RELIABILITY AND VALIDITY OF PHYSICAL-TECHNICAL APTITUDE TESTS IN MALE SOCCER PLAYERS

CONFIABILIDAD Y VALIDEZ DE PRUEBAS DE APTITUD FÍSICO-TÉCNICAS EN JUGADORES DE FÚTBOL MASCULINOS

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Abstract

There is limited literature about tests that assess technical-tactical skills in adolescents male soccer players, even though the onset at professional levels is earlier, so it is important to identify the tests with better psychometric properties depending on the stages of growth and biological characteristics of the players for identification and development of talents. The present study aims to review the psychometric properties of tests assessing technical–tactical skills in youth football players. Four databases from PubMed, Springer, Sciencedirect, Google Scholar and Proquest were reviewed to identify studies that had validated tests to assess technical-tactical skills in adolescent football players aged 11-18 years from professional football academies, using the guidelines of PRISMA. The risk of bias and methodological quality of the included studies was evaluated, with reporting quality assessed according to the STROBE checklist. We reviewed 20681 articles from which 12 were selected, published between 2013 and 2024. Twenty-six tests were found, of which the most measured skills were specific (*n*=11) and non-specific (*n*=7) agility. All tests presented good to excellent reliability and validation with a CCI of 0.70 to 0.99 and a Pearson correlation coefficient ranging from 0.83 to 0.99, respectively. The tests with the best psychometric properties were change of direction without ball, change of direction speed, agility with ball, agility with goal success, and agility with dribbling and passing.

Keywords: Adolescent soccer players, agility test, coordination test, motor skills, reliability.

Resumen

Las pruebas que evalúan habilidades técnico-tácticas en soccer han sido poco estudiadas en adolescentes, a pesar de que el inicio en niveles profesionales es cada vez más temprano, por lo que resulta importante identificar las pruebas con mejores propiedades psicométricas en función de las etapas de crecimiento y características biológicas de los jugadores. Por lo tanto, el objetivo es examinar las cualidades psicométricas de las pruebas de evaluación de habilidades técnico-tácticas en el fútbol durante etapas formativas. Se revisaron cuatro bases de datos Pubmed, Springer, Sciencedirect, Google Scholar y Proquest para identificar estudios donde se hayan validado pruebas para evaluar habilidades técnico-tácticas en futbolistas adolescentes de 11 a 18 años pertenecientes a academias profesionales de futbol, a través de los lineamientos de la Declaración PRISMA. Se evaluó el riesgo de sesgo y calidad metodológica mediante la escala STROBES. Se revisaron 20681 títulos de los cuales se seleccionaron 12, publicados entre 2013 y 2024. Se encontraron 26 pruebas, de las cuales las habilidades más medidas fueron agilidad específica (*n*=11) y no específica (*n*=7). Todas las pruebas presentaron una buena a excelente confiabilidad y validación con un CCI (0.70 a 0.99) y un coeficiente de correlación de Pearson que osciló entre (0.83 a 0.99), respectivamente. Las pruebas con mejores propiedades psicométricas fueron cambio de dirección sin balón, velocidad de cambió de dirección, agilidad con balón, agilidad con éxito de gol, y agilidad con regate y pase.

Palabras clave: Confiabilidad, habilidades motoras, jugadores de fútbol adolescente, test de agilidad, test de coordinación.

Introduction

The combination of physical and technical skill tests in soccer has been scarcely examined among adolescent players. The starting ages in professional-level play are becoming increasingly younger, making talent identification an important concern. The performance characteristics observed during this developmental phase should reflect those required in actual play. Therefore, coaches and trainers need comprehensive, reliable, and valid test designs available that enable the identification of potential players while respecting each stage of growth and its specific biological characteristics (Dugdale et al., 2020).

In soccer practice, numerous tests have been developed to evaluate specific physical attributes and technical skills. Among the fundamental physical qualities essential to the game are speed and agility (Pruna et al., 2018); both planned and unplanned changes of direction (COD) are strongly considered components for evaluating these abilities. However, a recent study (Morral-Yepes et al., 2023) suggests that agility and COD are independent skills.

Agility, as a physical capacity, is defined as the rapid movement of the body involving a change of speed or direction in response to stimuli (Altmann et al., 2022). The COD, on the other hand, refers to the ability to change direction toward a specific location on the field (Dugdale et al., 2020). These two abilities, change of direction and agility, have been regarded as important criteria for talent identification and selection in soccer (Bustos et al., 2017).

Technical skills such as receiving, passing, shooting, and dribbling are considered among the most influential factors in achieving success during play (Putra & Bahtra, 2021). In early adolescence, these skills may have a greater impact on performance than speed (Kokštejn & Musalek, 2019; Slaidiņš & Fernāte, 2021). It has been observed that during a Premier League match, an average player performs between 100 and 150 technical actions such as those mentioned above (Alfonso-Mora et al., 2018), and between 1,000 and 1,500 changes of direction or movement per game, that is, a change in movement every 3.5 seconds, with COD being involved in approximately 10% of goals (Dugdale et al., 2020).

Widely used tests in soccer include the K-test for agility assessment, as well as the m505COD and the Illinois Change of Direction (ICOD) tests, in addition to 10 m and 20 m sprint tests. These tests have demonstrated good reliability and validity, although they do not incorporate technical skills or simulate realistic game situations (Kovacevic et al., 2018).

