)	(120)
20yd sprint	Time (s)	(103)
20-30m sprint	Time (s)	(81), (114)
	Velocity (m/s)	(44)
25m sprint	Time (s)	(16), (71), (72)
30m sprint	Theoretical relative maximal horizontal force F0 (N/kg)	(106), (16), (18)
	Maximal velocity V0 (m/s)	(16), (18)
	Velocity (m/s)	(166), (123)
	Time (s)	(35), (24), (30), (16), (158), (112), (90), (26), (169), (159), (38), (160), (87), (29), (104), (179), (23), (18), (4), (43), (182), (37), (163), (155), (105), (49), (66), (156), (145), (62), (75), (115), (162), (175), (41), (176), (94), (44), (195), (114), (40), (194), (42)
	Theoretical relative maximal horizontal power Pmax (W/kg)	(16), (18)
	Theoretical maximal horizontal power Pmax (W)	(18)
	Theoretical maximal horizontal force F0 (N)	(18)
	Force-Velocity profile	(16)
	Mean ratio of forces 10m (%)	(16)
	Ratio of forces peak (%)	(16)
	Index of force application technique	(16)
	Distance in 2 sec (m)	(16)
	Distance in 4 sec (m)	(16)
	Top speed (m/s)	(35), (16)
Flying 30m sprint	Time (s)	(126), (14)
30-40m sprint	Time (s)	(81), (167)
30-50m sprint	Time (s)	(49)
35m sprint	Time (s)	(89)

40m sprint	Time (s)	(80), (172), (23), (182), (79), (88), (168), (167), (59), (83)
	Theoretical maximal horizontal force F0 (N)	(80), (79)
	Theoretical relative maximal horizontal force F0 (N/kg)	(92), (79)
	Maximal velocity V0 (m/s)	(92), (80), (79), (52)
	Theoretical maximal horizontal power Pmax (W)	(79)
	Theoretical relative maximal horizontal power Pmax (W/kg)	(92), (80), (79)
	Force-velocity slope	(92), (80), (79)
	Decrease of ratio forces (%)	(92)
	Ratio of force RFmax (%)	(92), (80)
	Index of force application technique (%)	(80)
40yd sprint	Time (s)	(45), (103)
50m sprint	Time (s)	(49)

Table 2. COD tests and outcome variables

Test	Outcome Variable	Reference
Zig-zag test	Velocity (m/s)	(118), (125), (117), (120), (123), (124), (119)
	Time (s)	(154), (153), (71), (49), (135), (108)
	CODD (m/s)	(118), (117), (120)
	CODD (s)	(154), (153)
	Velocity (km/h)	(171)
Agility T-test	Time (s)	(74), (43), (65), (61), (162), (175), (41), (176), (177), (45)
	Velocity (m/s)	(166)
505 COD test	Time (s)	(24), (112), (26), (179), (23), (25), (159), (98)
	CODD (s)	(26), (179)
Illinois agility test	Time (s)	(158), (172), (48), (6)
Sprint 9-3-6-3-9m with 180° turns	Time (s)	(104), (132), (177)
Modified agility T-test	Time (s)	(7)
Modified agility T-test with constraints (touching the top of the cone)	Time (s)	(7)
Modified zig-zag test	Velocity (m/s)	(69)
	CODD (m/s)	(69)
Modified Barrow zigzag test	Time (s)	(10)
5m shuttle run-sprint test	Time (s)	(41)
10m shuttle run-sprint test	Time (s)	(194)
Y-shaped agility test (preplanned)	Time (s)	(146)
Curved sprint test	Velocity (m/s)	(69)
	Curved sprint test deficit (m/s)	(69)
L-test	Time (s)	(154)
Arrowhead agility test	Time (s)	(145)
Slalom test	Time (s)	(177)
Sprint 4x5m test	Time (s)	(177)
Sprint with 90° turns	Time (s)	(177)
Sprint 9-3-6-3-9m with backward and forward running	Time (s)	(177)
COD course	Time (s)	(97)
Balsom agility test	Time (s)	(165)
V-cut test	Time (s)	(149)
Nonlinear sprint test (22m including four changes of direction)	Time (s)	(38), (37)
10 x 5m test	Time (s)	(135)
Shuttle test	Time (s)	(95)
15m agility run test	Velocity (m/s)	(139), (140)
135° COD test	Time (s)	(153)
	CODD (s)	(153)

