Are Current Physical Match Performance Metrics in Elite Soccer Fit for Purpose or is the Adoption of an Integrated Approach Needed?

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Abstract

Time–motion analysis is a valuable data-collection technique used to quantify the physical match performance of elite soccer players. For over 40 years researchers have adopted a 'traditional' approach when evaluating match demands by simply reporting the distance covered or time spent along a motion continuum of walking through to sprinting. This methodology quantifies physical metrics in isolation without integrating other factors and this ultimately leads to a one-dimensional insight into match performance. Thus, this commentary proposes a novel 'integrated' approach that focuses on a sensitive physical metric such as high-intensity running but contextualizes this in relation to key tactical activities for each position and collectively for the team. In the example presented, the 'integrated' model clearly unveils the unique high-intensity profile that exists due to distinct tactical roles, rather than one-dimensional 'blind' distances produced by 'traditional' models. Intuitively this innovative concept may aid the coaches understanding of the physical performance in relation to the tactical roles and instructions given to the players. Additionally, it will enable practitioners to more effectively translate match metrics into training and testing protocols. This innovative model may well aid advances in other team sports that incorporate similar intermittent movements with tactical purpose. Evidence of the merits and application of this new concept are needed before the scientific community accepts this model as it may well add complexity to an area that conceivably needs simplicity.

Key words: Match analysis, football, tactics, physical performance.

Introduction

Soccer is a complex sport with unpredictable movement patterns during matches[1]. Players regularly transition between short multi-directional high-intensity efforts and longer periods of low-intensity activity.[2] The 'traditional' approach to quantifying demands in the absence of physiological and mechanical measures during match play is to determine the distance covered or the time spent at different speeds.[3] Whilst not accounting for metabolically taxing accelerations and directional changes,[4] it still crudely provides an indirect energetics measure. Studies reveal that elite players cover 9–14 km in total during a game with high-intensity running accounting for 5-15% of this distance.[5-7] Although only a small proportion is covered at high-intensity, it's assumed that this is related to important phases of play and critical to game outcome,[8] but this remains to be elucidated scientifically[9].

Using the 'traditional' approach, physical match performances have been quantified across competitions such as the English Premier League,[10, 11] Italian Serie A,[6, 12] Spanish La Liga,[13] French Ligue 1,[14] German Bundesliga[15] in addition to the European Champions League[16, 17] and International tournaments.[18, 19] Research demonstrates high-intensity running during matches has increased by a third in some Leagues across the last decade.[20-22] Thus, preparing players so they are robust enough to cope with modern game requirements has received increasing attention.[23-25] But despite hundreds of publications centering on the physical match demands, little progress has been made regarding optimizing the array of metrics used by applied staff within clubs. The first in-depth study on this subject was published more than 40 years ago by the pioneer Professor Tom Reilly[26] and since then researchers have adopted this 'traditional' approach of reporting distance covered and time spent along a motion continuum of walking through to sprinting. Acceleration and metabolic cost indices have been progressively introduced alongside this approach, with the former a welcome addition[4, 27] whilst the latter remains controversial[28]. Despite the simplistic nature of the 'traditional' approach, researchers have still been able to reveal the rudimental demands of various positions,[10, 11] competitive standards,[6, 29, 30] sex,[31-33] formations,[34] and match related fatigue patterns.[5, 6] However, at present a new 'integrated' approach that contextualizes match physical performance would surely progress the fields understanding of the global demands and assimilate the physical and tactical data more effectively. Intuitively this may aid the coaches understanding of the physical performance in relation to the tactical roles and instructions given to the players and enable practitioners to more effectively translate match metrics into training and testing.[35] Alternatively, this contemporary approach may well add

complexity to an area that conceivably needs more simplicity regarding the quantification and interpretation of match exertion.

Therefore, this commentary specifies the advantages of such an integrative model by demonstrating the concept using current computerized tracking technology. An example will demonstrate an alternative or complimentary way of analysing and interpreting physical match performances. At the very least, this piece should generate constructive dialogue within the academic and applied domains. The feasibility and challenges associated with such multi-facetted match data will also be discussed given the infancy of the proposed approach.

Defining the Approaches to Quantifying Match Physical Performance

The 'Traditional' Approach

In the last four decades the 'traditional' approach has quantified the relative or absolute distance covered and time spent along a motion continuum of walking through to sprinting (Figure 1). This has been accomplished with the aid of validated computerized tracking or global positioning technology.[11, 36, 37] Although researchers have used generic descriptors for movement categories (jogging etc), they have assigned a wide range of speed thresholds to these activities. This is due to variations in player sex,[16, 38] maturation,[39] competitive standard[6] and physical capacity.[40] To complicate matters, technologies use different algorithms and dwell times to classify high-intensity actions and this limits comparability between studies.[41]

Studies using this 'traditional' approach are reductionist, whereby the physical metrics are explored without consideration for the technical and tactical indices.[4, 5, 10, 11, 27, 36, 42, 43] One could argue that this enables an in-depth physical analysis, with the inclusion of other factors diluting this, especially if the study aims do not include a technical-tactical element. Moreover, it's difficult for researchers to gain access to technical analyses[44] and the tactical aspects of the game are a challenge to quantify at present.[34] Despite shortcomings, the demands using this approach are well understood and have been for some time now. So is it wise to keep going over 'old ground' or produce similar research questions with slight permutations! The question that begs an answer is: will this approach progress this field from both a fundamental or applied perspective? Well with a saturated research area that boasts hundreds of papers that have varying degrees of originality and application, the inconvenient and uncomfortable answer to this question is probably 'No'. Studies have attempted to expand on this

reductionism by incorporating technical, tactical and physical metrics within their methodology.[20-22] However, data are still reported separately within the results with limited synthesis and consequently our understanding of the global game demands still remains superficial.

Some tracking systems do provide a basic physical-tactical perspective by categorizing high-intensity running with/without ball possession and when the ball is out of play.[45] It is debatable as to the benefits of this information in isolation as it simply reflects ball possession status. Regarding possession based running metrics, teams that employ defensive formations with a direct style of play, have comparable overall high-intensity performances to offensive formations that dominate possession. But the former covers the majority of the distance without the ball while the latter does it with the ball.[18, 46] In fact, only a small proportion of high-intensity running (~5-10%) is covered when the ball is out of play (e.g. corners and throw ins). [11, 20, 21, 29, 45, 46] No study to date has highlighted its sensitivity or application, thus this could be removed, otherwise reclassified as effective playing time/distance or 'in play' activity.[13] This may shed light on match performance fluctuations as effective playing time/distance decreases as a product of more game interruptions rather than fatigue.[14] Therefore, this approach does not seem to be the solution as it provides negligible insight regarding physical efforts with a tactical purpose (e.g. recovery running). The scarcity of research merging physical, technical and tactical components is even more surprising when evidence suggests that the last two aspects are notable discriminators between competitive standards.[29, 47] Consequently they should be considered when contextualizing match performance.