Some authors emphasize the need to bring testing conditions closer to actual match scenarios and skill performance, as ball-skill tests are among the most demanded assessments in soccer, thereby increasing test validity (Bustos et al., 2017; Qowiyyuridho & Fauzi, 2021; Alfonso-Mora et al., 2018; Costa et al., 2021). For example, some protocols, such as those evaluating maximum ball velocity (MBV), differ from real-game conditions, because they are often performed without soccer footwear (cleats), over very short distances, and without an intention of reaching maximum speed (Medina & Alvarado, 2018). Therefore, it is important that evaluations of technical skills and motor abilities reflect common match situations, such as ball control, passing, and shooting. This is particularly relevant in tests assessing ball-specific agility and agility related to goal-scoring success (Kutlu et al., 2012, 2014; Altmann et al., 2022).

Moreover, during adolescence, measurement bias may occur due to body growth and the biological maturation process, factors that should be considered while evaluating technical skills (Salinero et al., 2013). Finally, it is essential to review and analyze field testing instruments based on reliability and validity criteria to ensure high-quality soccer evaluations that reflect players' individual characteristics (Triana-Cardona & Buitrago Espitia, 2019).

In the background, the present study aims to review the psychometric properties of tests assessing technical–tactical skills in youth football players.

Materials and Methods

Search Strategy

This review was conducted following the PRISMA guidelines (Page et al., 2021). The search was performed in April 2023 across the databases of PubMed, ProQuest, ScienceDirect, and Springer. Along with Google Scholar was also used, where the first 100 results were considered.

The descriptors or keywords were obtained from the MeSH (Medical Subject Headings) thesaurus and included: (1) adolescents, (2) maturation status, (3) coordination, (4) motor skills, (5) agility test, (6) change of direction, (7) dribbling, (8)

validity, (9) reliability, and (10) soccer. Seven combinations were generated for each language using the Boolean operators AND and OR.

Selection of Studies

Potential articles were first identified based on their title and abstract. The following inclusion criteria were then applied for selection:

a) articles written in English or Spanish;

b) original research articles;

c) full-text availability;

d) studies involving male soccer players;

e) age range between 11 and 18 years;

f) studies that evaluated the validity and reliability of tests measuring specific or technical soccer skills related to agility, change of direction, dribbling, and running around obstacles.

The final selection of studies was performed by two independent researchers. In cases of disagreement, a consensus was reached through discussion with two additional researchers to decide on inclusion or exclusion. For each selected article, the following information was extracted: language, authors, year, objective, study design, sample size, tests used, variables, statistical analysis, primary and secondary results, and conclusions.

Methodological Assessment

The methodological quality of the selected studies was assessed using the STROBE statement, which provides general recommendations for descriptive studies (Vandenbroucke et al., 2009). The checklist consists of 22 verification items related to the title, abstract, introduction, methods, results, and discussion sections; however, only 21 items were considered in this study, excluding the item “Other information”.

Each item was scored as 1 = meets the criterion and 0 = does not meet the criterion. Studies with higher scores were considered to have greater methodological rigor (Vandenbroucke et al., 2009). After scoring, studies were classified as follows:

(1) low methodological quality for scores ≤50%;

(2) good methodological quality for scores between 51% and 75%; and

(3) excellent methodological quality for scores >75%.

Results

From a total of 20,681 titles identified, 12 articles were selected. Figure 1 presents the flow diagram of the article selection process included in this review and table 1 presents the general and methodological characteristics of the selected studies.

Reliability

The reliability of the tests was primarily analyzed using relative and absolute methods. Among the most frequently employed statistical techniques were the Intraclass Correlation Coefficient (ICC), used in 58% of the studies (A1, A2, A4, A5, A8, A9, A11, A12); the Standard Error of Measurement (SEM), applied in 42% (A1, A2, A5, A9, A12); Pearson’s correlation coefficient, also in 42% (A3, A4, A7, A11, A12); the paired-sample t-test, in 12% (A4, A7, A9); and Cronbach’s alpha, in 8% (A10).

Overall, the results showed that all evaluated tests demonstrated good to excellent reliability in both relative and absolute terms, supporting their use in the assessment of physical–technical abilities in male soccer players.

