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Tracking the game: A scoping review of physical and technical performance metrics in women's football

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Abstract

Women's football continues to experience rapid growth globally, yet the evidence base available to inform training prescription, performance analysis, and player development remains limited. This scoping review synthesised published research examining physical and technical performance metrics of women's football players during matches and training and identified key gaps to inform future research. A systematic search and screening process identified 91 peer-reviewed studies, with supplementary grey literature sources from FIFA Technical Reports and Hudl StatsBomb open-source datasets used to provide additional contextual evidence. Physical match performance was extensively represented in the literature, whereas technical performance, training environments, and youth cohorts were markedly underrepresented. Data collection approaches were dominated by GPS-based systems and video analysis, while the use of emerging foot-mounted inertial technologies, capable of capturing ball-specific interactions, remained minimal. The review highlights substantial gaps in the measurement of technical skill, the characterisation of training demands, and age-specific evidence essential for supporting youth development pathways. Establishing standardised reporting frameworks and appropriately validated thresholds, alongside expanding the integration of accessible tracking technologies, will be critical for advancing evidence-based practice across all levels of the women's game.

Keywords

Female athletes, global positioning system, soccer, sport analytics, wearable technology

Reviewer: Nuno Nunes (Solent University, UK)

Introduction

Women's football is a high-intensity intermittent team sport that places substantial physical and technical demands on players.[1,2] Performance in the women's game is increasingly quantified using wearable tracking systems and video-based analysis,[3,4] with studies commonly reporting physical metrics (e.g., total distance covered, running distance across different speed thresholds),[5] alongside technical actions (e.g., passes, ball receptions, dribbles, tackles).[2] Together, these components underpin tactical effectiveness, player development, and match outcomes.[4,6,7] Physical and technical performance are closely connected, as high-intensity movements can create the conditions for decisive technical actions, while technical proficiency can shape physical demands by reducing unnecessary movement or increasing recovery requirements following errors.[4] Because these elements interact continuously in real time, evaluating physical or technical performance in isolation provides an incomplete understanding of football demands.[8] However, much of the literature has examined these performance aspects separately, often prioritising match play and physical outputs, and drawing on measurement approaches and reference values derived from men's football.[8–10] Consequently, there is a need to synthesise evidence that considers physical and technical performance together across both match and training environments in women's football.

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Physical performance in women's football matches has most commonly been quantified using metrics such as total distance covered, running at predefined speed thresholds, and counts of high intensity actions such as sprints, accelerations, and decelerations.[11] Collectively, this body of work indicates that elite senior women accumulate substantial running volumes and repeated high intensity efforts during match play, informing load management, physical preparation, and return to play practices.[1] Physical demands during training have also been examined, with particular emphasis on small-sided games and how their parameters can be manipulated to elicit specific running or high intensity outputs.[12] However, fewer studies have characterised whole session training loads, considered session proximity to match day, or extended analyses beyond elite environments.[13] As a result, despite a growing evidence base, it remains unclear how consistently current monitoring approaches characterise physical outputs across matches and training, and how these outputs vary by competition level and age group.

Technical actions are equally important for understanding football performance, as the ability to repeatedly pass, receive, tackle, and dribble is closely linked to tactical effectiveness and match outcomes.[4] In applied practice, technical actions are embedded within almost all on-field training, with coaches manipulating drill constraints and game-based formats to emphasise specific technical behaviours while simultaneously imposing physical demands.[14] Despite this, technical actions are rarely integrated into training load monitoring frameworks in women's football, limiting understanding of how technical demands during training relate to those experienced in match play or vary across competition levels and age groups.[10,15,16] Existing research has largely relied on video-based coding to assess technical performance, which is labour intensive and requires trained analysts or costly automated platforms, constraining use outside well-resourced environments.[3,4] Emerging wearable technologies, such as foot-mounted inertial measurement units (IMUs), may offer a more accessible means of capturing foot-level interactions across match and training contexts.[16,17] However, the extent to which technical demands have been characterised in women's football and how they have been quantified remains unclear, highlighting the need to map the available evidence.

Physical and technical performance outputs vary across playing levels and age groups, as youth players experience different match formats, training structures, and developmental priorities than senior players.[1,18–21] To date, insights are largely drawn from individual studies, underscoring the need to systematically map and synthesise the available evidence. Without age-specific evidence for both physical and technical characteristics, comparisons across age groups are difficult, and developmental expectations risk misalignment with players' biological and maturation profiles. However, evidence in women's football is fragmented, with limited integration of physical and technical measures across both training and match contexts and across both senior and youth levels. Therefore, this scoping review aims to map the existing literature on women's football performance. Specifically, this review will: i) examine reported physical and technical performance metrics during training sessions and matches, ii) investigate the technologies used to quantify these metrics, and iii) characterise differences in performance metrics across senior and youth levels.

Method

Protocol and registration

The scoping review protocol was preliminarily submitted and published on the Open Science Framework.[22]

Study design

This scoping review followed the PRISMA-ScR framework to map the current evidence on physical and technical performance metrics reported in women's football.[23] The objective was to describe how performance has been quantified in matches and training sessions and to identify applied practice gaps. Consistent with scoping review methodology, no critical appraisal of study quality was undertaken. Ethical approval was not required as no new data were collected.

Data sources and searches

A structured search of four electronic databases (SPORTDiscus, PubMed, CINAHL, and Scopus) was conducted on 1 December 2025, covering each database's inception through 30 November 2025. Search strings were developed around three concept blocks: 1) population (e.g., female, women, girls, female youth, U12-U23 female), 2) performance characteristics (e.g., physical performance, technical performance, match demands, training demands, technical outputs), and 3) sport (football, soccer, association football). Boolean exclusion terms (e.g., rugby, American football, NFL, AFL, Gaelic football, referees) were used to remove irrelevant sports. The full search strings are provided in Supplementary File 1. Reference lists were manually screened for additional peer-reviewed sources.

FIFA Technical Reports and Hudl StatsBomb open-source datasets were included as supplementary grey literature to provide contextual evidence from large-scale women's football competitions. These sources were identified via pre-existing knowledge of the authorship team and targeted searches of relevant organisational websites and open-data repositories, rather than through a structured electronic database search. FIFA Technical Reports were selected because they provide official tournament-level physical and technical match data from recent international women's competitions, with reports from recent editions of Senior, U20, and U17 FIFA Women's World Cups. Hudl StatsBomb open-source datasets were selected because they provide publicly available, detailed event data from prominent women's domestic leagues and international tournaments. These sources were incorporated as supplementary evidence from large-scale women's football competitions and were not included in the peer-reviewed study count.

A qualitative synthesis was conducted for the included peer-reviewed studies, with supplementary grey literature sources incorporated separately as contextual evidence. For each source, key information was extracted, including the author and publication year, characteristics of population studied (e.g., age group, playing level, competition tier), and the technologies or systems used to collect and quantify performance data (e.g., GPS, video analysis).

Eligibility criteria

Peer-reviewed studies were eligible if they were published in English and investigated women's football players of any age or competitive level. Included studies had to report original, per-match or per-session physical and/or technical performance data obtained during competitive matches or typical team training sessions. Studies presenting only aggregated season-long data, or data from interventions, laboratory-based tasks, or modified formats such as small-sided games were excluded. All included studies were required to report quantitative outcomes derived from recognised tracking technologies or analysis systems (e.g., GPS, inertial measurement units, optical tracking, or video analysis). Non-English publications, reviews, commentaries, and studies involving male players, referees, or coaches were excluded. Screening was conducted in three stages: 1) removal of duplicates, 2) title and abstract screening for relevance, and 3) full text assessment. These eligibility criteria were applied to the peer-reviewed literature search only; supplementary grey literature sources were incorporated separately as contextual evidence.

Data extraction

Screening and data extraction were conducted by a single reviewer (CM). Any uncertainties regarding study eligibility or data charting were discussed with the co-authors. Study characteristics were charted using a structured Microsoft Excel spreadsheet (Microsoft 365, version 2410; Washington, USA), capturing participant information (e.g., sample size, age); team information (e.g., playing level/team, playing positions); equipment used (e.g., device type, model details); physical outputs (e.g., total distance, high speed running [HSR]); technical outputs (e.g., passes, dribbles); and classification thresholds for speed, acceleration, and deceleration (e.g., HSR = > 15 km/h). An individual player observation was defined as one player's recorded contribution to a single match or training session, where reported by the original source; therefore, this value reflected player-match or player-session observations rather than the number of unique players. Means and standard deviations (SD) or standard errors (SE), where applicable, were extracted for physical and technical performance metrics and presented as whole-match or whole-session summaries. Summary averages calculated across studies were reported as simple, unweighted means of the available study-level values, rather than weighted by sample size. These averages were calculated for descriptive synthesis only and were not intended to represent normative benchmarks. Given methodological variation across studies, no formal meta-analysis was undertaken. For technical performance metrics, the unit of analysis was recorded as reported in the original source. Where this was not explicitly stated, the unit was inferred from the study design, table headings, sample description, and magnitude of reported values, and classified as player-level or team-level. Where results were only reported by playing position or subgroup, values were either manually averaged using a simple, unweighted mean or expressed as a range to provide an overall representation of match or session performance.

Results

Resource characteristics

A total of 91 peer-reviewed journal articles were included in the final review (Figure 1), supplemented by grey literature sources from FIFA Technical Reports and Hudl StatsBomb open-source datasets. The peer-reviewed studies are summarised first, followed by the supplementary grey literature sources. Of the 91 peer-reviewed studies, 77 studies investigated women's football players' match performance, five examined training performance, and nine included both match and training contexts (Table 1 and Table 2). Among match-based studies, 59 focused on physical performance metrics, 11 on technical performance metrics, and seven on both. Within training-based research, four studies analysed physical performance metrics, and one reported both physical and technical performance metrics. For studies encompassing both match and training data, eight analysed physical metrics and one examined both physical and technical performance metrics.

Research articles that investigated matches observed an average of 74 matches (median = 18; range 1–3510), and individual player observations used for analysis averaged 342 (median = 144; range 2–3268). Fourteen articles did not detail how many matches were analysed, and 44 articles did not specify how many individual player observations were included.

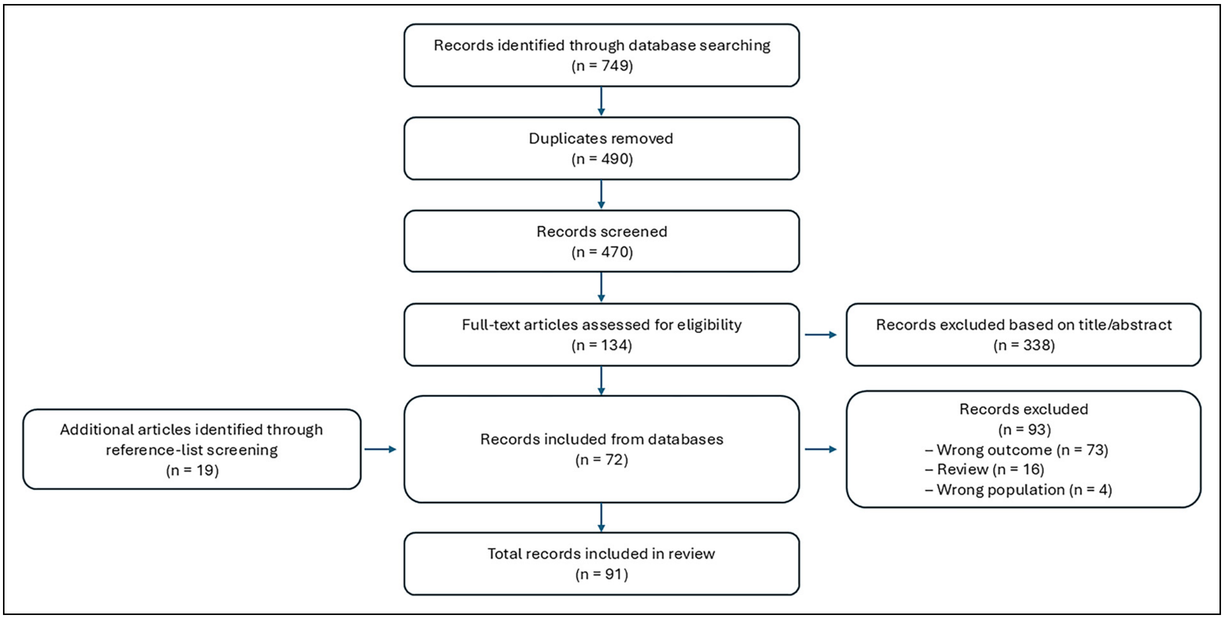

Figure 1. Selection process of eligible studies for review.

Supplementary grey literature sources included full match reports from the most recent U17, U20, and Senior FIFA Women's World Cups (WWC), with 32, 34, and 64 reports available, respectively.[24–26] Four match reports were incomplete from the U17 WWC. Open-source event data from 509 matches across the Women's Super League (WSL), National Women's Soccer League (NWSL), WWC, and UEFA Women's Euros (EUROs) were included.[27]

Regarding training observations (Table 2), the average number of training sessions and individual observations analysed were 36 (median = 23; range 6–90) and 2653 (median = 668; range 72–12416), respectively. Two articles did not describe the number of training sessions analysed,[16,28] and individual training observations were not reported in six articles.[28–36] Fourteen articles examined women's footballers' training loads, but only seven explicitly reported the match-day proximity (MD±) of the sessions analysed.[28,29,33,36–39] Reported schedules varied widely, spanning MD-7 to MD + 2 across studies, with most studies incorporating sessions on MD-5 to MD-1.

Player characteristics

A total of 5648 participants were observed across the reviewed peer-reviewed studies. The average number of participants observed per study was 62 (median = 22; range = 8–546). Senior women's football players (> 20 y) were the dominant age group analysed across reviewed articles reporting match and training performance metrics, with 4305 participants assessed across 77 articles. Ten articles examined youth players (≤ 20 y; n = 1183 participants),[15,19,40–47] and four studies examined both senior and youth players (n = 160 participants).[48–51] Six articles did not report the number of participants observed.[52–57]

Within the supplementary open-source datasets, the available Hudl StatsBomb open-access data included 1642 unique players from recorded matches between 2018 and 2023, spanning four competitions: WSL (n = 372 [2018–2021 seasons]), NWSL (n = 170 [2018 season]), EUROs (n = 290 [2022 tournament]), and WWC (n = 810 [2019, 2023 tournaments]).[27] FIFA technical match reports indicated that 579 outfield players participated in the 2023 WWC,[24] while 414 outfield players participated in the 2024 U20 WWC,[26] and 276 outfield players in the 2024 U17 WWC.[25]

The average age, height, and body mass of senior players from peer-reviewed articles were 23.9 y, 163.7 cm, and 62.0 kg, respectively. Four articles included female players in both senior and youth age groups.[48–51] Ten articles analysed youth players in matches[15,19,40–47]; none of the reviewed articles analysed training performance in youth players. The average age, height, and body mass of youth players were 14.5 y, 162.6 cm, and 55.4 kg, respectively. Twenty articles did not report age, height, and/or body mass characteristics of participants.[16,34,45,47,48,52–66]

Domestic-level women's football players were the most frequently studied playing level (n = 40), followed by national team players (n = 16). Fourteen articles investigated university- and collegiate-level women's footballers.[32,35,62,65,67–76] Nine articles detailed performance metrics at the youth level (U11: n = 1[19]; U14–17: n = 5[15,43–45,49]; U18–19: n = 3).[40,41,45] Two reviewed articles did not provide details on the playing level of participants.[60,64]

Table 1. Study characteristics of physical and technical actions observed during women's football matches.