Arguably this approach has provided some insight into fatigue, context and positional demands to name just a few.[10, 11, 13, 17, 35, 36, 48-50] However, the application of this data into practice is limited as most simply report game or half by half averages for general categories such as sprinting. Few studies have translated discrete actions into useable metrics such as angles of turns, technical sequences and tactical actions associated with physical data that could be used within the club setting.[35, 51] To progress this field and to advance the application of physical match data, it's imperative that scientists examine updated methodologies that develop our understanding of contextualizing game demands or at the very least generate constructive dialogue within the literature.

The 'Integrated' Approach

Soccer is a multi-facetted sport with the physical, tactical and technical factors amalgamating to influence performance with each factor not mutually exclusive of another.[52] Hence, this article proposes a novel 'integrated' approach that focuses on a sensitive metric such as high-intensity running[32, 53] but contextualizes this in relation to key tactical activities for each position (e.g. overlapping for a full back) and collectively for the team (e.g. closing down opposition players).

Figure 2 depicts the generalized model using a Venn format. Three performance factors are represented in isolation and combination as circles. The regions in which factors overlap are the intersections. The area whereby all factors overlay is called the union (black dot) and denotes innovation in match analysis as full integration occurs (considered beyond the realms of technology and expertise at present). This commentary will focus on the intersection of the Venn between physical-tactical factors. The variables listed within this intersection were adapted from a recently developed High Intensity Movement Programme.[35] This data set was used in the example below and comprised of a single team tracked across three consecutive English Premier League seasons using a computerized tracking system (Amisco Pro, Sport-Universal Process, Nice, France). High-intensity efforts were activities reaching speeds $\geq$21 km·h^{-1} for a minimal dwell time of 1 s. To synchronize data, the tactical actions associated with each effort were manually coded from video recordings viewed using computerised tracking software. Definitions for the tactical actions are in Table 1 and zonal areas are depicted in Figure 3.

Example of the 'Integrated' Approach Using Current Match Analysis Technology

Practitioners tend to use a 'one size fits all' approach when measuring the work rate profiles of various positions, as the same categories are uniformly used.[6, 10, 11, 13, 14, 17, 22, 29, 34, 36, 50, 54-56] To make sense of this information, some advocate individualized rather than arbitrary speed thresholds that are founded on player's physical fitness indices.[38-40] This is centered on the premise that positional variation has consistently been found for fitness attributes.[1, 7, 53, 57-58] This provides a more representative indicator of a player's physical match exertion rather than the use of arbitrary thresholds that are likely to over or underestimate demands.[40] Irrespective of speed thresholds, players in selected positions will only be able exert themselves based on match scenarios as a result of tactical, contextual and physical factors.[56] Accordingly, some suggest that 'in game' running performance should be used to assign such

thresholds.[19] This is a particularly pertinent point given the games submaximal nature, which results in some positions working well within their physical capabilities, particularly if constrained by tactical rather than physical factors.[56] As such, the tactical role of a player seems to be a powerful determinant of their match physical performance. Thus, a 'one size fits all' approach even with optimal speed thresholds could provide tactically constrained data for selected positions that is challenging to interpret given the lack contextualization.

A more customized approach that is derived from physical actions with a tactical purpose could be advantageous. Even if tactics or context are the main physical modulators then practitioners could still establish if crucial roles were fulfilled or not using this new model. Figure 4 presents the 'integrated' approach specialized to the position of each player. The nodal size (circle) denotes the high-intensity distance covered by each position/activity and the edge thickness (line) represents the frequency of actions (data derived from Ade et al.[35]). Ten individual variables are presented, with six occurring in possession and four out of possession. Defensive positions have a lower ratio of in/out of possession variables (centre backs: ⅕) whilst offensive positions are assigned a higher ratio (centre forwards: ⅘). Covering and recovery running are common for all positions except centre forwards, whilst closing down/intercepting is the only collective variable. The inclusion of specialist variables enables key actions to be contextualized (e.g running in behind for centre forwards). The diversity of actions makes its challenging to catalogue each players unique physical-tactical profile using five variables, thus a sixth entitled 'other' was created to amass additional activities.

Match physical performance data for each position are displayed in Figures 5 using both models. Central midfielders, full backs and centre forwards covered similar high-intensity distances (~600 m), so using the 'traditional' approach one could argue that these performances are comparable. As match physical performances are complex,[52, 58, 59] this does not infer that the demands are similar (i.e. a multitude of physiological and mechanical factors impact this). The 'integrated' method compartmentalizes data more clearly by unveiling the unique high-intensity profile that exists due to distinct tactical roles, rather than one-dimensional 'blind' distances produced by existing models. This purposeful distance could be valuable to practitioners, as they do not necessarily want to determine which positions are the most demanding or cover the most distance. But rather how each performs their duties in relation to a specific opponent and team philosophy. The 'traditional' model cannot provide this insight and thus the subsequent section will detail the sensitivity of this integrative methodology.

Out of possession, positions with a major defensive role in the team like centre backs, full backs and central midfielders (26-31%) cover a greater proportion of their distance at high-intensity covering space or team-mates compared to wide midfielders (13%). This innovative approach provides defensive insight to practitioners on how players cover one another at high-intensity and their propensity to remain compact to limit space for the opposition during defensive phases of play.[60] The proportion of high-intensity distance covered in defensive activities such as closing down/intercepting were similar for central (16-19%) and wide positions (14-16%) but greatest for the most offensive position in the team (centre forward: 23%). Centre forwards frequently perform arc runs out of possession[35] to channel an opponent with the ball one way while closing them down in order to delay their attack and enable team-mates to support the press.[61] This assimilated information could conceivably verify if players are adhering to tactical directives during phases of play that require high-intensity efforts. This may well be a particularly powerful communication tool to coaches if combined with zonal data and translated into informative graphics. The position covering the greatest relative high-intensity distance in the category of recovery running was centre backs (20%) with full backs, centre midfielders, wide midfielders producing similar proportions (15-17%). Full backs typically preceded efforts with a 90–180° turn as they transition from offensive into defensive roles, executing more tackles post effort than other positions.[35] Ball over the top/down side contributed to 20% of the total high-intensity distance covered by centre backs. This position performed more 0-90° turns compared to other defensive players with most efforts anticipated with players already on a half turn as sudden directional changes are necessary to react to opposition movement.[35] The physiological and mechanical consequences of directional changes during matches remain to be elucidated but some have quantified them in isolation.[62, 63] Obtaining true match demands should incorporate accelerations but such data has yet to be validated using optical tracking systems. Although including accelerometer indices is more representative of current practices, it must be noted that these are typically presented 'blind' and without context. Thus, this new approach could be used to contextualize accelerations. As the aforementioned variables are considered notable defensive attributes in the literature,[64] this approach could add real world value by detailing the physical-tactical match behaviour across position.

