‘Context is King’ when Interpreting Match Physical Performances

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Caption: *‘I was blind, now I can see’. Thus, is it time to retire the ‘blind’ distance covered model that’s been used in football for decades and replace it with an integrated model that contextualises physical efforts during matches.*

Introduction

Football incorporates unpredictable movements during matches where players transition between multi-directional high-intensity efforts and low-intensity activity. High-intensity running during matches has increased by a third in the English Premier League across the last decade, thus players must be robust enough to cope with such demands[1]. The ‘traditional’ approach to quantifying demands in the absence of physiological and mechanical measures during match play is to determine the distance covered at different speeds. Whilst not accounting for metabolically taxing accelerations and directional changes,[2] it still crudely provides an indirect energetics measure. Despite hundreds of publications on the physical match demands, little progress has been made regarding optimizing the array of metrics used by applied staff within clubs. 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. Therefore, this piece 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.

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. Studies using this ‘traditional’ approach are reductionist, whereby the physical metrics are explored without consideration for the technical and tactical indices.[2, 3, 4,] 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 and the tactical aspects of the game are a challenge to quantify at present. 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.[1,5] 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.[1, 4, 5] It is debatable as to the benefits of this information in isolation as it simply reflects ball possession status. 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 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.[6] 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

Football is a multi-facetted sport with the physical, tactical and technical factors amalgamating to influence performance with each factor not mutually exclusive of another.[7] Hence, this piece proposes a novel 'integrated' approach that focuses on a sensitive metric such as high-intensity running[6] 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 1 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 article 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.[6] 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 $km{\cdot}h^{-1}$ 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.

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.[1,3-6] To make sense of this information, some advocate individualized rather than arbitrary speed thresholds that are founded on player's physical fitness indices.[8] This is based on the premise that positional variation has consistently been found for fitness attributes.[3,8,9] 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.[8] Irrespective of speed thresholds, players in selected positions will only be able to exert themselves based on match scenarios as a result of tactical, contextual and physical factors.[6] Accordingly, some suggest that 'in game' running performance should be used to assign such thresholds.[10] 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. 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 2B presents the 'integrated' approach specialized to the position of each player (data derived from Ade et al.[6]). 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 2A and 2B 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 (Figure 2A). The 'integrated' method compartmentalizes data more clearly by unveiling the unique high-intensity profile that exists due to distinct tactical roles (Figure 2B), 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.[6] 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 forwards: 23%). Centre forwards frequently perform arc runs out of possession[6] 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. This assimilated information could conceivably verify if players are adhering to tactical directives during phases of play that require high-intensity efforts. 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.[6] 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.[6] Obtaining true match demands should incorporate accelerations but such data has yet to be robustly 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 is now being used to contextualize accelerations. As the aforementioned variables are considered notable defensive attributes in the literature,[11] 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,[6] 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, 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.[6] 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.[6] High-intensity running by full back has increased by ~40% in the English Premier League in the last decade[5] 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[11] highlighting the importance of amalgamating physical-tactical actions.

Could Artificial Intelligence (AI) be the Answer?

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. It may be possible in future through supervised machine learning and artificial intelligence to have a more automated system. To enable this to happen, we are taking the concept a step further and collaborating on a new project between the Sports Science and Computing Departments of Liverpool John Moores University. The plan is to create a cutting edge product that elite teams can use to monitor players. It will combine techniques from artificial intelligence and machine learning to facilitate the rapid pattern matching needed to contextualise tactical activities. Such techniques generally rely on the availability of large amounts of data from a specific domain of interest. Consequently, employing highly sophisticated computerised scanning systems in football matches represents an excellent candidate for the application of one or more of the innovative techniques available from these highly active research areas. The scanned match data can be resolved to identify the activities of particular players performing specific roles in their respective team. Moreover, it is implicit within those roles that the player spatial dynamics will vary in their characteristics depending on the overarching state of game play at the point their data readings were taken. Accordingly, by directly associating a player’s spatial data to a contextual match activity coding scheme, the real prospect exists of being able to provide a series of activity data patterns to an artificial neural network[12] so that it can learn to automatically classify them appropriately.