Author (year)	Topic	Players (n) Playing level/Team Positions	Age (years) Height (cm) Mass (kg)	Device data collection details	Matches (n, observations)
(Andersen et al., 2012)[41]	Physical & Technical	n = 25 Youth Denmark U18	15.9 ± 0.2 y 169 ± 1 cm 58 ± 2 kg	**Device:** Video Camera (DM-VM 600; Canon) **SR:** NS **Placement:** pitch side at halfway line; tripod 5–20 m from sideline; camera up to 5 m high **AM:** Manual computerised coding (Sports Code Elite, v 5.1.0) **Collection notes:** Individual player footage	n = 10 (2 matches per player)
(Andersen et al., 2016)[92]	Physical & Technical	n = 15 Senior Norwegian second and third divisions Outfield players	21 ± 6 y 170 ± 7 cm 62 ± 7 kg	**Device:** GPS (ZXY Sport Tracking System) **SR:** 20 Hz **Placement:** Lumbar belt **AM:** Automatic computerised coding **Device:** Video Camera (HF20E; Canon) **SR:** NS **Placement:** 20 × 20 m area; following ball **AM:** Semi-manual computerised coding (Instat)	n = 2
(Andersson et al., 2010)[79]	Physical	n = 17 Senior Sweden and Denmark national team players DF, MF, FW	27 ± 1 y 168.2 ± 1.5 cm 61.0 ± 1.4 kg	**Device:** Video Camera (DM-VM 600; Canon) **SR:** NS **Placement:** pitch side at halfway line; tripod 30–40 m from sideline; camera 15 m high **AM:** Manual computerised coding **Collection notes:** Individual player footage; regular starters, full international and domestic matches	n = 54 (1–3 matches per player)
(Baptista et al., 2023)[95]	Physical	n = 59 Senior Norwegian top tier clubs CD, WD, CM, WM, FW	~ 19.2–29.6 y	**Device:** GPS (APEX; STATSports) **SR:** 10 Hz **Placement:** Chest harness **AM**: Semi-manual computerised coding (Sonra 2.1.4; StatSport) **Collection notes: F**ull domestic matches across 2 seasons, in normal playing position, in > 3 matches	n = 150

(continued)

Table 1. Continued.

Author (year)	Topic	Players (n) Playing level/Team Positions	Age (years) Height (cm) Mass (kg)	Device data collection details	Matches (n, observations)
(Barbero-Alvarez et al., 2008)[42]	Physical	n = 12 Youth	12.1 ± 0.9 y 155.6 ± 6 cm 48.4 ± 9.2 kg	**Device:** GPS (SPI Elite, GPSports Systems) **SR:** 1 Hz GPS + 100 Hz triaxial accelerometer **Placement:** Chest harness **AM:** Automatic computerised coding (Team AMS)	n = 1
(Beare et al., 2019)[48]	Physical	n = 22 Youth and Senior Romanian First League CB, FB, MF, FW	16 + y	**Device:** GPS (K-Sport) **SR:** 50 Hz **Placement:** Chest harness **AM:** Manual computerised coding	n = 6
(Bendiksen et al., 2013)[89]	Physical	n = 11 Senior Norwegian First Division teams	21.0 ± 4.5 y 169.3 ± 5.5 cm 58.7 ± 6.0 kg	**Device:** GPS & Video (ZXYSport Tracking system) **SR:** 20 Hz **Placement:** Waist belt, 10 stationary sensors surrounding field **AM:** Semi-manual computerised coding (ZXYSport Tracking Software)	n = 1
(Bozzini et al., 2020)[73]	Physical	n = 11 Senior NCAA DI	19.0 ± 1.0 y 68.06 ± 5.4 kg	**Device:** GPS **(**Polar TeamPro) **SR:** NS **Placement:** NS **AM:** Automatic computerised coding (Polar TeamPro) **Collection notes:** Conference and non-conference matches; 45 + min playing time for > 50% of matches	n = 18
(Bradley et al., 2014)[58]	Physical & Technical	n = 59 Senior UEFA Women's Champions League CD, FB, CM, WM, FW		**Device:** Video (Amisco Pro) **SR:** 25 Hz **Placement:** Stadium roof **AM:** Automatic computerised coding (Amisco Viewer) **Collection notes:** Full UEFA Women's Champions League matches	Not reported
(Bransen and Davis, 2024)[52]	Technical	Senior Swedish Damallsvenskan; German Frau Bundesliga; French Division Feminine I; American NWSL; Spanish		**Device:** Video (SciSports event data, SPADL format) **SR:** NS	n = 3510

(continued)

Table 1. Continued.

Author (year)	Topic	Players (n) Playing level/Team Positions	Age (years) Height (cm) Mass (kg)	Device data collection details	Matches (n, observations)
		Primera division; English WSL; Women's Champions League Outfield		**Placement:** Broadcast video feeds (multi-angle, elevated full-pitch view) **AM:** Automated computerised analysis using machine learning	
(Casal et al., 2021)[53]	Technical	Senior Spanish Women's League		**Device:** Video (Instat Scout) **SR:** NS **Placement:** NS **AM:** Automatic computerised coding	n = 68
(Choi and Joo, 2022)[97]	Physical	n = 24 Senior Korean professional league CB, FB, MF, WF, FW	27.8 ± 3.9 y 165.7 ± 5.1 cm	**Device:** GPS **SR:** NS **Placement:** Chest harness **AM:** NS	n = 21
(Choice et al., 2023)[70]	Physical	n = 13 Senior NCAA DII DF, MF, FW	20.5 ± 2.5 y 167.4 ± 5.6 cm	**Device:** GPS (PlayerTek) **SR:** 10 Hz **Placement:** Chest harness **AM:** Automatic computerised coding (PlayerTek) **Collection notes:** Starters, played > 50% of minutes across the season; regular season matches	n = 17 (164 individual match observations)
(Datson et al., 2017)[115]	Physical	n = 107 Senior Europe national teams CD, WD, CM, WM, FW		**Device:** Video (Semi Automated; Prozone Sports) **SR:** NS **Placement:** NS **AM:** Automatic computerised coding **Collection notes:** Full matches	n = 10 (148 individual match observations)
(Datson et al., 2019)[116]	Physical	n = 107 Senior International matches CD, WD, CM, WM, FW		**Device:** Video (Semi Automated; STATSports) SR: NS Placement: NS AM: Automatic computerised coding Collection notes: Full matches	= 13 (108 individual match observations)
(Datson et al., 2024)[98]	Physical	n = 19 Senior	23 ± 2 y 166 ± 30 cm 61.3 ± 3.6 kg	**Device:** GPS (Vector; Catapult Sports) **SR:** 10 Hz GPS + 100 Hz triaxial accelerometers	n = 14 (133 individual match observations)

(continued)

Table 1. Continued.

Author (year)	Topic	Players (n) Playing level/Team Positions	Age (years) Height (cm) Mass (kg)	Device data collection details	Matches (n, observations)
		Scottish Premier League/UEFA Women's Champions League CD, CDM, CAM, WM, FW		**Placement:** Chest harness **AM:** Automatic computerised coding (Openfield; Catapult Sports) **Collection notes:** Full regular season matches	
(DeWitt et al., 2018)[100]	Physical	n = 18 Senior NWSL CD, FM, CM, FW	25.1 ± 3.3 y 168.5 ± 4.8 cm 61.5 ± 4.6 kg	**Device:** GPS (Optimeye; Catapult Sports) **SR:** 10 Hz **Placement:** Chest harness **AM:** Automatic computerised coding (Openfield; Catapult Sports)	n = 20
(Diaz-Seradilla et al., 2022)[37]	Physical	n = 17 Senior Spanish First Division CB, FB, CM, FW	26.3 ± 4.6 y 166.3 ± 6.1 cm 59.8 ± 6.8 kg	**Device:** GPS (WIMU PRO, RealTrack Systems) **SR:** 10 Hz GPS + 100 Hz triaxial accelerometer **Placement:** Chest harness **AM:** Automated computerised coding (WIMU SPRO)	n = 4 (68 individual match observations)
(Dipple et al. 2022)[54]	Technical	Senior NWSL and WSL		**Device:** Video (StatsPerform) **SR:** NS **Placement:** NS **AM:** Automatic computerised coding	n = 170
(Domingues et al., 2025)[93]	Physical	n = 14 Senior Brazilian Championship CB, FB, CDM, MF, FW	26 ± 5 y 167 ± 6 cm 61.2 ± 6.3 kg	**Device:** GPS (PlayerTek; Catapult Sports) **SR:** 10 Hz GPS **Placement:** Chest harness **AM:** Automated computerised coding (PlayertekPlus; Catapult Sports)	n = 15
(Fernandes et al., 2022)[29] [a]	Physical	n = 10 Senior Portugal First League DF, MF, FW	24.6 ± 2.3 y 165 ± 6 cm 58.5 ± 9.3 kg	**Device:** GPS (PlayerTek; Catapult Sports) **SR:** 10 Hz GPS + 100 Hz triaxial accelerometer **Placement:** Chest harness **AM:** Automated computerised coding	n = 15
(Floersch et al., 2024)[72] [a]	Physical	n = 48 Senior NCAA DIII CD, WD, CM, WM	19.5 ± 1.2 y 167 ± 50 cm 64.8 ± 7.4 kg	**Device:** GPS (Polar TeamPro) **SR:** NS **Placement:** Chest harness **AM:** Automatic computerised coding	n = 46

(continued)

Table 1. Continued.

Author (year)	Topic	Players (n) Playing level/Team Positions	Age (years) Height (cm) Mass (kg)	Device data collection details	Matches (n, observations)
				Collection notes: Starting players only	
(Gabbett and Mulvey, 2008)[30 a]	Physical & Technical	n = 13 Senior Australian academy/national team DF, MF, FW	21 ± 2 y	**Device:** Video Camera (Sony DCR-TRV 950E) **SR:** NS **Placement:** Positioned at halfway line, 30 m above field of play. **AM:** Manual computerised coding **Collection notes:** Single player focus with 10 m radius; max four cameras per match	n = 31 Domestic (n = 10) National League (n = 9) International (n = 12)
(García-Ceberino et al., 2022)[31 a]	Physical	n = 18 Senior Spanish First League DF, FB, MF, WM, FW	26.3 ± 3.9 y 166 ± 7 cm 60.7 ± 7.3 kg	**Device:** GPS (WIMU Pro; RealTrack Systems) **SR:** 18 Hz + 100 Hz triaxial accelerometer **Placement:** Chest harness **AM:** Automatic computerised coding (SPRO; RealTrack Systems) **Collection notes:** Only starters analysed	n = 3
(Garcia-Unanue et al., 2020)[80]	Technical	n = 518 Senior 2011 and 2015 FIFA Women's World Cup DF, MF, FW	~27.7 y	**Device:** Video (OPTA Sports) **SR:** NS **Placement:** Broadcast video feeds (multi-angle, elevated full-pitch view) **AM:** Automatic computerised coding **Collection notes:** Played full match	Not reported
(Gentles et al., 2018)[32 a]	Physical	n = 25 Senior NCAA DII	20.2 ± 1.1 y 166.3 ± 5.9 cm 62.0 ± 7.0 kg	**Device:** GPS (BioHarness (version 3); Zephyr) **SR:** 5 Hz GPS + 100 Hz triaxial accelerometer **Placement:** Strap placed at xyphoid process, sensor on midaxillary line **AM:** Automatic computerised coding **Collection notes:** Data analysed: accelerometer = 392 matches; GPS = 305 matches	n = 17 (392 individual match observations)
(Gonzalez-Garcia et al., 2023)[101]	Physical	n = 21 Senior Spanish First Division CD, WD, CM, WM, FW	26.5 ± 5.7 y 164.4 ± 5.3 cm 58.6 ± 5.6 kg	**Device:** GPS (EVO; GPSports) **SR:** 10 Hz GPS + 100 Hz triaxial accelerometer **Placement:** Chest harness **AM:** Automatic computerised coding (GPSports Console Team AMS)	n = 27 (235 individual match observations)

(continued)

Table 1. Continued.

Author (year)	Topic	Players (n) Playing level/Team Positions	Age (years) Height (cm) Mass (kg)	Device data collection details	Matches (n, observations)
				Collection notes: Played > 75 min per match	
(Griffin et al., 2021)[81]	Physical	n = 33 Senior Australian domestic and international DF, MF, FW	25.6 ± 3.4 y 167.1 ± 8.1 cm 60.5 ± 6.5 kg	**Device:** GPS (*Domestic Matches:* VX Sport, Visuallex Sport International; *International Matches:* SPI HPU, GPSports) **SR:** 10 Hz **Placement:** Chest harness **AM:** Automatic computerised coding (VX View, VX Sport; Team AMS, GPSports) **Collection notes:** Played full match	= 21 (85 individual match observations) 15 international matches 6 domestic matches
(Harkness-Armstrong et al., 2020)[43]	Technical	n = 189 Youth English academy U14 and U16 CD, WD, CM, WM, FW	13.95 ± 0.65 y 160.55 ± 6.15 cm 52.3 ± 7.65 kg	**Device:** Video Camera (HC-V750; Panasonic) **SR:** NS **Placement:** Pitch side at halfway line **AM:** Manual computerised coding (Nacsport Pro Plus; Nacsport)	n = 45 (604 individual match observations)
(Harkness-Armstrong et al., 2021)[44]	Physical	n = 201 Youth English academy U14 and U16 CD, WD, CM, WM, FW	13.95 ± 0.65 y 160.55 ± 6.15 cm 52.3 ± 7.65 kg	**Device:** GPS (Optimeye S5 Catapult) **SR:** 10 Hz **Placement:** Chest harness **AM:** Automatic computerised coding (OpenField)	n = 50 (641 individual match observations)
(Harkness-Armstrong et al., 2023)[15]	Physical & Technical	n = 189 Youth English academy U14 and U16 CD, WD, CM, WM, FW	13.95 ± 0.65 y 160.55 ± 6.15 cm 52.3 ± 7.65 kg	*Physical Performance Outputs:* **Device:** GPS (Optimeye S5 Catapult) **SR:** 10 Hz **Placement:** Chest harness **AM:** Automatic computerised coding (OpenField) *Technical Performance Outputs:* **Device:** Video Camera (HC-V750; Panasonic) **SR:** NS **Placement:** Pitch side at halfway line **AM:** Manual computerised coding (Nacsport Pro Plus; Nacsport)	n = 45 (577 individual match observations) U14 = 24 matches U16 = 21 matches
(Hewitt et al., 2014)[82]	Physical	n = 15 Senior	23.5 ± 0.7[b] y 170 ± 1[b] cm	**Device:** GPS (MinimaxX; Catapult) **SR:** 5 Hz	n = 13 (58 individual match observations)

(continued)

Table 1. Continued.

Author (year)	Topic	Players (n) Playing level/Team Positions	Age (years) Height (cm) Mass (kg)	Device data collection details	Matches (n, observations)
		Australian national team DF, MF, FW	64.9 ± 1.3[b] kg	**Placement:** NS **AM:** Automatic computerised coding (LoganPlus; Catapult Sports) **Collection notes:** Played entire international matches	
(Ishida et al., 2022)[74]	Physical	n = 17 Senior NCAA DI DF, MF, FW	21.8 ± 1.7 y 165.1 ± 6.2 cm 63.7 ± 7.9 kg	**Device:** GPS (OptimEye S5; Catapult) **SR:** 10 Hz **Placement:** NS **AM:** Automatic computerised coding (Catapult Innovation) **Collection notes:** Outfield players only; Conference and non-conference matches	n = 19 (271 individual match observations)
(Jagim et al., 2020)[68]	Physical	n = 22 Senior NCAA DIII CD, FB, FW, CM	19.67 ± 1.07 y 161 ± 3 cm 66.7 ± 7.5 kg	**Device:** GPS (Polar TeamPro) **SR:** 10 Hz **Placement:** NS **AM:** Automatic computerised coding **Collection notes:** Starters; played >50% of match duration	n = 22 (241 individual match observations)
(Jagim et al., 2022)[71 a]	Physical	n = 22 Senior NCAA DIII	167 ± 5 cm 65.42 ± 6.33 kg	**Device:** GPS (Polar TeamPro) **SR:** 10 Hz **Placement:** NS **AM:** Automatic computerised coding	n = 22 (467 individual matches observations)
(Julian et al., 2021)[107]	Physical	n = 15 Senior German First and Second Leagues	23 ± 4 y 169 ± 80 cm 64.3 ± 8.2 kg	**Device:** GPS (Tracktics TT01) **SR:** 5 Hz **Placement:** NS **AM:** NS **Collection notes:** Played > 75 min in at least two matches	76 individual match observations)
(Karlsson et al., 2023)[33 a]	Physical	n = 21 Senior Norwegian Premier Division	22.2 ± 3.7 y 168.6 ± 4.3 cm 64.1 ± 6.6 kg	**Device:** GPS (Polar Electro; Polar) **SR:** 10 Hz + 200 Hz triaxial accelerometer **Placement:** Chest harness **AM:** Automatic computerised coding (Polar Team Pro System) **Collection notes:** Played >85 min	n = 15 (100 individual match observations)
(Kobal et al., 2022)[49]	Physical	n = 68 Youth and Senior Brazil professional, U20, U17 Outfield players	20.63 ± 2.0 y 162.77 ± 6.50 cm	**Device:** GPS (PlayerTek; Catapult) **SR:** 10 Hz **Placement:** NS **AM:** Automatic computerised coding	n = 27

(continued)

Table 1. Continued.

