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Analysis of the distances covered and sprint activities in FIFA Arab Cup 2021

تحليل المسافات المقطوعة وأنشطة الجري السريع في كأس العرب 2021

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Abstract:

This study presents a detailed analysis of distances covered and sprint activities by Arab football players in FIFA Arab cup 2021 which took place in Qatar from November 30 to December 18, 2021.

The study examined at 756 physical performance data from 368 players who took part in 32 matches of this competition, taking into consideration variables including the mean distance covered, the percentage of sprint activities according to intensity, and the player's maximum running speed during the match. The physical performance data from players were categorized into four different positions (goalkeepers: n=64; defenders: n=276; midfielders: n=241; and forwards: n=175) which required a minimum 90 minutes of play by match.

The study was carried out using data from TRACAB® Optical-Tracking System Certified by FIFA Quality Program for Electronic performance and Tracking Systems (EPTS).

Results indicate wide variations in the analyzed variables, depending on the playing position on the pitch and tactical tasks. Individualization of training speed and endurance loads will help to optimize the training process of football players at different levels of their athletic skills.

Keywords: Football; Physical Performance Data; Player position; Distance covered; Sprint intensity.

ملخص

تقدم هذه الدراسة تحليلاً مفصلاً للمسافات التي قطعتها وأنشطة العدو السريع للاعبي كرة القدم العرب في كأس العرب 2021 التي أقيمت في قطر في الفترة من 30 نوفمبر إلى 18 ديسمبر 2021.

فحصت الدراسة 756 من بيانات الأداء البدني من 368 لاعبًا شاركوا في 32 مباراة من هذه المسابقة ، مع الأخذ في الاعتبار المتغيرات بما في ذلك متوسط المسافة المقطوعة ، ونسبة أنشطة العدو وفقًا للشدة ، وسرعة الجري القصوى للاعب أثناء المباراة. تم تصنيف بيانات الأداء البدني للاعبين إلى أربعة مواضع مختلفة (حراس المرمى n = 64 :؛ المدافعون n = 276 :؛ لاعبي الوسط n = 241 :؛ المهاجمون n = 175) والتي تطلبت مشاركة اللاعب ل90 دقيقة على الأقل في مباراة.

تم إجراء الدراسة باستخدام بيانات من نظام التتبع البصري TRACAB® المعتمد من قبل برنامج الجودة FIFA لأنظمة الأداء والتتبع الإلكترونية.(EPTS)

تشير النتائج إلى اختلافات واسعة في المتغيرات التي تم تحليلها، اعتمادًا على مركز اللعب والمهام التكتيكية لكل لاعب على ان يساعد التدريب الفردي لقدرة السرعة و التحمل على تحسين عملية تدريب لاعبي كرة القدم على مستويات مختلفة من مهاراتهم الرياضية.

الكلمات الرئيسية: كرة القدم؛ بيانات الأداء البدني؛ مركز اللاعب؛ المسافة المقطوعة؛ شدة الركض.

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Introduction:

Football is a multifactorial activity of which all the demands imposed upon players within the competitive game itself should be understood. Managers, technical and physical coaches, as well as medical professionals involved within the rehabilitation and training of professional football players must have an understanding regarding the internal and external physical and physiological loadings that are placed on their players and team during matches.

In the sport at top level of competition physical activities profile may be influenced by several factors as well as environmental or biological factors. Some factors in football strongly effect on team success. Distance covered and maximum speed of players during a full match will show important data to the coaches.

However, the question remains; Can we claim that the levels of physical activity elite Arab footballers engage in during a match are similar to the physical demands of top-level competitions?

Thus, exercise intensity and load during competitive football can be indicated by the distance covered within the different speed zones set; Average Speed and the total distance covered (TDC) in a match. Several methods have been developed and used to determine distance covered during competitive games. These variations have included the use of hand notation systems (Knowles and Brookes, 1974), coded commentary (Reilly and Thomas, 1976), video filming (Van Gool et al., 1988), and semi-automatic video tracking analysis (Barros et al., 2007, Dellal et al., 2011).

Recent research concerning distances covered within professional football highlights significant differences between outputs and specific values. Differing values may be attributed to numerous factors influencing the data such as the use of different methods to measure distances covered.

In order to understand and clarify recent systems being used to report data within professional football, Randers et al., (2010) performed a comparative study involving the use of four different commercially available football match analysis systems (i.e. a video-based time–motion analysis system; a semi-automatic multiple-camera system, and two commercially available GPS systems).

There are several multi-camera motion analysis systems, such as Amisco, ProZone, and SICS, to analyse player movements, the study concentrates on time and speed data. The latter is a tracking video analysis system that is semi-automatic and has six cameras (three on each side of the field), and it is mostly used in Italy (Aouir. S and Syphax. O, 2020).

However, we assume that the application of the TRACAB® Optical-Tracking System (Certified by FIFA) enabled an objective analysis of sprinting performance and total distance covered by Arab football players during FIFA Arab Cup 2021.