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. 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.

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Bio

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Figure Legends

Figure 1. A Venn diagram depicting a generalized 'integrated' approach to quantifying and interpreting the physical match performance of players. This piece will focus on high-intensity running efforts across the game but contextualizes these actions in relation to key technical and tactical activities (the intersection between physical and tactical).

Figure 2. High-intensity distance covered using (A) the Traditional Approach or 'blind' distance covered versus (B) the Integrated Approach or 'purposeful' distance covered. Please note in Figure 2B: The bottom of each stack includes out of possession variables while the top includes in possession variables for each position.

Table Legend

Table 1. Definitions used to characterise physical-tactical actions (Adapted from Ade et al [6]).

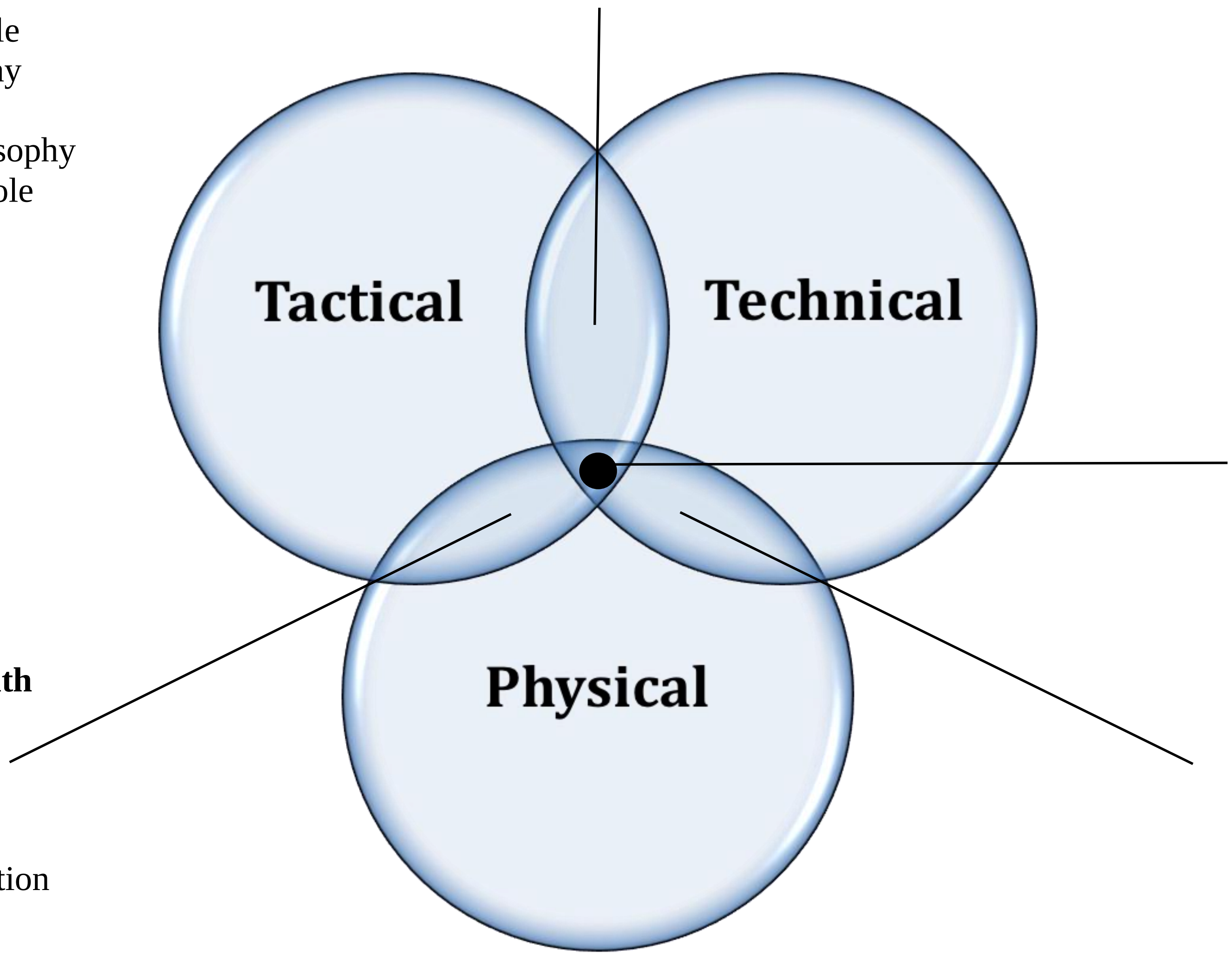
Technical Activities with Tactical Purpose
Technical Events during Transitions/Phases of Play
Technical Events during Set Pieces
Tactical
Playing Style
Phase of Play
Formation
Coaching Philosophy
Positional Role
Technical
Passes
Tackles
Shots
Headers
Dribbling
Crosses
Tactical
Technical
Full Integration
Physical
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 1.