Author (year)	Topic	Players (n) Playing level/Team Positions	Age (years) Height (cm) Mass (kg)	Device data collection details	Matches (n, observations)
			58.83 ± 6.37 kg		
(Kobal et al., 2022)[86]	Physical & Technical	n = 24 Senior National Brazilian Championships Outfield players	28.0 ± 4.6 y 163.7 ± 5.2 cm 58.8 ± 7.7 kg	**Device:** GPS (PlayerTek; Catapult) **SR:** 10 Hz **Placement:** Chest harness **AM:** Automatic computerised coding **Collection notes:** Instat for technical outputs	n = 38
(Krustrup et al., 2005)[83]	Physical	n = 14 Senior Danish top tier domestic CD, FB, MF, FW	24.0 ± 4.3 y 166.3 ± 5.0 cm 58.5 ± 5.3 kg	**Device:** Video Camera **(**NV-M50; Panasonic) **SR:** NS **Placement:** pitch side at halfway line; 15 m high; 30–40 m from the touch line **AM:** Manual computerised coding **Collection notes:** Players individually filmed	n = 1
(Kubayi and Larkin, 2020)[55]	Technical	Senior 2019 FIFA Women's World Cup		**Device:** Video (Instat Scout; Instat) **SR:** NS **Placement:** Broadcast video feeds (multi-angle, elevated full-pitch view) **AM:** Automatic computerised coding (Instat Scout) **Collection notes:** Matches that resulted in draws were excluded from analysis (n = 4)	n = 48
(Mäkiniemi et al., 2023)[108]	Physical	n = 85 Senior Finnish top tier domestic CD, FB, CM, WM, FW	23.7 ± 4.1 y 168.0 ± 6.2 cm 64.3 ± 8.1 kg	**Device:** GPS (Polar TeamPro) **SR:** 10 Hz GPS + 200 Hz triaxial accelerometer **Placement:** NS **AM:** Automatic computerised coding **Collection notes:** Full matches played	n = 68 (340 individual match observations)
(Mara et al., 2015)[77] [a]	Physical	n = 8 Senior National league team DF, MF, FW	23–30 y 172.9 ± 5.5 cm 65.1 ± 5.9 kg	**Device:** GPS (SPI HPU; GPSports Systems) **SR:** 15 Hz **Placement:** NS **AM:** Automatic computerised coding (Team AMS; GPSports Systems) **Collection notes:** Friendly match	n = 1
(Mara et al., 2017)[113]	Physical	n = 12 Senior	24.3 ± 4.2 y 171.9 ± 5.1 cm	**Device:** Video Camera (Legria HF R38;	n = 7 (49 individual match observations)

(continued)

Table 1. Continued.

Author (year)	Topic	Players (n) Playing level/Team Positions	Age (years) Height (cm) Mass (kg)	Device data collection details	Matches (n, observations)
		Australian national league team CD, WD, MF, CAM, WM	65.3 ± 5.1 kg	Canon, ×8; Optical Player Tracking System; Australian Institute of Sport (25 fps)) **Placement:** Positioned to collectively capture 105 × 68 m playing area **AM:** Semi-automatic computerised coding **Collection notes:** Full matches played	
(Mara et al., 2017)[112]	Physical	n = 12 Senior Australian national league team CD, WD, MF, CAM, WM	24.3 ± 4.2 y 171.9 ± 5.1 cm 65.3 ± 5.1 kg	**Device:** Video Camera **(**Legria HF R38; Canon, ×8; Optical Player Tracking System; Australian Institute of Sport (25 fps)) **Placement:** Positioned to collectively capture 105 × 68 m playing area **AM:** Semi-automatic computerised coding **Collection notes:** Full matches played	n = 7 (49 individual match observations)
(McCormack et al., 2015)[67]	Physical	n = 10 Senior NCAA DI FB, MF, FW	20.5 ± 1.0 y 166.6 ± 5.1 cm 61.1 ± 5.8 kg	**Device:** GPS (MinimaxX 4.0; Catapult) **SR:** 10 Hz **Placement:** Chest harness **AM:** Automatic computerised coding	n = 8
(McFadden et al., 2020)[35] [a]	Physical	n = 16 Senior NCAA DI	19.3 ± 1.4 y 166.6 ± 5.3 cm 63.9 ± 5.7 kg	**Device:** GPS **(**Polar TeamPro) **SR:** NS **Placement:** NS **AM:** Automatic computerised coding	n = 23
(Meylan et al., 2017)[87]	Physical	n = 13 Senior National team	27.0 ± 5.3 y 170.3 ± 6.1 cm 65.7 ± 5.3 kg	**Device:** GPS (Minimax S4; Catapult) **SR:** 10 Hz + 100 Hz triaxial accelerometer **Placement:** Chest harness **AM:** Automatic computerised coding (Sprint; Catapult) **Collection notes:** Played full matches	n = 34 (157 individual observations)
(Modric et al., 2023)[110]	Physical	n = 8 Senior Slovenia National League CD, FB, CM, WM, FW	24.9 ± 3.9 y 165.8 ± 4.7 cm 60.9 ± 3.8 kg	**Device:** GPS (APEX; STATSport) **SR:** 10 Hz **Placement:** NS **AM:** Automatic computerised coding (STATSport software) **Collection notes:** Played entire match; one match excluded from analysis due to red card	n = 13 (70 individual match observations)
(Mohr et al., 2008)[59]	Physical & Technical	n = 34 Senior National teams and top domestic leagues CD, MF, FW		**Device:** Video Camera **(**NV-M50, Panasonic) **SR:** NS	n = 2

(continued)

Table 1. Continued.

Author (year)	Topic	Players (n) Playing level/Team Positions	Age (years) Height (cm) Mass (kg)	Device data collection details	Matches (n, observations)
				Placement: Sideline at centre line; 15 m high and 30–40 m from the touch line **AM:** Manual computerised coding **Collection notes:** Players filmed individually	
(Mordillo and Zago, 2023)[45]	Physical	n = 60 Youth Italian U15, U17, U19 CD, FB, MF, FW		**Device:** GPS (BT-Q1000eX; Qstarz) **SR:** 10 Hz **Placement:** NS **AM:** Automatic computerised coding	n = 40 U15 (n = 12; 35 individual match observations) U17 (n = 12; 35 individual match observations) U19 (n = 16; 50 individual match observations)
(Myhill et al., 2025)[40]	Physical	n = 257 Youth Women's Super League Academy CD, WD, CDM, CAM, WM, FW	18 ± 1 y 165.1 ± 12.2 cm 62.6 ± 7.5 kg	**Device:** IMU (Playermaker) **SR:** 10 Hz **Placement:** Foot-mounted **AM:** Automatic computerised coding	n = 171 (1672 individual match observations)
(Nakamura et al., 2017)[103]	Physical	n = 11 Senior Sao Paulo State Championship players CD, FB, CM	21.0 ± 3.0 y 163.8 ± 4.5 cm 59.7 ± 8.0 kg	**Device:** GPS (SPI Elite; GPSports Systems) **SR:** 5 Hz **Placement:** Chest harness **AM:** Automatic computerised coding	n = 10 (61 individual match observations)
(Olaizola et al., 2022)[36 a]	Physical	n = 22 Senior Spanish Second Division	24.6 ± 4.0 y 163.9 ± 5.0 cm 58.5 ± 4.2 kg	**Device:** GPS (WIMU PRO, RealTrack Systems) **SR:** 10 Hz **Placement:** Chest harness **AM:** Automatic computerised coding	n = 12 (805 individual match observations)
(Ørntoft et al., 2016)[19]	Physical & Technical	n = 24 Youth Danish U11	9–10 y	**Device:** GPS (SPI Elite; GPSports) **SR:** 5 Hz **Placement:** Chest harness **AM:** Automatic computerised coding **Device:** Video Camera (HF20E; Canon) **SR:** NS **Placement:** NS **AM:** Automatic computerised coding	n = 2
(Panduro et al., 2020)[104]	Physical	n = 94	22.5 ± 4.2 y	**Device:** GPS (Polar TeamPro)	n = 2–4 matches (108

(continued)

Table 1. Continued.

Author (year)	Topic	Players (n) Playing level/Team Positions	Age (years) Height (cm) Mass (kg)	Device data collection details	Matches (n, observations)
		Senior Danish First Division CD, FB, CM, WM, FW	170 ± 6 cm 64.0 ± 6.1 kg	**SR:** 10 Hz GPS + 200 Hz triaxial accelerometer **Placement:** NS **AM:** Automatic computerised coding **Collection notes:** Full match played	individual match observations)
(Pappalardo et al., 2021)[60]	Technical	n = 546 Senior 2019 FIFA Women's World Cup		**Device:** Video (WyScout) **SR:** NS **Placement:** Broadcast video feeds (multi-angle, elevated full-pitch view) **AM:** Manual computerised coding	n = 44
(Pascual-Verdú et al., 2018)[88]	Technical	n = 300 Senior Spanish First Division	15–30 y	**Device:** Video Camera **SR:** NS **Placement:** NS **AM:** Semi-automatic computerised coding	n = 30
(Pedersen et al., 2022)[94]	Physical	n = 37 Senior Norway Second and Third Division CD, FB, CM, WM, FW	18.4 ± 3.6 y 167 ± 5 cm 61.8 ± 5.4 kg	**Device:** GPS (ZXY Sport Tracking System) **SR:** 20 Hz **Placement:** Waist belt **AM:** NS **Collection notes:** Played 90 min in at least one match	49 individual match observations
(Póvoas et al., 2022)[114]	Technical	n = 13 Senior National team players CD, FB, CM, WM, FW	26 ± 4 y 170 ± 4 cm 63.4 ± 4.8 kg	**Device:** Video camera (Instat) **SR:** NS **Placement:** NS **AM:** Automatic computerised coding	n = 4
(Principe et al., 2021)[78]	Physical	n = 23 Senior Top tier Brazilian domestic team DF, MF, FW	27.65 ± 4.66 y 165.35 ± 5.82 cm 60.91 ± 5.34 kg	**Device:** GPS (Polar Electro; Polar TeamPro) **SR:** 10 Hz GPS + 200 Hz triaxial accelerometer **Placement:** Chest harness **AM:** Automatic computerised coding	n = 23 Sao Paulo State Championship (n = 12) A1 Brazilian Championship (n = 11)
(Ramos et al., 2017)[46]	Physical	n = 12 Youth Brazil U20 national team	18.0 ± 0.7 y 167 ± 5.8 cm 62.0 ± 6.2 kg	**Device:** GPS (MinimaxX S5; Catapult) **SR:** 10 Hz GPS + 100 Hz triaxial accelerometer	n = 7

(continued)

Table 1. Continued.

Author (year)	Topic	Players (n) Playing level/Team Positions	Age (years) Height (cm) Mass (kg)	Device data collection details	Matches (n, observations)
				Placement: Chest harness **AM:** Automatic computerised coding	
(Ramos et al., 2019)[50]	Physical	n = 45 Youth and Senior Brazil national teams: U17, U20, senior CD, FB, MF, FW	20.23 ± 1.93 y 172.47 ± 6.00 cm 59.53 ± 5.00 kg	**Device:** GPS (MinimaxX S5; Catapult) **SR:** 10 Hz GPS + 100 Hz triaxial accelerometer **Placement:** NS **AM:** Automatic computerised coding (OpenField) **Collection notes:** Played full matches	n = 13 (144 individual match observations) U17 & U20 (n = 7; 97 individual match observations) Senior (n = 6; 47 individual match observations)
(Ramos et al., 2019)[111 a]	Physical	n = 21 Senior Brazil national team CD, FB, CM, WM, FW	26 ± 3.6 y 167 ± 5.8 cm	**Device:** GPS (MinimaxX S5; Catapult) **SR:** 10 Hz GPS + 100 Hz triaxial accelerometer **Placement:** Chest harness **AM:** Automatic computerised coding **Collection notes:** Played > 50% of a match; 2016 Olympic Games	n = 6
(Riboli et al., 2024)[61]	Physical	n = 28 Senior European championship and international UEFA		**Device:** GPS (GPEXE Pro2; Exelio) **SR:** 18 Hz **Placement:** NS **AM:** NS **Collection notes:** Played > 85 min	n = 38 (277 individual match observations)
(Romero-Moraleda et al., 2021)[105 a]	Physical	n = 18 Senior Spanish First Division CD, WD, CM, WM, FW	26.5 ± 5.7 y 164.4 ± 5.3 cm 58.56 ± 5.58 kg	**Device:** GPS (SPI Pro X; GPSports) **SR:** 5 Hz GPS + 100 Hz accelerometer **Placement:** Chest harness **AM:** Automatic computerised coding **Collection notes:** Played > 85% of match duration, plus participation in all training sessions the following week	94 individual match observations
(Sam et al., 2024)[62]	Physical	n = 21 Senior NCAA DI CB, CDM, WM, CAM, FW		**Device:** GPS **SR:** 10 Hz **Placement:** Chest harness **AM:** Automatic computerised coding	Not reported
(Sausaman et al., 2019)[76]	Physical	n = 23 Senior NCAA DI DF, MF, FW	20.3 ± 1.0 y 163.5 ± 13.3 cm 62.1 ± 7.1 kg	**Device:** GPS (Catapult) **SR:** 10 Hz **Placement:** Chest harness **AM:** Automatic computerised coding	375 individual match observations

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Table 1. Continued.

Author (year)	Topic	Players (n) Playing level/Team Positions	Age (years) Height (cm) Mass (kg)	Device data collection details	Matches (n, observations)
				Collection notes: Full matches played; collected over four consecutive seasons	
(Savolainen et al., 2023)[51]	Physical	n = 25 Youth and Senior Finland First Division; U18, senior DF, MF, FW	19.6 ± 3.1 y 169.1 ± 4.9 cm 64.5 ± 9.4 kg	**Device:** GPS (Polar TeamPro) **SR:** 10 Hz **Placement:** NS **AM:** Automatic computerised coding **Collection notes:** Played > 75 min in two matches	n = 17 (115 individual match observations) Senior (n = 9; 65 individual match observations) U18 (n = 8; 50 individual match observations)
(Scott et al., 2020)[99]	Physical	n = 220 Senior NWSL teams CD, WD, CDM, CAM, WM, FW	25.0 ± 3.3 y 166.7 ± 6.1 cm 64.0 ± 6.4 kg	**Device:** GPS **(**Optimeye S5; Catapult) **SR:** 10 Hz **Placement:** Chest harness **AM:** Automatic computerised coding	3268 individual match observations
(Scott et al., 2020)[106]	Physical	n = 36 Senior NWSL CD, FB, CM, WM, FW	~24.4 y ~168.2 cm ~62.9 kg	**Device:** GPS (Optimeye S5; Catapult) **SR:** 10 Hz **Placement:** Chest harness **AM:** Automatic computerised coding **Collection notes:** Played full matches	408 individual match observations
(Strauss et al., 2019)[69]	Physical	n = 30 Senior University teams DF, MF, FW	22.8 ± 2.4 y 159 ± 5 cm 54.1 ± 6.1 kg	**Device:** GPS **(**MinimaxX S4; Catapult) **SR:** 10 Hz GPS + 100 Hz accelerometer **Placement:** Chest harness **AM:** Automatic computerised coding **Collection notes:** Full match played	84 individual match observations
(Trewin et al., 2018)[96]	Physical	n = 45 Senior National team CD, FB, MF, FW	15–34 y	**Device:** GPS (MinimaxX S4; Catapult) **SR:** 10 Hz **Placement:** NS **AM:** Automatic computerised coding **Collection notes:** Played > 75 min per match	606 individual match observations
(Trewin et al., 2018)[63]	Physical	n = 45 Senior National team CD, FB, MF, FW		**Device:** GPS **(**MinimaxX S4; Catapult) **SR:** 10 Hz GPS + 100 Hz accelerometer **Placement:** NS **AM:** Automatic computerised coding **Collection notes:** > 2 full matches played	n = 55 (606 individual match observations)
(Trușcă et al., 2023)[56]	Technical	Senior		**Device:** Video (WyScout) **SR:** NS	n = 30

(continued)

Table 1. Continued.

