ORIGINAL ARTICLE

Influence of age category and playing position on match physical demands in football players

Nicola Trotta . *Department of Neurosciences, Biomedicine and Movement Sciences. University of Verona. Verona, Italy.*
Department of Clinical and Experimental Medicine. University of Foggia. Foggia, Italy.
Luigi Armiento. *Department of Neurosciences, Biomedicine and Movement Sciences. University of Verona. Verona, Italy.*
Department of Clinical and Experimental Medicine. University of Foggia. Foggia, Italy.
Italo Sannicandro. *Department of Clinical and Experimental Medicine. University of Foggia. Foggia, Italy.*

ABSTRACT

This study aimed to compare the physical match demands between first-team and U19 players during the football season and to evaluate the differences across playing positions. A total of 41 matches and 395 individual player game observations (U19 = 188 and first-team = 207) were included in this study. The following playing positions were examined: Centre Backs (CB), Wide Midfielders (WM), Defensive Midfielders (DM), Attacking Midfielders (AM) and Forwards (FW). Total distance covered (TD), high-speed running distance (HSR), sprint running distance (SR), high metabolic load distance (HMLD), number of sprints (NS) and maximal sprinting speed (MSS) were measured using an 18.18 Hz global positioning system (GPEXE® SYSTEM, EXELIO srl, Udine, Italy). First-team players demonstrated greater physical match demands and higher exposure to high-intensity activities than U19 players, although no significant difference was observed for MSS. Regarding positional differences, WM, AM, and FW exhibited greater physical requirements, while CB and DM generally experienced lower locomotor and sprint-related demands during competitive matches. These findings may help practitioners facilitate the progression of young players into senior environments and optimize training prescriptions according to playing position.
Keywords: performance analysis; youth soccer; motor activity; global positioning system; team sport.

Cite this article as:
Trotta, N., Armiento, L., & Sannicandro, I. (2026). Influence of age category and playing position on match physical demands in football players. *Journal of Human Sport and Exercise, 21*(4), 1428-1442. https://doi.org/10.55860/hta61465

Corresponding author. *Department of Neurosciences, Biomedicine and Movement Sciences. University of Verona. Verona, Italy.*
E-mail: nicola.trotta@univr.it
Submitted for publication June 07, 2026.
Accepted for publication July 21, 2026.
Published August 19, 2026.
Journal of Human Sport and Exercise. ISSN 1988-5202.

doi: https://doi.org/10.55860/hta61465

INTRODUCTION

Football is one of the most widely played sports in the world and requires players to possess well-developed aerobic and anaerobic capacities to cope with the substantial physical demands of competitive matches (Bangsbo et al., 2006; D'Elia et al., 2023). In recent years, the analysis of football performance models has gained considerable attention in the scientific literature following the development of advanced tracking technologies such as global positioning systems (GPS) (D'Isanto et al., 2019; Altavilla et al., 2017). These tools enable practitioners and sports scientists to quantify players' external load demands, design sport-specific training exercises that replicate the intensities required by the performance model (Dios-Álvarez et al., 2024), and support coaches in planning recovery strategies based on the load imposed during a game (Buckthorpe et al., 2019; Vanrenterghem et al., 2017). An earlier study has reported that professional football players cover approximately 10–13 km during competitive matches (Taylor et al., 2023), and the total distance covered has been associated with the aerobic component (Impellizzeri et al., 2006). However, this parameter may have some limitations, as it does not account for the different movement intensities of football players (Kavanagh et al., 2024). Currently, high-speed running (distance covered at speeds between 19.8 km·h^{-1} and 25.2 km·h^{-1}) and sprinting (>25.2 km·h^{-1}) are of huge importance in training load monitoring, as they may contribute to hamstring injury prevention and represent key physical characteristics required to compete in official matches (Gualtieri et al., 2023; Edouard et al., 2023). Based on these considerations, although the total distance covered showed only minor changes (3%) between the FIFA World Cup Russia 2018 and Qatar 2022, the high-speed running distance substantially increased by 16–19% (Bradley, 2024). Additionally, the high metabolic load distance has become increasingly integrated into external load analysis by sports scientists (Gaudino et al., 2014). As suggested by Osgnach et al. (2010), this parameter quantifies the energetic expenditure derived from football-specific actions and is significantly related to the aerobic component of football players (Manzi et al., 2022).

Professional football is a well-established organization that encompasses youth teams up to the first-team. This aspect is particularly relevant, as physical performance may vary significantly based on players' age (Palucci Vieira et al., 2019; Giardullo et al., 2026). Although a substantial body of literature has investigated external load in professional football, limited evidence is currently available regarding differences across age categories within Italian youth football (Izzo and Vardè, 2017). Indeed, the advanced technologies mentioned above entail substantial financial costs, which may constrain youth academies from assessing external load metrics (Reynolds et al., 2021). Moreover, the transition from academy to first-team represents a complex process in the development of elite youth players (Tomás et al., 2025). During this phase, players are required to adapt to the greater physical demands of senior professional football to successfully progress to the highest competitive level. Therefore, understanding the differences in match-running demands between U19 and first-team players may help practitioners better prepare academy players for this developmental transition.

Furthermore, as observed in a prior study involving an Italian professional football team, physical performance can be affected by playing position (Perrotta et al., 2025). Although this topic has been extensively investigated, inconsistent findings and a lack of consensus regarding positional classification persist (Sarmento et al., 2024). This may lead to misleading interpretations of the findings and limit the development of practical applications tailored to the specific demands of each playing position. Therefore, the aims of the present study were: i) to compare external load demands imposed during competitive matches between a professional first-team and U19, and ii) to investigate the differences in external load metrics according to playing position. We hypothesized that first-team players would demonstrate greater physical demands than U19. Furthermore, wide midfielders and attacking players are expected to exhibit superior high-intensity performance compared to players positioned in the central areas of the pitch.