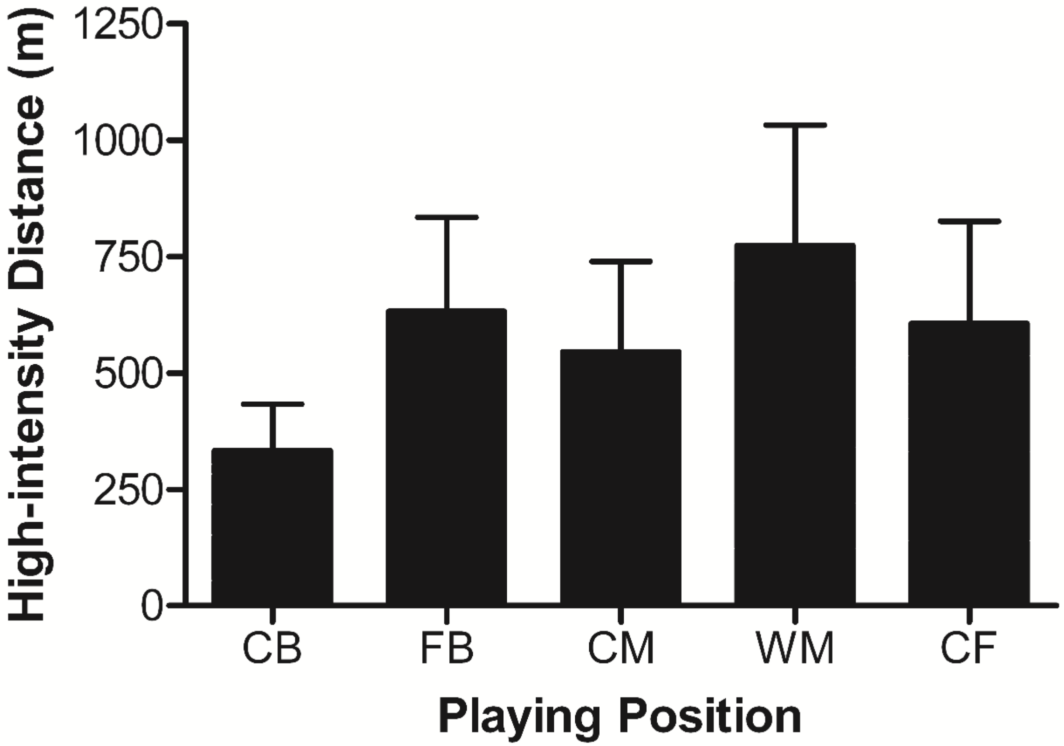
High-intensity Distance (m)
1250
1000
750
500
250
0
CB
FB
CM
WM
CF
Playing Position

Figure 2A.