20+20m shuttle test	Time (s)	(43)
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CODD = change of direction deficit

Table 3. Normative values for 5m, 10m, 20m and 30m linear sprints

Study	Playing standard	Playing position/subgroup	5m sprint time (s)	10m sprint time (s)	20m sprint time (s)	30m sprint time (s)
Byrkjedal et al. (35)	Senior professionals	All		1.52 ± 0.06		3.93 ± 0.14
Bishop et al. (24)	Elite youth	All	0.95 ± 0.02	1.63 ± 0.03	2.84 ± 0.06	3.94 ± 0.13
Papla et al. (154)	Senior professionals	All	1.02 ± 0.06		2.95 ± 0.12	
Boraczyński et al. (30)	Senior professionals	All	1.04 ± 0.03			4.22 ± 0.12
Keiner et al. (97)	Elite youth	All			2.98 ± 0.08	
Azcárate et al. (16)	Senior professionals	All	1.40 ± 0.04	2.15 ± 0.06	3.44 ± 0.09	4.63 ± 0.12
Querido and Clemente (158)	Elite youth	All				4.39 ± 0.22
Shalaj et al. (172)	Senior professionals	All			3.13 ± 0.14	
Krespi et al. (104)	Elite youth	All	1.15 ± 0.14	2.07 ± 0.18	4.33 ± 0.20	
Stern et al. (179)	Elite youth	All		1.71 ± 0.06		4.05 ± 0.09
Suarez-Arrones et al. (181)	Elite youth	All	1.05 ± 0.06	1.80 ± 0.07	3.07 ± 0.10	
McMorrow et al. (132)	Senior professionals	All	1.18 ± 0.06	1.93 ± 0.07	3.20 ± 0.08	
Haugen et al. (80)	Senior professionals	National team group		2.01 ± 0.05		
		First Division group		2.02 ± 0.06		
Lockie et al. (112)	Elite youth	All	1.01 ± 0.05	1.72 ± 0.06		4.11 ± 0.15
Ishøi et al. (90)	Senior professionals	Senior professionals' group				3.97 ± 0.11
	Elite youth	U19 group				4.05 ± 0.14
Bishop et al. (26)	Elite youth	All		1.78 ± 0.12		4.23 ± 0.26
Bishop et al. (25)	Elite youth	U23 group	0.98 ± 0.04	1.68 ± 0.04	2.90 ± 0.06	
		U18 group	0.97 ± 0.05	1.70 ± 0.07	2.92 ± 0.11	
Rabbani et al. (159)	Senior professionals	Senior professionals' group		1.80 ± 0.05		4.20 ± 0.11
	Elite youth	U19 group		1.85 ± 0.07		4.30 ± 0.14
Cardoso De Araújo et al. (38)	Senior professionals	All	1.09 ± 0.03	1.81 ± 0.04	3.04 ± 0.06	4.19 ± 0.08
Papla et al. (153)	Senior professionals	All			3.02 ± 0.1	
Grazioli et al. (73)	Senior professionals	All		1.57 ± 0.08	2.81 ± 0.12	
Radzimiński et al. (160)	Senior professionals	All		1.72 ± 0.05		4.10 ± 0.13
Hoppe et al. (87)	Elite youth	U21 group	1.09 ± 0.01	1.81 ± 0.02	3.04 ± 0.03	4.18 ± 0.05
		U19 group	1.09 ± 0.01	1.82 ± 0.02	3.09 ± 0.02	4.26 ± 0.03