MATERIAL AND METHODS

Participants

A total of 51 male football players from the same Italian club were included in this study. The sample consisted of first-team players (n = 23; age = 25.78 ± 0.87 years; height = 183.3 ± 2.9 cm; weight = 79.9 ± 3.23 kg) competing in the Italian third professional division and U19 players (n = 28; age = 17.32 ± 0.49 years; height = 175.32 ± 2.15cm; weight = 75.9 ± 1.87 kg) from the Primavera 2 championship during the 2024–2025 competitive season. The use of the same playing formation (1-3-5-2) in both squads improved the comparability between age categories and reduced the potential bias associated with positional match demands (Savoia et al., 2024). The following playing positions were examined: Centre Backs (CB), Wide Midfielders (WM), Defensive Midfielders (DM), Attacking Midfielders (AM) and Forwards (FW). The Ethics Committee of University of Foggia approved this study (approval number 0069/2024; date of approval: 06-09-2024). Informed consent to take part in this research was signed by the club. All procedures were conducted in accordance with the Declaration of Helsinki for human studies.

Measures

External load was collected using 18.18 Hz GPS units (GPEXE® SYSTEM, EXELIO srl, Udine, Italy) previously validated (Hoppe et al., 2018). All devices were activated 30-min before data collection to allow the acquisition of satellite signals and to synchronize the GPS clock with the satellite's atomic clock (Maddison and Ni Mhurchu, 2009). Total distance (TD), maximum sprinting speed (MSS), number of sprints (NS), high-speed running distance (HSR; 19.8 $km \cdot h^{-1}$ and 25.2 $km \cdot h^{-1}$), sprint running distance (SR; >25.2 $km \cdot h^{-1}$), and high metabolic load distance (HMLD), defined as the distance covered with a power consumption >20 $W \cdot kg^{-1}$, were analysed in the present study. To standardize the data according to effective match exposure and facilitate comparisons between players, distance-based variables ($m \cdot min^{-1}$) and sprint events ($n \cdot min^{-1}$) were expressed relative to the playing time.

Procedures

A total of 41 matches and 395 individual player game observations (U19 = 188 and first-team = 207) from an Italian club were included in the analysis. Table 1 presents the number of players according to their positional role in each age category. The inclusion criteria were as follows: i) absence of disease and musculoskeletal injuries among outfield players, as certified by the club's medical staff; and ii) players who completed at least 60 min of match play. In contrast, matches played under numerical inferiority following a red card were excluded, as this condition may have altered the physical demands of remaining players. Similarly, games involving playing formation modifications or positional changes imposed by the coach during the match were excluded, since players were required to perform different tactical roles.

Table 1. Number of players according to playing position in first-team and U19.

Category	Playing position				
	CB (n = 11)	WM (n = 15)	DM (n = 4)	AM (n = 8)	FW (n = 12)
First team	4	6	2	4	6
U19	7	9	2	4	6

Note. CB: centre backs; WM: wide midfielders; DM: defensive midfielders; AM: attacking midfielders; FW: forward.

Analysis

Mean ± standard deviation (SD) were reported for all external load metrics. The data were tested for normality using Q-Q plots and the Shapiro-Wilk test. Linearity and homoscedasticity were evaluated using scatterplots of independent versus dependent variables and residuals versus predicted values. Linear Mixed Models (LMM) was used to assess the differences in external load variables in relation to age category (first-team vs

U19 team; fixed effects), playing position (CB vs DM vs WM vs AM vs FW; fixed effects), and their interaction on physical performance. The players' identity was modelled as a random effect to account for repeated measurements. When there was a significant effect of playing position, marginal mean values (contrasts) were estimated using post-hoc Tukey corrections for multiple comparisons. The estimated marginal means, 95% CIs for positions (CB, WM, DM, AM, and FW), and contrasts analysis are reported in the Supplementary Materials. Effect sizes (ES) were calculated from the t and df of the contrast, as suggested by Beato et al. (2024), and interpreted using Cohen's d principle as follows: trivial = < 0.2, small = 0.2–0.6, moderate = 0.6–1.2, large = 1.2–2.0, and very large = >2.0 (Hopkins et al., 2009). The statistical analyses were carried out using JASP software (version 0.19.2, Amsterdam, The Netherlands), with a significance level of $p < .05$.

RESULTS

Table 2. External load metrics according to playing positions and age category.

Parameters	First-team	U19
Centre-backs		
TD (m·min⁻¹)	106.78 ± 5.49	97.03 ± 7.12
MSS (km·h⁻¹)	29.89 ± 1.84	29.14 ± 1.43
NS (n·min⁻¹)	0.06 ± 0.03	0.04 ± 0.03
HSR (m·min⁻¹)	4.53 ± 1.46	3.22 ± 1.13
SR (m·min⁻¹)	1.30 ± 0.71	0.81 ± 0.63
HMLD (m·min⁻¹)	15.09 ± 2.99	13.02 ± 3.47
Defensive midfielders		
TD (m·min⁻¹)	116.42 ± 5.03	107.70 ± 4.65
MSS (km·h⁻¹)	28.10 ± 1.84	28.28 ± 2.13
NS (n·min⁻¹)	0.03 ± 0.02	0.02 ± 0.01
HSR (m·min⁻¹)	5.02 ± 1.43	3.00 ± 1.27
SR (m·min⁻¹)	0.61 ± 0.40	0.40 ± 0.30
HMLD (m·min⁻¹)	18.85 ± 2.92	13.07 ± 3.71
Wide midfielders		
TD (m·min⁻¹)	114.22 ± 6.17	110.73 ± 8.89
MSS (km·h⁻¹)	30.26 ± 1.51	30.06 ± 1.46
NS (n·min⁻¹)	0.08 ± 0.04	0.09 ± 0.05
HSR (m·min⁻¹)	7.47 ± 1.31	6.55 ± 1.85
SR (m·min⁻¹)	1.86 ± 0.95	2.03 ± 1.17
HMLD (m·min⁻¹)	20.75 ± 3.13	17.78 ± 3.62
Attacking midfielders		
TD (m·min⁻¹)	120.65 ± 7.39	109.54 ± 10.75
MSS (km·h⁻¹)	29.99 ± 1.56	30.42 ± 1.67
NS (n·min⁻¹)	0.09 ± 0.03	0.06 ± 0.03
HSR (m·min⁻¹)	8.35 ± 1.83	5.20 ± 1.68
SR (m·min⁻¹)	2.03 ± 0.91	1.48 ± 0.72
HMLD (m·min⁻¹)	22.17 ± 4.04	16.69 ± 3.29
Forward		
TD (m·min⁻¹)	114.61 ± 6.46	105.56 ± 10.08
MSS (km·h⁻¹)	29.83 ± 1.69	29.09 ± 1.42
NS (n·min⁻¹)	0.07 ± 0.03	0.06 ± 0.03
HSR (m·min⁻¹)	6.50 ± 1.04	4.72 ± 1.59
SR (m·min⁻¹)	1.42 ± 0.86	1.21 ± 0.69
HMLD (m·min⁻¹)	19.35 ± 3.38	15.20 ± 3.63

Table 2 reports the mean ± SD of the examined external load variables collected during the official season.