Figure 1

Schematization of Search Results and Selection of Items

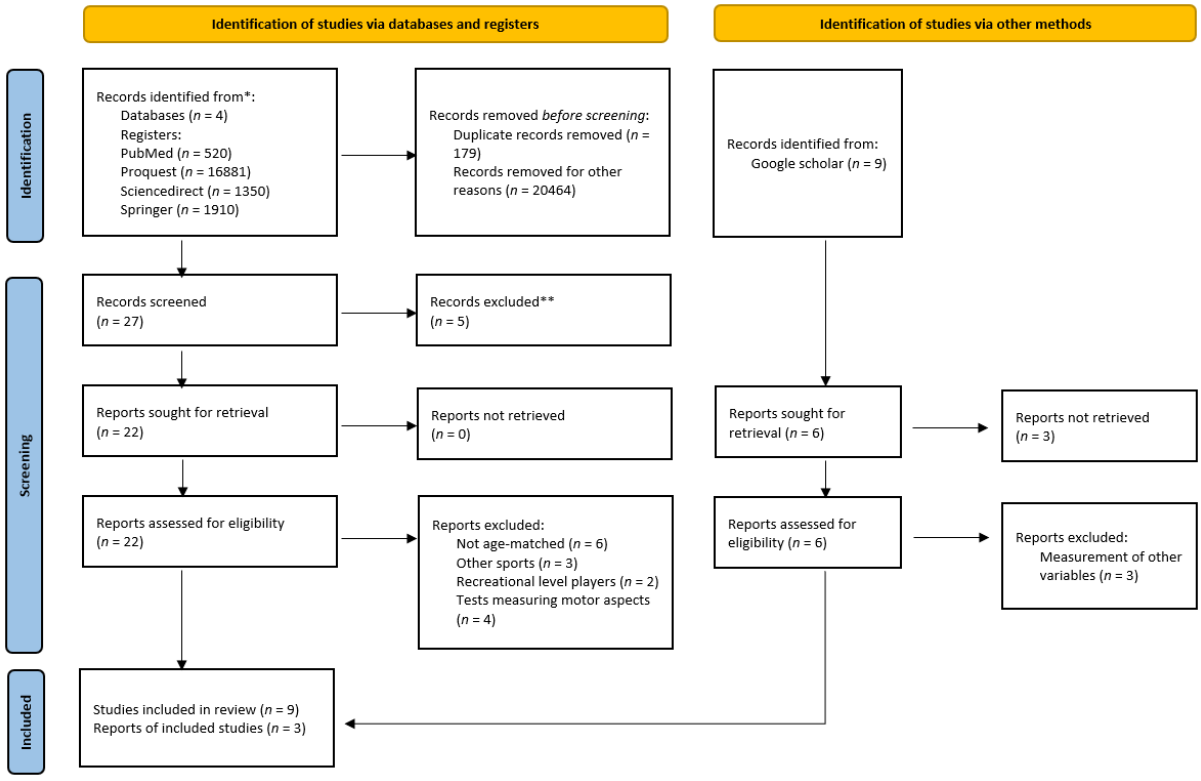

Table 1

General and Methodological Characteristics of the Selected Studies

ID, Author, Year	Sample	Design	Variables	Test	Statistical test used
A1, Brahim et al. 2013	21 international and 23 national players (17.4 ± 0.6 years)	Test-Retest	a) Agility without the ball b) Agility with the ball	a) Multidirectional agility test without the ball (NMAT) b) Multidirectional agility test with the ball (NMAT with ball) c) Dribbling with the ball (Ball–15 m)	**Relative Reliability** Intraclass correlation coefficient (ICC) for NMAT and NMAT with ball. **Absolute Reliability** Standard error of measurement (SEM) for NMAT and NMAT with ball.**Discriminant Validity**Paired-sample t-test. ROC curve analysis for NMAT and NMAT with ball. Pearson correlation between NMAT and NMAT with ball in relation to 15-m dribbling agility.

Table 1 (cont.)

General and Methodological Characteristics of the Selected Studies

ID, Author, Year	Sample	Design	Variables	Test	Statistical test used
A2, Hachana et al. 2014	95 U14 players from a professional and semi-professional academy (13.61 ± 1.04 years)	Test-Retest	Change ofdirectionspeed	a) Illinois Change of Direction Test (ICODT) b) Modified ICODT (MICODT)	**Reliability**ICC and SEM.**Criterion Validity** Pearson correlation between ICODT and MICODT. **Discriminant Validity**ROC curve analysis, independent-sample t-test, and Pearson correlation between elite vs. sub-elite players.
A3, Kutlu et al. 2014	68 soccer players (11.6 ± 0.5 years)	Test-Retest	a) Agility with the ball	a) Agility while dribbling (AS) b) Agility for goal success (AS-goal) c) Agility for change of direction (zig-zag)	**Reliability**Pearson correlation between AS, AS-goal, and T-Drill. **Criterion Validity** Pearson correlation between AS, AS-goal, and coordination tests with ball and zig-zag courses.
A4, Rebelo-Gonc#alves et al. 2016	66 elite and sub-elite players aged 13, 14, and 15 years	Test-Retest	a) Lateral jump technique	a) Sprint-Keeper (S-Keeper) speed and jump test b) Lateral shuffle jump test (LS-Keeper).	**Reliability**Pearson correlation, ICC, SEM, and coefficient of variation (CV) between S-Keeper and LS-Keeper. **Discriminant Validity** Independent-sample t-test between elite vs. sub-elite players.
A5, Hulka et al. 2018	98 Czech players with 8 years of experience, from U17 and U19 categories (16.9 ± 1.3 years).	Test-Retest	Agility	K-test agility test.	**Reliability**ICC and SEM. **Discriminant Validity**Two-way ANOVA considering competitive level and player position.
A6, Mitrotasios et al. 2018	21 players with 6.05 ± 0.51 years of playing experience (14.48 ± 0.11 years).	Test-Retest	a) Agility with the ball.	a) MM-with ball b) Little-with ball (criterion method)	**Reliability**Paired-sample t-test for MM with ball and Little with ball across different sessions. **Criterion Validity (90% confidence level)**Pearson correlation between MM with ball and Little with ball variables.

Table 1 (cont.)

General and Methodological Characteristics of the Selected Studies

ID, Author, Year	Sample	Design	Variables	Test	Statistical test used
A7, Pojskic et al. 2019	20 players with >6 years of experience (17.0 ± 0.9 years).	Cross-sectional study with three phases.	a) Agility and change-of-direction speed.	a) Non-reactive agility (S-CODS) b) Reactive agility (S-RAG).	**Reliability**ICC, CV, and Pearson correlation between S-CODS and S-RAG. **Discriminant Validity** Comparison between categories (U17 vs. U19) using independent-sample t-test.
A8, Dugdale et al. 2020	87 French players from U13, U14, U15, and U17 categories, aged 10.6–17.3 years.	Test-Retest	a) Change of direction b) Agility	a) 505COD test b) Non-reactive agility (Y-Sprint-Pre) and reactive agility (Y-Sprint React).	**Reliability**ICC, CV. **Discriminant Validity**Pearson correlation of m505COD, Y-Sprint PRE, and Y-Sprint React with chronological age and somatic maturation.
A9, Krolo et al. 2020	59 Croatian players aged 11–12 and 14–15 years.	Test-retest	a) Change-of-direction speed b) Reactive Agility.	a) General change of direction (CODS) and soccer-specific change of direction (FS-CODS) b) Soccer-specific reactive agility (FS-RAG).	**Reliability**ICC, CV, and SEM between FS-CODS and FS-RAG. **Discriminant Validity** Comparison between age groups and performance levels using independent-sample t-test. **Criterion Validity** Pearson correlation and linear regression of FS-CODS and FS-RAG with reactive strength, 10- and 20-m sprint speed, and lower-limb power (countermovement jump).
A10, Qowiyyuridho&Fauz 2021	20 players with one year of experience, aged 13–14 years.	Test-Retest	a) Agility with dribbling.	a) Dribbling and Passing Agility Test.	**Reliability** Cronbach's alpha. **Content Validity** Delphi method calculated using a validity index (Aiken) for the dribbling and passing agility test.**Criterion Validity** Pearson correlation for the dribbling and passing agility test.

