REVIEW ARTICLE

Physical and Physiological Stresses on Footballers at Different Playing Positions: A Narrative Review

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Abstract

Introduction: Football is a physically demanding sport that calls for significant amount of fitness, technical and tactical expertise. Interestingly, team positioning is one of most crucial components because it exhibits shared decision-making and player interaction in conformity with team principles of gameplay. Football training guidelines should be based on the unique necessities of distinguishable playing positions. The goal of this article was to confirm inconsistencies and consolidate existing research.

Materials and methods: Searched databases included PubMed, Google Scholar and Medline. Inclusion criteria was published article between 1991 and 2021, human subjects, being available in English, including population relating to football and have the outcome of interest.

Results: Based on relevance, 22 studies met the inclusion criteria for qualitative syntheses.

Discussion: Research suggests that activities during football game are directly influenced by playing position, and athletes tend to develop physical characteristics following the demands of their specific position. Physiological, physical and behavioral monitoring techniques are utilized to assess the changes occurring during a competitive game.

Conclusion: Patterns and level of work rate observed during game play vary from individual to individual and cannot be generalized throughout even players playing at a similar position, l*et al*one the entire population of football players.

Keywords: Football Players, FItness, Physiological Stresses, Playing Positions

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Introduction

Football is a physically demanding sport that presupposes a high level of conditioning and extremely skilled technical and tactical competence. It is categorized by a predominant aerobic exercise coupled with frequent momentary short intense activities with differing physiologic and energy metabolism demands contingent on the athletes' positions.[4] Different roles, orientation shifts, propulsion, numerous runs over a length technical maneuvers with the ball, striding, and trotting are among the motor activities involved.[1] Peculiar movement patterns and the execution of specialized skills may precede these unpredictably changing circumstances. Individual activity characteristics are very dynamic and include characteristics of self-pacing, as decisions dictate individual activities regarding opportunities to engage in game.[8] Many interwoven factors are involved in football's most astounding performances. It is a fast-paced game with many direct matchups that require professionals' top-notch physical, technological, tactical, and psychological conditioning.[1] Remarkably, team positioning and dispersion on the playing field is one of the principal reasons of football performance since it demonstrates shared decisions and players' collaboration in conformity with team principles of play.[10] Central defenders, external defenders, central midfielders, external midfielders, and forwards are the five principal categories.[1] In team sports, gauging physical demands has traditionally been viewed as crucial to programming precise conditioning programs and ensuring optimal competition conditions.[10] As per sport science, the most effective training for preparing players for competitiveness is that which most accurately mirrors competitive performance circumstances. As a corollary, football training recommendations should be based on the specific requirements of the distinct playing positions, guaranteeing that players are better prepared to carry out their tactical tasks during the game.[7] Behavioral monitoring during games, physiological measurements in matches, and estimates of player physical prowess have all been used to explore the strains on individuals during championship performances.[8] The substantial variation of the footballers' time–motion profiles as the game progresses is likely owing to the tactical–dominant way the game is played and their sophisticated and dynamical traits.[10] In essence, the players' effort might be viewed as a result of the ecological constraints placed on their learning and memory.[7] Match-analysis has been essential in understanding the physiological demands of the game and evaluating how a certain player responds to the specifications of his event. To construct a sport-specific