Author (year)	Topic	Players (n) Playing level/Team Positions	Age (years) Height (cm) Mass (kg)	Device data collection details	Matches (n, observations)
		2023 FIFA Women's World Cup Qualifying UEFA Group G		**Placement:** NS **AM:** NS	
(Vescovi, 2012)[64]	Physical	n = 71 Senior NWSL DF, MF, FW		**Device:** GPS (SPI Pro; GPSports) **SR:** 5 Hz **Placement:** Chest harness **AM:** Automatic computerised coding **Collection notes:** Played full match	n = 12 (139 individual match observations)
(Vescovi, 2014)[47]	Physical	n = 89 Youth National championship tournament or talent identification camp; U15, U16, U17 DF, MF, FW		**Device:** GPS (SPI Pro; GPSports) **SR:** 5 Hz **Placement:** Chest harness **AM:** Automatic computerised coding **Collection notes:** Played full match	Not reported
(Vescovi and Favero, 2014)[65]	Physical	n = 83 Senior NCAA DI DF, MF, FW		**Device:** GPS (SPI Pro; GPSports) **SR:** 5 Hz **Placement:** Chest harness **AM:** Automatic computerised coding	Not reported
(Vescovi and Falenchuk, 2019)[66]	Physical	n = 28 Senior NWSL DF, MF, FW		**Device:** GPS (SPI Pro; GPSports) **SR:** 5 Hz **Placement:** Chest harness **AM:** Automatic computerised coding **Collection notes:** Played full match	Not reported
(Villaseca-Vicuña et al., 2021)[84]	Physical	n = 26 Senior Chile national team Outfield	26.8 ± 3.3 y 157.8 ± 21.5 cm 58.9 ± 4.9 kg	**Device:** GPS (Optimeye S5; Catapult) **SR:** 10 Hz **Placement:** Chest harness **AM:** Automatic computerised coding	n = 26
(Villaseca-Vicuña et al., 2023)[85]	Physical	n = 10 Senior Chile national team Outfield	27 ± 3.4 y 162.8 ± 4.32 cm 60.5 ± 4.6 kg	**Device:** GPS (Optimeye S5; Catapult) **SR:** 10 Hz **Placement:** Chest harness **AM:** Automatic computerised coding **Collection notes:** Played > 80 min	n = 6
(Villaseca-Vicuña et al., 2024)[90]	Physical & Technical	n = 27 Senior Chile national team	30 ± 3.4 y 162.8 ± 4.32 cm 60.5 ± 4.6 kg	**Device**: GPS (Optimeye S5; Catapult) **SR:** 10 Hz GPS + 100 Hz triaxial accelerometer **Placement:** Chest harness **AM:** Automatic computerised coding **Device:** Video Camera **SR:** NS **Placement:** NS	n = 34

(continued)

Table 1. Continued.

Author (year)	Topic	Players (n) Playing level/Team Positions	Age (years) Height (cm) Mass (kg)	Device data collection details	Matches (n, observations)
				AM: Automatic computerised coding **Collection notes:** 2019 FIFA Women's World Cup; 2021 Tokyo Olympic Games	
(Wang and Qin, 2020)[57]	Technical	Senior National teams DF, MF, FW		**Device:** Video **Model:** NS **SR:** NS **Placement:** NS **AM:** Manual computerised coding **Collection notes:** 4 teams: China, Japan, South Korea, Chinese Tai Pei	n = 50
(Wells et al., 2015)[75]	Physical	n = 9 Senior NCAA DI CD, WD, MF, FW	21.3 ± 0.9 y 170.3 ± 5.7 cm 64.0 ± 5.76 kg	**Device:** GPS (MinimaxX S4; Catapult) **SR:** 10 Hz GPS + 100 Hz triaxial accelerometer **Placement:** Chest harness **AM:** Automatic computerised coding **Collection notes:** > 55 min per game	n = 21
(Winther et al., 2022)[102]	Physical	n = 54 Senior Norwegian top tier domestic CD, FB, CM, WM, FW	22 ± 4 y	**Device:** GPS (APEX; STATSports) SR: 10 Hz **Placement:** Chest harness **AM:** Automatic computerised coding **Collection notes:** > 2 full matches played	n = 60 (393 individual match observations)
(Yousefian et al., 2021)[109]	Physical	n = 21 Senior National team CD, WD, MF, FW	26.8 ± 3.7 y 172 ± 5.1 cm 64.6 ± 3.7 kg	**Device:** GPS (S5; Catapult) **SR:** 10 Hz **Placement:** NS **AM:** Automatic computerised coding **Collection notes:** Full matches played; 2019 FIFA Women's World Cup	n = 7

Note: [a] also has training analyses; [b] (±SE); SR: sampling rate; NS: not stated; GPS: global positioning system; AM: method of performance analysis; U11; aged 11 years or younger; U14: aged 14 years or younger; U15: aged 15 years or younger; U16: aged 16 years or younger; U17: aged 17 years or younger; U18: aged 18 years or younger; U20: aged 20 years or younger; CD: centre defender; WD: wide defender; FB: full back; DF: defender; CDM: centre defensive midfielder; CM: centre midfielder; CAM: centre attacking midfielder; MF: midfielder; WM: wide midfielder; FW: forward; NCAA: National Collegiate Athletic Association; DI: Division I; DII: Division II; DIII: Division III; UEFA; Union of European Football Associations; NWSL: National Women's Super League.

Table 2. Study characteristics of physical and technical actions observed during women's football training sessions.

Author (year)	Topic	Players (n) Playing level/Team Positions	Age (years) Height (cm) Mass (kg)	Device Data collection details	Training sessions (n, observations) MD timing Drills
(Diaz-Seradilla et al., 2022)[37]	Physical	n = 17 Senior Spanish First Division CB, FB, CM, FW	26.3 ± 4.6 y 166.3 ± 6.1 cm 59.8 ± 6.8 kg	**Device:** GPS (WIMU PRO, RealTrack Systems) **SR:** 10 Hz GPS + 100 Hz triaxial accelerometer **Placement:** Chest harness **AM:** Automated computerised coding (WIMU SPRO; RealTrack Systems)	n = 16 (272 individual training observations) n = 4 (MD-4, MD-3, MD-2, MD-1) MD-4: Recovery session and general resistance gym training MD-3: Specific resistance and endurance training (i.e., plyometrics, strength, small and medium sided games) MD-2: Speed and tactical approximation (i.e., sprints, large sided games) MD-1: Activation (i.e., reaction speed and small sided games)
(Douchet et al., 2021)[38]	Physical	n = 17 Senior French First Division DF, MF, FW	24.2 ± 2.3 y 169.7 ± 5.2 cm 62.3 ± 5.1 kg	**Device:** GPS (Polar TeamPro) **SR:** 20 Hz GPS + 200 Hz triaxial accelerometer **Placement:** Chest harness **AM:** Automatic computerised coding (Polar TeamPro)	n = 6 (72 individual training observations) across two weeks n = 2 (MD-4, MD-3, MD-1)
(Doyle et al., 2022)[39]	Physical	n = 18 Senior International team DF, MF, FW	24.2 ± 4.4 y 171.7 ± 5.3 cm 64.1 ± 5.8 kg	**Device:** GPS (Apex; STATSports) **SR:** 10 Hz GPS **Placement:** Chest harness **AM:** Automatic computerised coding (Apex)	n = 6 (101 individual training observations) MD-7: Passing; 5 × 5 + 6; 11v11 MD-6: Passing; possession; 9v9 MD-5: 4v2; defending possession; 1v1 sprints; 9v9 MD-3: 2v2; 5v5 + 1; 3v2/2v1; 9 v 9 MD-2: 1v1 defending; possession; 11v11 MD-1: 4v2; 5v5 + 3; shooting; 4v4 + 2; 11v11 set pieces
(Emmonds et al., 2023)[16]	Physical & Technical	n = 458 Senior England first and second leagues CD, WD, CDM, CAM, WM, FW		**Device:** IMU (Playermaker) **SR:** 16 g triaxial accelerometer + 2000°•s^{-1} triaxial gyroscope **Placement:** Foot-mounted **AM:** Automatic computerised coding	12416 individual training observations Position-specific: positions separated and coached as a unit Possession: keep ball from the opposition, no goals SSGi: reduced pitch size; 1v1 – 3v3 SSGe: as above; > 4v4 Tactical: set pieces and positional roles during match play Technical: developing football-specific skills
(Fernandes et al., 2022)[29] [a]	Physical	n = 10 Senior	24.6 ± 2.3 y	**Device:** GPS (PlayerTek; Catapult Systems) **SR:** 10 Hz GPS + 100 Hz triaxial accelerometer	n = 87 MD-5, MD-4, MD-2

(continued)

Table 2. Continued.

Author (year)	Topic	Players (n) Playing level/Team Positions	Age (years) Height (cm) Mass (kg)	Device Data collection details	Training sessions (n, observations) MD timing Drills
		Portugal First League DF, MF, FW	165 ± 6 cm 58.5 ± 9.3 kg	**Placement:** Chest harness **AM:** Automated computerised coding	
(Floersch et al., 2024)[72]	Physical	n = 48 Senior NCAA DIII CD, WD, CM, WM	19.5 ± 1.2 y 167 ± 50 cm 64.8 ± 7.4 kg	**Device:** GPS (Polar TeamPro) **SR:** NS **Placement:** Chest harness **AM:** Automatic computerised coding **Collection notes:** Starters and substitutes	n = 103
(Gabbett and Mulvey, 2008)[30]	Physical & Technical	n = 13 Senior Australian Academy/ National team DF, MF, FW	21 ± 2 y	**Device:** Video Camera (DCR-TRV 950E; Sony) **SR:** NS **Placement:** Positioned at halfway line, 30 m above field of play. **AM:** Manual computerised coding **Collection notes:** Single player focus with 10 m radius	n = 39 SSG: 3v3, 5v5 (50 × 50 m); 20–45 min per training
(García-Ceberino et al., 2022)[31] [a]	Physical	n = 18 Senior Spanish First League DF, FB, MF, WM, FW	26.3 ± 3.9 y 166 ± 7 cm 60.7 ± 7.3 kg	**Device:** GPS (WIMU Pro; RealTrack Systems) **SR:** 18 Hz + 100 Hz triaxial accelerometer **Placement:** Chest harness **AM:** Automatic computerised coding (SPRO; RealTrack Systems)	n = 13 Five weeks within one mesocycle
(Gentles et al., 2018)[32]	Physical	n = 25 Senior NCAA DII	20.2 ± 1.1 y 166.3 ± 5.9 cm 62.0 ± 7.0 kg	**Device:** GPS (BioHarness (version 3); Zephyr) **SR:** 5 Hz GPS, 100 Hz triaxial accelerometer **Placement:** Strap placed at xyphoid process, sensor on midaxillary line **AM:** Automatic computerised coding **Collection notes:** Data analysed: accelerometer = 522 training sessions; GPS = 407 training sessions	n = 24 (522 individual training observations)
(Jagim et al., 2022)[71]	Physical	n = 22 Senior NCAA DIII	167 ± 5 cm 65.42 ± 6.33 kg	**Device:** GPS (Polar TeamPro) **SR:** NS **Placement:** NS **AM:** Automatic computerised coding	n = 47 (977 individual training observations)
(Karlsson et al., 2023)[33] [a]	Physical	n = 21 Senior	22.2 ± 3.7 y	**Device:** GPS (Polar Electro; Polar) **SR:** 10 Hz + 200 Hz triaxial accelerometer **Placement:** Chest harness	n = 84 (852 individual training observations) n = 21 (MD-4, MD-3, MD-2, MD-1)

(continued)

Table 2. Continued.

Author (year)	Topic	Players (n) Playing level/Team Positions	Age (years) Height (cm) Mass (kg)	Device Data collection details	Training sessions (n, observations) MD timing Drills
		Norwegian Premier Division	168.6 ± 4.3 cm 64.1 ± 6.6 kg	**AM:** Automatic computerised coding (Polar Team Pro System) **Collection notes:** Participated in entire session	
(Mara et al., 2015)[34]	Physical	n = 17 Senior National league team	172.9 ± 5.5 cm 64.3 ± 5.9 kg	**Device:** GPS (SPI HPU; GPSports Systems) **SR:** 15 Hz **Placement:** NS **AM:** Automatic computerised coding	n = 90 Training structure: 2 recovery days post-match 1 conditioning session 1 skill session 2 tactical sessions
(Mara et al., 2015)[77 a]	Physical	n = 8 Senior National league team DF, MF, FW	23–30 y 172.9 ± 5.5 cm 65.1 ± 5.9 kg	**Device:** GPS (SPI HPU; GPSports Systems) **SR:** 15 Hz **Placement:** NS **AM:** Automatic computerised coding	n = 4 1 week during pre-season Shooting, passing, sprinting SSG: 4v4, 5v5, 7v7
(McFadden et al., 2020)[35 a]	Physical	n = 16 Senior NCAA DI	19.3 ± 1.4 y 166.6 ± 5.3 cm 63.9 ± 5.7 kg	**Device:** GPS (Polar TeamPro) **SR:** NS **Placement:** NS **AM:** Automatic computerised coding	n = 60
(Myhill et al., 2023)[28]	Physical	n = 293 Senior English WSL and WC CD, WD, CDM, CAM, WM, FW	∼167 cm ∼63 kg		6176 individual training observations MD-4, MD-3, MD-2, MD-1, MD + 1, MD + 2
(Olaizola et al., 2022)[36 a]	Physical	n = 22 Senior Spanish Second Division	24.6 ± 4.0 y 163.9 ± 5.0 cm 58.5 ± 4.2 kg	**Device:** GPS (WIMU PRO, RealTrack Systems) **SR:** 10 Hz **Placement:** Chest harness **AM:** Automatic computerised coding	n = 46 • MD + 2 & MD-5/-6: Velocity session (n = 7) Intermittent velocity training • MD + 3/+4 & MD-4/-5: Strength or intensity session (n = 10) Positional games; 1v1 – 6v6 • MD + 4/+5 & MD-2/-3: Endurance or

(continued)

Table 2. Continued.