In possession, centre forwards covered more high-intensity distance in the offensive third of the pitch,[35] whilst driving inside/through the middle (32%), running in behind (12%), breaking into the box (10%) and running the channel (11%). These tactics exploit space in order to score and create

opportunities for teammates,[65] so they provide data to practitioners concerning purposeful offensive running. Wide players like full backs and wide midfielders covered a greater proportion of high-intensity distance running the channel than other positions (20-24%). They perform more crosses after these runs than other positions due to more efforts finishing in wide attacking pitch areas.[64] Strategies that employ offensive wide players means that specialist variables within this model could provide confirmation that players are abiding to the tactical philosophy. Such as full backs, who cover 9% of their total high-intensity distance overlapping players to deliver a cross.[35] High-intensity running by full back has increased by ~40% in this league in the last decade[22] as a duel role requires them to be defensive out of possession but conduct offensive in possession actions such as overlapping to cross. The aforementioned actions are meaningful offensive attributes for the relevant positions within the literature[22, 64, 65] highlighting the importance of amalgamating physical-tactical actions. Activities consigned to the variable 'other' contributed to ~10% of the high-intensity distance covered by each position. These actions are certainly not redundant but to simplify this innovative concept it was imperative that some actions were reclassified.

Feasibility and Challenges of the 'Integrated' Approach

Scientists have a duty of care to provide a balanced view of contemporary methodologies including their practicalities and shortcomings. The 'integrated' approach is manually coded within computerized tracking software by time stamping each high-intensity effort before then observing associated video footage to derive its tactical purpose. Although time consuming at present, algorithms could be incorporated within such technologies so this becomes part of the normal coding process. This manual technique limits the proposed model and at this moment in time its more applicable to the research setting. Thus, it could be difficult to analyse the reference team and the opposition when multiple games are played in a congested period. As the levels of complexity increase, the ability to clearly define actions and scenarios becomes more difficult. It may be possible in future through supervised machine learning to have a more automated system, however there would be an extensive period of filtering to refine the data. In an effort to minimize uninteresting actions, such as a centre back running up for a set play or a central midfielder moving up the pitch supporting the play. The analyst could consider reducing the number of efforts by modifying the minimum duration above the high-intensity speed threshold required to register a high-intensity effort (>3s) or only analyse sprint efforts as it is

more likely those actions are of greater importance to the outcome of the match[9]. The categorization of actions can also be problematic. Although most are straightforward to classify, on occasions some cross over is evident between variables. For instance, a player may initially produce an effort to cover space but then transition into closing down the opposition. This could be coded as different activities depending on the start or end of the effort. One must decide the primary nature of the action to enable this approach to work, thus operational definitions must be clear for repeatability. Although a major concern, reasonable inter- and intra-observer agreement was reported for this approach[35] but this needs to be replicated by others to verify if issues exist.

The High Intensity Movement Programme is a starting point for the proposed 'integrated' model, but additional factors should be considered in future when contextualizing physical performance. Quantifying physical data relevant to the tactical actions in and out of possession is beneficial but would be more informative if condensed into phases of play. These could be classified as in possession construction, in possession counter-attack, out of possession low/medium block, out of possession counter-defending. This is particularly important, as success in transition moments has been shown to be critical to match outcome[66]. Are the technical and tactical actions associated with high-intensity efforts performed by players during these moments successful? An overall value score could be placed on the action based on its success, area of the pitch and impact on the game (e.g. assist, goal). Therefore, each player would have an impact rating on the match. There are caveats associated with each model but another drawback relates to information overload. Scientists can easily drown themselves and coaching staff with considerable data outputs,[44] which used ineffectively could lead to the rejection of this approach. However, as this concept merges physical with tactical actions, it should intuitively interest coaches as opposed to overwhelming them.

Conclusions

The 'traditional' approach has been used for four decades to quantify match physical performances. However, the 'integrated' approach contextualizes match demands by assimilating physical and tactical data effectively. In the example presented, the contemporary model unveiled the unique high-intensity profile that exists due to distinct tactical roles, rather than the one-dimensional 'blind' distance covered produced by existing models. This model may well aid advances in other team sports (e.g. rugby, hockey) that incorporate similar intermittent movements with tactical purpose. Evidence of the merits

and application of this new concept are needed before the scientific community accepts it as it may well add complexity to an area that conceivably needs simplicity. Finally, it imperative that the reader focusses more on the overall concept of this new approach as opposed to the intricacy of each variable and trend, especially given that the data are generated from a single team.

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References

1. Di Mascio M, Ade J, Bradley PS. The reliability, validity and sensitivity of a novel soccer-specific reactive repeated-sprint test (RRST). *Eur J Appl Physiol*. 2015; 115(12): 2531-42.
2. Bangsbo J, Mohr M, Krustrup P. Physical and metabolic demands of training and match-play in the elite football player. *J Sports Sci*. 2006; 24(7): 665-74.
3. Castellano J, Alvarez-Pastor D, Bradley PS. Evaluation of research using computerised tracking systems (Amisco and Prozone) to analyse physical performance in elite soccer: a systematic review. *Sports Med*. 2014; 44(5): 701-12.
4. Varley MC, Aughey RJ. Acceleration profiles in elite Australian soccer. *Int J Sports Med*. 2013; 34(1): 34-9.
5. Di Mascio M, Bradley PS. Evaluation of the most intense high-intensity running period in English FA premier league soccer matches. *J Strength Cond Res*. 2013; 27(4): 909-15.
6. Mohr M, Krustrup P, Bangsbo J. Match performance of high-standard soccer players with special reference to development of fatigue. *J Sports Sci*. 2003; 21(7): 519-28.
7. Stolen T, Chamari K, Castagna C, Wisloff U. Physiology of soccer: an update. *Sports Med*. . 2005; 35(6): 501–536.
8. Reilly T, Williams AM. *Science and Soccer*. 2nd ed. London: Routledge; 2003.
9. Faude O, Koch T, Meyer T. Straight sprinting is the most frequent action in goal situations in professional football. *J Sports Sci*. 2012; 30(7): 625-31.
10. Bradley PS, Sheldon W, Wooster B, et al. High-intensity running in English FA Premier League soccer matches. *J Sports Sci*. 2009; 27(2): 159-68.
11. Di Salvo V, Gregson W, Atkinson G, et al. Analysis of high intensity activity in Premier League soccer. *Int J Sports Med*. 2009; 30(3): 205-12.
12. Vigne G, et al. Activity profile in elite Italian soccer team. *Int J Sports Med*. 2010; 31(5): 304-10.
13. Castellano J, Blanco-Villasenor A, Alvarez D. Contextual variables and time-motion analysis in soccer. *Int J Sports Med*. 2011; 32(6): 415-21.
14. Carling C, Dupont G. Are declines in physical performance associated with a reduction in skill-related performance during professional soccer match-play? *J Sports Sci*. 2011; 29(1): 63-71.
15. Hoppe MW, Slomka M, Baumgart C, et al. Match Running Performance and Success Across a Season in German Bundesliga Soccer Teams. *Int J Sports Med*. 2015; 36(7): 563-6.