Table 1 (cont.)

General and Methodological Characteristics of the Selected Studies

ID, Author, Year	Sample	Design	Variables	Test	Statistical test used
A11, Petrucci et al. 2021	69 players from the city of Palermo, Italy (11.1 ± 1 years).	Cross-sectional study.	a) Maximum speed b) Dynamic motor coordination.	a) 20-metre test (20m) b) Harre Circuit Test (HCT) c) Petrucci Skill Test (PAT)	**Criterion Validity** Pearson correlation between PAT, HCT, and 20-m test.
A12, Makhlouf et al. 2022	65 elite and amateur players classified into two categories according to maturation status: pre-PHV velocity and circum-PHV (11.4 ± 1.18 years).	Test-Retest	a) Change of direction	a) Change of direction without the ball (ICODT) b) Change of direction with the ball (ICODT-with ball)	**Reliability**Pearson correlation, ICC (test-retest). **Absolute Reliability**SEM.**Criterion Validity** Pearson correlation between ICODT and ICODT with ball.**Discriminant Validity**ROC curve analysis.

The ICC values ranged from 0.70 to 0.99, with most studies reporting values above 0.89, indicating excellent inter- and intra-rater stability. The exceptions were studies A9 (ICC = 0.79) and A7 (ICC = 0.70), corresponding to the FS-RAG and S-RAG tests. Pearson's correlation coefficients ranged from 0.83 to 0.99, indicating strong correlations between measures.

The SEM was reported in five studies and remained consistently low, with values below 5%, suggesting good measurement precision. In the studies using the paired-sample t-test (A3 and A6), no significant differences were found between repeated measures (p> 0.05), indicating adequate temporal stability. In study A10, Cronbach's alpha was 0.95, reflecting excellent internal consistency, while in A4, the reliability index R ranged from 0.88 to 0.90.

Detailed reliability and validity results are presented in Table 2.

Table 2

Reliability and Validity Results of the Selected Articles

Id, Author, Year	Reliability and validity results	Conclusions
A1, Brahim et al. 2013	**Reliability** ICC of 0.96 (CI, 0.94–0.98) for NMAT and 0.97 (CI, 0.94–0.98) for NMAT with ball. The SEM for NMAT was 0.16%, and for NMAT with ball, 0.25%. **Discriminant validity** a) International players showed shorter execution times compared to national players for NMAT (9.33 ± 0.27 vs. 9.70 ± 0.22) and for NMAT with ball (11.48 ± 0.42 vs. 12.24 ± 0.42, respectively). b) The ROC curve between international and national players showed an area under the curve (AUC) of 0.85 for NMAT and 0.92 for NMAT with ball. c) The correlation between the 15 m dribbling test and NMAT was 0.78, and with NMAT with ball, 0.81 (p< 0.001).	NMAT and NMAT with ball demonstrated a high degree of reliability, good discriminant ability between international and national players, and a strong association with the agility criterion test, particularly for NMAT with ball.

Table 2 (cont.)

Reliability and Validity Results of the Selected Articles

Id, Author, Year	Reliability and validity results	Conclusions
A2, Hachana et al. 2014	**Reliability** The SEM for MICODT was 1.24% (below the 5% threshold) with an ICC of 0.99, and an adequate correlation with ICODT (r = 0.77, p = 0.001). **Criterion validity** A significant correlation (r = 0.77) was found between MICODT and ICODT. Discriminant validity: Elite players outperformed sub-elite players in both ICODT and MICODT. The MICODT test showed an AUC of 0.77, with a sensitivity of 88% and specificity of 56% to discriminate between elite and sub-elite players (cutoff = 12.78 s).	The MICODT is a reliable and valid test for assessing soccer-specific change of direction. It is effective for discriminating skill level among players.
A3, Kutlu et al. 2014	**Reliability** Both AS and AS-goal showed significant differences between test and retest sessions (p< 0.001). The test–retest correlation for both tests was ≥ 0.90. **Criterion validity** The correlation of AS and AS-goal with the zig-zag test was 0.70 and 0.71, respectively. The correlation between AS and AS-goal was 0.99.	The AS (with ball) and AS (goal success) tests demonstrated adequate reliability and validity.
A4, Rebelo-Gonc#alves et al. 2016	**Reliability** In the test–retest for S-Keeper and LS-Keeper, correlations were >0.88, ICC >0.908, and CV <4.37%. **Discriminant validity** The elite group performed better than the sub-elite group in the S-Keeper and LS-Keeper tests, mainly on the left side, with effect sizes (Cohen's d) of 0.219 and 0.329, respectively.	Both protocols showed adequate reliability (reproducibility) and validity for goalkeepers.
A5, Hulka et al. 2018	**Reliability** The ICC for the K-test was 0.89 with an SEM of 0.93% (below the accepted 5%). **Discriminant validity** The K-test showed significant discrimination by competitive level (F = 33.49; p = 0.001), but not by player position (F = 0.31; p = 0.81), nor interaction between level and position (F = 0.10; p = 0.96). U19 players outperformed U17 players.	The K-test demonstrated good reliability and adequate discriminant validity between players from different competitive categories.
A6, Mitrotasios et al. 2018	**Reliability** A difference was found in the Little-with-ball agility test between test and retest (7.00 ± 0.56 s vs. 7.17 ± 0.56 s, p< 0.1), but not for MM-with-ball (13.73 ± 1.15 s vs. 14.26 ± 1.21 s). **Criterion validity** The MM-with-ball agility test showed a moderate association with the Little-with-ball test (r = 0.59, p = 0.005), used as the criterion method.	The MM-with-ball agility test demonstrated adequate reliability and moderate validity for measuring dribbling and agility ability in soccer players.