Author (year)	Topic	Players (n) Playing level/Team Positions	Age (years) Height (cm) Mass (kg)	Device Data collection details	Training sessions (n, observations) MD timing Drills
					extensity session (n = 15) Cardiovascular training; > 6v6 • MD-1: Activation session (n = 14) Tactical and strategic approaches; > 6v6
(Ramos et al., 2019)[111 a]	Physical	n = 21 Senior Brazil national team CD, FB, CM, WM, FW	26 ± 3.6 y 167 ± 5.8 cm	**Device:** GPS (MinimaxX S5; Catapult) **SR:** 10 Hz; 100 Hz triaxial accelerometer **Placement:** Chest harness **AM:** Automatic computerised coding **Collection notes:** Pre-Olympics training camp	n = 22 (814 individual training observations) Warm up (n = 275) SSGs (n = 148) Technical and tactical (n = 312) Friendly matches (n = 79)
(Romero-Moraleda, et al., 2021)[105 a]	Physical	n = 18 Senior Spanish First Division CD, WD, CM, WM, FW	26.5 ± 5.7 y 164.4 ± 5.3 cm 58.56 ± 5.58 kg	**Device:** GPS (SPI Pro X; GPSports) **SR:** 5 Hz GPS + 100 Hz accelerometer **Placement:** Chest harness **AM:** Automatic computerised coding **Collection notes:** Played > 85% of match duration, plus participation in all training sessions the following week	358 individual training observations MD + 1: recovery session MD-4: conditioning and tactical session; small-medium SSG MD-3: conditioning and tactical session; medium-large SSG MD-2: skills and strategy exercises

Note: [a] also has match analyses; MD±: training proximity to match day; AM: method of performance analysis; GPS: global positioning system; IMU: inertial measurement unit; SR: sampling rate; NS: not stated; SSG: small sided games; SSGi: small sided games (intensive); SSGe: small sided games (extensive); WSL: English Women's Super League; WC: English Women's Championship; NCAA: National Collegiate Athletic Association; DI: Division I; DII: Division II; DIII: Division III; CD: centre defender; FB: full back; WD: wide defender; DF: defender; CDM: centre defensive midfielder; CAM: centre attacking midfielder; CM: centre midfielder; WM: wide midfielder; MF: midfielder; FW: forward.

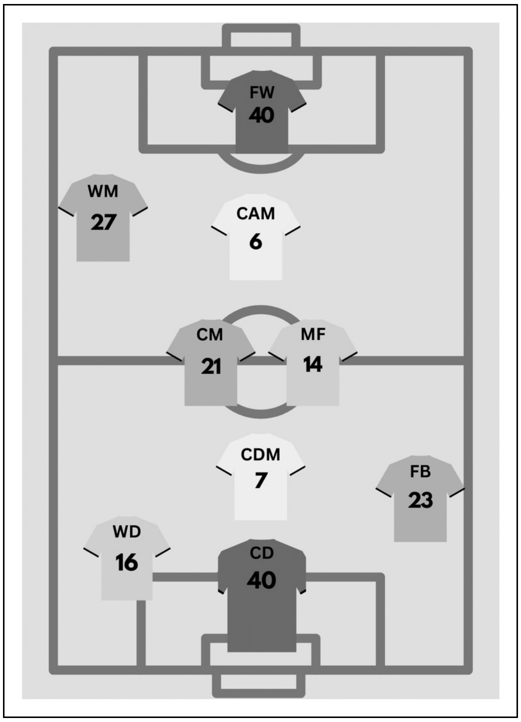

Figure 2. Frequency of positional categories reported across reviewed literature. *Note:* Shirt positions correspond to positional categories reported across reviewed articles, rather than tactical formations. Shirt shading represents the number of studies including each position (darker = more frequent). FW: forward; WM: wide midfielder; CAM: central attacking midfielder; CM: central midfielder; MF: midfielder; CDM: central defensive midfielder; FB: full back; WD: wide defender; CD: central defender.

Articles within the review frequently classified playing positions as defenders, midfielders, and forwards (n = 21).[29,30,38,39,47,51,57,59,65,66,69,70,74,76–83] Other articles (n = 41) divided players into specialised roles, as shown in Figure 2. Seven articles noted only outfield players' performance was analysed (i.e., no goalkeepers),[33,35,41,52,84–86] whereas 22 articles did not describe the playing positions of participants.[19,32,34,36,42,48,49,53–56,60,61,64,68,73,87–92]

Technologies

Wearable technologies

Satellite-based tracking technologies are referred to as GPS throughout this review, consistent with the terminology most used in the included studies. This technology was used to measure physical performance metrics in 64 peer-reviewed articles, including 56 match-based studies,[15,19,42,44–51,61–78,81,82,84–87,89,90,92–110] and eight studies that included both match and training contexts.[29,31–33,35–37,111] Units were commonly placed within a chest harness between the scapulae (n = 45)[15,19,29,31–33,36–39,42,44,46–48,50,62–67,69,70,72,75,76,78,81,84,85,87,90,93,95–102,105,106,111]; however, three studies utilised a waist belt for GPS unit placement at the lumbar spine.[89,92,94] The most prevalent GPS brand was Catapult Sports (n = 26),[15,29,44,46,49,50,63,67,69,74–76,82,84–87,90,93,96,98–100,106,109,111] followed by GPSports (n = 11)[19,34,42,47,64–66,77,101,103,105] and Polar GPS systems (n = 11).[33,35,38,51,68,71–73,78,104,108]

The devices' reported sampling rates ranged from 1 Hz (n = 1)[42] to 20 Hz (n = 1)[48]; the most frequent sampling rate was 10 Hz (n = 44).[15,29,33,36,37,39,44–46,49–51,62,63,67–71,74–76,78,81,84–87,90,93,95–102,104,106,108–111] Twenty-four GPS devices were reported to incorporate triaxial accelerometer technology, with 19 devices at a sampling rate of 100 Hz,[29,31,32,37,42,46,50,63,69,75,87,90,96–98,100,101,105,111] and five devices sampling at 200 Hz.[33,38,78,104,108]

Three studies used foot-mounted IMUs (Playermaker™) to quantify the physical and technical performance metrics in matches (n = 1),[40] and during various drill types in field training sessions (n = 2).[16,28] IMUs were positioned on the lateral aspect of the players' boots using silicone straps. Each unit contained a 16 g triaxial accelerometer and a 2000° s^{-1} triaxial gyroscope from the MPU-9150 multi-chip motion tracking module, sampling rate of 1000 Hz.

Video cameras. Video camera systems were used to gather physical and technical performance data in women's football matches and training sessions in 21 studies.[30,41,43,52–60,79,80,83,88,112–116] These systems represented different modes of data collection, including manual computerised coding (n = 9),[30,41,43,56,57,59,60,79,83] semi-automatic computerised coding, where algorithmic detection is combined with analyst verification (n = 3),[88,112,113] and automated optical/software platforms (n = 8; Amisco Viewer[58]; Instat[53,55,114]; OPTA Sports[80]; Prozone Sports[115]; StatsPerform[54]; STATSports[116]; SciSports).[52]

The majority of studies (n = 20) used video camera systems to record match performance metrics, either for technical performance metrics (n = 11),[43,52–57,60,80,88,114] physical performance metrics (n = 7),[59,79,83,112,113,115,116] or both (n = 2).[41,58] One study used video technology to record physical and technical performance metrics in both matches and training sessions.[30] Among these 21 studies, three explicitly reported data collection rates. Two studies specified a sampling rate of 25 frames per second,[112,113] and one reported a sampling rate of 25 Hz[58]; these values are equivalent but presented as originally reported. Reporting of sampling characteristics was otherwise inconsistent or absent across studies.

Beyond the peer-reviewed literature, supplementary match performance data from international tournaments and top-level domestic competitions have also been gathered through multi-camera video systems. Skilled football analysts, data scientists, and performance analysts process this footage to extract physical, technical, and tactical insights.[24–27,117] These consolidated reports contribute to the growing body of grey literature on football performance analysis, providing valuable insights into player and team

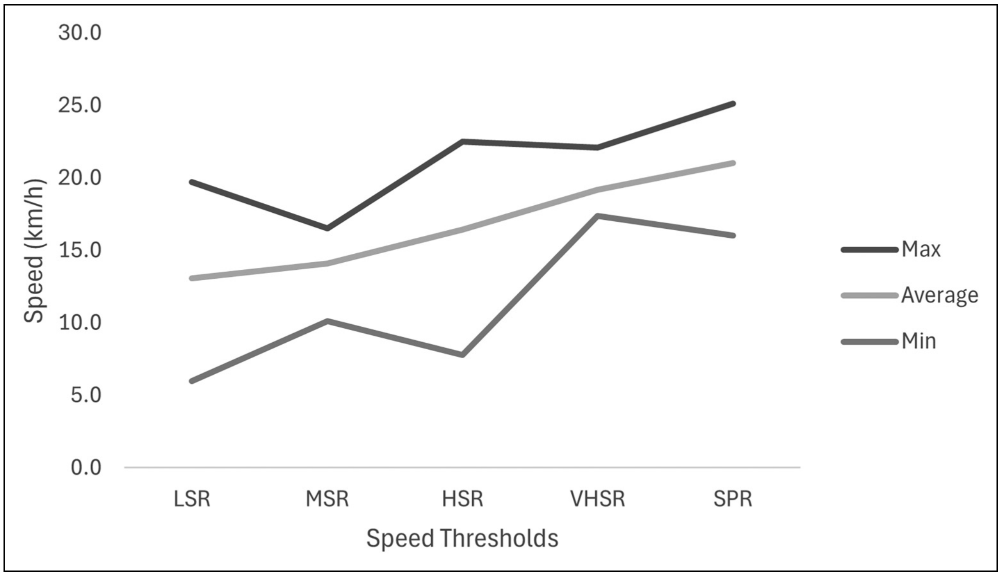

Figure 3. Averaged speed zone classifications From reviewed studies. *Note:* LSR: low speed running; MSR: moderate speed running; HSR: high speed running; VHSR: very high-speed running; SPR: sprinting.

performances at the highest levels. However, the reports do not describe the specific equipment or software used to capture or process these data, meaning methodological details are not openly reported within the documents themselves.

Performance metrics

Physical performance metrics. Nine primary physical performance metrics were extracted from the peer-reviewed articles (n = 75). The most frequently reported metrics were total distance covered (TD) (n = 55), high-speed running distance covered (HSR) (n = 51), and sprinting distance covered (SPR) (n = 36). Moderate speed running distance covered (MSR) was the least reported metric (n = 10).

The speed zones used to categorise running intensities of women's footballers varied across studies, with differences in both the number of zones used and their specific velocities. A summarised representation of speed zones can be seen in Figure 3, showing the range (low, high) and average of speed zones detailed across the reviewed studies. Seventy-two studies detailed specific zones, where most of the studies included multiple classifications; only 14 articles detailed a single speed zone.[16,19,29,36,41,62,64,70,74,89,93,98,103,113] The most frequently reported speed zones were high-speed running (HSR; n = 62)[15,16,28,29,32–35,37,38,40,42,44–48,50,51,58,59,61–63,65–69,71–79,81–83,87,89,90,94–102,104,105,107–112,115] and sprinting (SPR; n = 59).[15,19,28,32–35,37,39,40,42,44–50,58,59,61,63–68,70–73,75–79,81–83,86,87,92–97,99–104,107–109,111,112,115]

Match physical performance metrics. Match physical performance outputs were reported as per player, per match values by 75 peer-reviewed sources as shown in Table 3. The most frequently reported metrics were TD (n = 55)[19,29,30,32,33,36,37,40–42,44–46,48,50,51,58,63,68–72,74–79,81,84–86,89,90,92–95,97,99,100,102,104–106,108,110,112,115] and HSR (n = 46).[29,30,32,33,36,37,40–42,44–46,48,50,51,58,62,63,68,71,72,74–79,81,84,85,89,90,92,94,95,97,99,100,102,104–106,108,110,112,115] Overall, TD across senior-level matches ranged from ∼4–11 km, with an average of 9.2 km. High-speed running distances ranged from ∼300–2700 m, with sprint distances (SPR) averaging ∼270 m. Moderate speed running was the least reported metric from matches (n = 4).[66,78,97,111] The average number of high intensity actions performed in matches were 33 sprints,[35,37,62,63,68,72,84,85,90,92,100,103,112,116] 174 accelerations,[29,36,63,68,72,77,78,86,90,94,95,97,102,104,105,108,110,113] and 147 decelerations.[29,36,68,77,78,86,90,94,95,97,102,104,105,108,110,113]

Within peer-reviewed studies, youth (≤ 20 y) and senior (> 20 y) participants appeared across multiple articles; however, only eight reported distinct physical match performance metrics by age group.[15,19,41,42,44–47] Within this limited subset, reported values were generally lower for youth players than senior players for TD (∼6.4 km vs ∼9.2 km), HSR (∼ 900 m vs ∼1200 m), SPR (∼80 m vs ∼ 270 m), and top speed (∼21.3 km/h vs ∼26.4 km/h).

Supplementary evidence from FIFA tournament reports (Senior 2023; U20 2024; U17 2024) showed higher reported per-player match physical outputs across older age groups for TD (U17: 7.07 km; U20: 7.21 km; Senior: 7.45 km), HSR (U17: 241.7 m; U20: 249.4 m; Senior: 355.1 m), SPR (U17: 31.2 m; U20: 39.9 m; Senior: 160.1 m), number of sprints (U17: 2.9; U20: 3.5; Senior: 30.9), and top speed (U17: 26.4 km/h; U20: 26.6 km/h; Senior: 28.2 km/h).[24–26] Sprint count comparisons should be interpreted cautiously, as the U20 reports used a higher

Table 3. Physical performance metrics of women's football players during matches.

Matches Author (year) Match format [b]	TD (km) (m/min)	LSR (m) (m/min)	MSR (m) (m/min)	HSR (m) (m/min)	VHSR (m) (m/min)	SPR (m) (m/min)	SPR (n) (n/min)	Acc/Dec (n) (n/min)	Top speed (km/h)
(Andersen et al., 2012)[41] 2 × 40 min	9.1 ± 0.25 km[a]			1075 ± 75 m[a]					
(Andersen et al., 2016)[92]	10.5 ± 0.9 km			1483.5 ± 348.5 m		525 ± 185 m	11 ± 6.5	171 ± 32	
(Andersson et al., 2010)[79]	9.7–9.9 km			1330–1530 m		221–256 m			
(Baptista et al., 2023)[95]	9.03–10.8 km			969–1922m		222–528 m		Acc: 385 –572 Dec: 295–470	
(Barbero-Álvarez et al., 2008)[42] 7v7, 2 × 25 min, 30 × 50 m	3.97 ± 0.32 km			248 ± 97.9 m		20.6 ± 22.7 m			19.5 km/h
(Beare et al., 2019)[48]	7.91 ± 1.2 km (90.8 ± 3.7 m/min)	7598.5 ± 1102.2 m		308 ± 101.3 m		69.5 ± 28.5			25.13 km/h
(Bendiksen et al., 2013)[89]	9.67 ± 1.9 km			1193 ± 115 m		372 ± 46 m			
(Bozzini et al., 2020)[73]	(103.23–104.99 m/min)			(10.04–10.26 m/min)		(3.06 −3.20 m/min)			
(Bradley et al., 2014)[58]	~ 10.75 km	~ 9105 m		~ 1358 m		~ 291 m			
(Choi and Joo, 2022)[97]	~9.55 km	~ 3869 m	~1713m	~ 345 m		~ 104 m	~ 14	Acc: ~68 Dec: ~81	~ 26.2 km/h
(Choice et al., 2023)[70]	9.46 ± 2.59 km (172 ± 48 m/min)					531 ± 301 m			26 ± 2 km/h
(Datson et al., 2017)[115]	10.32 ± 0.86 km	~ 9518 m		608 ± 181 m		168 ± 82 m			
(Datson et al., 2019)[116]							33		
(Datson et al., 2024)[98]	(~106.5 m/min)			(~6.5 m/min)					
(DeWitt et al., 2018)[100]	8.8 ± 1.9 km			570 ± 407 m			9.0 ± 11.1		
(Diaz-Seradilla et al., 2022)[37]	9.35 ± 1.01 km (96.3 ± 8.8 m/min)			1110.5 ± 331.8 m (11.9 ± 3.6 m/min)		235.1 ± 20.6 m (2.6 ± 1.8 m/min)	13.4 ± 4		25.3 ± 0.3 km/h
(Díaz-Serradilla et al., 2023)[147]	8.26 ± 1.23 km (94.6 ± 8.0 m/min)			281.3 ± 99.6 m (3.5 ± 1.5 m/min)		45.8 ± 41.6 m (0.6 ± 0.5 m/min)		Acc: 23.9 ± 5.6 Dec: 0.5 ± 0.1	24.6 ± 1.9 km/h

(continued)

Table 3. Continued.