16. Bradley PS, Dellal A, Mohr M, et al. Gender differences in match performance characteristics of soccer players competing in the UEFA Champions League. *Hum Mov Sci*. 2014; 33: 159-71.
17. Di Salvo V, Baron R, Gonzalez-Haro C, et al. Sprinting analysis of elite soccer players during European Champions League and UEFA Cup matches. *J Sports Sci*. 2010; 28(14): 1489-94.
18. da Mota GR, Thiengo CR, Gimenes SV, et al. The effects of ball possession status on physical and technical indicators during the 2014 FIFA World Cup Finals. *J Sports Sci*. 2016; 34(6): 493-500.
19. Schimpchen J, Skorski S, Nopp S, et al. Are "classical" tests of repeated-sprint ability in football externally valid? A new approach to determine in-game sprinting behaviour in elite football players. *J Sports Sci*. 2016; 34(6): 519-26.
20. Barnes C, Archer DT, Hogg B, et al. The evolution of physical and technical performance parameters in the English Premier League. *Int J Sports Med*. 2014; 35(13): 1095-100.
21. Bradley PS, Archer DT, Hogg B, et al. Tier-specific evolution of match performance characteristics in the English Premier League: it's getting tougher at the top. *J Sports Sci*. 2016; 34(10): 980-7.
22. Bush M, Barnes C, Archer DT, et al. Evolution of match performance parameters for various playing positions in the English Premier League. *Hum Mov Sci*. 2015; 39: 1-11.
23. Ade JD, Harley JA, Bradley PS. Physiological response, time-motion characteristics, and reproducibility of various speed-endurance drills in elite youth soccer players: small-sided games versus generic running. *Int J Sports Physiol Perform*. 2014; 9(3): 471-9.
24. Iaia FM, Fiorenza M, Perri E, et al. The Effect of Two Speed Endurance Training Regimes on Performance of Soccer Players. *PLoS One*. 2015; doi: 10.1371/journal.pone.0138096.
25. Iaia FM, Rampinini E, Bangsbo J. High-intensity training in football. *Int J Sports Physiol Perform*. 2009; 4(3): 291-306.
26. Thomas V, Reilly T. Application of Motion Analysis to Assess Performance in Competitive Football. *Ergonomics*. 1976; 19(4): 530-530.
27. Akenhead R, Hayes PR, Thompson KG, et al. Diminutions of acceleration and deceleration output during professional football match play. *J Sci Med Sport*. 2013; 16(6): 556-61.
28. Osgnach C, Poser S, Bernardini R, et al. Energy Cost and Metabolic Power in Elite Soccer: A New Match Analysis Approach. *Med Sci Sports Exerc*. 2010; 42(1): 170-178.
29. Bradley PS, Carling C, Gomez Diaz A, et al. Match performance and physical capacity of players in the top three competitive standards of English professional soccer. *Hum Mov Sci*. 2013; 32(4): 808-21.
30. Di Salvo V, Pigozzi F, Gonzalez-Haro C, et al. Match performance comparison in top English soccer leagues. *Int J Sports Med*. 2013; 34(6): 526-32.
31. Datson N, Drust B, Weston M, et al. Match physical performance of elite female soccer players during international competition. *J Strength Cond Res*. 2016; doi:10.1519/JSC.0000000000001575.
32. Krustrup P, Mohr M, Ellingsgaard H, et al. Physical demands during an elite female soccer game: importance of training status. *Med Sci Sports Exerc*. 2005; 37(7): 1242-8.
33. Vescovi JD, Favero TJ. Motion characteristics of women's college soccer matches: Female Athletes in Motion (FAiM) study. *Int J Sports Physiol Perform*. 2014; 9(3): 405-14.
34. Bradley PS, Carling C, Archer D, et al. The effect of playing formation on high-intensity running and technical profiles in English FA Premier League soccer matches. *J Sports Sci*. 2011; 29(8): 821-30.
35. Ade J, Fitzpatrick J, Bradley PS. High-intensity efforts in elite soccer matches and associated movement patterns, technical skills and tactical actions. Information for position-specific training drills. *J Sports Sci*. 2016; 34(24): 2205-2214.
36. Bangsbo J, Norregaard L, Thorso F. Activity profile of competition soccer. *Can J Sport Sci*. 1991; 16(2): 110-6.
37. Buchheit M, Allen A, Poon TK, et al. Integrating different tracking systems in football: multiple camera semi-automatic system, local position measurement and GPS technologies. *J Sports Sci*. 2014; 32(20): 1844-1857.
38. Bradley PS, Vescovi JD. Velocity thresholds for women's soccer matches: sex specificity dictates high-speed running and sprinting thresholds - Female Athletes in Motion (FAiM). *Int J Sports Physiol Perform*. 2015; 10(1): 112-6.
39. Harley JA, Barnes CA, Portas M, et al. Motion analysis of match-play in elite U12 to U16 age-group soccer players. *J Sports Sci*. 2010; 28(13): 1391-7.