Table 2 (cont.)

Reliability and Validity Results of the Selected Articles

Id, Author, Year	Reliability and validity results	Conclusions
A7, Pojskic et al. 2019	**Reliability** ICC for S-CODS was 0.92 and for S-RAG ranged from 0.70 to 0.88, with CVs of 5.8% and <4.95%, respectively. Pearson correlations between S-CODS and the three SRAG protocols ranged from 0.5–0.6 (p< 0.05). **Discriminant validity** Performance in S-CODS was better for U19 compared to U17 players (7.22 ± 0.35 vs. 7.78 ± 0.33, p< 0.001), and for S-RAG (9.38 ± 0.24 vs. 9.73 ± 0.44, p< 0.05).	The S-CODS and S-RAG tests showed high reliability and adequate discriminant validity among players from different age categories
A8, Dugdale et al. 2020	**Reliability** ICC for COD ranged from 0.81–0.91 with a CV between 1.2–2.0, while for m505COD the ICC ranged from 0.84–0.89 and the CV from 0.0–5.3. **Discriminant validity** No correlation was found between session-to-session differences in m505COD and age (r = –0.14, p> 0.05) or somatic maturation (r = –0.19, p> 0.05), indicating that regardless of age or maturation status, the test shows adequate reproducibility. However, Y-Sprint-Pre and Y-Sprint-React showed a relationship between inter-session differences and both age and maturation.	The m505COD test demonstrated adequate inter-session reliability, whereas Y-Sprint-Pre and Y-Sprint-React showed greater variability among younger players and those who had not yet reached their Peak Height Velocity (PHV).
A9, Krolo et al. 2020	**Reliability** ICC for FS-CODS was 0.82 and for FS-RAG 0.79, with CVs of 4% and 5%, respectively. The SEM for FS-CODS ranged from 0.05–0.05 and for FS-RAG from 0.06–0.08.**Discriminant validity** U15 players performed better than U13 players for FS-RAG (t-test: 3.96, p< 0.001) and FS-CODS (t-test: 6.42, p< 0.001).**Criterion validity** FS-CODS and FS-RAG were moderately associated with strength and speed indicators (p< 0.05) in the U15 category, but not in U13, where no association was found.	The FS-RAG and FS-CODS tests showed good relative reliability, though FS-RAG had slightly higher CV values (>5%). Both tests demonstrated adequate validity within the U15 group.
A10, Qowiyyuridho& Fauzi, 2021	**Reliability** Cronbach's alpha = 0.995. **Content validity** Aiken's V index = 0.87. **Criterion validity** A correlation of 0.99 was found between the dribbling agility test and the passing agility test.	The dribbling and passing agility test showed excellent metric properties in both reliability and validity.
A11, Petrucci et al. 2021	**Criterion validity** The PAT test correlated with the 20 m sprint test (r = 0.51, p = 0.001) and with the Harre Circuit Test (HCT) (r = 0.83, p< 0.001).	The newly proposed agility test, PAT, demonstrated adequate criterion validity.
A12, Makhlouf et al. 2022	**Reliability** ICC for ICODT was 0.94, and for ICODT-with ball ranged from 0.993 to 0.943, both with SEMs of 0.07 and 0.02, respectively (below 5%). **Criterion validity** The ICODT-with ball test showed a moderate correlation with speed, strength, and power indicators (r = 0.37–0.59, p< 0.003) and with ICODT (r = 0.65, p< 0.001).**Discriminant validity** Players at their PHV performed better than those who had not yet reached PHV in the ICODT-with ball test (22.79 ± 1.69 vs. 24.25 ± 2.53, p = 0.028). Likewise, elite players outperformed non-elite players (22.55 ± 0.93 vs. 25.15 ± 2.79, p< 0.001).	The ICODT-with ball test showed excellent reliability and validity in young soccer players. It effectively discriminated between elite players and those with more advanced somatic maturation.

Validity

In general, based on the analyzed studies, most physical–technical tests applied to young male soccer players demonstrated adequate criterion and discriminant validity, with moderate to high correlations (. value between 0.48 and 0.99) and the ability to distinguish between competitive levels, age categories, and biological maturation stages. However, only a small number of studies examined content validity, and most focused on a single type of validation, limiting the generalizability of their findings.

The main types of validity identified were criterion validity (A6, A12, A2, A9, A3, A10, A11) and construct or discriminant validity (A1, A2, A4, A5, A7, A9), both reported in seven studies. Only one study (A10) assessed content validity. Nine studies employed a single type of validity analysis, while three (A2, A4, and A9) combined two validation methods.