Significant differences between the first-team and U19 were found for the following external variables: TD (F = 16.864, $p < .001$; ES = 1.37), NS (F = 4.880, $p = .034$; ES = 0.74), HSR (F = 19.481, $p < .001$; ES = 1.50), SR (F = 4.988, $p = .032$; ES = 0.73), and HMLD (F = 23.389, $p < .001$; ES = 1.48). Conversely, no significant age-related differences were observed for MSS (F = 2.884, $p = .098$; ES = 0.56). Significant differences between playing positions were reported for the following external load metrics: TD (F = 8.682, $p < .001$), MSS (F = 4.263, $p = .006$), NS (F = 5.199, $p = .002$), HSR (F = 10.203, $p < .001$), SR (F = 4.802, $p = .003$), and HMLD (F = 8.835, $p < .001$). The LMM analysis revealed no significant team x position interaction effects ($p > .05$) for all examined dependent variables.

The estimated marginal means, 95% CIs for playing positions (CB, WM, DM, AM, and FW), and contrasts analyses are provided in Supplementary materials (Appendix 1).

DISCUSSION

The present study aimed to compare physical match demands between first-team and U19 players, and to analyse position-related differences within an Italian football club. The main findings significantly revealed greater TD, NS, HSR, SR, and HMLD values in first-team players compared with the U19 group. In contrast, no significant differences were observed between the groups for MSS. Regarding playing position, WM, AM, and FW exhibited greater physical demands than players positioned in central roles. Overall, the results of the present study support our initial hypothesis.

The greater exposure to high-intensity activities observed in first-team players may be associated with their superior repeated sprint ability (RSA) performance compared to youth players (Kessouri et al., 2026). The RSA test reflects the capacity to perform multiple short-duration sprints interspersed with brief recovery periods and is considered a key physical quality during crucial phases of match play (Asimakidis et al., 2025). In support of this interpretation, Wong et al. (2012) reported that first-team players showed a lower percentage decrement than U19 players (1.75 ± 0.98% vs 2.51 ± 1.17%, respectively). Consequently, players experiencing lower fatigue during repeated sprint tasks may be better able to sustain high-intensity efforts and maintain greater locomotor outputs throughout competitive matches. This advantage may also be related to the greater aerobic fitness typically observed in first-team players, which may improve recovery during repeated high-intensity efforts (Tomlin and Wenger, 2001). Consistent with this interpretation, first-team players have shown greater Yo-Yo Intermittent Recovery Test Level 1 (YYIR1) performance than youth players (Mujika et al., 2009; Rodríguez-Fernández et al., 2018), a test strongly associated with repeated high-intensity match actions (Castagna et al., 2010; Aquino et al., 2018). Overall, these age-related differences provide further insight into the physical performance gap between academy and senior professional football. This information may contribute to a better understanding of the physical demands associated with the transition to first-team competition. Nonetheless, previous studies examining differences in external match load across age groups have yielded inconsistent results. More precisely, Vigh-Larsen et al. (2018) reported greater acceleration and deceleration values in U19 players compared with both U17 and first-team players, whereas comparable results were observed in high-intensity running and sprint distance. Likewise, Morgans et al. (2022) reported similar physical performance between U18 and senior players competing in the Scottish Championship. Additionally, Kessouri et al. (2026) reported comparable high-intensity metrics between senior and U20 teams, except for greater walking distance in senior professionals. Conversely, Reynolds et al. (2021) reported that first-team and U23 players demonstrated greater match demands than U18 in terms of sprint distance, high-intensity burst distance, and dynamic stress load. These heterogeneous findings reported in the scientific literature may be attributed to differences in playing style, competitive standards, and cultural contexts across countries, which are known to influence locomotor demands in football (Morgans et al., 2022).

No statistically significant difference was identified for MSS across the various age categories. These findings suggest that U19 players may have already completed most of the physical adaptations associated with maximal sprint speed. To further reinforce this interpretation, Rey et al. (2023) reported similar results in the maximum running speed between Spanish professional players aged 18–20 and 20–25 years. However, this finding is not in line with those reported by Kessouri et al. (2026), who observed superior MSS values in first-team players compared with those in youth categories.

Playing position is widely recognized as one of the main factors influencing the physical demands of football matches (Perrotta et al., 2025; Sarmento et al., 2024). Notably, wide and offensive playing positions are generally associated with greater locomotor demands. These findings are consistent with the normative benchmarks proposed by Savoia et al. (2024), who reported greater high-intensity demands in wide and offensive positions than in central defenders within the 1-3-5-2 playing system.

Regarding TD, DM demonstrated the greatest locomotor demands and a large difference compared with CB, which exhibited the lowest values for this parameter among all playing positions. This may be explained by the tactical demands associated with the DM role, as players are required to cover multiple areas of the pitch to support build-up play and contribute to the defensive phase. In contrast, CB tended to adopt a more positional behaviour aimed at maintaining defensive compactness and facilitating ball possession. These findings are consistent with those of previous studies that reported lower physical requirements in CB and greater TD values in DM during competitive matches (Sarmento et al., 2024; Chaize et al., 2024).

The analysis of HSR reported that AM and WM significantly demonstrated higher demands than CB and DM. This may be associated with the tactical responsibilities performed in different areas of the pitch.