40. Abt G, Lovell R. The use of individualized speed and intensity thresholds for determining the distance run at high-intensity in professional soccer. *J Sports Sci*. 2009; 27(9): 893-8.
41. Varley MC, Jaspers A, Helsen WF, et al. Methodological Considerations When Quantifying High-Intensity Efforts in Team Sport Using Global Positioning System Technology. *Int J Sports Physiol Perform*. 2017: 1-25.doi: 10.1123/ijspp.2016-0534.
42. Aughey RJ, Varley MC. Acceleration profiles in elite Australian soccer. *Int J Sports Med*. 2013; 34(3): 282.
43. Carling C, Bloomfield J. The effect of an early dismissal on player work-rate in a professional soccer match. *J Sci Med Sport*. 2010; 13(1): 126-8.
44. Carling C, Wright C, Nelson LJ, et al. Comment on 'Performance analysis in football: a critical review and implications for future research'. *J Sports Sci*. 2014; 32(1): 2-7.
45. Gregson W, Drust B, Atkinson G, et al., Match-to-match variability of high-speed activities in premier league soccer. *Int J Sports Med*. 2010; 31(4): 237-42.
46. Bradley PS, Lago-Penas C, Rey E, et al. The effect of high and low percentage ball possession on physical and technical profiles in English FA Premier League soccer matches. *J Sports Sci*. 2013; 31(12): 1261-70.
47. Collet C. The possession game? A comparative analysis of ball retention and team success in European and international football, 2007-2010. *J Sports Sci*. 2013; 31(2): 123-36.
48. Bradley PS, Di Mascio M, Peart D, et al. High-intensity activity profiles of elite soccer players at different performance levels. *J Strength Cond Res*. 2010; 24(9): 2343-51.
49. Carling C. Analysis of physical activity profiles when running with the ball in a professional soccer team. *J Sports Sci*. 2010; 28(3): 319-26.
50. Lago C, Casais L, Dominguez E, et al. The effects of situational variables on distance covered at various speeds in elite soccer. *Eur J of Sport Sci*. 2010; 10(2): 103-109.
51. Bloomfield J, Polman R, O'Donogue P. The 'Bloomfield Movement Classification': Motion analysis of individual players in dynamic movement sports. *Int J Perform Anal Sport*. 2004; 4(2): 20-31.
52. Paul DJ, Bradley PS, Nassis GP. Factors affecting match running performance of elite soccer players: shedding some light on the complexity. *Int J Sports Physiol Perform*. 2015; 10(4): 516-9.
53. Krustrup P, Mohr M, Nybo L, et al. The Yo-Yo IR2 test: physiological response, reliability, and application to elite soccer. *Med Sci Sports Exerc*. 2006; 38(9): 1666-73.
54. Bradley PS, Noakes TD. Match running performance fluctuations in elite soccer: indicative of fatigue, pacing or situational influences? *J Sports Sci*. 2013; 31(15): 1627-38.
55. Carling C, Le Gall F, Dupont G. Analysis of repeated high-intensity running performance in professional soccer. *J Sports Sci*. 2012; 30(4): 325-36.
56. Schuth G, Carr G, Barnes C, et al. Positional interchanges influence the physical and technical match performance variables of elite soccer players. *J Sports Sci*. 2016; 34(6): 501-8.
57. Bradley PS, Mohr M, Bendiksen M, et al. Sub-maximal and maximal Yo-Yo intermittent endurance test level 2: heart rate response, reproducibility and application to elite soccer. *Eur J Appl Physiol*. 2011; 111(6): 969-78.
58. Bradley PS, Di Mascio M, Bangsbo J, et al. The maximal and sub-maximal versions of the Yo-Yo intermittent endurance test level 2 are simply reproducible, sensitive and valid. *Eur J Appl Physiol*. 2011; 112(5): 1973-75.
59. Carling C. Interpreting physical performance in professional soccer match-play: should we be more pragmatic in our approach? *Sports Med*. 2013; 43(8): 655-63.
60. Bangsbo J, Peitersen B. *Defensive Soccer Tactics*. Champaign, IL: Human Kinetics; 2002.
61. Michels R. *Team Building: the Road to Success*. Spring City: PA: Reedswain; 2001.
62. Akenhead R, French D, Thompson KG, et al. The physiological consequences of acceleration during shuttle running. *Int J Sports Med*. 2015; 36(4): 302-7.
63. Hader K, Mendez-Villanueva A, Palazzi D, et al. Metabolic Power Requirement of Change of Direction Speed in Young Soccer Players: Not All Is What It Seems. *PLoS One*. 2016; doi: 10.1371/journal.pone.0149839.
64. Hughes M, Caudrelier T, James N, et al. Moneyball and Soccer - an analysis of the key performance indicators of elite male soccer players by position. *J of Hum Sport and Exerc*. 2012; 7(2): 402-412.
65. Bangsbo J, Peitersen B, *Offensive Soccer Tactics*., Champaign, IL: Human Kinetics; 2004.
66. Tenga A, Holme I, Tore Ronglan L, et al. Effect of playing tactics on goal scoring in Norwegian professional soccer. *J Sports Sci.* 2010; 28 (3), 237-244.

Figure Legends

Figure 1. The 'traditional' approach has been used for the last four decades to detail the match physical performance of players by quantifying the relative or absolute distance covered, frequency of occurrence and time spent along a motion continuum of walking through to sprinting. Data derived from Bradley et al.[10].

Figure 2. A Venn diagram depicting a generalized 'integrated' approach to quantifying and interpreting the physical match performance of players. This focuses on high-intensity running efforts across the game but contextualizes these actions in relation to key technical and tactical activities.

Figure 3. Pitch zone areas that were used to code physical-tactical actions. The pitch location of a high-intensity effort was calculated using a grid generated from the semi-automated systems software. Pitch length was divided into thirds to establish defensive, middle and attacking zones while central areas of the pitch were equal to the width of the penalty box with the remaining areas considered wide. Descriptions adapted from Ade et al. [35].

Figure 4. Position-specific application of the 'integrated' approach in relation to physical-tactical activities. Please note the node size has been adjusted to represent the distance covered in each position/activity and the edge thickness for the frequency of efforts. Data derived from Ade et al.[35].

Figure 5. Purposeful high-intensity distance covered during matches for: centre backs (CB; *n*=4; observations = 5), full backs (FB; *n*=4; observations = 5), central midfielders (CM; *n*=4; observations = 5), wide midfielders (WM; *n*=4; observations = 5) and centre forwards (CF; *n*=4; observations = 5). Please note: The bottom of each stack includes out of possession variables while the top includes in possession variables for each position.

Table Legend

Table 1. The High-Intensity Movement Programme. Definitions are adapted from Ade et al. [35]