Matches Author (year) Match format [b]	TD (km) (m/min)	LSR (m) (m/min)	MSR (m) (m/min)	HSR (m) (m/min)	VHSR (m) (m/min)	SPR (m) (m/min)	SPR (n) (n/min)	Acc/Dec (n) (n/min)	Top speed (km/h)
(Domingues et al., 2025)[93]	9.0 ± 0.7 km (93.4 ± 7.8 m/min)					679.6 ± 182.9 m			25.9 ± 1.9 km/h
(FIFA, 2023)[24 c]	7.45 ± 0.86 km			355.1 ± 54.0 m		160.1 ± 165.6 m	30.9 ± 4.5		28.2 ± 0.9 km/h
(FIFA, 2024)[25 c]	7.07 ± 0.58 km			241.7 ± 53 m		31.2 ± 15.7 m	2.9 ± 1.1		26.4 ± 4 km/h
(FIFA, 2024)[26 c]	7.31 ± 2.5 km			254.3 ± 48.5 m		40.7 ± 15 m	3.5 ± 1.2		26.7 ± 0.7 km/h
(Fernandes et al., 2022)[29]	7.62 ± 0.4 km (89.9 ± 5.4 m/min)			879.9 ± 102.2 m				Acc: ~329 Dec: ~326	26.7 ± 1.2 km/h
(Floersch et al., 2024)[72]	10.35 ± 2.6 km (65.35 ± 14.8 m/min)			1216 ± 485			17.5 ± 7.5	Acc: 171 ± 51.6 (1.08 ± 0.3 n/min)	
(Gabbett and Mulvey, 2008)[30] (García-Ceberino et al., 2022)[31]	9.97 ± 966 km (91.28 ± 11.64 m/min)	3744.2 ± 395 m		1483.7 ± 410 m		995 ± 263 m	 (7.11 ± 14.86 n/min)	 Acc: (31.15 ± 2.6 n/min) Dec: (31.14 ± 2.61 n/min)	
(Gentles et al., 2018)[32] (González-García, et al., 2023)[101]	5.48 ± 2.35 km (167.80 ± 16 m/min)	~1150 m		~310 m (47.12 ± 14.3 m/min)	 (30.54 ± 12.98 m/min)	~15 m (19.06 ± 11.86 m/min)			
(Griffin et al., 2021)[81] (Harkness-Armstrong et al., 2021)[44] U14: 2 × 35 min; 75 × 45 m; size 4 ball U16: 2 × 40 min; 91 × 56 m; size 5 ball	~9.08 km ~7.41 km (~92.5 m/min)			~687.45 m ~1612.95 m (~20.15 m/min)	 ~218.5 m (~2.7 m/min)	~335 m ~41.1 m[a] (~0.5 m/min)			 ~24.43 km/h
(Harkness-Armstrong et al., 2023)[15] U14: 2 × 35 min; 75 × 45 m; size 4 ball	(~97.05 m/min)			(~32.23 m/min)	(~5.46 m/min)	(~1.53 m/min)			

(continued)

Table 3. Continued.

Matches Author (year) Match format [b]	TD (km) (m/min)	LSR (m) (m/min)	MSR (m) (m/min)	HSR (m) (m/min)	VHSR (m) (m/min)	SPR (m) (m/min)	SPR (n) (n/min)	Acc/Dec (n) (n/min)	Top speed (km/h)
U16: 2 × 40 min; 91 × 56 m; size 5 ball									
(Hewitt et al., 2014)[82]	9.29 ± 0.18 km[a]			2407 ± 125[a]		338 ± 30[a]			
(Ishida et al., 2022)[74]	7.73 ± 3.89 km			670.27 ± 429.1 m					
(Jagim et a., 2020)[68]	9.60 ± 1.99 km	4281.5 ± 1160.5 m		773.75 ± 301.5 m		279.5 ± 150.83 m	15.4 ± 6.7	Acc: 37.05 ± 11.93 Dec: 41.25 ± 13.36	
(Jagim et al., 2022)[71] (Julian et al., 2021)[107] (Karlsson et al., 2023)[33]	7.34 ± 1.36 km (∼103.5 m/min) 10.2 ± 0.45 km (108.2 ± 4.6 m/min)	3277.27 ± 736.36 m (∼81.8 m /min)		570.45 ± 220.45 m (∼11.5 m/min) 1279.1 ± 149.7 m (13.6 ± 1.6 m/min)	 (∼6.3 m/min)	211.36 ± 125 m (∼3.9 m/min) 136.5 m		59.36 ± 6.52 ∼177 193.1 ± 15.7 (2.0 ± 0.2 n/min)	
(Kobal et al., 2022)[49] Pro: 2 × 45 min U20: 2 × 40 min U17: 2 × 35 min	(95.87 ± 16.23 m/min)					(6.53 ± 2.63 m/min)		Acc: (0.69 ± 0.23 n/min) Dec: (0.90 ± 0.27 n/min)	25.9 ± 2.13 km/h
(Kobal et al., 2022)[86]	9.83 ± 0.5 km (104 ± 6 m/min)					(7.9 ± 1.5 m/min)		Acc: 71.5 ± 8.1 Dec: 91.2 ± 77	26.6 ± 0.6 km/h
(Krustrup et al., 2005)[83]	10.3 km (9.7–11.3 km)	9000 (8400–9800)		1310 m (710–1700 m)		160 m (50–280 m)	26 (9–43)		
(Mäkiniemi, et al., 2023)[108]	10.21 ± 0.69 km			1962.2 ± 381.8 m	341.6 ± 113.2 m	87.8 ± 58.2 m		Acc: 83.1 ± 18.94 Dec: 102.86 ± 21.02	26.94 ± 1.86 km/h

(continued)

Table 3. Continued.

Matches Author (year) Match format [b]	TD (km) (m/min)	LSR (m) (m/min)	MSR (m) (m/min)	HSR (m) (m/min)	VHSR (m) (m/min)	SPR (m) (m/min)	SPR (n) (n/min)	Acc/Dec (n) (n/min)	Top speed (km/h)
(Mara et al., 2015)[77] 3 × 20 min	7.96 ± .41 km			1995 ± 185 m		301 ± 126 m		Acc: 49 ± 20 Dec: 21 ± 9	
(Mara et al., 2017)[113]								Acc: 423 ± 126 Dec: 430 ± 125	
(Mara et al., 2017)[112] (McCormack et al., 2015)[67] (McFadden et al., 2020)[35] (Meylan et al., 2017)[87]	10.03 ± 0.78 km (118.0 ± 8.1 m/min) 7.2 ± 1.8 km (107 ± 16.3 m/min)			2452 ± 636 m (24.1 ± 6.5 m/min) (6.02 ± 2.12 m/min)		615 ± 258 m (2.87 ± 1.23 m/min)	70 ± 29 4.5 ± 3.6 12.5 ± 5 (0.73 ± 0.25 n/min)	 (Acc: 1.78 ± 0.67 n/min)	
(Modric et al., 2023)[110]	9.42 ± 1.37 km			1350 ± 300		241 ± 101 m		Acc: 40 ± 11 Dec: 54 ± 13	25.9 ± 1.5 km/h
(Mohr et al., 2008)[59] (Mordillo and Zago, 2023)[45] U15: 9v9, 3 × 20 min, 60–75 × 40–50 m, size 4 ball, 5 × 2 m goal size U17: 2 × 40 min	10.39 ± 0.15 km[a] 7.34 ± 0.68 km			1490 ± 100 m[a] (589–1200 m)		420 ± 40 m[a]	28 ± 1.5[a]		
(Myhill et al., 2025)[40]	8.94 ± 1.09 km (92 ± 11 m/min)			262 ± 137 m (3 ± 1 m/min)		39 ± 39 m (0.4 ± 0.4 m/min)			
(Nakamura et al., 2017)[103] (Olaizola et al., 2022)[36]	 10.58 ± 0.60 km (90.8 ± 5.3 m/min)			 906.7 ± 208.0 m		318.7 ± 184.6 m 69.2 ± 51.2 m	19.6 ± 10.5	 Acc: 181.8 ± 35.1 Dec: 190.2 ± 33.7	
(Ørntoft, et al., 2016)[19] 20 min matches 7v7: 40 × 56 m 8v8: 52.5 × 68 m	1.60 ± 0.26 km					48.5 ± 29 m			20.1 ± 2.05 km/h

(continued)

Table 3. Continued.

Matches Author (year) Match format [b]	TD (km) (m/min)	LSR (m) (m/min)	MSR (m) (m/min)	HSR (m) (m/min)	VHSR (m) (m/min)	SPR (m) (m/min)	SPR (n) (n/min)	Acc/Dec (n) (n/min)	Top speed (km/h)
(Panduro et al., 2020)[104]	10.03 ± 0.85 km			1496.4 ± 405.6 m	676.4 ± 290.2 m	49.0 ± 44.4 m		Acc: 8.8 ± 5.6 Dec: 17.5 ± 5.0	28.1 ± 2.6 km/h
(Pedersen et al., 2022)[94]	10.0 ± 0.9 km	1765 ± 417 m		912 ± 343 m		211 ± 129		Acc: 26 ± 12 Dec: 34 ± 14	24.70 ± 1.4 km/h
(Principe et al., 2021)[78]	3.94 ± 1.26 km	1479.8 ± 512.1 m	679.5 ± 280.7 m	299.9 ± 128.3 m		151.1 ± 89.7 m		Acc: 118.3 ± 41.7 Dec: 38.8 ± 15.5	
(Ramos et al., 2017)[46]	8.70 ± 0.54 km			687.6 ± 119.93 m		223.23 ± 74.28 m		Acc: 14.55 ± 5 Dec: 17.05 ± 6	
(Ramos et al., 2019)[50]	9.03 ± 0.85 km			642.72 ± 152.15 m		240.58 ± 99.28 m		Acc: 189.08 ± 39.7 Dec: 133.76 ± 19.68	
(Ramos et al., 2019)[111]	(108.02 ± 5.34 m/min[a])	(11.7 ± 0.86 m/min[a])	(25.74 ± 1.86 m/min[a])	(13.82 ± 1.06 m/min[a])	(7.71 ± 0.8 m/min[a])	(3.38 ± 0.6 m/min[a])			
(Riboli et al., 2024)[61]	(104.2 ± 8.5 m/min)			(12.3 ± 3.3 m/min)	(2.9 ± 1.4 m/min)	(0.7 ± 0.4 m/min)		Acc: (0.1 ± 0.0 n/min) Dec: (0.4 ± 0.2 n/min)	
(Romero-Moraleda et al., 2021)[105]	9.04 ± 0.94 km (95 ± 9 m/min)			1108 ± 294 m (12.1 ± 2.4 m/min)				Acc: 255 ± 40	

(continued)

Table 3. Continued.

Matches Author (year) Match format [b]	TD (km) (m/min)	LSR (m) (m/min)	MSR (m) (m/min)	HSR (m) (m/min)	VHSR (m) (m/min)	SPR (m) (m/min)	SPR (n) (n/min)	Acc/Dec (n) (n/min)	Top speed (km/h)
								Dec: 78 ± 16	
(Sam et al., 2024)[62]				2743 ± 1440			135 ± 73.1		
(Sausaman et al., 2019)[76]	9.49 ± 0.30 km			1014 ± 118 m		428 ± 70 m			
(Savolainen et al., 2023)[51]	9.20 ± 0.88 km	7308 ± 485		1600 ± 405 m	295 ± 161 m				
(Scott et al., 2020)[99]	9.398–10.64 km			1936–2749 m	316–666 m	59–248 m			28.7–30.6 km/h
(Scott et al., 2020)[106]	10.07 ± 0.62 km			2401 ± 454 m	398 ± 143 m	122 ± 69 m			
(Strauss et al., 2019)[69] 2 × 35 min	5.83 ± 0.81 km (80.57 ± 11 m/min)	(69.27 ± 9.1 m/min)		(4.77 ± 2.6 m/min)					
(Trewin et al., 2018)[96]	(107.5 ± 9.7 m/min)	(97.8 ± 8.1 m/min)		(9.7 ± 3.3 m/min)				Acc: (1.81 ± 0.38 n/min)	
(Trewin et al., 2018)[63]	10.37 ± 0.95 km (108 ± 10 m/min)	9437 ± 771 m (99 ± 8.3 m/min)		930 ± 348 m (9.7 ± 3.7 m/min)			20 ± 9	Acc: 174 ± 33	
(Vescovi, 2012)[64]						111 ± 93 m			21.8 ± 2.3 km/h
(Vescovi, 2014)[47] 11v11 U15 + U16: 2 × 35–40 min U17: 2 × 45 min	8.06 ± 0.19 km	2287 ± 113.3 m	1222 ± 89.3 m	618.3 ± 46 m		198 ± 27.3 m	11 ± 1		25.7 ± 0.4 km/h
(Vescovi and Favero, 2014)[65]	9.77 ± 0.12 km[a] (103 ± 2.5 m/min[a])	2997.67 ± 76.67 m[a]	1539.33 ± 55 m[a]	813 ± 34.17 m[a]		267.3 ± 18.7 m[a]			
(Vescovi and Falenchuk, 2019)[66]		(30.9 ± 0.85 m/min)	(19.2 ± 0.9 m/min)	(8.25 ± 0.4 m/min)		(3.9 ± 0.35 m/min)			
(Villaseca-Vicuña et al., 2021)[84]	9.42 ± 0.76 km (108.14 ± 6.97 m/min)			515.34 ± 162.31 m			35.28 ± 11.09	102.36 ± 28.04	25.27 ± 2.65 km/h
(Villaseca-Vicuña et al., 2023)[85]	~9.75 km			~566 m			~42.9		~26.1 km/h

(continued)

Table 3. Continued.

Matches Author (year) Match format [b]	TD (km) (m/min)	LSR (m) (m/min)	MSR (m) (m/min)	HSR (m) (m/min)	VHSR (m) (m/min)	SPR (m) (m/min)	SPR (n) (n/min)	Acc/Dec (n) (n/min)	Top speed (km/h)
	(~108.5 m/min)			(~6.37 m/min)			(~0.32 n/min)		
(Villaseca-Vicuña et al., 2024)[90]	9.47 ± 1.09 km (106 ± 11.2 m/min)			560.5 ± 234.5 m			41.25 ± 15.5	Acc: 107 ± 44.7 Dec: 66.9 ± 24.1	27.1 ± 9.7 km/h
(Wells et al., 2015)[75]	7.84 ± 0.83 km (101.08 m/min)	6389.55 ± 756.86 m (82.12 ± 10.11 m/min)		1451.81 ± 232.52 m (18.96 ± 4.25 m/min)		85.71 ± 80.7 m (1.09 ± 1.02 m/min)			23.47 ± 1.9 km/h
(Winther et al., 2022)[102]	8.93–10.13 km			1054–1894 m		227–530 m		Acc: 427–578 Dec: 305–493	27–29 km/h
(Yousefian et al., 2021)[109]	(99.56 ± 5.81 m/min)			(22.04 ± 3.43 m/min)	(4.40 ± 3.00 m/min)				

Note: Data reported represents average performance outputs per player per match; [a] ± SE; [b] Match formats are 11v11, 2 × 45 min on a regulation-sized pitch with regulation goal size, and size 5 ball, unless otherwise specified; [c] indicates grey literature findings; TD: total distance covered; LSR: low speed running; MSR: moderate speed running; HSR: high speed running; VHSR: very high-speed running; SPR: sprinting; ACC: accelerations; DEC: decelerations; SZ: speed zone speed threshold for sprinting (>25 km/h) than the U17 and Senior reports (>23 km/h).