Arcos et al. (7)	Senior professionals	Senior professionals' group	0.96 ± 0.03			
	Elite youth	U19 group	0.96 ± 0.04			
		U17 group	1.00 ± 0.05			
Boraczyński et al. (29)	Senior professionals	All	1.04 ± 0.03			4.22 ± 0.11
Bianchi et al. (23)	Elite youth	All		1.84 ± 0.08		4.30 ± 0.16
Northeast et al. (146)	Senior professionals	All	1.02 ± 0.07	1.72 ± 0.09	2.94 ± 0.11	
Baumgart et al. (18)	Senior professionals	Senior professionals' group	1.11 ± 0.03	1.84 ± 0.05	3.09 ± 0.08	4.25 ± 0.10
	Elite youth	U23 & U19 group	1.11 ± 0.03	1.85 ± 0.04	3.11 ± 0.08	4.29 ± 0.12
Los Arcos and Martins (116)	Elite youth	All	0.96 ± 0.03			
Altmann et al. (4)	Senior professionals	All				4.15 ± 0.11
Coratella et al. (43)	Elite youth	All		1.77 ± 0.10		4.23 ± 0.19
Enright et al. (61)	Elite youth	All	1.01 ± 0.06	1.77 ± 0.07	3.09 ± 0.12	
Gil et al. (71)	Senior professionals	All	1.06 ± 0.10	1.78 ± 0.10	3.05 ± 0.10	
Cardoso De Araújo et al. (37)	Senior professionals	Senior professionals' group	1.08 ± 0.03	1.80 ± 0.05	3.03 ± 0.07	4.18 ± 0.10
	Elite youth	U19 group	1.08 ± 0.04	1.82 ± 0.06	3.08 ± 0.09	4.26 ± 0.11
Haugen (79)	Senior professionals	All			2.77 ± 0.08	
Otero-Esquina et al. (149)	Elite youth	All		1.78 ± 0.05	3.00 ± 0.07	
Requena et al. (163)	Senior professionals	All				4.24 ± 0.10
Pareja-Blanco et al. (155)	Senior professionals	All				4.30 ± 0.16
Krommes et al. (105)	Senior professionals	All	0.86 ± 0.06	1.63 ± 0.09		4.05 ± 0.12
Yanci and Los Arcos (196)	Elite youth	All	0.97 ± 0.02			
De Hoyo et al. (49)	Elite youth	All		1.70 ± 0.06	2.98 ± 0.08	4.17 ± 0.12
Fessi et al. (66)	Senior professionals	All		1.70 ± 0.10		4.70 ± 0.10
Rey et al. (165)	Senior professionals	All			3.12 ± 0.09	
Martinez-Santos et al. (129)	Elite youth	All	0.95 ± 0.03			
Pareja-Blanco et al. (156)	Senior professionals	All				4.27 ± 0.15
Noon et al. (145)	Elite youth	All				4.43 ± 0.20
Enright et al. (62)	Elite youth	All		1.76 ± 0.5		4.25 ± 0.48

Gil et al. (72)	Senior professionals	All	1.08 ± 0.07	1.87 ± 0.17	3.06 ± 0.13	
laia et al. (88)	Elite youth	All			2.87 ± 0.09	
Arcos et al. (8)	Elite youth	All	0.95 ± 0.02			
López-Segovia et al. (115)	Elite youth	All				4.21 ± 0.11
Edholm et al. (60)	Senior professionals	All		1.89 ± 0.05		
Brocherie et al. (33)	Senior professionals	All			2.95 ± 0.10	
Haddad et al. (75)	Senior professionals	All		1.77 ± 0.14	3.21 ± 0.14	4.32 ± 0.23
Arcos et al. (9)	Senior professionals	All	0.97 ± 0.04			
Koundourakis et al. (101)	Senior professionals	All		1.74 ± 0.08	3.02 ± 0.06	
Koundourakis et al. (102)	Senior professionals	All		1.73 ± 0.06	3.06 ± 0.06	
Ingebrigtsen et al. (89)	Senior professionals	All		1.83 ± 0.09	3.11 ± 0.12	
Milanović et al. (134)	Elite youth	All	1.43 ± 0.02	2.15 ± 0.02	3.36 ± 0.02	
Haugen et al. (81)	Senior professionals	National team group		1.51 ± 0.05		
		1 st Division group		1.52 ± 0.06		
		2 nd Division group		1.53 ± 0.05		
	Elite youth	Youth national team group		1.54 ± 0.06		
Rebello et al. (162)	Elite youth	Elite U19 group (excluding goalkeepers)	1.06 ± 0.08			4.28 ± 0.18
Silva et al. (175)	Senior professionals	All	1.02 ± 0.05			4.2 ± 0.13
Daneshjoo et al. (48)	Elite youth	All			3.04 ± 0.27	
Silva et al. (176)	Senior professionals	All	1.03 ± 0.07			4.16 ± 0.17
Helgerud et al. (84)	Senior professionals	All		1.87 ± 0.07	3.13 ± 0.11	
Cotte and Chatard (44)	Senior professionals	All		1.69 ± 0.08	2.94 ± 0.11	4.10 ± 0.14
Wong et al. (195)	Senior professionals	All		1.85 ± 0.02		4.44 ± 0.03
López-Segovia et al. (114)	Elite youth	All		1.85 ± 0.05	3.12 ± 0.10	4.32 ± 0.15
Till and Cooke (185)	Elite youth	All		1.80 ± 0.06	3.10 ± 0.08	
Sporis et al. (178)	Senior professionals	All	1.44 ± 0.50	2.27 ± 0.40	3.38 ± 0.70	
Jullien et al. (95)	Elite youth	All		$1.85 (0.03)$		
Rønnestad et al. (167)	Senior professionals	All		1.76 ± 0.02		
Mirkov et al. (135)	Senior professionals	All		1.90 ± 0.08		