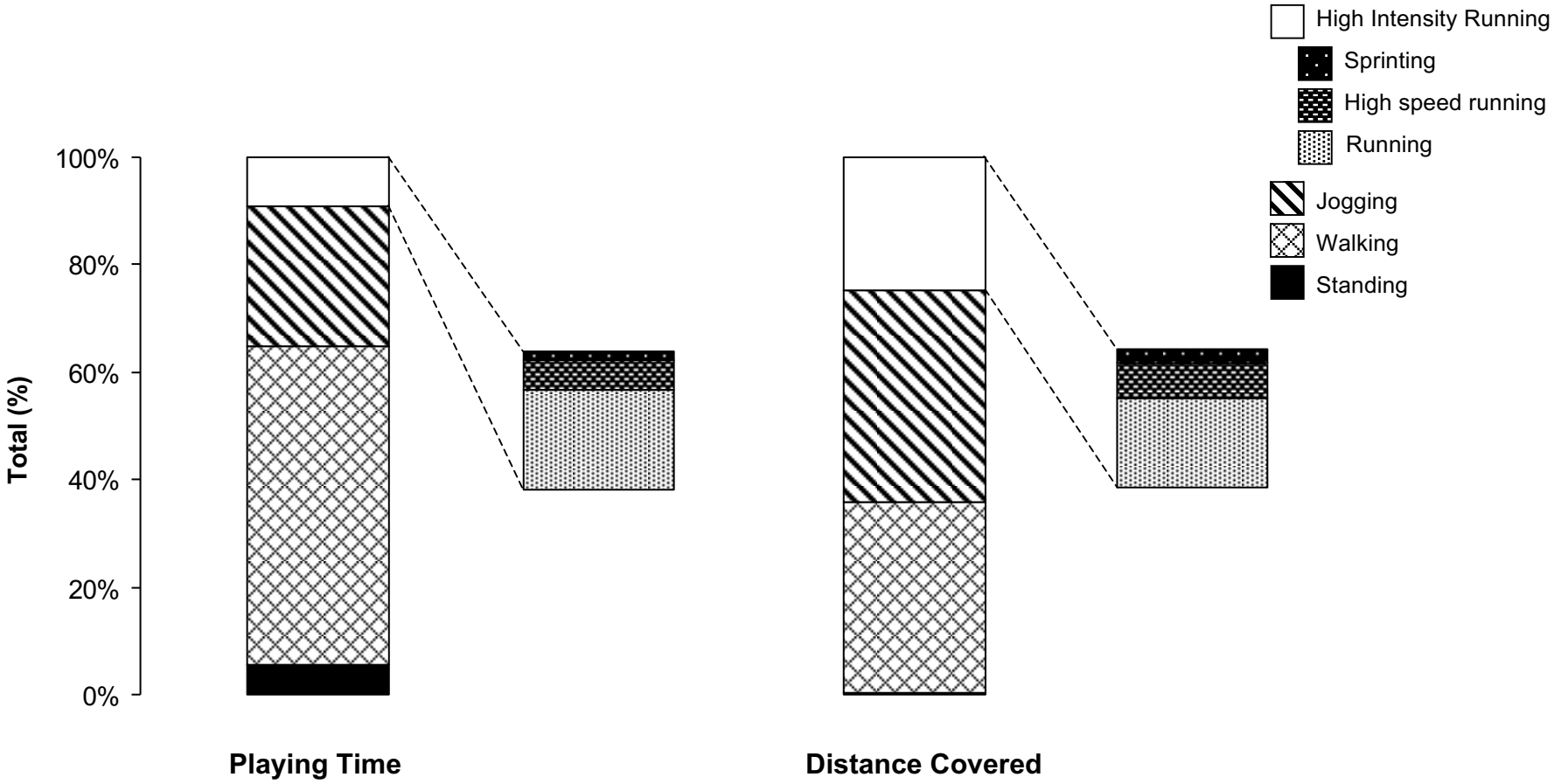
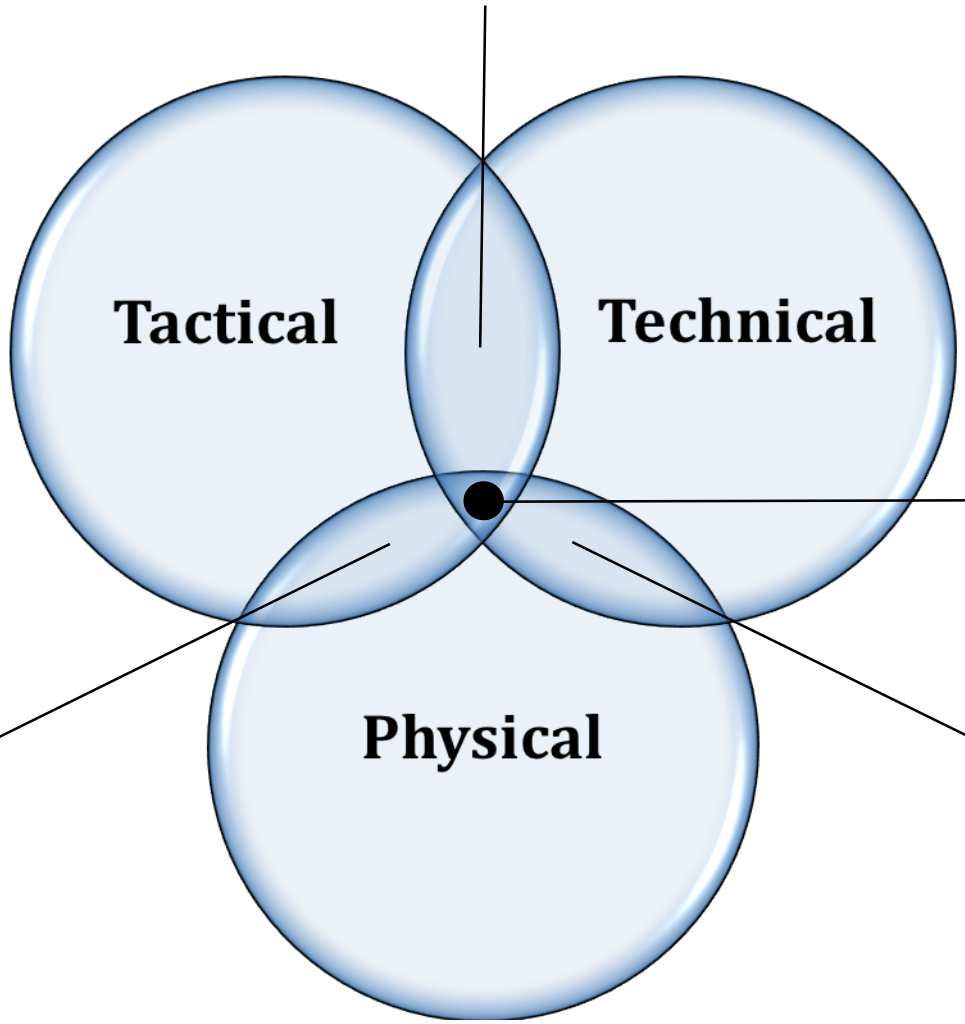

High Intensity Running
Sprinting
High speed running
Running
Jogging
Walking
Standing
100%
80%
60%
40%
20%
0%
Total (%)
Playing Time
Distance Covered

Figure 1.

Technical Activities with Tactical Purpose
Technical Events during Transitions/Phases of Play
Technical Events during Set Pieces

Tactical
Playing Style
Phase of Play
Formation
Coaching Philosophy
Positional Role

Technical
Passes
Tackles
Shots
Headers
Dribbling
Crosses



Full Integration

Physical Activities with Tactical Purpose
Recovery Run
Covering
Overlapping
Closing Down/Interception
Push up Pitch
Run in Behind
Break into Box

Physical Activities with Technical Purpose
Dribbling Ball
Run to Cross Ball/Tackle
Jumping to Head Ball

Physical
Total Distance
High-Intensity Running Distance
Sprinting Distance
Accelerations/Decelerations

Figure 2.