More specifically, during the offensive phase, these playing positions require players to perform high-speed actions to attack the opponent's penalty area, create numerical superiority, and generate goal-scoring opportunities. Conversely, during the defensive phase, they must track opponents' off-ball movements to regain possession and limit attacking opportunities.

Similar results have been reported previously, indicating greater high-intensity running demands in WM and AM (Beato et al., 2024; Sarmento et al., 2024), whereas CB were exposed to lower physical load requirements (Chaize et al., 2024).

Sprint-related activities and MSS are crucial physical qualities for both football performance and hamstring injury risk prevention (Gualtieri et al., 2023; Tedeschi et al., 2025).

Regarding MSS, DM exhibited significantly lower values than all other playing positions, with *moderate* differences compared with FW and a *large* ES relative to AM and WM. These findings align with previous evidence reporting higher maximal running speed in wide midfielders, full-backs, and forwards throughout an entire competitive season (Nakamura et al., 2025). A possible explanation for this finding may be that players positioned in central areas of the pitch have less available space to reach higher running speeds, whereas WM and offensive players are more frequently exposed to 1vs1 situations.

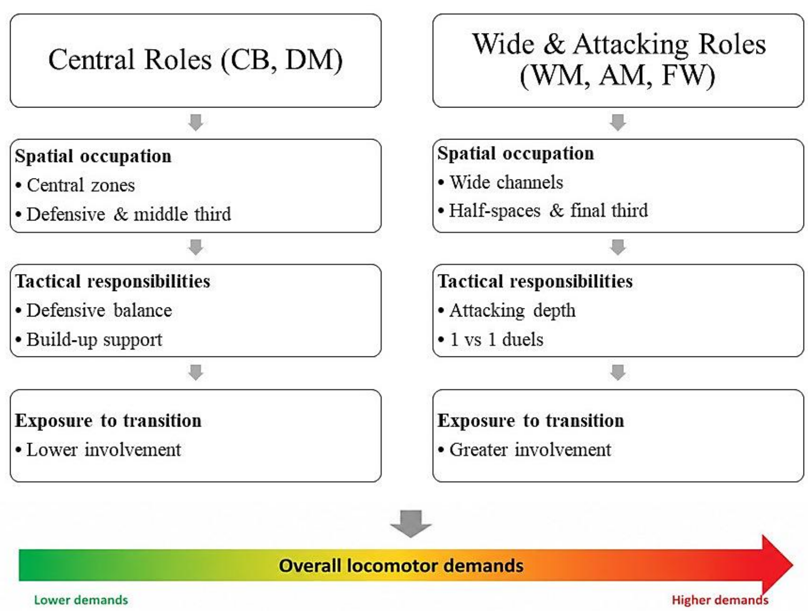
Similarly, WM demonstrated increased exposure to sprint demands, as highlighted by elevated NS and SR values, with *moderate* and *large* differences than CB and DM, respectively. Furthermore, AM and FW significantly displayed elevated values and *moderate* differences than DM.

One plausible rationale is that these positional roles are predominantly engaged in counterattacking situations, during which players attempt to attack space rapidly for generating goal-scoring opportunities.

Interestingly, the sprint distances covered by DM from first-team in the present study were substantially lower compared to those previously reported in players from the English Premier League and UEFA Champions League (Morgans et al., 2025). This comparison may help contextualize the gap in sprint-related performance between DM from the Italian third professional division and players competing at the international level.

The analysis of HMLD highlighted that AM, WM and FW were subjected to greater metabolic demands than CB. These findings are consistent with those reported for high-intensity parameters, indicating that greater exposure to high-intensity activities may have contributed to the increased HMLD demands observed in these playing positions. Consistent with our findings, Beato et al. (2024) reported similar HMLD values in AM and CB, whereas Chaize et al. (2024) found the highest HMLD values in CM and AM and the lowest in WM and CB. Interestingly, in the present study WM were among the playing positions exposed to substantial metabolic demands during competitive matches, partially contrasting with previous findings. This discrepancy may be explained by differences in the thresholds adopted for HMLD quantification and/or tactical characteristics associated with the playing formation, which was not explicitly reported in the previous investigation.

Overall, the positional differences observed in the present study may reflect the interaction between spatial occupation, tactical responsibilities, and transition involvement associated with each playing role. The conceptual framework provides a practical interpretation of how positional characteristics may contribute to the distinct locomotor demands observed during competitive match play (Figure 1).



Note: AM: attacking midfielders; CB: centre backs; DM: defensive midfielders; FW: forwards; WM: wide midfielders.

Figure 1. Conceptual framework of positional characteristics influencing locomotor demands in football.

Practical implications

The present findings have several practical implications for coaches and sports scientists involved in the development of academy players and their transition to senior professional football. The greater match-running demands observed in first-team players suggest that academy players may benefit from progressive training interventions designed to reproduce the neuromuscular and metabolic demands of senior professional match play. For example, large-sided games and running drills involving distances of 40-60 m could be useful in achieving these objectives. Additionally, practitioners should promote high volumes of football-specific practice throughout the developmental pathway, as this has been associated with a greater likelihood of successfully progressing from academy to senior professional football (Ford and Williams, 2012; Hendry and Hodges, 2018). However, physical preparation alone is unlikely to ensure a successful transition. Progression to senior professional football also requires well-developed tactical competencies, particularly positioning and decision-making, together with psychological attributes such as resilience, self-regulation, and intrinsic motivation (Tomás et al., 2025). Therefore, an integrated multidisciplinary approach combining physical, tactical, and psychological development may better support the progression of talented academy players toward first-team. Furthermore, the position-specific differences identified in the present study highlight the importance of implementing training and conditioning interventions that reflect the distinct locomotor demands of each playing position. For example, central players may benefit from greater exposure to small-sided games, complemented by aerobic conditioning, to better reflect the locomotor profile observed during competitive matches. Conversely, wide and attacking players may require a greater emphasis on transition-based games and speed-endurance maintenance training given the greater high-intensity demands identified in these positions.