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It is argued that the player position on the pitch determines the duration of performed sprint runs, duration of the rest pause between the sprinting activities and the top speed recorded during the match. Statistically significant differences were assumed to exist between the player's pitch position and the above variables.

Findings from this particular study revealed how all four systems detected similar statistics for decreasing performance levels during matches, indicating a game-induced fatigue. However, large differences were found when comparing the total distances covered (TDC) using different systems, highlighting the fact that comparison of results between different match systems should be done with caution. Concluding the findings of this study, it may be reasonable to suggest that as long as the same system is being used and shows a high level of reliability, then confidence in data may be achieved.

It has been shown that distance covered during football games strongly influenced on team success. Of course some other factors are involved in football games which may effect on football results. By the way distance covered has key role of completion success during official tournament.

Research concerning the actual distances covered during competitive matches has been conducted across many continental leagues such as elite Spanish (Di Salvo et al., 2006), Belgian (Van Gool et al., 1988), Brazilian (Barros et al., 2007), Danish (Bangsbo and Linquist, 1992) English (Reilly and Thomas, 1976), and Swedish (Saltin, 1973) professional teams. However, on the basis of recent studies with marginally improved equipment showing increased levels of reliability, it can generally be accepted that on average, professional football players cover a distance of 9-12 km during a match (Barros et al., 2007; Wehbe et al., 2014; Vigne et al., 2012).

Further analysis into movement changes within elite professional football also suggested that players perform between 1000 to 1400 short duration actions in a game, lasting 2-4 seconds (Stolen et al, 2005), with approximately 220 of them being at a high intensity (Mohr, 2003). Bangsbo (1994), suggested that players perform a different action every 4-6 seconds throughout a competitive match

Many research articles have been published about the different physical demands for different playing positions (Carling et al., 2008; Dellal et al., 2011; Carling, 2010). Research concerning positional demands in football indicates that midfield players and full backs cover significantly greater distances than centre backs (Strudwick and Reilly, 2001; Barros et al., 2007). This is due to the continued running support function they perform in their role between defending and attacking. As a result, managing the training elements of these high energy positions and using a squad rotation structure to manage fatigue and injury risk is a factor that should be highlighted.

The greater distances covered by midfield players may be attributed to the amount of lower-intensity activity throughout the course of a match, which therefore indicates that more aerobic activity is produced by midfield players when compared to other positions. It is also

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possible that more tactical limitations may be placed upon them than other playing positions. Positional demands of elite level players have recently been further examined through a research study investigating the most intense period of high-intensity running during English Premier League matches (Di Mascio and Bradley, 2012). Within the study, elite players were analysed using a multi-camera computerised tracking system measuring the highintensity running distance (speed ≥19.8 km/h) covered during the most intense 5 minute periods of matches.

Di Salvo et al. (2007) showed that football players performed from 3 to 40 sprints per game. The number of a player's sprinting activities depends, first of all, on the player's position on the pitch. In professional football the mean distance and duration of a sprint run are relatively short: sprinting distances rarely exceed 20 m and are no longer than 4 s.

The aim of this study was to present a detailed analysis of physical activities (the mean distance covered, percentage of distance of sprint activities according to intensity running and maximal running speed recorded during the match.) of Arab football players during the FIFA Arab Cup 2021 with regard to their playing position.

1. Material and methods

1.1 Subjects

The FIFA Arab Cup 2021 with 32 matches played by 16 Arab national teams was monitored between (the 30 November and 18 December 2021). The analysis was carried out using data from TRACAB® Optical-Tracking System Certified by FIFA. The analysis involved on the physical activities of 756 data recording for 368 players participating in this competition.

The players were assigned to one of four positional groups: Goalkeepers (GK, n=64), defenders (D, n=276), midfielder players (M, n=241), and forwards (F, n=175) which played minimum 90 minutes. The profile of the different playing positions was based on the activities performed on the pitch and the primary area in which these activities were carried out, as in (Di Salvo et al, 2007).

1.2 Procedures

A player tracking system TRACAB® optical (5th generation - certified by FIFA) was used to characterize activity profiles for all the players. It is delivers the most accurate real-time data in sports. Delivered to leagues, clubs, broadcasters and rights holders across the globe, TRACAB® Optical Gen5 builds on the advancements of the previous four generations with more accurate ball tracking, real-time limb-tracking and skeletal modelling.

Coupled with a convolutional neural network artificial intelligence (AI) , TRACAB® Optical powers low latency skeletal modelling and facilitates accurate live positioning data for specific body-parts down to the precise moment of key plays with an accuracy of <7m in real-time.

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Data processing procedures, such as the derivation of kinematic metrics from position data, may vary drastically between different EPTS and even between different software versions of the same EPTS (Malone et al., 2017).

The 5th generation TRACAB® system (Gen5, installed at a height of 16m), represents a distributed camera architecture, combining two stereo pairs on each side of the field as well as two monocular systems behind the goal areas. In total, the tested Gen5 systems comprised 16 IP-HD cameras with a resolution of 1920x1200 pixels. An exemplary still image of one of Gen5's multiple-camera units is depicted in Fig 1.