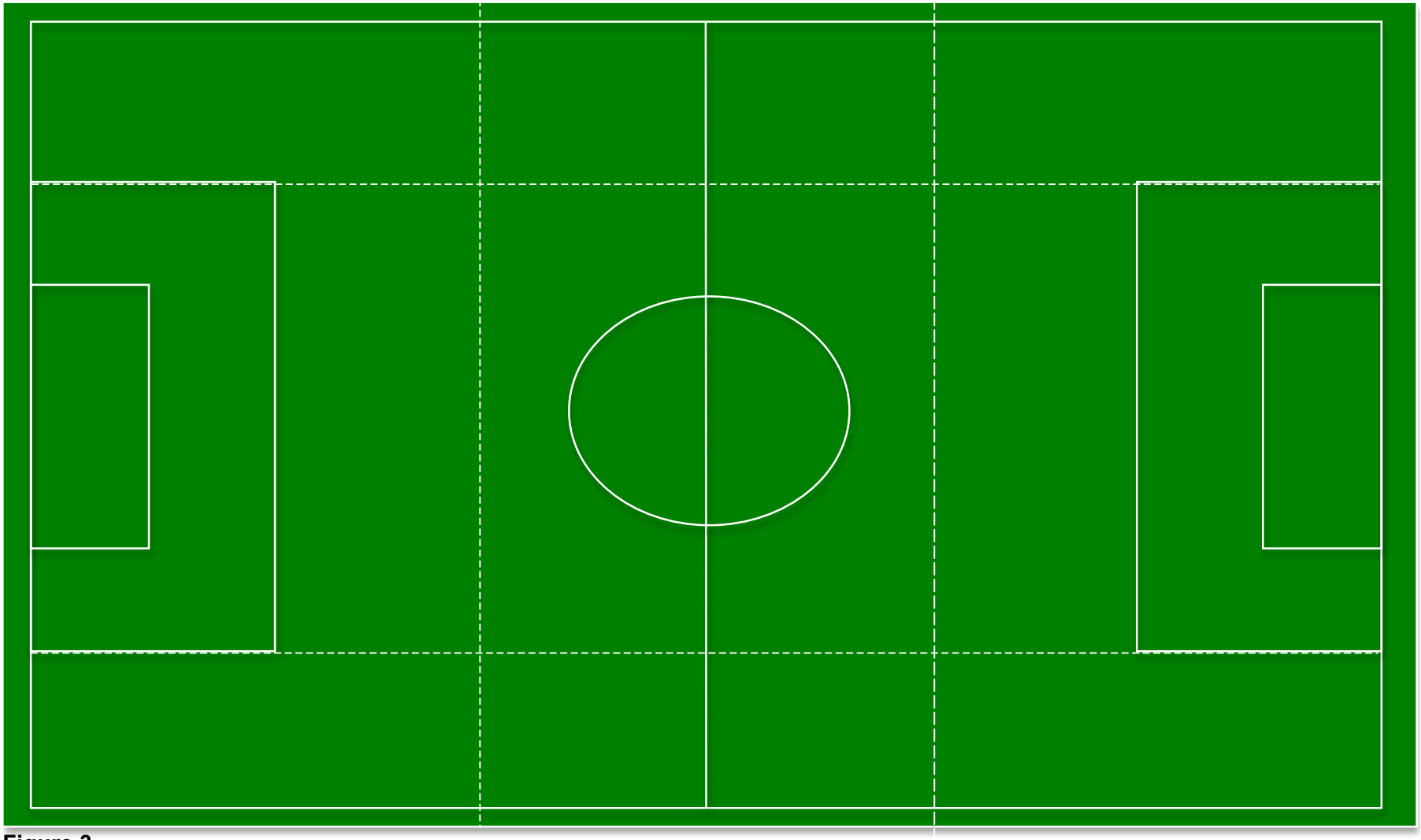


Figure 3.