Limitations

Despite the practical relevance of the present findings, several limitations should be acknowledged. First, given that this study included a single Italian football club, caution is required when generalizing the findings to other competitive contexts. Indeed, the observed physical demands may partly reflect the club's playing philosophy, coaching methodology, and competitive environment rather than universal developmental patterns. Therefore, future studies should include a greater number of professional clubs and elite academies to confirm these findings. Second, the sample of matches was not balanced in terms of home and away fixtures, and this contextual factor should be considered when analysing players' physical data. Moreover, other contextual match factors (e.g., opponent quality, match outcome, ball possession and playing style) were not included in the present analysis and may have contributed to the observed results in external load metrics. Future research should also examine the effects of age category and playing position using the worst-case scenario approach, which is increasingly adopted by sports scientists to quantify peak external load demands during match play (Mandorino and Lacome, 2024). Furthermore, a further step may involve the use of individualized speed thresholds, as suggested by Kavanagh et al. (2024), and internal load measures (e.g., heart rate responses). This may provide a more comprehensive understanding of the physical and physiological demands experienced by first-team and U19 players.

CONCLUSIONS

The present study aimed to compare external load demands between age categories (first-team vs U19) and examine positional differences in match physical performance. The main findings showed that U19 were subjected to lower physical requirements than first-team players, particularly in variables associated with high-speed and sprinting activities. Regarding positional differences, WM, AM, and FW demonstrated greater physical demands among all playing positions during competitive matches. In addition, CB generally exhibited lower external load demands, whereas DM demonstrated reduced sprint-related performance compared with other playing positions. These findings may support sports scientists and coaches in the prescription of tailored interventions according to age groups and playing position in professional football players.

AUTHOR CONTRIBUTIONS

All authors meet the criteria for authorship in accordance with established ethical guidelines. Contributions are specified according to the CRediT (Contributor Roles Taxonomy) as follows: Conceptualisation: Nicola Trotta, Italo Sannicandro. Methodology: Nicola Trotta, Italo Sannicandro. Formal analysis: Nicola Trotta, Luigi Armiento. Investigation: Nicola Trotta, Luigi Armiento. Data curation: Nicola Trotta, Luigi Armiento. Writing – original draft: Nicola Trotta, Italo Sannicandro. Writing – review & editing: Nicola Trotta, Italo Sannicandro. Supervision: Italo Sannicandro.

All authors have critically reviewed and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

FUNDING

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this manuscript.

AI USE DISCLOSURE

In accordance with current publishing ethics and transparency recommendations, artificial intelligence (AI) tools were used solely to assist with translation and language editing, with the aim of improving clarity and readability. No AI tools were used in the generation of scientific content, including the study design, data collection, analysis, interpretation of results, or the formulation of conclusions. The authors retain full responsibility for the content of the manuscript and confirm its originality, integrity, and accuracy.

REFERENCES

Altavilla, G., Riela, L., Di Tore, A. P., & Raiola, G. (2017). The physical effort required from professional football players in different playing positions. *Journal of Physical Education and Sport*, 17(3), 2007-2012. https://doi.org/10.7752/jpes.2017.03200

Aquino, R., Palucci Vieira, L. H., De Paula Oliveira, L., Cruz Gonçalves, L. G., & Pereira Santiago, P. R. (2018). Relationship between field tests and match running performance in high-level young Brazilian soccer players. *The Journal of Sports Medicine and Physical Fitness*, *58*(3), 256-262. https://doi.org/10.23736/S0022-4707.17.06651-8

Asimakidis, N. D., Bishop, C., Beato, M., & Turner, A. N. (2025). Assessment of aerobic fitness and repeated sprint ability in elite male soccer: A systematic review of test protocols used in practice and research. *Sports Medicine*, *55*(5), 1233-1264. https://doi.org/10.1007/s40279-025-02188-4

Bangsbo, J., Mohr, M., & Krustrup, P. (2006). Physical and metabolic demands of training and match-play in the elite football player. *Journal of Sports Sciences*, *24*, 665-674. https://doi.org/10.1080/02640410500482529

Beato, M., Youngs, A., & Costin, A. J. (2024). The analysis of physical performance during official competitions in professional English football: Do positions, game locations, and results influence players' game demands? Journal of Strength and Conditioning Research, 38(5), e226-e234. https://doi.org/10.1519/JSC.0000000000004717

Bradley, P. S. (2024). Setting the benchmark part 2: Contextualising the physical demands of teams in the FIFA World Cup Qatar 2022. *Biology of Sport*, *41*(1), 271-278. https://doi.org/10.5114/biolsport.2024.131091

Buckthorpe, M., Wright, S., Bruce-Low, S., Nanni, G., Sturdy, T., Gross, A. S., Bowen, L., Styles, B., Della Villa, S., Davison, M., & Gimpel, M. (2019). Recommendations for hamstring injury prevention in elite football: Translating research into practice. *British Journal of Sports Medicine*, *53*(7), 449-456. https://doi.org/10.1136/bjsports-2018-099616

Castagna, C., Manzi, V., Impellizzeri, F., Weston, M., & Barbero Alvarez, J. C. (2010). Relationship between endurance field tests and match performance in young soccer players. *Journal of Strength and Conditioning Research*, *24*(12), 3227-3233. https://doi.org/10.1519/JSC.0b013e3181e72709

Chaize, C., Allen, M., & Beato, M. (2024). Physical performance is affected by players' position, game location, and substitutions during official competitions in professional Championship English football. *Journal of Strength and Conditioning Research*, *38*(12), e744-e753. https://doi.org/10.1519/JSC.0000000000004926

D'Elia, F., D'Isanto, T., Altavilla, G., Esposito, G., & Raiola, G. (2023). Does training with visual occlusion improve technical skills in Under-14 football players? *Acta Gymnica, 53*. https://doi.org/10.5507/ag.2023.004

D'Isanto, T., D'Elia, F., Raiola, G., & Altavilla, G. (2019). Assessment of sport performance: Theoretical aspects and practical indications. *Sport Mont*, *17*(1), 79-82. https://doi.org/10.26773/smj.190214

Dios-Álvarez, V. D., Castellano, J., Padrón-Cabo, A., & Rey, E. (2024). Do small-sided games prepare players for the worst-case scenarios of match play in elite young soccer players? Biology of Sport, 41(1), 95-106. https://doi.org/10.5114/biolsport.2024.127389