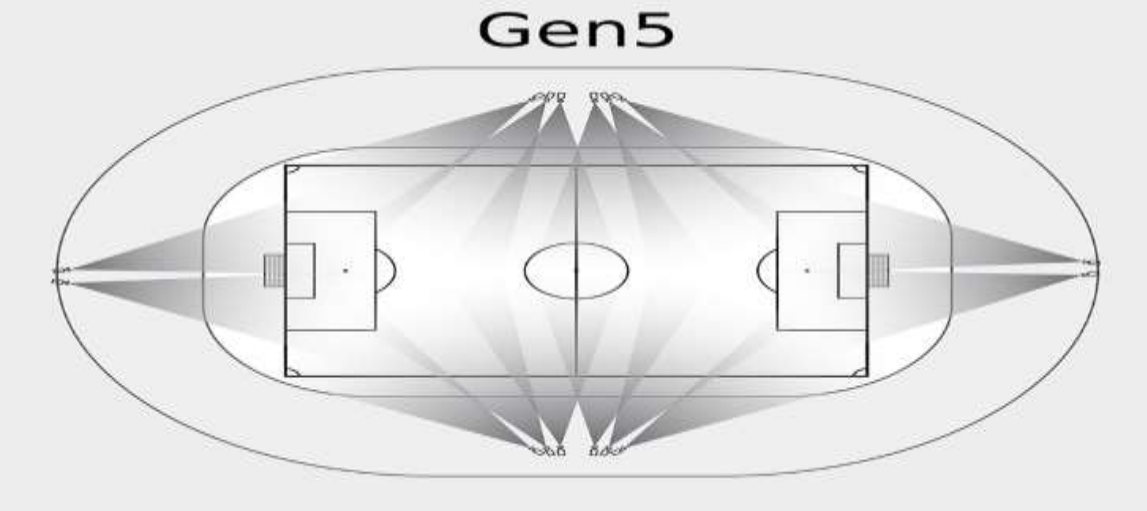

Figure 1. Spatial representation of the 5th generation TRACAB® optical system-tracking (16m height) camera architecture. (Linke D, et al.,2020)

1.3 Performance variables

The distance covered was calculated using the "waypoint approach by TRACAB®," which reduces the accumulation of little movements and tracking errors that do not accurately represent by player's performance motion (Linke D, et al, .2018).

The total distance covered by players, percentage of distance of sprinting according intensity during a match and the top running speed was measured. The analysis's minimum threshold for distance values was set at 1 m. Low speed (0-7 km/h), moderate speed (>7 to 15 km/h), elevated speed (>15 to 20 km/h), high speed (>20 to 25 km/h), and very high speed (>25 km/h) were all used to identify running intensities.

1.4 Statistical analyses

For all the variables, the following descriptive statistics were calculated: arithmetic mean (M) and standard deviation (SD), and percentage (%) – on the graphs. To check normality, the Shapiro-Wilk test was used. The level of statistical significance was set at $p \leq 0.05$.

The significance of differences of mean values between players in different positions on the pitch was checked with a non-parametric Kruskal-Wallis test (H) for parameters with a

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distribution other than normal or with heterogeneous variances. Statistical analysis was carried out using the IBM® SPSS® software.

2. Results

2.1. Total Distance Covered (TDA)

The analysis of the mean total distance covered by the players during a match (minimum 90 minute) revealed statistically significant differences between players in all positions on the pitch ($p<0.05$). The midfielders covered the longest distance (11 760±797 m) in comparison with players in other positions. Significant differences were found between midfielders, goalkeepers, defenders and forwards, respectively ($p<0.05$) during match. Also a significant difference was found between defenders and forwards (Figure 2).