Training physical performance metrics. An overview of the physical training performance metrics reported by 18 peer-reviewed articles can be seen in Table 4. TD and HSR were the most reported metrics (n = 14), with averages of 4.50 km[16,28–30,32–39,71,72,77,105] and 300 m covered,[28–30,32–34,36–39,71,72,77,105] respectively. The SPR covered during training sessions ranged between ∼17–330 m,[28,30,32,33,36–39,71,77] with players reaching top speeds of ∼23.4 km/h.[29,37] The average number of high intensity actions performed during training were ∼9 sprints,[34,35,37–39,72] ∼80 accelerations,[29,34,36,38,39,71,72,77,105] and ∼68 decelerations.[29,34,36,38,39,77,105]

Technical performance metrics. In women's football matches, a wide range of technical performance metrics (n = 22) were reported in 20 peer-reviewed articles.[15,16,30,41,43,52–60,80,86,88,90,92,114] The most frequently reported metrics were number of passes performed (n = 15)[30,41,43,53–55,57,58,60,80,86,88,90,92] and passing success rate (n = 13).[41,43,52–57,60,80,90,92,114] Only five metrics were reported across the two reviewed articles that investigated technical performance metrics in training sessions.[16,30] Video-based analysis was the primary method for coding technical actions (n = 18).[15,30,41,43,52–58,60,80,86,88,90,92,105,114] A single study utilised foot-mounted IMUs to measure ball contacts.[16]

Match and training technical performance metrics. A summary of match and training technical performance metrics is displayed in Table 5. Within the reviewed peer-reviewed articles, team-level match passing averaged ∼456 passes per team per match, with an accuracy of ∼73%. Player-level match passing averaged ∼46 per player per match, with an accuracy of ∼72%. Training passing was reported in fewer studies, with ∼27 passes performed per player per training session; passing accuracy was not reported.[16,30] Tackle counts during matches were ∼27 per team per match, and ∼8 per player per match.[30,43,53,55,57,80,88,90,92,114] Training tackle counts were reported in one study, with 10 per player per training session.[30] Only one peer-reviewed study examined age group differences in youth technical performance metrics, noting that U16 players recorded slightly higher counts of possession (34.7 vs 32.2), passes (25.1 vs 21.8), and dribbles (4.2 vs 3.9) compared with U14 players, although these differences were not statistically significant.[43]

Supplementary evidence from FIFA women's tournaments reported higher team-level match values across older age groups for several technical performance metrics, including number of passes (U17: ∼380; U20: ∼390; Senior: ∼430), passing accuracy (U17 and U20: ∼72.6%; Senior: ∼74.8%), and number of crosses (U17 and U20: ∼16.6; Senior: ∼19.0).[24–26] However, U20 teams were reported to perform a greater number of shots on goal (∼5.5 vs U17: ∼5.1; Senior: ∼4.3) and scored more goals (∼2.15 vs U17: ∼1.47; Senior: ∼1.3) than senior and U17 teams.[24–26] On average, U17 teams took more shots (∼14.4) than senior (∼12.6) and U20 teams (∼13.6).[24–26] The number of tackles made was similar across the three age groups (n = ∼39).[24–26]

Supplementary open-source data from the Hudl StatsBomb's repository for prominent women's domestic leagues (WSL (2018/19, 2019/20, 2020/21 seasons); NWSL (2018 season) and international tournaments (FIFA WWC (2019, 2023); EUROs (2022)) provided further contextual detail on technical match performance.[27] Per match, teams made 459 passes (accuracy = 73%), with an average pass length of 21.6 m. The average number of crosses, shots, and goals scored were 11.6, 13.6, and 1.4, respectively. Teams made an average of 20.2 tackles per match.

Within the same four women's competitions, notable differences emerged in shot location and location of goal scored from (Figure 4). The WSL featured a higher proportion of shots scored from outside the 18-yard box, whereas the NWSL, EUROs, and WWC competitions showed a greater concentration of shots taken inside the box, particularly near the penalty spot or 6-yard area.[27]

Regarding passing metrics in the supplementary open-source data, the WSL and EUROs teams typically involved more passes in the build-up to scoring goals (> 10 passes), whereas the NWSL teams exhibited fewer passes (< 10) prior to goals. Left vs right foot usage was relatively consistent across all competitions, averaging around 29% left and 71% right. Positional differences in foot usage were minimal overall, though defenders exhibited the most balanced left-to-right ratio across the four competitions (∼33% vs ∼67%) compared with midfielders (∼24% vs ∼76%) and forwards (∼28% vs ∼72%) (Figure 5).[27]

Discussion

This scoping review summarised current academic research examining the physical and technical performance metrics of women's football players during matches and training sessions. Physical performance metrics were well represented, whereas technical performance, particularly within training environments, remains underexplored. Youth players were notably underrepresented, limiting developmental comparisons, and variation in speed thresholds continues to hinder cross-study comparability.

Senior women's footballers (> 20 y) appeared in 85% of studies, with only a small number (10%) focused solely on youth cohorts. Approximately 39% of studies reported incomplete anthropometric information, limiting the contextualisation of performance findings. Sample sizes varied substantially (8–546 participants), alongside individual

Table 4. Physical performance metrics of women's football players during training sessions.

Author (year)	TD (km) (m/min)	LSR (m)	HSR (m) (m/min)	SPR (m) (m/min)	SPR (n) (n/min)	Acc/Dec (n) (n/min)	Top speed (km/h)
(Diaz-Seradilla et al., 2022)[37]	4.08–5.95 km (54.3–57.3 m/min)		215.6–699.4 m (2.9–8.7 m/min)	24.8–151.7 m (0.3–1.7 m/min)	1.9–7.3		21.9–25.0 km/h
(Douchet et al., 2021)[38]	3.87–5.09 km (56.7–65.2 m/min)	2450–3296 m	956–1267 m	124–155 m	~6.7	Acc: 28.2–56.1 Dec: 31.5–60.9	
(Doyle et al., 2022)[39]	~4.70 km		~165 m	~48 m	~3	Acc: ~37 Dec: ~37.6	
(Emmonds et al., 2023)[16]	POS: 1.72 km (57.3 m/min) PS: 1.93 km (64.4 m/min) SSGe: 2.02 km (67.4 m/min) SSGi: 1.99 km (66.5 m/min) TAC: 1.85 km (61.8 m/min) TEC: 2.08 km (69.2 m/min)		POS: 17 m (0.6 m/min) PS: 24 m (0.8 m/min) SSGe: 25 m (0.8 m/min) SSGi: 26 m (0.9 m/min) TAC: 19 m (0.6 m/min) TEC: 28 m (0.9 m/min)				
(Fernandes et al., 2022)[29]	~4.54 km (~54 m/min)		~310.2 m			Acc: ~228 Dec: ~220	~23.2 km/h
(Floersch et al., 2024)[72]	4.15 ± 1.7 km (45.5 ± 13.3 m/min)		347.5 ± 291.5 m		6.95 ± 6.7	Acc: 70.3 ± 38.8 (0.75 ± 0.35 n/min)	
(Gabbett and Mulvey, 2008)[30]	4.45 ± 1.30 km	< 2500 m	< 500 m	< 300 m			
(García-Ceberino et al., 2022)[31]	(57.26 ± 20.95 m/min)				(1.71 ± 5.96 n/min)	Acc: (37.11 ± 7.09 n/min) Dec: (37.09 ± 7.09 n/min)	
(Gentles et al., 2018)[32]	2.95 ± 0.95 km	~1785m	~890 m	~65 m			
(Jagim et al., 2022)[71]	3.74 ± 0.40 km	1717.02 ± 225 m	306.38 ± 85.11 m	97.87 ± 38.30 m		Acc: 31.55 ± 6.53	
(Karlsson et al., 2023)[33]	~5.18 km (~53 m/min)		~406.5 m (~3.95 m/min)	~35.13 m		~105.3 (~1.05 n/min)	
(Mara et al., 2015)[34]	5.56 ± 0.11 km		1061.3 ± 41.0 m		22 ± 11	Acc: 45.7 ± 18.7 Dec: 18.0 ± 9.7	
(Mara et al., 2015)[77]	6.58 ± 0.85 km		880 ± 244 m	333 ± 107 m		Acc: 49 ± 13 Dec: 18 ± 9	

(continued)

Table 4. Continued.

Author (year)	TD (km) (m/min)	LSR (m)	HSR (m) (m/min)	SPR (m) (m/min)	SPR (n) (n/min)	Acc/Dec (n) (n/min)	Top speed (km/h)
(McFadden et al., 2020)[35]	4.53 ± 0.3 km				10.5 ± 2.5		
(Myhill et al., 2023)[28]	~5.63 km		~154 m (~1.4 m/min)	~28 m (~0.21 m/min)			
(Olaizola et al., 2022)[36]	4.72 ± 0.98 km (77.1 ± 11.1 m/min)		367.0 ± 219.7 m	17.4 ± 28.2 m		Acc: 107.8 ± 28.7 Dec: 106.4 ± 29.1	
(Ramos et al., 2019)[111]	(67.3 ± 5.64 m/min[a])		(9.07 ± 0.91 m/min[a])	(2.19 ± 0.52 m/min[a])			
(Romero-Moraleda et al., 2021)[105]	3.83 ± 1.26 km (52.75 ± 13.75 m/min)		304.75 ± 206.25 m (4.35 ± 3.25 m/min)			Acc: 104.75 ± 43.75 Dec: 28.25 ± 14.75	

Note: Data reported represents average performance outputs per player per training session; [a] = ± SE; TD: total distance covered; LSR: low speed running; MSR: moderate speed running; HSR: high speed running; VHSR: very high speed running; SPR: sprinting; ACC: accelerations; DEC: decelerations; SZ: speed zone; SSG: small sided games; RBD: running based drills; POS: possession; PS: position-specific training; SSGi: small sided games intensive; SSGe: small sided game extensive; TAC: tactical; TEC: technical

observations for matches (2–3268) and training sessions (72–12416), which further complicates the applicability of findings across competition levels ranging from youth and collegiate programmes to senior domestic, professional, and international contexts.

Physical performance

Technology. The primary method used for capturing physical performance was GPS (~85% of studies); video systems were used less frequently (~13%) and only three studies utilised foot-mounted IMUs (~4%). GPS has become widely adopted in football over the last decade following FIFA's approval of its use in official matches,[118] contributing to the rapid expansion of commercially available systems (e.g., Catapult, STATSports). Its popularity is further supported by the accessibility of automated data processing, with most platforms offering a vast range of physical performance metrics with dashboard outputs that facilitate practitioner interpretation.[119] Although GPS systems demonstrate acceptable validity and reliability,[120] practitioners are encouraged to conduct their own in-house assessments to account for within-device error and variability between different models and brands, particularly when using these metrics to guide training loads.[121,122]

Three studies in this review utilised foot-mounted IMUs to collect physical performance data, primarily within training environments. These devices show promise for capturing physical performance outputs related to lower-limb movement patterns that may not be fully captured by traditional GPS units, which are typically positioned between the scapulae on the upper back.[123,124] However, foot-mounted IMUs were used far less frequently than both GPS and video recording, likely reflecting their relatively recent integration within applied football settings[125] and the limited evidence currently available in women's football. In contrast, video analysis, although widely accessible due to the general availability of recording technology, remains substantially more labour-intensive and requires highly trained analysts who can reliably code events and communicate key findings to coaching staff.[126] Obtaining more advanced performance insights (e.g., event-level data) further relies on specialised analysis software, coding expertise, and financial investment to ensure high quality recordings.[127]

Performance metrics. Among physical performance metrics, the most frequently reported were TD, HSR, and SPR. However, the speed thresholds used to categorise HSR and SPR varied substantially (HSR: 12.5–22.5 km/h; SPR: 16–25.1 km/h), limiting comparability between studies.[1] Although a moderate number of studies did report acceleration, deceleration, or peak speed metrics, far fewer examined these variables relative to the attention given to distance-based outputs. This is notable because accelerations, decelerations, and peak speed actions provide critical insight into explosive movement capacity and change of direction ability.[11] These high intensity actions are also among the most physiologically taxing, as accelerations and decelerations in particular have been associated with elevated muscle damage markers such as creatine kinase.[128] Their relative underrepresentation across studies therefore

Table 5. Technical performance metrics of women's football players during matches and training sessions.

Author (year)	Passes (n) Success (%)	One touch pass (n) Success (%)	Receives (n) Success (%)	Dribbles (n) Success (%)	Touches (n) (per possession (n/min)	Cross (n) Success (%)	Shot (n) On goal (n)	Goals scored (n)	Possessions (n) (n/min)	Total possession (s)	Avg possession (s)	Tackles (n) Success (%)	Fouls (n)
Matches													
(Andersen et al., 2012)[41 d]	248 ± 19[a] (55.5 ± 3.5%[a])		164 ± 18[a] (82 ± 2%[a])			10 ± 3[a] (32 ± 6%[a])	17 ± 5[a]	3.05 ± 0.95[a]					
(Andersen et al., 2016)[92 c]	43.5 ± 14 (68 ± 10%)					20–22	1.5 ± 1.7 (0.8 ± 1.2)					6 ± 4	
(Bradley et al., 2014)[58 c]	71.5 ± 1.5									66.5 ± 3.4 s			
(Bransen and Davis, 2024)[52 d]	(~77.7%)						~23.4				~13.3 s		
(Casal et al., 2021)[53 d]	~393 (~70%)			~33 (~16.5%)		~11	~11 (~4)					~44 (~59%)	~12
(Dipple et al. 2022)[54 d]	428.9 ± 100.4 (69.2 ± 7.37%)			(47.1 ± 16.3%)									
(FIFA, 2023)[24 b, d]	432 ± 183 (74.8 ± 10.3%)					19 ± 11.1	12.6 ± 7.7 (4.3 ± 3.2)	1.3 ± 1.6				38.8 ± 11.8	
(FIFA, 2024)[25 b, d]	382 ± 133 (72.6 ± 11.7%)					16.6 ± 9.6	14.4 ± 9.0 (5.1 ± 3.7)	1.47 ± 1.52				39.7 ± 11.2	
(FIFA, 2024)[26 b, d]	408 ± 155 (74.4 ± 10.5%)					17.5 ± 11.0	13.4 ± 8.3 (5.0 ± 4.0)	1.8 ± 2.2				39.8 ± 52.6	
(Gabbett and Mulvey, 2008)[3◦ c]	28–49		22–35	14–28								9–16	
(Garcia-Unanue et al., 2020)[8◦ c]	~36.6 (~68%)			~2.51 (~51%)		~1.3	~1.04	~0.12				~2.5 (~81%)	~1.1
(Harkness-Armstrong et al., 2020)[43 c]	23.45 ± 1.85[a] (64.3 ± 30.9%[a])	7.5 ± 0.25[a] (62.75 ± 30.15%[a])		4.05 ± 0.5[a] (32.2 ± 15.55%[a])	43.23 ± 3.8[a]	0.75 ± 0.0 [a]	1.05 ± 0.2[a]		33.45 ± 2.3[a]	42.1 ± 5.95 s [a]	1.14 ± 0.07 s [a]	3.7 ± 0.3[a]	0.5 ± 0.1[a]
(Harkness-Armstrong et al., 2023)[15 c] U14: 2 × 35 min; 75 × 45 m; size 4 ball					(~6.64 n/min)				(~1.94 n/min)		~11.2 s		

(continued)

Table 5. Continued.