Edouard, P., Mendiguchia, J., Guex, K., Lahti, J., Prince, C., Samozino, P., & Morin, J. B. (2023). Sprinting: A key piece of the hamstring injury risk management puzzle. *British Journal of Sports Medicine*, *57*(1), 4-6. https://doi.org/10.1136/bjsports-2022-105532

Ford, P. R., & Williams, A. M. (2012). The developmental activities engaged in by elite youth soccer players who progressed to professional status compared to those who did not. *Psychology of Sport and Exercise*, *13*(3), 349-352. https://doi.org/10.1016/j.psychsport.2011.09.004

Gaudino, P., Alberti, G., & Iaia, F. M. (2014). Estimated metabolic and mechanical demands during different small-sided games in elite soccer players. *Human Movement Science*, *36*, 123-133. https://doi.org/10.1016/j.humov.2014.05.006

Giardullo, G., Taleb, M., Raiola, G., Ruggieri, R. A., Lascio, G. D., & Ceruso, R. (2026). Influence of age category and anthropometric characteristics on aerobic and explosive performance in youth soccer players. *Sci*, *8*(6), 139. https://doi.org/10.3390/sci8060139

Gualtieri, A., Rampinini, E., Dello Iacono, A., & Beato, M. (2023). High-speed running and sprinting in professional adult soccer: Current thresholds definition, match demands and training strategies. A systematic review. *Frontiers in Sports and Active Living*, *5*, 1116293. https://doi.org/10.3389/fspor.2023.1116293

Hendry, D. T., & Hodges, N. J. (2018). Early majority engagement pathway best defines transitions from youth to adult elite men's soccer in the UK: A three time-point retrospective and prospective study. *Psychology of Sport and Exercise*, *36*, 81-89. https://doi.org/10.1016/j.psychsport.2018.01.009

Hopkins, W. G., Marshall, S. W., Batterham, A. M., & Hanin, J. (2009). Progressive statistics for studies in sports medicine and exercise science. *Medicine & Science in Sports & Exercise*, *41*(1), 3-12. https://doi.org/10.1249/MSS.0b013e31818cb278

Hoppe, M. W., Baumgart, C., Polglaze, T., & Freiwald, J. (2018). Validity and reliability of GPS and LPS for measuring distances covered and sprint mechanical properties in team sports. *PLOS ONE*, *13*(2), e0192708. https://doi.org/10.1371/journal.pone.0192708

Impellizzeri, F., Marcora, S., Castagna, C., Reilly, T., Sassi, A., Iaia, F., & Rampinini, E. (2006). Physiological and performance effects of generic versus specific aerobic training in soccer players. *International Journal of Sports Medicine*, *27*(6), 483-492. https://doi.org/10.1055/s-2005-865839

Izzo, R., & Vardè, I. C. H. (2017). Differences by field positions between young and senior amateur soccer players using GPS technologies. *Ovidius University Annals: Series Physical Education and Sport/Science, Movement and Health*, 17, 344-352.

Kavanagh, R., Carling, C., Malone, S., Di Michele, R., Morgans, R., & Rhodes, D. (2024). Bridging the gap: Differences in training and match physical load in first-team and U23 players from the English Premier League. *International Journal of Sports Science & Coaching*, *19*(3), 1011-1018. https://doi.org/10.1177/17479541231186227

Kessouri, O., Grine, W., & Belfritas, Y. (2026). Match running performance in elite soccer: A comparison of team and individual performance across age categories. *The Journal of Sports Medicine and Physical Fitness*, *66*(1), 120-129. https://doi.org/10.23736/S0022-4707.25.17085-0

Maddison, R., & Ni Mhurchu, C. (2009). Global positioning system: A new opportunity in physical activity measurement. *International Journal of Behavioral Nutrition and Physical Activity*, *6*(1), 73. https://doi.org/10.1186/1479-5868-6-73

Mandorino, M., & Lacome, M. (2024). Defining worst-case-scenario thresholds in soccer: Intensity versus volume. *International Journal of Sports Physiology and Performance*, *19*(8), 836-840. https://doi.org/10.1123/ijspp.2024-0038

Manzi, V., Annino, G., Savoia, C., Caminiti, G., Padua, E., Masucci, M., D'Onofrio, R., & Iellamo, F. (2022). Relationship between aerobic fitness and metabolic power metrics in elite male soccer players. *Biology of Sport*, *39*(3), 599-606. https://doi.org/10.5114/biolsport.2022.106389

Morgans, R., Bezuglov, E., Orme, P., Burns, K., Rhodes, D., Babraj, J., Di Michele, R., & Oliveira, R. F. S. (2022). The physical demands of match-play in academy and senior soccer players from the Scottish Premiership. *Sports*, *10*(10), 150. https://doi.org/10.3390/sports10100150

Morgans, R., Di Michele, R., Ceylan, I. H., Ryan, B., Haslam, C., King, M., Zmijewski, P., & Oliveira, R. (2025). Physical match performance of elite soccer players from the English Championship League and the English Premier League: The effects of opponent ranking and positional differences. *Biology of Sport*, *42*(1), 29-38. https://doi.org/10.5114/biolsport.2025.139079

Mujika, I., Santisteban, J., Impellizzeri, F. M., & Castagna, C. (2009). Fitness determinants of success in men's and women's football. *Journal of Sports Sciences*, *27*(2), 107-114. https://doi.org/10.1080/02640410802428071

Nakamura, F. Y., Gómez-Diaz, A., Menezes, P., Marcelino, R., & Silva, H. (2025). Match peak speed of elite male soccer players across a full season: The influence of playing position, competition, match outcome, and match location. *Kinesiology*, *57*(1), 83-91. https://doi.org/10.26582/k.57.1.7

Osgnach, C., Poser, S., Bernardini, R., Rinaldo, R., & Di Prampero, P. E. (2010). Energy cost and metabolic power in elite soccer: A new match analysis approach. *Medicine & Science in Sports & Exercise*, *42*(1), 170-178. https://doi.org/10.1249/MSS.0b013e3181ae5cfd