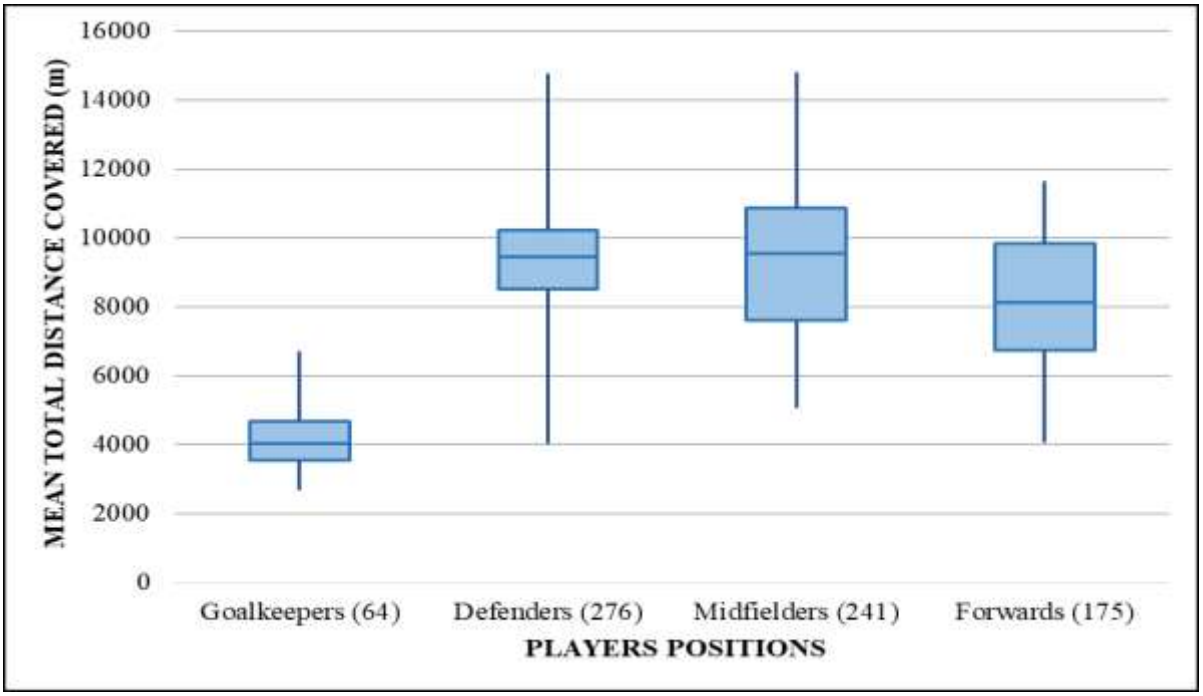

Figure.2. Comparaison at Mean Total Distance Covered (TDA) by player according to players positions during FIFA Arab Cup 2021

Differences between all positions: GK > D> F > M ($p < 0.05$).

2.2. Percentage of the total sprinting distance

With regard to the player's position on the pitch, the mean percentage contribution of distance covered in sprint to the total distance varied from 1.4% to 3.1%. Statistically significant differences were revealed between all positions on the pitch ($p < 0.05$): forwards and external midfielders, and central defenders and central midfielders. The external defenders were found to cover a greater sprinting distance (in percent) than central midfielders ($p < 0.05$). Analysis of position on the pitch in every single half showed similar results to the mean results of both (figure 3,4,5,6 and 7).

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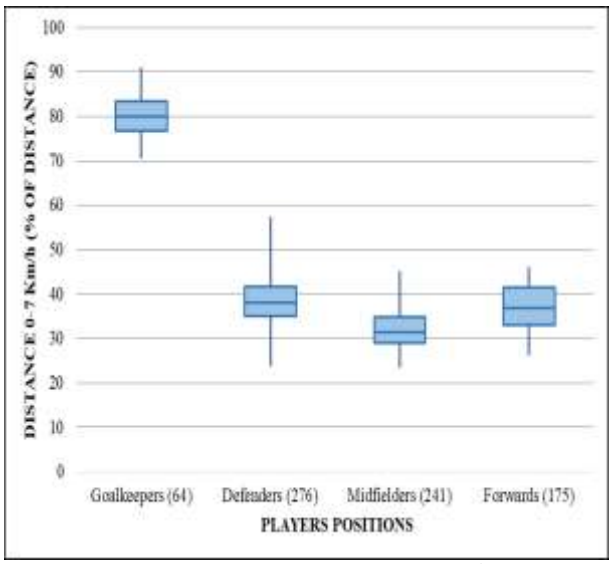

Figure 3. Comparaison at distance 0 -7 Km/h (% of distance) by player according to positions during FIFA Arab Cup 2021

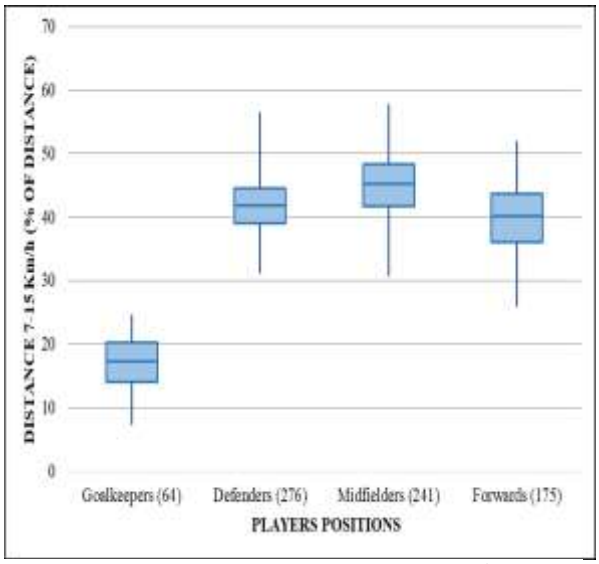

Figure 4. Comparaison at distance 7 -15 Km/h (% of distance) by player according to positions during FIFA Arab Cup 2021

Differences between all positions: D> F > M >GK ($p < 0.05$).