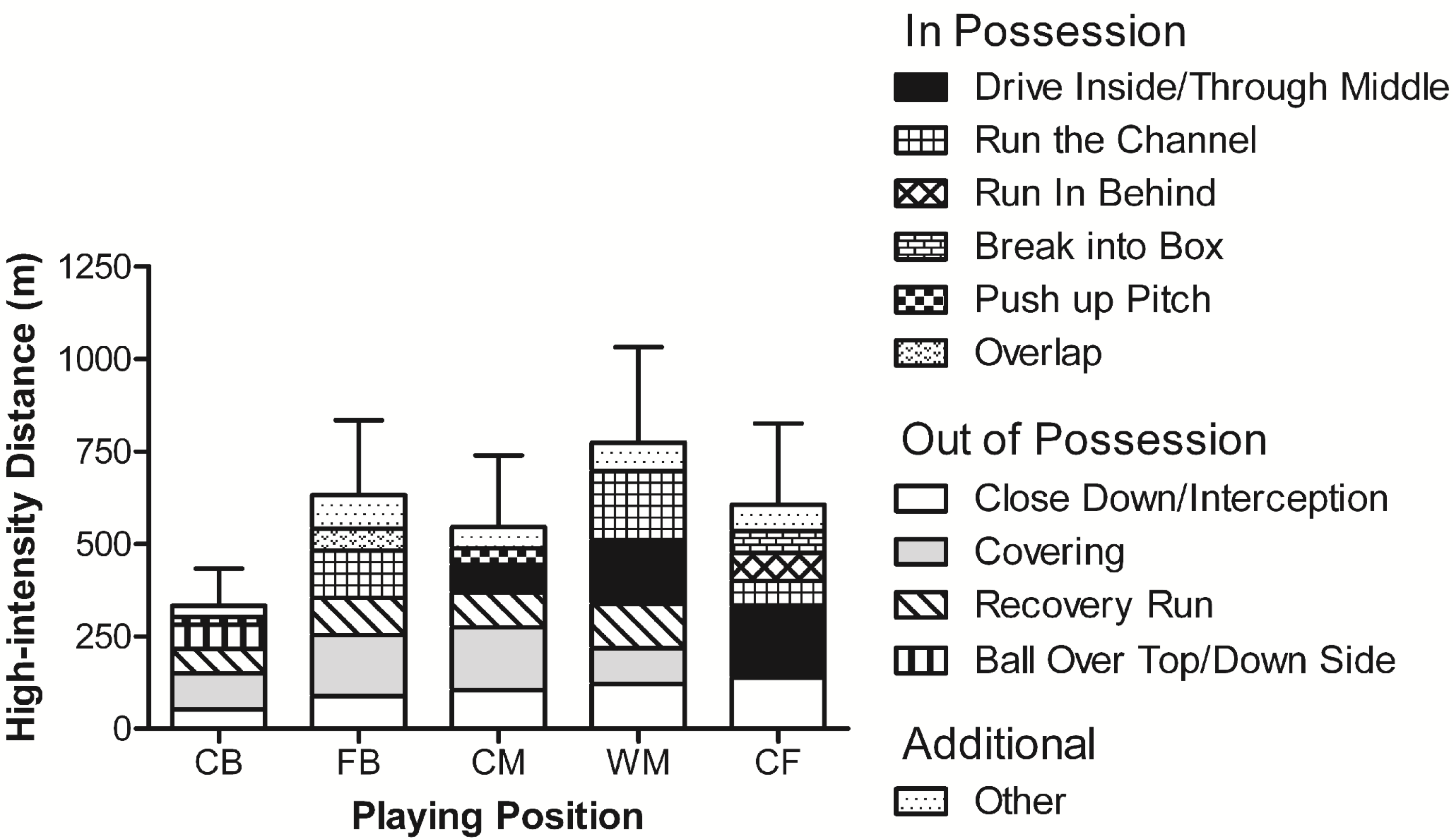
In Possession
Drive Inside/Through Middle
Run the Channel
Run In Behind
Break into Box
Push up Pitch
Overlap
Out of Possession
Close Down/Interception
Covering
Recovery Run
Ball Over Top/Down Side
Additional
Other
High-intensity Distance (m)
1250
1000
750
500
250
0
CB
FB
CM
WM
CF
Playing Position

Figure 2B.

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