Palucci Vieira, L. H., Carling, C., Barbieri, F. A., Aquino, R., & Santiago, P. R. P. (2019). Match running performance in young soccer players: A systematic review. *Sports Medicine*, *49*(2), 289-318. https://doi.org/10.1007/s40279-018-01048-8

Perrotta, R., Ungureanu, A. N., Cherubini, D., Brustio, P. R., & Lupo, C. (2025). Technical, tactical, and time-motion match profiles of the forwards, midfielders, and defenders of a men's football Serie A team. *Sports*, *13*(2), 28. https://doi.org/10.3390/sports13020028

Rampinini, E., Impellizzeri, F. M., Castagna, C., Azzalin, A., Bravo, D. F., & Wisløff, U. (2008). Effect of match-related fatigue on short-passing ability in young soccer players. *Medicine & Science in Sports & Exercise*, *40*(5), 934-942. https://doi.org/10.1249/MSS.0b013e3181666eb8

Rey, E., Costa, P. B., Corredoira, F. J., & Sal de Rellán Guerra, A. (2023). Effects of age on physical match performance in professional soccer players. *Journal of Strength and Conditioning Research*, *37*(6), 1244-1249. https://doi.org/10.1519/JSC.0000000000003244

Reynolds, J., Connor, M., Jamil, M., & Beato, M. (2021). Quantifying and comparing the match demands of U18, U23, and first-team English professional soccer players. *Frontiers in Physiology*, *12*, 706451. https://doi.org/10.3389/fphys.2021.706451

Rodríguez-Fernández, A., Sánchez-Sánchez, J., Ramirez-Campillo, R., Rodríguez-Marroyo, J. A., Villa Vicente, J. G., & Nakamura, F. Y. (2018). Effects of short-term in-season break detraining on repeated-sprint ability and intermittent endurance according to initial performance of soccer player. *PLOS ONE*, *13*(8), e0201111. https://doi.org/10.1371/journal.pone.0201111

Sarmento, H., Martinho, D. V., Gouveia, É. R., Afonso, J., Chmura, P., Field, A., Savedra, N. O., Oliveira, R., Praça, G., Silva, R., Barrera-Díaz, J., & Clemente, F. M. (2024). The influence of playing position on physical, physiological, and technical demands in adult male soccer matches: A systematic scoping review with evidence gap map. *Sports Medicine*, *54*(11), 2841-2864. https://doi.org/10.1007/s40279-024-02088-z

Savoia, C., Laterza, F., Lucadamo, A., Manzi, V., Azzone, V., Pullinger, S. A., Beattie, C. E., Bertollo, M., & Pompa, D. (2024). The relationship between playing formations, team ranking, and physical performance in the Serie A soccer league. *Sports*, *12*(11), 286. https://doi.org/10.3390/sports12110286

Taylor, J. M., Madden, J. L., Hunter, F., Thorne, B. J., & McLaren, S. J. (2023). Mind the gap: A comparison of the weekly training loads of English Premier League academy soccer players in under-23, under-18, and under-16 age groups. *Journal of Science in Sport and Exercise*, *5*(1), 34-43. https://doi.org/10.1007/s42978-022-00162-4

Tedeschi, R., Giorgi, F., & Donati, D. (2025). Sprint training for hamstring injury prevention: A scoping review. *Applied Sciences*, *15*(16), 9003. https://doi.org/10.3390/app15169003

Tomás, J., Araújo, D., Martinho, D., Ribeiro, J., Sousa, H., Field, A., & Sarmento, H. (2025). Barriers and facilitators in the junior-to-senior transition in male football: A scoping review. *Sports*, *13*(12), 440. https://doi.org/10.3390/sports13120440

Tomlin, D. L., & Wenger, H. A. (2001). The relationship between aerobic fitness and recovery from high-intensity intermittent exercise. *Sports Medicine*, *31*(1), 1-11. https://doi.org/10.2165/00007256-200131010-00001

Vanrenterghem, J., Nedergaard, N. J., Robinson, M. A., & Drust, B. (2017). Training load monitoring in team sports: A novel framework separating physiological and biomechanical load-adaptation pathways. *Sports Medicine*, *47*, 2135-2142. https://doi.org/10.1007/s40279-017-0714-2

Vigh-Larsen, J. F., Dalgas, U., & Andersen, T. B. (2018). Position-specific acceleration and deceleration profiles in elite youth and senior soccer players. *Journal of Strength and Conditioning Research*, *32*(4), 1114-1122. https://doi.org/10.1519/JSC.0000000000001918

Wong, D. P., Chan, G. S., & Smith, A. W. (2012). Repeated-sprint and change-of-direction abilities in physically active individuals and soccer players: Training and testing implications. *Journal of Strength and Conditioning Research*, *26*(9), 2324-2330. https://doi.org/10.1519/JSC.0b013e31823daeab

APPENDIX 1. SUPPLEMENTARY MATERIALS

Table 3 (a-o). Estimated marginal means and contrasts analyses for external load variables according to playing position.

Table 3a. Estimated marginal means - total distance.

Row	Position	Estimate	SE	df	Lower (95% CI)	Upper (95% CI)
1	FW	111.722	1.756	44.868	108.186	115.258
2	DM	112.870	2.614	31.554	107.541	118.198
3	CB	102.851	1.550	45.700	99.730	105.973
4	AM	115.385	1.934	35.514	111.461	119.309
5	WM	112.159	1.659	56.427	108.837	115.481

Table 3b. Contrasts.

Contrast	Estimate	SE	df	t	*p*†
Contrast 1	-8.871	2.342	45.230	-3.787	.002
Contrast 2	-10.018	3.040	34.562	-3.296	.009
Contrast 3	-12.534	2.479	39.077	-5.056	<.001
Contrast 4	-10.067	2.117	76.343	-4.396	<.001

Note. † P-values are adjusted using Tukey adjustment; Contrast estimates were calculated using CB as the reference playing position.

Table 3c. Estimated marginal Means – Maximum sprinting speed.