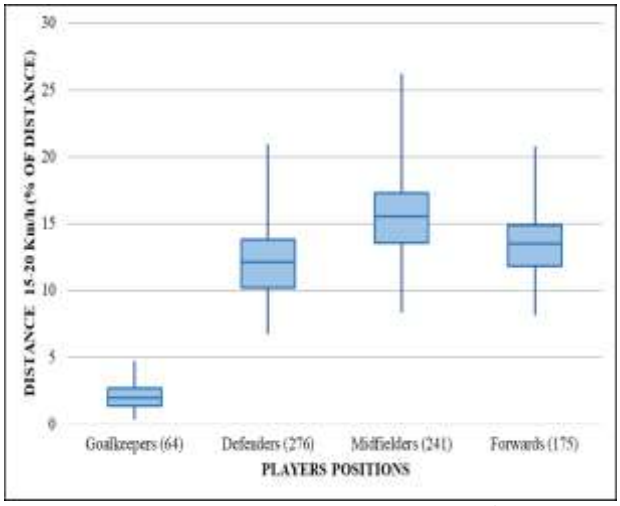

Figure 5. Comparaison at distance15 -20 Km/h (% of distance) by player according to positions during FIFA Arab Cup 2021

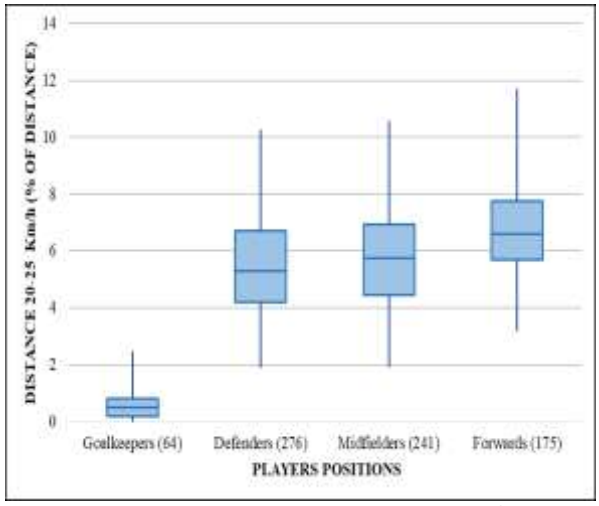

Figure 6. Comparaison at distance 20 -25 Km/h (% of distance) by player according to positions during FIFA Arab Cup 2021

Differences between all positions: GK> D = M > F ($p < 0.05$).

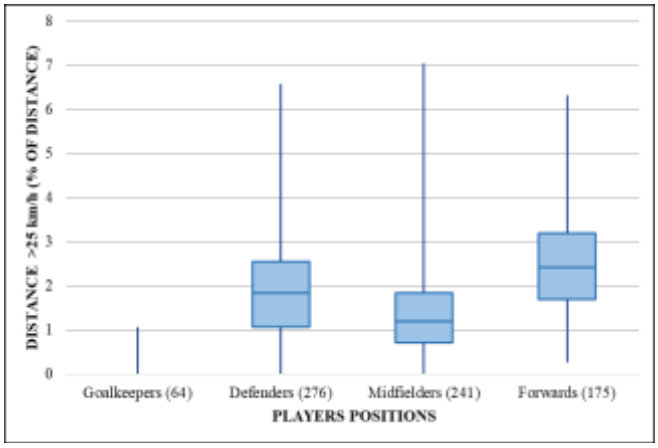

Figure 7. Comparaison at distance > 25 Km/h (% of distance) by player according to positions during FIFA Arab Cup 2021

Differences between all positions: GK> D > M > F ($p < 0.05$).

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2.3. Number of sprint per match

The mean number of sprints per match according to all available data (n = 756) was (99.67± 40.70) sprints with an intensity between 15 and 20 km/h and (37.69 ± 17.99) sprints with a higher than 20km/h. Statistically significant differences in terms of the total number of sprints performed were noted between playing positions ($p < 0.05$), i.e. between attackers, midfielders, defenders and goalkeepers. ($p < 0.05$) (figure 8 and 9).