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training routine, sportsmen must first understand the physiological stress imposed by their positional function during competitive matches. The most fundamental type of training, especially for elite athletes, is that which complements the power usage and kinematics of a planned tournament performance.[10] While substantial progress has been made in aiding performance analysis in football match environments, there are still obstacles in articulating and combining performance indicators from several dimensions (e.g. tactical and physiological). This perspective may provide further information regarding the movement behavior of certain positions of players within well-defined physiological demands.[7] A person's practice is frequently centred on honing technical or tactical skills at the expense of developing motor skills. Although positive correlations between footballers' body composition, muscular strength, and work-rate profile have been established, the relationship between other anthropometric variables and work-rate profile is more complex. An examination of players' motor activities during a match can be used to analyze the criteria for playing football in terms of efficiency.[1] As an outcome, this work may allow us to identify the physical profile of players in proportion to their position on the field, offering for more personalized training. It should be emphasized that, in addition to technical and tactical abilities, a player's physical profile is a key measure of their ability.[4] As a basis, the objective of this article was to confirm disparities, summarize the literature in playing roles, and estimate the requirements imposed on professional football players in each position during team sports. The length between players and the team centroid can be used to measure tactical behaviour in football, and this data can disclose important information about the players' and intra-team collaboration activities. Also will help delve deeper on how players converse to create single emergent execution steps. Recently, considerable attention has been put on identifying individuals with optimal anthropometric and efficiency attributes, permitting structured practices that allow participants to achieve peak performance. Match-analyses and physiological characteristics assessments will be valuable in establishing personalized training that mirrors physiological parameters and personalization because they simplify scheduling and reporting training loads for individual players. The ability to organise football training in real-game conditions is facilitated by analyzing the profiles of players' physical activities during title matches.

Materials and Methods

Ethical Statement

As this review was compiled of already ethically approved studies, no ethical clearance was needed. Moreover, it is just a qualitative synthesis, not involving any human or animal subjects.

Information sources- The searched databases included PubMed, Google Scholar and Medline.

Search Strategy

A literature search was developed by the primary author. An electronic literature search of studies published between 1991 and 2021 was completed. Bibliographies of full texts were surveyed for additional pertinent studies through manual citations search. The limits were applied to English language and dates.

Eligibility Criteria

Inclusion Criteria

- article of any genre published between 1991 and 2021;
- human subjects;
- being available in English;
- including a population or sub-population of participants relating to football,
- have outcome of interest.

Exclusion Criteria

- Any article published before 1991,
- Not including human subjects,
- Not being available in English

Selection Process

Once studies were identified, 2 independent reviewers examined each article's title and abstract to determine whether the article met the inclusion criteria. If the reviewers disagreed, a third reviewer made the determination and then was confirmed.

Results

All the studies meeting the criteria were considered for qualitative syntheses only and 22 studies met the inclusion criteria.

Discussion

This review was done to elucidate football players' varying physiological and physical demands in different positions and situations. The game of football is tactical and physical, and it requires physiological and physical adaptations along with tactical skills to excel in it. Players undergo physiological stress in the form of blood lactate accumulation, depleted muscle glycogen stores and dehydration. These stressors may lead to depletion in performance during the game, and may lead to substitution. Power, speed and lower body strength are important parameters contributing to selection and playing time in team sports like football.[18] The football consists of various activities of intermittent nature that include walking, running slowly, sprinting etc. These activities pose varying degrees of physical and physiological demands on the athletes' bodies. Understanding these demands is essential to enhance performance and prevent sport-related injuries in the players.[13] Anthropometric and physiological characteristics of football players are important in the view of talent identification and development and training

specificity according to specific demands of the players. Players at the highest level of football are needed to adapt to the multi-factorial physical demands of the game, with a reasonably high level within all the areas of fitness and tactical excellence.[17]

Positional Differences

Research suggests that activities during a football game are directly influenced by playing position, and athletes tend to develop physical characteristics following the demands of their specific position. Professional football players cover a distance of approximately 9-12 km during a single competitive match, with distances covered varying slightly depending upon the position of play. The players must perform various movement patterns at different intensities, like kicking, dribbling, ackling etc.[19] Studies conducted by Bangsbo[3], Mohr *et al*.[14] and Krustrup *et al*.[12] conclude that central defenders have lower physical capacity as compared to other playing positions; and linked it to their tactical position and requirement to cover less distance with a lower intensity. Midfielders were found to cover longer distance. Types of sprints also differ according to playing position.[3,4,12] A study by Bloomfield *et al*. (2007) on English Premier League football showed that central midfielders and defenders performed fewer sprints in comparison to other playing positions.

Aerobic Capacity**:** Aerobic capacity differs in different playing position, with central defenders achieving low Yo-Yo IR-1 scores versus players in other positions.[3] The studies have found that full-backs and midfielders exhibit highest maximal oxygen uptake, when measured via intermittent exercise tests. Physiological characteristics can result from the individual's genetic makeup or can develop through training adaptations.[17] Bangsbo and Michalsik (2002) studied the physiology of elite Danish footballers, and found that midfield players had higher VO2max than the fullbacks.