In study A2, the MICODT and ICODT tests showed a Pearson's correlation coefficient (r) = 0.77, as well as adequate discriminant validity for MICODT, which effectively distinguished between elite and sub-elite soccer players through ROC analysis, with elite players showing better physical performance. Similar findings were observed in A9, where the FS-RAG and FS-CODS tests correlated with 10 m and 20 m sprints, 20 m change-of-direction tasks, and vertical jump performance (r> 0.79), and also discriminated between U15 and U13 age groups.

In A10, the Dribbling and Passing Agility Test—which integrates technical indicators such as dribbling, change of direction, and difficulty—demonstrated adequate content validity according to the Delphi method (Aiken's V > 0.8) and high criterion validity with another agility test (r = 0.99).

Studies A1, A4, A5, and A7 assessed discriminant validity using the Student's t-test, comparing athletes across competitive levels and technical demands. The NMAT tests with and without the ball (A1) significantly discriminated between competitive levels (AUC ≥ 0.85 and 0.92, respectively), correlating with other agility tests (Agility-15m, Ball-15m). The K-Agility test (A5) showed significant differences between international and national athletes; the S-COD and S-RAG tests (A7) favored U19 over U17 players; and the S-Keeper and SL-Keeper tests (A4) demonstrated better performance among elite compared to sub-elite players.

Additionally, in A10, older and more biologically mature players (based on peak height velocity) achieved better results in 10m and 20m sprints, although the M505COD test did not adequately discriminate between groups by maturation or age.

In studies A3, A6, A11, and A12, only criterion validity was assessed, with Pearson correlation coefficients ranging from r = 0.48 to 0.99. In A12, the ICODT with the ball correlated significantly with the version without the ball (r = 0.65; p< 0.05); in A3, the AS–Ball Conduction test correlated with AS–Goal Success, T-Drill, and Zig-Zag tests (r = 0.99, 0.43, and 0.70; p< 0.001).

Complete results for validity and reliability are presented in Table 2, while Table 3 describes the specific soccer skill assessment tests identified in this review.

Table 3

Description of Tests That Used Soccer-Specific Skills

ID, Author, Year	Test	Description
A1, Brahim et al. 2013	a) Multidirectional agility without a ball (NMAT). b) Multidirectional agility with a ball (NMAT with ball).	a, b) The test consists of measuring players' speed during a 25-meter agility run using a photocell gate system. The athlete begins with a 2.5-meter lateral movement to one side and returns covering the same distance to reach the starting point. Next, they run 2.5 meters in a straight line followed by a 3-meter forward run. In the next stage, the player changes direction covering 1 meter and then performs a linear run of 1.35 meters. Subsequently, they must overcome a 0.5-meter high hurdle. The test concludes with a 5-meter straight sprint.

Table 3 (cont.)

Description of Tests That Used Soccer-Specific Skills

ID, Author, Year	Test	Description
c) Dribbling with a ball (Ball-15 m).	c) The test requires players to dribble a ball along the course. Upon reaching a hurdle, they kick the ball underneath it and then shoot the ball freely towards one of two small goals, positioned diagonally 7 meters from the hurdle, one to the left and one to the right. After the shot, the player runs to the finish line. Each player performs two attempts over a 15-meter distance, with 3 minutes of passive recovery between attempts. The fastest time achieved in either trial is recorded for analysis.	
A2, Hachana et al. 2014	a) Illinois Change of Direction Test (ICODT).b) Modified ICODT (MICODST).	a) Test not described.b) This agility test is performed in an area marked by four cones. The total distance is 30 meters. The athlete starts standing, and at the signal, runs 9.2 meters forward, turns, and returns to the starting point. Then, they weave around the four markers, completing two additional 9.2-meter sprints. Participants must complete the course as fast as possible, without technical instructions on optimal movement. They are required to go around the markers rather than cut through them. If an athlete fails to comply, the test is stopped and repeated after the necessary recovery time.
A3, Kutlu et al. 2014	Agility without a ball (AS).Agility with a ball (AS with ball).	Test not described.
A4, Rebelo-Gonc#alves et al. 2016	a) Sprint-Keeper (S-Keeper) Speed and Jump Testb) Shuffle-Keeper (LS-Keeper) Lateral Jump Test	a) The participant begins with a rapid acceleration from a standing position. Then, they continue with a straight-line sprint. Upon reaching a cone, they must perform a turn while changing direction and finally dive to catch a stationary ball. If the participant fails to catch the ball with both hands, the test must be repeated. b) The goalkeeper starts standing and accelerates in a straight line towards cone A, located 3 meters from the starting point. From this position, they perform a lateral movement towards cone B, situated 2 meters away, without crossing their feet and keeping their face forward in the direction of movement. Then, they return to cone A in the same manner, ensuring they pass inside the cones. Finally, they must block and catch a stationary ball with both hands. If the goalkeeper crosses their feet or fails to catch the ball correctly, the test is invalid and must be repeated. Total time is recorded.
A5, Hulka et al. 2018	K-test.	The test consists of completing a course between cones, with distances of 4.5 m from cone 1 to 2 and from cone 1 to 5; and 3 m from cone 2 to 3 and from cone 4 to 5. Each player performs three attempts, with 10 minutes of rest between them. The best recorded time is used for analysis.

Table 3 (cont.)