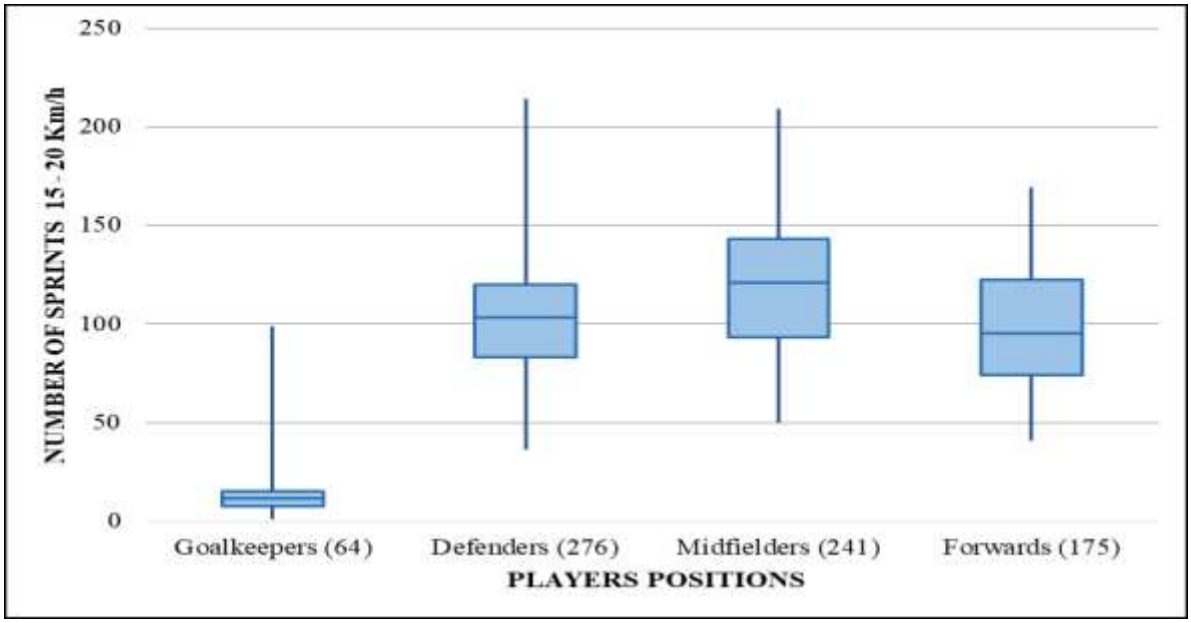

Figure 8. Comparaison at Number of Sprints (15-20 Km/h) by player according to positions during FIFA Arab Cup 2021

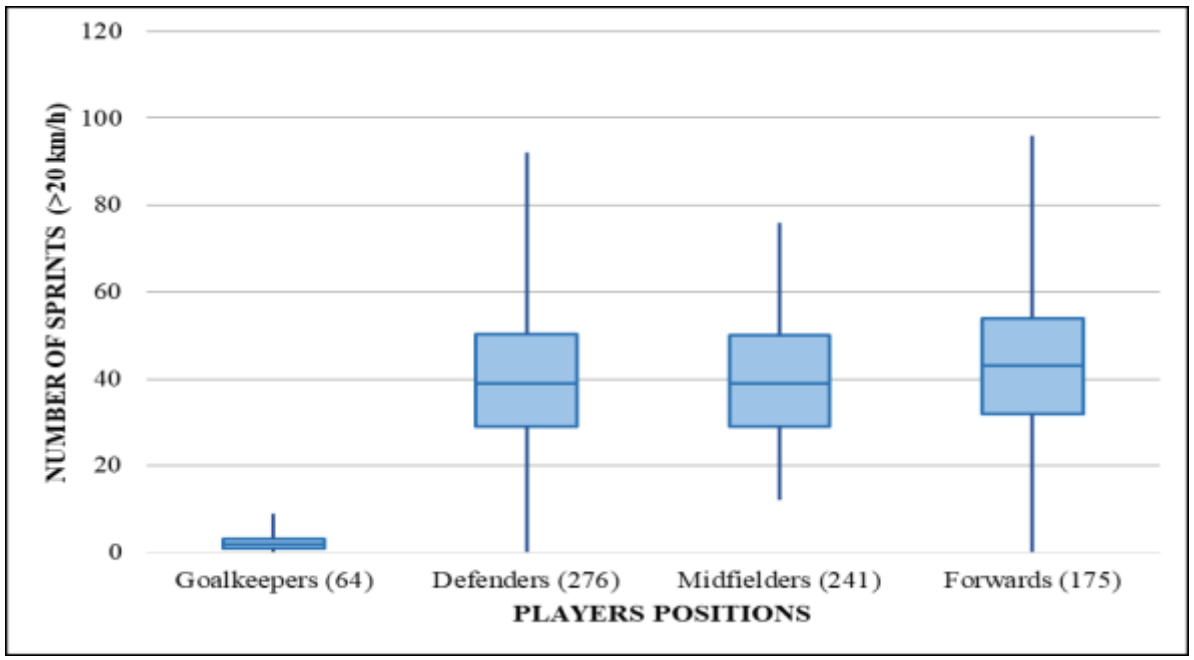

Figure 9. Comparaison at Number of Sprints (> 20 Km/h) by player according to positions during FIFA Arab Cup 2021

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2.4. Top (Maximal) running speed

The mean top running speed in the group of players studied was (30,37±2,71 km/h). Statistically significant differences were noted between all players' positions on the pitch: in particular between midfielders and forwards and defenders ($p < 0,05$).

In terms of players' pitch positions, the highest mean top running speed was attained by the forwards (31,56±1,51km/h) followed by midfielders (30,22±1,07km/h),defenders (31,22±2,73 km/h) . The lowest top running speed was among the goalkeepers (23,83±0,10 km/h) which is normal for them (Figure 10).