Central defenders had the lowest average of VO2max according to this study. The suggested reason was the coverage of greater distances by the midfield players at higher intensity.[7] The observations based on GPS monitoring during competitive games found that defenders cover more distance than strikers and defenders. If high-speed sprinting is considered, it was found to be less in defenders in comparison to midfielders and attackers[5, 9] assessed the role of tactical adaptations of players according to playing position and time of the season. Players were monitored for VO_2max, HR response, strength etc., during the pre-season. They showed lower physical fitness levels at the beginning of pre-season, but their agility, speed aerobic capacity all improved as the season progressed. The study also found that players became progressively more tactically aware as the season progressed, and it was shown in the less distance covered during a game at the end of pre-season compared to the beginning. A comparison of running distances according to the position showed that the midfielders covered maximum distance as compared to players at other playing positions, at various intensities.[9]

Muscle strength**:** Muscular strength is the basis of most of the movement patterns in football. Working on this aspect during training is an important task for the athletes to excel in their sport. The concentric action of quadriceps muscle is primarily utilized during passing, kicking or jumping. On the other hand, the hamstrings work eccentrically to decelerate and stabilize the knee during these movements. The functional ratio of these two muscles becomes essential to prevent injury and perform sport-specific skills at optimum levels. Weaker hamstrings may not produce enough torque to stabilize the knee, thus predisposing the player to anterior cruciate ligament tear.

Studies suggest that there is no significant difference in Hamstrings: Quadriceps functional ratio in players at different playing positions. Goalkeepers exhibited greater vertical jump scores compared to other field players, and these results may be attributed to their involvement in repetitive jumping movements at high velocities to catch and deflect. Although football players have a preferred leg for kicking, the side-to-side symmetry is also essential in football players, as an asymmetry greater than 15% is indicative of strength imbalance, and poses increased risk of injury.[15-20] Midfield players exhibit lowest muscle strength among all the playing positions. These findings; however, cannot be generalized on all the playing populations, due to variation in training programs, stature of the individual and other environmental factors.[17]

Speed and Agility: A study by Aychiluhim[2] on Ethiopian footballers to identify the relationship between sprint and agility performance and anthropometric measurements revealed that strikers had the maximum body mass and height compared to defenders and midfield players, and also had greater circumference at the calf and thighs. No significant correlation was found between 30 m sprint speed, agility and playing position of the players.[2] Research has suggested that player's performance can be optimized by inducing the physiological responses seen during the competitive event into the training sessions.[6] Studies have found position-specific distinctions in the running intensity, sprint numbers etc. Physiological responses during the match provide an idea of the endocrine responses of the body during a football game, and these could be studies in conjunction with the time-motion analysis during the match play.[6]

Physiological Demands in Small-sided Games

Training in the form of small-sided games in football has been used to promote performance-enhancing adaptations in the players. A study was conducted to study the physiological demands created on players while playing these small-sided games, comparing 5-per-side, 4-per-side and 3-per-side games. It revealed that mean heart rate was highest in 5-per-side games compared to the other two. Blood lactate

accumulation and total distance covered were highest in the 3-per-side group. These findings suggest that specific physiological stressors differ according to number of players per side. These format-specific changes can be utilized to condition the athletes according to their playing position in the team.[20]

Small-sided games exhibited exaggerated heart rate response as compared to actual match play. Many studies also consider the RPE to measure the intensity during a match. Blood lactate levels were found to be lower during small-sided games, and the reason attached to this was that the duration of high-intensity runs was shorter in small-sided games.[6] Small-sided games were observed to exert higher intensity demands on the players, which was attributed to the increased ball possession time in small-sided games. Field dimensions also play a role in varying physiological responses during the game (Rampinini *et al*., 2007)

The Goalkeeper: Physicality and Physiology

The role of a goalkeeper is of utmost relevance in the game of football. Goalkeepers must show high levels of physical fitness and game skills to save goals. Deflecting the shots, catching, saving counter attacks and one-on-one attacks are defensive acts; kicking and distributing the ball are offensive roles that a goalkeeper plays during a football game.