Description of Tests That Used Soccer-Specific Skills

ID, Author, Year	Test	Description
A6, Mitrotasio et al. 2018	a) MM with ball b) Little with ball	a) Players start at point A, with one foot positioned 40 cm before the start line, and complete a zig-zag course changing direction around cones B, C, D, E, F, G, and H, finishing by crossing line I. b) Players move along a 20-meter distance, changing direction by 100° every 5 meters in a zig-zag pattern while dribbling the ball. The fastest time is recorded.
A7, Pojskic et al. 2019	a) Non-reactive agility (S-CODS)b) Reactive agility (S-RAG)	For S-CODS, players start from a starting line and move toward one of four cones (A, B, C, D) depending on which cone lights up (first cone A, then B, C, and D) to kick the ball, and must quickly return to the starting line. For S-RAG, the protocol is similar, but the first cone to light up is unknown. The total time to complete the 4-cone course is recorded. Pojskic et al. (2019) provides a figure for further clarification.
A8, Dugdale et al. 2020	a) 505 COD Test b) Non-reactive agility (Y-Sprint PRE) Reactive agility (Y-Sprint React).	a) The 505 COD test consists of a 10-meter sprint from a designated point, followed by a 180° turn on a predetermined leg (right or left) upon reaching 10 meters, and finally a 5-meter sprint back to the finish line. b) The Y-Sprint PRE involves a 6-meter sprint from a starting point in a straight line, followed by a 4-meter sprint with a 45° turn to the right or left (direction predetermined). Two attempts are completed for each side, and the best times for each direction are averaged. c) This test is similar to the previous one, but LEDs or light stimuli randomly indicate the direction the participant must go.
A9, Krolo et al. 2020	a) Reactive agility (FS-RAG)b) Change of direction speed (FS-CODS)	a) The player sprints at maximum speed along a 1-meter straight line. Then a light (right or left) turns on, and the player must turn 45° toward the indicated direction and sprint 3.5 meters to a cone where a ball is placed on the side, then shoot at the goal. The goal is 4 meters from the cone and 1.5 meters wide. The player returns as fast as possible and repeats until five successful shots are completed. Total time for the five attempts is recorded. b) The FS-CODS test is similar to FS-RAG, with the difference that the player knows in advance which direction to take (right or left).
A10, Qowiyyuridho & Fauzi, 2021	Dribbling and Passing Agility Test	The player starts at a designated point, dribbles to point A, then quickly runs to point B and pushes the ball to the right to score with the right foot. Next, they run to point C, push the ball to the left, and score with the left foot. The sequence continues to point D (right foot) and point E (left foot) toward the goal. Finally, the player returns to point A, dribbles, and stops the ball. The test is performed twice, and the attempt with the fastest recorded time is used for analysis.

Table 3 (cont.)

Description of Tests That Used Soccer-Specific Skills

ID, Author, Year	Test	Description
A11, Petrucci et al. 2021	a) 20-metre test (20m)b1) Harre circuit test (HCT)b2) Pretucci Agility Test (PAT)	a) The player starts with the ball 1 meter behind the starting line, where a pair of photocells is placed. The player then dribbles the ball at maximum speed for 20 meters to another pair of photocells. They must touch the ball at least 4 times in the space between the two pairs of photocells and at least once within the first 3 meters. The time to cover the 20 meters (from photocell to photocell) is recorded. b1) In the Harre test, the participant performs a somersault and jumps three hurdles spaced 2.5 meters from the central cone. The test begins at the starting point (south), running toward a cone, turning right, and jumping over hurdle A (west), then returning to pass under it. This sequence is repeated with hurdles B (north) and C (east), always turning right and returning to the central cone. The test ends by returning to the starting point. Total time is recorded. b2) The PAT is performed similarly to the HCT, except that the initial somersault is not performed, and the central cone must not be touched.
A12, Makhlouf et al. 2022	a) Change of direction with ball (ICODT with ball)b) Change of direction without ball (ICODT)	a) The player dribbles the ball in a straight line for 10 meters, then returns to the starting point. Next, they dribble the ball in a zig-zag pattern around four cones spaced 3.3 meters apart, back and forth. Finally, the player dribbles the ball 10 meters straight ahead, back and forth. The best time of two attempts is recorded, with 3 minutes of rest between attempts. b) Similar to the ICODT with ball but performed without a ball.

Discussion

In the present systematic review, we examined the validity and reliability of tests used to assess specific physical and technical qualities in soccer. These tests were categorized into specific and non-specific agility tests, as well as specific and non-specific change of direction (COD) tests. The significance of these assessments lies in their ability to capture not only physical capabilities but also technical, ball-related skills that occur in real-game scenarios. A total of 23 tests from 12 studies that met established validity and reliability criteria were analyzed. Among the specific agility tests showing the strongest psychometric properties, the NMAT test stood out, demonstrating high test–retest reliability (ICC = 0.97 without the ball and 0.96 with the ball) and excellent discriminant capacity (AUC = 0.85 and 0.92, respectively). These findings support its usefulness in evaluating both change-of-direction speed and soccer-specific agility (Brahim et al., 2013).

Regarding the relationship between agility and other physical qualities (such as change of direction, jumping ability, and acceleration), results were mixed. Some studies reported strong correlations, while others found weak or non-significant associations, indicating variability depending on training context. For instance, Calleja-González et al. (2015) found no significant correlations between linear acceleration and tests such as MAT or 90ºS (r = 0.53 and r = 0.46; p< 0.01), whereas Salguero-Rubio et al. (2023) reported a low correlation (r = 0.034) between agility and soccer skills, possibly influenced by players' age and physical capacity.

With respect to reliability, most tests reported ICC values above 0.89, consistent with previous research in soccer players (Sporis et al., 2010). The ICODT with ball and the Illinois with ball tests reached ICC > 0.90 and measurement error <5%, indicating excellent stability (Makhlouf et al., 2022). These tests, which incorporate movement patterns characteristic of soccer (Makhlouf et al., 2018; Negra et al., 2017), reinforce the ecological validity of performance assessment.