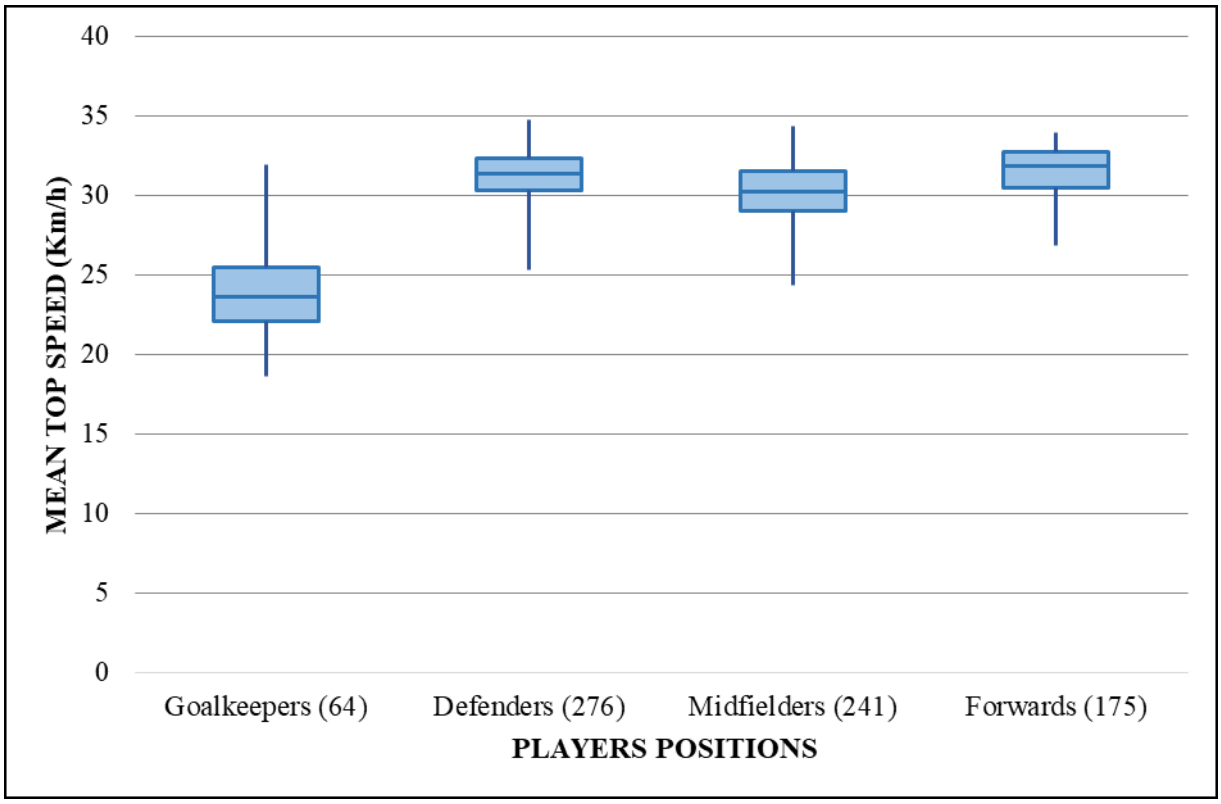

Figure 10. Comparison at Mean Top speed (Km/h) by player according to players positions during FIFA Arab Cup 2021

Differences between all positions: GK > M > F > D ($p < 0.05$).

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3. Discussion

Football as a sport encompasses kinematic, physiological, neuromuscular and tactical variables (Rico-González, et al., 2020) that are determinants of training optimization and match performance improvement (Beato, Jamil and Devereux, 2018). The behaviour of the players during matches must be carefully monitored by coaches and training staff. The limitation of human observation in the coaching process has been confirmed by Franks (1993). Every match and training behaviour of every player on the field is monitored by Electronic Performance and Tracking Systems (EPTS) to guarantee that all technical, tactical, and physical characteristics are evaluated.

Players' performance data is increasingly being gathered automatically throughout training and matches, providing athletes, coaches, and training staff the knowledge they need to reduce injury risks, determine appropriate training loads, personalize training and modifying training methods, improving tactical behaviour, supporting in decision-making, etc.

However, EPTS have become a significant component in monitoring and improving individual football player's and football team's overall external load and qualitative performance (Linke, Link and Lames, 2018). Players in football are undergoing important physical load in game like accelerations, decelerations, changes of direction, sprints, and high intensity distances. Readiness fitness is key to the optimal practice at the highest level. Coaches and training staff have to ensure that players have the right physical preparation and meet the minimum expectation to be ready on game day.

The data presented in the study were obtained from the FIFA Arab Cup 2021. The results revealed differences in the total distance covered during a match between players in different pitch positions. On average, the longest distance was covered by midfielders (9 249,63±130,01 m), followed by defenders (9 233,90 ±3 660,10 m). A shorter distance was covered by forwards (8 273,05 ± 27,89 m), and finally far shorter the goalkeepers (4 207,61 ± 315,73 m).

In order to understand why the total distances covered by the defenders are closer to those of the midfielders, it is necessary to identify the activities of defenders in their corridors, since this shows that the full back defenders and the central defenders exert different amounts of effort during a match.

These results are confirmed by (Di Salvo et al., 2007 ; Dellal, A, et al. ,2011) who in their analysis the Spanish League and the French League respectively, showed that midfielders covered the longest total distance. These higher values than other positions are explained by the dual role of midfielders. Indeed, they participate both in offensive sequences but also in defensive sequences.