Compared with other players who play different positions, GKs appear to be taller and heavier, with higher body fat percentage. Several studies on European football players of different nationalities have shown similar conclusions. A few studies also conclude with contrasting results.

Goalkeepers were found to have lower VO_2max when compared to other field players. These differences in Vo_2max could likely be due to differences in requirements during the game, as field players are required to cover more ground during a single match than the goalkeepers. However, improving the Vo_2max for goalkeepers would be beneficial, by delaying fatigue and improving recovery between bouts of high-intensity movements. Speed and agility are innate to the sport of football, not only for the field players, but also for the goalkeepers, who need agility as they are required to change directions for saving goals quickly. Jump performance is of immense importance to the goalkeepers, as they ae often required to jump vertically to deflect the ball. Studies have found no difference between the jump performance of goalkeepers and field players.[21]

Physical and Physiological Demands in Women's Football

While a vast number of researches are available in the arena of male football; the number of studies conducted to assess the physiological demands in female football has been limited. Physiological demands could be similar for both men's and women's football, but women cover around 33% less distance during a competitive match; however, the intensity at which this distance is covered is higher in women's football when compared to men's game. The pattern of covering these distances may vary according to playing the player's position, and lesser distance covered in the second half versus the first half. The research suggests fatigue, depleted muscle glycogen, blood lactate accumulation and fluid loss are the reasons behind this decrement. Total distance covered was not likely related to playing position according to studies by Gabbett and Mulvey in 2008 and Mohr *et al*, 2008. Although the intensity varied according to playing position, strikers covered more distance with high-intensity running as compared to midfielders and defenders.[13]

High-intensity running is one of the types of runs that players undertake during a football game. A study by Vescovi on NCAA women's division I football showed that the forwards cover most distance while running at high intensity, followed by the midfielders and the defenders, during a game. A comparison of starter players and non-starters shows that starters have more speed than non-starters; however, both physiological variables like jump and high intensity running performance were similar.[18]

Measuring the Heart rate fluctuations and peak heart rate during a competitive match can indicate the intensity of the exercise. The study by N. Datson *et al*, estimated that average VO_2 during a game was approximately 77-80% of the VO_2max. This is suggestive of high involvement of aerobic metabolism during women's football. Analysis of anaerobic contribution in women's football done via monitoring blood lactate showed that elite female football players exhibited decreased blood lactate concentration in the second half contrary to the first. This decrement is attributed to decreased intensity during the game's latter half. These results; however, should be read with caution, as differences exist between player movement patterns, situations and tactics of the game. Contrasting findings exist for anthropometric measures in women's football, with some studies suggesting similar height and body mass among different playing positions; others conclude that goalkeepers and defenders tend to be heavier and taller than strikers and midfielders.

Menses and OCPs: Menstrual cycle can be adversely affected by higher training loads, with young players with low body mass experiencing delayed menarche. Variations in endocrine hormone activity during the menstrual cycle can also influence physiological changes. Studies show that VO_2 max remains mostly unaffected due to menstrual cycle, but variables like minute ventilation, rating of perceived exertion etc. Increase during the luteal phase. It is largely attributed to the increment in core body temperature during the luteal phase. The usage of Oral Contraceptive Pills (OCPs) by athletes has grown over the years, and studies show that anaerobic and high intensity performance are not affected by the consumption of OCPs. [5]

Conclusion

Football involves performing various high and low-intensity running patterns during the course a game. The activity

profile of individuals also varies according to the position and pattern of play. The physiological, physical and behavioral monitoring techniques are utilized to assess the changes occurring during a competitive game. The patterns and level of work rate observed during game play vary from individual to individual and cannot be generalized throughout even the players playing at similar positions, l*et al*one the entire population of football players. Many studies to assess these patterns may differ in their methodologies and equipment used for the assessment, which may provide varying results. However, the role of these monitoring and assessment techniques has not been denied in building improvised and specific training programs for the athletes and tactical planning for the team as a unit.

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