Similarly, soccer-specific change-of-direction tests (FS-CODS and FS-RAG), which integrate agility and shooting precision, also showed high reliability (ICC = 0.82–0.79; variation <5%) and good discriminant validity between youth categories (Krolo et al., 2020). Likewise, the AS with ball and AS for goal success tests (Kutlu et al., 2014), as well as the Dribbling and Passing Agility Test (Qowiyyuridho & Fauzi, 2021), demonstrated higher psychometric rigor, as they included two types of validation.

Reactive COD tests, such as Y-Sprint-React, FS-RAG, and S-RAG, exhibited greater variability due to the perceptual and cognitive complexity of their protocols (Brahim et al., 2013; Hulka et al., 2018; Makhlouf et al., 2022). Because these tests involve responses to unpredictable stimuli, they reflect open motor situations similar to real-game contexts (Pérez-Gómez et al., 2017). In this regard, Rebelo-Gonçalves et al. (2016) observed that goalkeepers' typical movements, such as diving toward the ball, were more closely associated with acceleration and change of direction than with jump power.

Among the methodological factors influencing validity are course length, turning angle, and recovery time between trials (Nimphius et al., 2018). In study A8, the m505COD and Y-SprintP tests, involving 180° and 45° turns respectively, demonstrated high reliability (Dugdale et al., 2020). Across the reviewed studies, recovery times ranged from 3 to 5 minutes; those employing longer recovery periods (A1, A2, A3, A7, A9, A12) showed reduced fatigue and improved technical performance, especially in ball-related tests (Brahim et al., 2013; Makhlouf et al., 2022; Hachana et al., 2014; Pojskic et al., 2019; Krolo et al., 2020).

Instrumentation also influenced measurement precision. Nine studies used photoelectric timing gates (A1–A9, A12), two used electronic devices and stopwatches (A5, A11), and one used a manual chronograph (A10). The height of the timing gates and the player's starting posture affect measurement accuracy (Condello et al., 2020). Only five studies controlled these factors (A2–A7), achieving higher precision. It is recommended to position the gates at hip height, as lower placements tend to underestimate times (López et al., 2012); as well as the use of photoelectric cells, used to carry out the timing of the tests and other systems such as GPS and the use of multi-camera videos that serve to collect information on the performance of the players (Kubayi, 2019; López et al., 2012).

From a biological perspective, several authors have highlighted the influence of biological maturation and sport experience on the validity and reliability of these tests (Machek-Casanova & Gamardo-Hernández, 2017; Manangón-Pesantez. et al., 2020; Méndez-Pérez, 2020). Only three studies considered maturation status (Dugdale et al., 2020; Hachana et al., 2014; Krolo et al., 2020), finding a significant relationship between maturation level and agility performance, particularly around peak height velocity (Živković et al., 2022). Elite players, who tend to be more mature and experienced, achieved higher scores (Sonesson et al., 2021).

Familiarization with the tests was another critical factor; eight studies (A1, A2, A3, A4, A5, A7, A8, A12) included familiarization sessions with demonstrations and technical instructions, which improved result consistency (Pojskic et al., 2019). Familiarization reduces intra- and inter-session error and promotes more standardized execution.

Some of the main limitations identified were:(a) the limited consideration of player position, a key aspect given that each role demands specific skills—only one study included goalkeepers;(b) more than 50% of studies did not evaluate measurement bias; and(c) approximately half assessed only one type of validity, whereas the literature recommends at least two. Finally, instrumental variability hinders comparability across studies and limits the standardization of testing protocols.

Conclusions

This systematic review characterized the validity and reliability of 23 tests assessing various physical and technical abilities used in soccer performance evaluation. Key factors influencing test validity and reliability include methodological differences among tests, the precision of measurement equipment, biological maturation status, training age and volume, and familiarization with the testing protocol. Among the tests with the strongest psychometric properties were the ICODT with ball (A12), the Soccer-Specific Change-of-Direction Speed Test (FS-CODS) (A9), Agility in Soccer with Ball (AS–with ball), Agility in Soccer for Goal Success (A3), and the Dribbling and Passing Agility Test (A10).

Ethics Committee Statement

Not applicable due to the type of scientific study, which is a systematic review.

Conflict of Interest Statement

The authors declare no conflicts of interest. The affiliating entities or institutions had no influence on the design of the study, the analysis of the data, or the interpretation of the results.

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Authors' Contribution

For multi-authored research articles, you must detail their individual contributions. For this purpose, use the CRedit taxonomy (https://credit.niso.org/): Conceptualization D.L.D. & L.A.F.O. ; Methodology D.L.D. & L.A.F.O.; Validation D.L.D. & L.A.F.O. & M.I.J.C.F; Formal Analysis M.I.J.C.F; L.A.F.O; S.D.B.; Investigation D.L.D. & L.A.F.O; M.I.J.C.F.; Data Curation D.L.D. & L.A.F.O; Writing – Original Draft D.L.D. & L.A.F.O; Writing – Review & Editing D.L.D. & L.A.F.O & M.I.J.C.F & S.D.B. & L.A.E.C; N.C.H; Visualization D.L.D. & M.I.J.C.F & L.A.F.O.; Supervision L.A.F.O. & M.I.J.C.F; Project Administration D.L.D.; L.A.F.O. & M.I.J.C.F. All authors have read and agreed to the published version of the manuscript.'

Data Availability Statement

Data could be find in https://www.ncbi.nlm.nih.gov/pmc/, https://www.proquest.com, https://www.sciencedirect.com, https://link.springer.com.

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