Row	Position	Estimate	SE	df	Lower (95% CI)	Upper (95% CI)
1	FW	29.582	0.365	46.815	28.848	30.316
2	DM	27.759	0.528	30.064	26.681	28.838
3	CB	29.369	0.322	43.368	28.720	30.017
4	AM	30.117	0.394	34.532	29.315	30.918
5	WM	30.150	0.349	54.934	6.384	30.849

Table 3d. Contrasts.

Contrast	Estimate	SE	df	t	*p*†
Contrast 1	-1.823	0.642	34.388	-2.841	.030
Contrast 2	-1.609	0.618	33.017	-2.603	.054
Contrast 3	-2.357	0.659	31.564	-3.577	.005
Contrast 4	-2.390	0.633	35.566	-3.777	.002

Note. † P-values are adjusted using Tukey adjustment. Contrast estimates were calculated using DM as the reference playing position.

Table 3e. Estimated marginal Means – High-speed running distance.

Row	Position	Estimate	SE	df	Lower (95% CI)	Upper (95% CI)
1	FW	5.916	0.372	41.444	5.165	6.666
2	DM	4.377	0.563	30.689	3.228	5.525
3	CB	4.101	0.328	44.928	3.441	4.761
4	AM	6.340	0.414	34.204	5.499	7.181
5	WM	6.504	0.347	54.709	5.808	7.200

Table 3f. Contrasts (DM reference).

Contrast	Estimate	SE	df	t	*p*†
Contrast 1	-1.539	0.674	33.489	-2.282	.111
Contrast 2	0.276	0.651	33.608	0.424	.989
Contrast 3	-1.963	0.699	31.861	-2.810	.033
Contrast 4	-2.128	0.661	35.522	-3.217	.011

Note. † P-values are adjusted using Tukey adjustment. Contrast estimates were calculated using DM as the reference playing position.

Table 3g. Contrasts (CB reference).

Contrast	Estimate	SE	df	t	*p*†
Contrast 1	-1.815	0.495	42.918	-3.664	.003
Contrast 2	-0.276	0.651	33.608	-0.424	.989
Contrast 3	-2.239	0.528	37.856	-4.242	<.001
Contrast 4	-2.403	0.437	81.678	-5.501	<.001

Note. † P-values are adjusted using Tukey adjustment. Contrast estimates were calculated using CB as the reference playing position.

Table 3h. Estimated marginal Means – Sprint running distance.

Row	Position	Estimate	SE	df	Lower (95% CI)	Upper (95% CI)
1	FW	1.510	0.194	45.314	1.119	1.901
2	DM	0.431	0.293	33.405	-0.166	1.027
3	CB	1.142	0.171	48.545	0.797	1.486
4	AM	1.608	0.216	37.241	1.170	2.045
5	WM	1.751	0.182	59.039	1.388	2.115

Table 3i. Contrasts (DM reference).

Contrast	Estimate	SE	df	t	*p*†
Contrast 1	-1.079	0.352	36.513	-3.067	.016
Contrast 2	-0.711	0.340	36.542	-2.092	.163
Contrast 3	-1.177	0.364	34.686	-3.231	.011
Contrast 4	-1.321	0.345	38.640	-3.826	.002

Note. † P-values are adjusted using Tukey adjustment. Contrast estimates were calculated using DM as the reference playing position.

Table 3j. Contrasts (CB reference).

Contrast	Estimate	SE	df	t	*p*†
Contrast 1	-0.368	0.259	46.689	-1.423	.506
Contrast 2	0.711	0.340	36.542	2.092	.163
Contrast 3	-0.466	0.276	41.119	-1.692	.339
Contrast 4	-0.610	0.229	85.714	-2.658	.037

Note. † P-values are adjusted using Tukey adjustment. Contrast estimates were calculated using CB as the reference playing position.

Table 3k. Estimated marginal Means – Number of sprints.

Row	Position	Estimate	SE	df	Lower (95% CI)	Upper (95% CI)
1	FW	0.073	0.008	44.467	0.056	0.090
2	DM	0.024	0.012	30.749	-0.002	0.049
3	CB	0.056	0.007	44.520	0.041	0.071
4	AM	0.075	0.009	34.730	0.056	0.094
5	WM	0.083	0.008	55.266	0.067	0.099

Table 3l. Contrasts (DM reference).

Contrast	Estimate	SE	df	t	*p*†
Contrast 1	-0.050	0.015	34.305	-3.317	.009
Contrast 2	-0.033	0.014	33.699	-2.256	.117
Contrast 3	-0.051	0.015	32.082	-3.336	.009
Contrast 4	-0.060	0.015	35.946	-4.059	.001

Note. † P-values are adjusted using Tukey adjustment. Contrast estimates were calculated using DM as the reference playing position.

Table 3m. Contrasts (CB reference).

Contrast	Estimate	SE	df	t	*p*†
Contrast 1	-0.017	0.011	44.490	-1.528	.436
Contrast 2	0.033	0.014	33.699	2.256	.117
Contrast 3	-0.019	0.012	38.174	-1.604	.392
Contrast 4	-0.027	0.010	73.219	-2.677	.036

Note. † P-values are adjusted using Tukey adjustment. Contrast estimates were calculated using CB as the reference playing position.

Table 3n. Estimated marginal Means – High metabolic load distance.

Row	Position	Estimate	SE	df	Lower (95% CI)	Upper (95% CI)
1	FW	17.915	0.742	48.376	16.422	19.407
2	DM	16.666	1.126	34.204	14.377	18.954
3	CB	14.460	0.654	44.386	13.142	15.777
4	AM	19.505	0.801	35.493	17.880	21.130
5	WM	19.030	0.711	56.261	17.606	20.454

Table 3o. Contrasts (CB reference).

Contrast	Estimate	SE	df	t	*p*†
Contrast 1	-3.455	0.989	46.574	-3.492	.004
Contrast 2	-2.206	1.302	36.433	-1.694	.341
Contrast 3	-5.045	1.034	38.721	-4.879	<.001
Contrast 4	-4.570	0.922	67.330	-4.957	<.001

Note. † P-values are adjusted using Tukey adjustment. Contrast estimates were calculated using CB as the reference playing position.