Author (year)	Passes (n) Success (%)	One touch pass (n) Success (%)	Receives (n) Success (%)	Dribbles (n) Success (%)	Touches (n) (per possession (n/min)	Cross (n) Success (%)	Shot (n) On goal (n)	Goals scored (n)	Possessions (n) (n/min)	Total possession (s)	Avg possession (s)	Tackles (n) Success (%)	Fouls (n)
U16: 2 × 40 min; 91 × 56 m; size 5 ball													
(Hudl StatsBomb, 2024)[27 b, d]	425.8 ± 92.6 (69.4 ± 6.5%)		386 ± 93.2 (77.3 ± 5.9%)	17.2 ± 4.2		10.0 ± 3.9 (27.5 ± 3.8%)	11.8 ± 4.4 (3.9 ± 1.7)	1.2 ± 0.8			1.25 ± 0.12	21.2 ± 3.5 (28.1 ± 4.5%)	
(Kobal et al., 2022)[86 d]	523.5 ± 88			28.7 ± 9		15.2 ± 7	19.35 ± 7.5 (8.45 ± 3.3)	2.8 ± 2.1					
(Kubayi and Larkin, 2020)[55 d]	~459.6 (~76.9%)			~27.4 (~50.9%)			~11.9 (~4.6)					~37.3 (~62.6%)	~10.1
(Mohr et al., 2008)[59 c]												7.5 ± 1[a]	
(Pappalardo et al., 2021)[60 d]	790.86 ± 98.76 (~76%)						21.98 ± 6.03						19.95 ± 5.94
(Pascual-Verdú et al., 2018)[88 d]	240.3 ± 71.3		160.2 ± 42.2	11.9 ± 6.6	19.9 ± 7.6		9.0 ± 2.8					4.5 ± 3.6	
(Póvoas et al., 2022)[114 c]	(75.7 ± 8.15%)											1.55 ± 0.9	
(Trușcă et al., 2023)[56 c]	(~73.9%)												~11.2
(Villaseca-Vicuña et al., 2024)[9o c]	~37.7 (~74.3%)											~15.9	
(Wang and Qin, 2020)[57 d]	383 ± 2.5 (73.5 ± 2.05%)						13 ± 1.73 (3.75 ± 0.88)	1.40 ± 0.15				15.85 ± 5.97 (51.7 ± 16.6%)	
Training Sessions													
(Emmonds et al., 2023)[16 c]	POS: 9 PS: 7 SSGe: 11 SSGi: 16 TAC: 38 TEC: 49				POS: 77 PS: 75 SSGe: 65 SSGi: 75 TAC: 88 TEC: 73								
(Gabbett and Mulvey, 2008)[3o c]	30 - 45		26–38	15–24								8–12	

Note: Match formats are 11v11, 2 × 45 min on a regulation-sized pitch with regulation goal size, and size 5 ball, unless otherwise specified.
[a] = ± SE; [b] findings from grey literature; [c] per-player value; [d] team-level value; POS: possession; PS: position-specific training; SSGi: small-sided games intensive; SSGe: small-sided game extensive; TAC: tactical; TEC: technical.

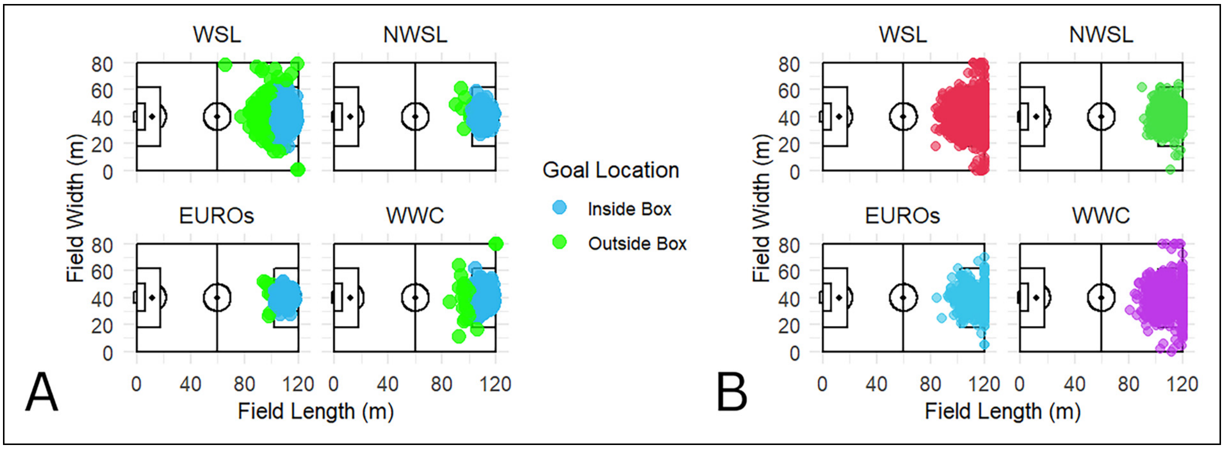

Figure 4. Visual representation of shot locations and goal scoring locations across women's football competitions. A) Location of shots taken across competitions; B) Locations of goals scored across competitions. *Note:* WSL: Women's Super League; NWSL: National Women's Soccer League; EUROs: UEFA Women's European Championship; WWC: FIFA Women's World Cup.

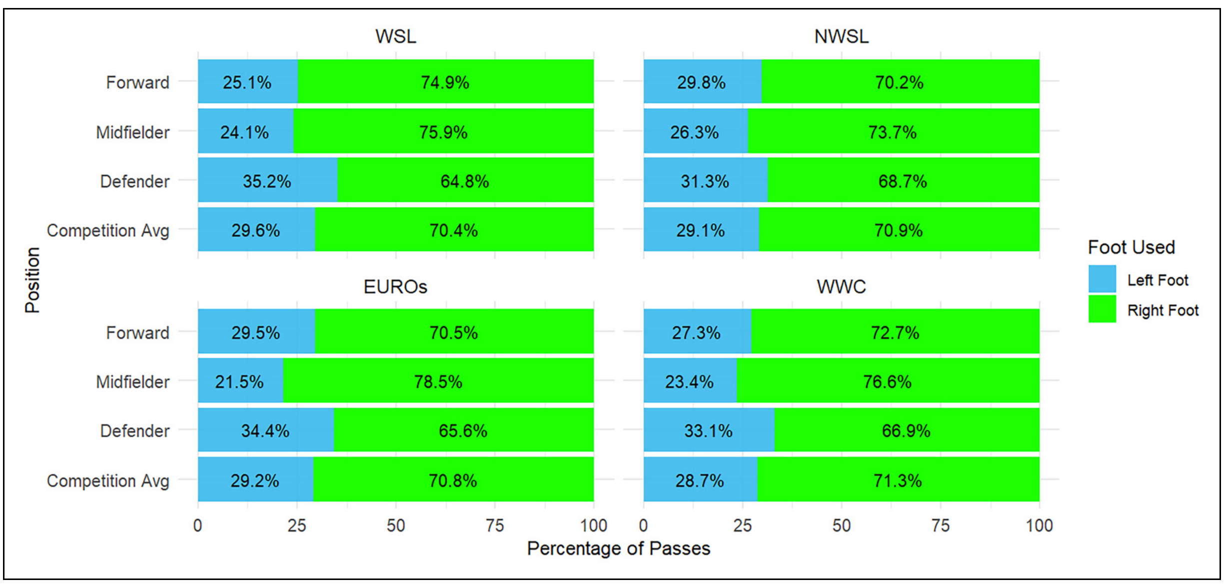

Figure 5. Left vs right foot passing by position. *Note:* WSL: Women's Super League; NWSL: National Women's Soccer League; EUROs: UEFA Women's European Championship; WWC: FIFA Women's World Cup.

limits a more complete characterisation of the physical demands experienced by women's footballers.

When comparing match and training physical demands across the reviewed studies, reported TD values were higher in matches (~9.5 km) than in training (~4.5 km). HSR distances also differed considerably, with matches producing far higher HSR volumes (~1200 m) than training (~300 m). However, these differences should not be interpreted as evidence that training is necessarily insufficient or unable to prepare players for competition. Match and training outputs are influenced by tactical approaches, competition level, playing position, session duration, session structure, and other contextual factors.[11,30,79,129] Therefore, lower average training demands may reflect the intended purpose of specific sessions rather than an inability to replicate match demands. Without more detailed reporting of sprint occurrences, acceleration patterns, session context, or match-day proximity, it is difficult to determine how training exposure relates to the physical intensity of competition.[74]

Youth vs senior comparisons. Variations in speed threshold selection complicate the interpretation of youth-senior comparisons. Many GPS systems default to male-based classifications, highlighting the need for appropriately validated thresholds and clearer reporting frameworks in women's football.[130] However, the substantial variability in thresholds reported across studies makes it difficult to establish or implement consistent standards in practice.[13,130,131] Youth players also require age-appropriate performance standards, as senior benchmarks are not suitable for quantifying or interpreting younger players' physical capacities.[132] Without age-specific standards, youth performance may be misinterpreted, resulting in developmental expectations that do not align with youth physiological or maturation profiles.[45,133]

Few included studies or reports directly compared age groups, but available evidence indicates lower reported running volumes and technical involvements among youth players.[15,19,24–26,41–47] These comparisons should be interpreted cautiously, as studies differed in match formats, competition levels, technologies, and speed thresholds. Differences in the design of youth matches (i.e., smaller pitch sizes and goals, shorter duration, smaller ball) make comparisons between age groups challenging.[45] No included sources within this review detailed the training performance of youth players. The absence of such data represents a critical gap in the literature, as understanding training demands is essential for optimising long-term player development and injury mitigation strategies.

Technical performance

Technology. Video analysis remained the primary method for capturing technical performance, enabling detailed identification of ball contacts, passing patterns, and tactical interactions that cannot be derived from position-only tracking systems (e.g., GPS). However, the financial outlay of having specialised equipment and staff to obtain technical performance outputs from video recordings provides a substantial limitation for many teams outside of well-funded high-performance environments.[126,127]

GPS is inherently limited in its ability to capture foot-level technical actions, as the technology is designed to quantify whole-body locomotor movements rather than ball-specific interactions.[69] Although some systems offer higher sampling rates than the commonly used 5–10 Hz,[134,135] accuracy issues persist during high-speed movements such as accelerations and decelerations.[122,136] Embedded accelerometers operate at higher frequencies (~100 Hz),[137] but these sensors reflect gross movement rather than ball contact. As a result, GPS cannot quantify ball touches, pass execution, dribbling mechanics, or other ball-specific actions that underpin technical performance in football.[123,138,139]

While only three studies in this review employed foot-mounted IMUs, these devices show promise for detecting ball contacts and lower-limb movement patterns, suggesting potential for future technical performance monitoring.[124,138,140] However, their current use in women's football research is limited. Playermaker, currently the most widely adopted foot-mounted IMU system, only recently received certification under FIFA's EPTS Quality Programme, meaning its formal recognition as an approved performance tracking technology is still new.[125] As with any emerging technology, there is typically a lag between initial validation, practitioner uptake, and the accumulation of peer-reviewed research. Practical barriers such as cost, staff familiarity, and the absence of established research protocols may further slow adoption.[141,142] Foot-mounted IMUs may provide a potential option for quantifying aspects of players' technical performance without the need for expensive video equipment and highly skilled analysts, but their practical value, accessibility, and broader applicability in women's football require further validation.[17]

Performance metrics. Technical performance received far less attention in the reviewed literature than physical performance. Players' technical performance in matches and training sessions was frequently described using basic action counts with minimal information about how actions were performed. In contrast, supplementary open-source event data from Hudl StatsBomb demonstrated the level of technical detail that can be captured, including pass length, pass height, foot usage, build-up actions prior to goals, and shot location. Future peer-reviewed studies could adopt similarly contextualised technical frameworks by reporting information such as pass distance, receiving foot, body orientation, pressure from opponents, and field location. Without this level of detail, the reviewed peer-reviewed studies provide limited insight into the quality, context, or tactical value of technical actions, restricting meaningful interpretation and comparison.[8]

Very few studies have differentiated between positional roles when reporting technical performance, with only one of the 18 studies providing position-specific analyses.[80] This is noteworthy given the likelihood that defenders, midfielders, forwards, and specialised sub-roles within these groups possess distinct technical profiles. For example, full backs and centre backs (both typically grouped as "defenders") differ markedly in passing demands, dribbling involvement, and defensive responsibilities.[6] Aggregating positions in analyses may therefore obscure role-specific demands and overlook meaningful differences in how players interact with the ball.[143,144] Supplementary elite competition datasets, such as FIFA technical reports and Hudl StatsBomb, routinely provide positional breakdowns for both physical and technical metrics, highlighting that such analyses are feasible and increasingly standard in high-performance environments, yet still underrepresented in the peer-reviewed literature.

Variation in operational definitions and coding frameworks further contributes to inconsistencies across studies. Reporting of inter- or intra-operator reliability was inconsistent or absent across many studies, limiting the ability to determine how analyst agreement may have contributed to variations in technical outcomes. While discrete, objective actions such as tackles or number of passes are unlikely to be influenced by analyst judgement, many context-dependent technical events (e.g., types of passes, successful vs unsuccessful involvements) carry a greater risk of subjective interpretation. These inconsistencies are compounded by the labour-intensive nature of manual, frame-by-frame video coding, which requires substantial analyst time and expertise. This limits the scalability of large observational datasets, particularly in women's programmes where staffing and financial resources may be more constrained, and helps explain why technical performance remains comparatively under-represented in women's football literature.[8,145]

Supplementary contextual data from large-scale competitions

Supplementary elite-level performance datasets from major women's football competitions provide useful context for interpreting the findings of this review. FIFA technical reports from recent U17, U20, and Senior Women's World Cups reported higher values across older age groups for several physical and technical performance outputs, including higher total distances, greater high-speed running, increased sprint actions, more passes completed, and improved passing accuracy. These datasets are generated through multi-camera optical tracking and structured event coding by trained analysts, and similar systems (e.g., OPTA, Hudl StatsBomb) have demonstrated high inter-operator agreement and strong reliability for discrete technical events.[146] Large-scale repositories such as Hudl StatsBomb further illustrate the level of technical detail attainable in elite environments, extending beyond simple action counts to describe how, where, and under what conditions technical actions occur across positions and competitions.

These datasets highlight a clear disconnect between the level of detail achievable at elite performance levels and what is currently reflected in peer-reviewed women's football research. However, such datasets are primarily derived from senior international or top tier domestic competitions, leaving substantial knowledge gaps across youth, sub-elite, and training contexts. This reinforces the need for wider application of contextualised technical metrics and more standardised reporting frameworks to expand physical and technical performance analysis beyond elite environments.

Limitations

A limitation of this review is that study screening and data extraction were conducted by a single reviewer. While uncertainties regarding study eligibility and data charting were resolved through discussion with the co-authors, independent duplicate screening and extraction were not performed. Therefore, the possibility of selection bias or subjective interpretation cannot be fully excluded. Additionally, no appraisal of study quality or risk of bias was undertaken, consistent with the aims of this scoping review. As a result, the methodological rigour of included studies could not be evaluated, and conclusions regarding the strength of available evidence should be interpreted cautiously.

This review did not examine positional or tactical variation in detail, largely because these factors were inconsistently reported and often oversimplified within the included studies. As a result, the findings reflect broad positional categories rather than the more nuanced demands associated with specific roles or formations. Technological representation and measurement consistency also limit interpretation. Most peer-reviewed studies relied on GPS or video analysis systems, with minimal use of emerging tools with potential practical utility, such as foot-mounted IMUs. Although open-source event datasets provided useful supplementary evidence for technical performance comparisons, their limited integration within peer-reviewed research highlights an opportunity for future studies to make greater use of accessible event data. Variation in speed thresholds and technical performance metrics further restricted comparability, an issue amplified in youth cohorts where maturation strongly influences performance. More standardised reporting frameworks and appropriately validated thresholds for both physical and technical metrics are needed to improve future research comparability and practical application.

Conclusion

This scoping review mapped the literature on physical and technical performance in women's football during matches and training contexts. The current evidence base is heavily skewed toward physical match performance, while technical performance and training demands, particularly at the youth level, remain substantially underrepresented. Positional variation, consistent reporting standards, and age-appropriate benchmarks are also limited, restricting meaningful comparisons across studies. Although GPS remains the dominant tool for physical monitoring, it cannot capture foot-ball interactions, while video analysis systems, still the primary method for assessing technical actions, are labour-intensive and difficult to scale. Foot-mounted IMUs may offer an accessible means of capturing both physical and selected technical performance metrics; however, only three included studies used this technology, and further validation is required before their practical value and broader applicability in women's football can be established.

Future research should prioritise the development of standardised reporting frameworks and appropriately validated thresholds, while increasing representation of youth cohorts and training contexts to support evidence-based development pathways. Continued evaluation of accessible tracking technologies may help address current methodological limitations and improve the consistency and relevance of performance analysis in women's football. Collectively, these advancements are needed to establish a more complete and contextually appropriate understanding of the physical and technical performance of players across all levels of the women's game.

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Ethical considerations

Ethics approval was not required for this review, as no new data were collected.

Author contributions

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Aaron Uthoff: Conceptualisation; Methodology; Supervision; Writing – Review and Editing.
Matt Cross: Conceptualisation; Methodology; Supervision; Writing – Review and Editing.
Kirsten Spencer: Supervision, Writing – Review and Editing.

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Data availability

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Supplemental material

Supplemental material for this article is available online.

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