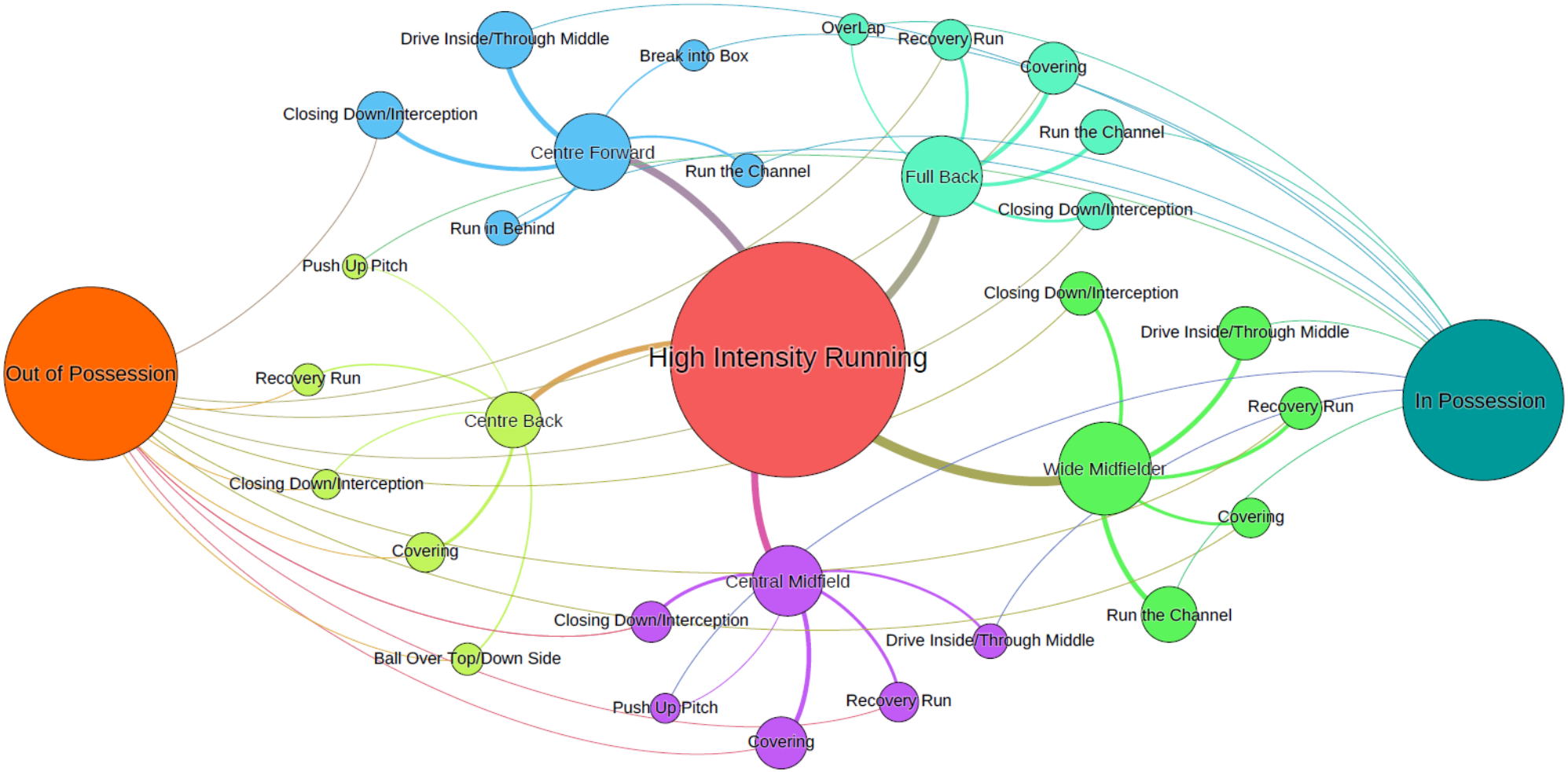

Drive Inside/Through Middle
Break into Box
OverLap
Recovery Run
Covering
Closing Down/Interception
Centre Forward
Run the Channel
Full Back
Run the Channel
Run in Behind
Closing Down/Interception
Push Up Pitch
Closing Down/Interception
Drive Inside/Through Middle
Out of Possession
High Intensity Running
In Possession
Recovery Run
Centre Back
Recovery Run
Wide Midfielder
Closing Down/Interception
Covering
Covering
Central Midfield
Run the Channel
Closing Down/Interception
Drive Inside/Through Middle
Ball Over Top/Down Side
Push Up Pitch
Recovery Run
Covering

Figure 4.

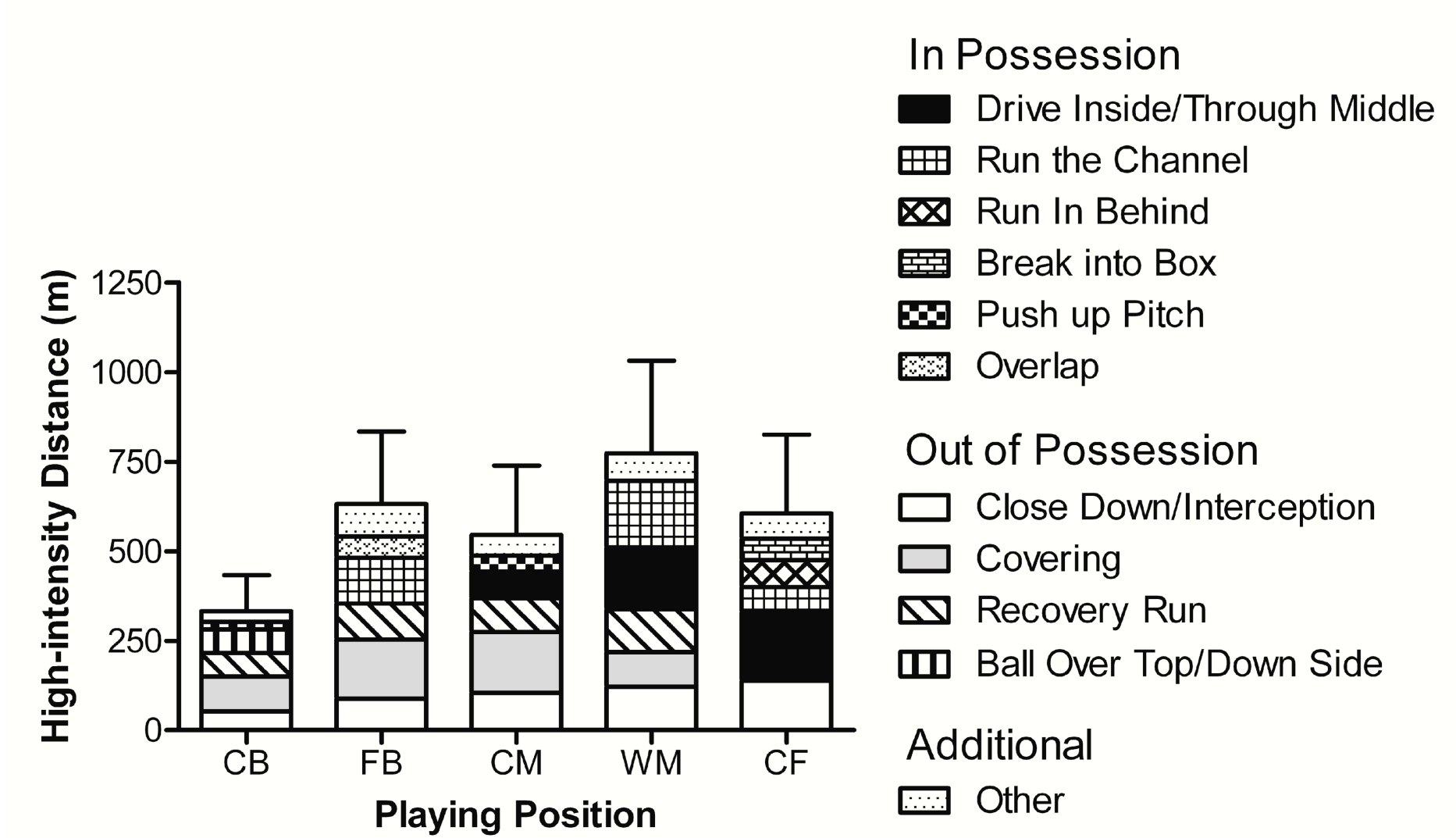

High-intensity Distance (m)
1250
1000
750
500
250
0
CB
FB
CM
WM
CF
Playing Position
In Possession
Drive Inside/Through Middle
Run the Channel
Run In Behind
Break into Box
Push up Pitch
Overlap
Out of Possession
Close Down/Interception
Covering
Recovery Run
Ball Over Top/Down Side
Additional
Other

Figure 4

Table 1:

Physical-Tactical Variable	Description
In Possession	
Break into box	Player enters the opposition penalty box
Overlap	Player runs from behind to in front of, or parallel to the player on the ball
Push up pitch	Player moves up the pitch to support the play (defensive and middle third of the pitch only)
Run the channel	Player runs with or without the ball down one of the external areas of the pitch
Run in behind	Player aims to beat the opposition offside trap to run through onto the opposition goal
Drive inside/through the middle	Player runs with/without ball through the middle of the pitch or from external flank into the central area
Out of Possession	
Closing down/Interception	Player runs directly towards opposition player on the ball or cuts out pass from opposition player
Covering	Player moves to cover space or a player on the pitch whilst remaining goal side
Recovery run	Player runs back towards own goal when out of position to be goal side
Ball over the top/down side	Opposition plays a pass over the defence through the centre or down the side of pitch
Other	All other variables that could not be categorized by the above