Little and Williams (108)	Senior professionals	All		1.83 ± 0.08		
Chamari et al. (40)	Elite youth	All		1.87 ± 0.10		4.38 ± 0.18
Wisløff et al. (194)	Senior professionals	All		1.82 ± 0.30	3.00 ± 0.30	4.00 ± 0.20
Ozcakar (151)	Senior professionals	All	0.91 ± 0.07	1.69 ± 0.07	2.86 ± 0.12	
Helgerud et al. (83)	Elite youth	All		1.89 ± 0.06		
Cometti et al. (42)	Senior professionals	All		1.81 ± 0.06		4.23 ± 0.17

Data are presented as mean ± standard deviation.

Table 4. Normative values for zig-zag test, agility T-test, and 505 COD test

Study	Playing standard	Playing position/subgroup	Zig-zag test time (s)	Zig-zag test velocity (m/s)	Agility T-test time (s)	505 time (s)
Bishop et al. (24)	Elite youth	All				Left: 2.40 ± 0.10 Right: 2.38 ± 0.06
Guerra et al. (74)	Senior professionals	All			10.1 ± 0.3	
Papla et al. (154)	Senior professionals	All	6.65 ± 0.17			
Stern et al. (179)	Elite youth	All				Left: 2.34 ± 0.07 Right: 2.34 ± 0.07
Lockie et al. (112)	Elite youth	All				Left: 2.24 ± 0.14 Right: 2.20 ± 0.09
Bishop et al. (26)	Elite youth	All				Left: 2.23 ± 0.08 Right: 2.23 ± 0.10
Bishop et al. (25)	Elite youth	U23 group				Left: 2.46 ± 0.06 Right: 2.46 ± 0.08
		U18 group				Left: 2.50 ± 0.07 Right: 2.49 ± 0.08
Rabbani et al. (159)	Senior professionals	Senior professionals' group				2.31 ± 0.15
	Elite youth	U19 group				2.35 ± 0.12
Papla et al. (153)	Senior professionals	All	7.07 ± 0.25			
Loturco et al. (125)	Elite youth	All		3.42 ± 0.10		
Loturco et al. (120)	Elite youth	All		3.44 ± 0.10		

Coratella et al. (43)	Elite youth	All			8.73 ± 0.49	
Fessi et al. (65)	Senior professionals	All			9.50 ± 0.90	
Enright et al. (61)	Elite youth	All			9.17 ± 0.21	
Gil et al. (71)	Senior professionals	All	5.76 ± 0.15			
Loturco et al. (123)	Elite youth	All		3.61 ± 0.14		
De Hoyo et al. (49)	Elite youth	All	5.06 ± 0.15			
Loturco et al. (124)	Senior professionals	All		3.58 ± 0.11		
Rebelo et al. (162)	Elite youth	Elite U19 group (excluding goalkeepers)			9.50 ± 0.25	
Silva et al. (175)	Senior professionals	All			8.57 ± 0.4	
Silva et al. (176)	Senior professionals	All			8.50 ± 0.27	
Sporis et al. (177)	Elite youth	All			8.12 ± 0.27	
Mirkov et al. (135)	Senior professionals	All	4.92 ± 0.16			
Cressey et al. (45)	Elite youth	All			8.37 ± 0.26	
Little and Williams (108)	Senior professionals	All	5.34 ± 0.20			

Figure 2. Linear speed and COD testing in elite male soccer