Player match activity profiles were determined using percent match time spent in the following speed categories: walking (0 to ≤7 km/h), jogging (>7 to ≤15 km/h), running (>15

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to ≤ 20 km/h), high-speed running (>20 to ≤ 25km/h), and sprinting (>25 km/h). High-intensity running consisted of running, high-speed running, and sprinting (>15 km/h), and very high-intensity running (VHIR) consisted of high-speed running and sprinting (>20 km/h).

These categories have been defined previously for elite level soccer (Bradley PS and Di Mascio M et al,. 2010; Bradley PS and Sheldon W ,et al ,.2009; Di Salvo V and Baron R et al,.2010; Di Salvo V, et al,.2009; Rampinini E, and Bishop D et al,.2007; Rampinini E, and Coutts AJ,. et al,.2007). Distances covered during HIR and VHIR were reported as HIR distance and VHIR distance, respectively. Sprint frequency was determined using the number of entries into the sprinting category lasting at least 1 second where the speed category in the previous 1 second was less than sprinting (≤25km/h).

That is why; a football player must thus perform effectively during these intensive and brief periods since they correspond to important decisions that can determine the outcome of a match. They only represent a small percentage of the match's total time. In reality, the player spends between 7% to 8% of the match time participating in intense activity, about 40% of the time and move around, and between 15 and 20 minutes standing stationary (Mohr et al., 2003).

As according literature on various international competitions, midfielders cover the most total and high intensity running distance in a match while defenders, particularly central defenders, cover the least (Barros RML, et al, 2007; Burgess DJ, et al,.2006; Dellal A, et al,.2011; Rampinini E, et al,.2007). Defenders including central and fullbacks also assessed significantly less total and HIR distance than midfielders and attackers in the present study. However, the mean number of sprints exceed 25 km/h was higher among defenders than attackers (7,00 ± 24,49), with defenders having a higher frequency (7,39± 3,99) than midfielders (6,20± 5,00). Defenders may not necessarily incur the least amount of physiological strain in a match, while covered practically the entire field and needing less intense running distance than other positions.

The study's results indicated that Arab defenders sprint significantly less than attackers but as often as midfielders. Such a discovery has important implication for player training adapted to specific positions. Defenders may not need to cover as much of the field as midfielders do, but they still may need to be just as quick and explosive. Defenders must react to adverse circumstances quickly and stop attack hits. Defenders sometimes need to get to the ball first to stop possibilities for the opposition team to score goals. These activities typically involve higher metabolic rate at low speeds, which imposes a substantial physiological demand on the organism.

One of the most interesting findings in the present study is the observation that the top running speed attained during the studied FIFA Arab Cup 2021 matches by forwards (31,56±1.51 km/h) , midfielders (30,22 ± 1.07 km/h) and defenders (31,22 ± 2.77 km/h). It

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is reasonable to conclude that large differences in top running speeds are present between playing positions.

For forwards, the top running speed may be related to the fact that their high intensity runs are the longest, giving them more time to reach full acceleration. However, it is also likely that the forwards and external midfielders have the highest running speeds, as shown by 30- and 40-m sprint tests (Bangsbo, J., et al, 2006).

The top running speed in the present study was significantly higher than in (Bradley et al,.2009), who in their examination of FA Premier League players found the highest maximal running speed (28.5 km/h) among midfielders, followed by forwards and defenders (28.0 km/h). Bradley et al. (2009) used the Pro Zone computerized tracking system in their match analysis. Presented results correspond with those by (Rey et al,.2010), who observed players in the Spanish Soccer League and found the mean top running speed of professional players at 31 km/h.

Nevertheless, the report of the CIES Football Observatory with the collaboration of SkillCorner in its report (n° 61 – October 2021) noting, a statistically significant link was observed between the age of the players and the distances covered, whether for the total distance or that run at high intensity.

The strongest relationship was recorded between the attackers' age and high-speed runs. The younger the forwards in a team (or league), the greater the distance covered at high intensity. Over time, this decreases for well-known physiological reasons. This element may explain the results of our study

These results would tend to underline that the physical preparation of the top-level footballer Should revolve around intermittent exercise with a ratio 1/8 distance/recovery where the recovery time is calculated on the time allowed to complete the sprint distance.

It would be a work of capacity to repeat the sprints by high-level footballers (RSA). Supra-maximal intensity exercises can is organized over distances of 5 to 20 meters respecting a recovery time equal to 8 times the time needed to complete the sprint.

The recovery can therefore vary between 8 seconds for a 5 m sprint, 15 seconds for a 10 m sprint or even 24 seconds for a 20m sprint. The type of sprint must be random in order to get as close as possible to the activity requirements. Everything can be done in blocks of 4 to 6 minutes.

However, Physical recovery is still required because the recovery report refers to a match and not a physiological delay.

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4. Conclusion

The application of results of the present study based on precise research data from the TRACAB Optical tracking system can improve soccer training effectiveness through greater individualization in speed training and optimal choice of tactical tasks for individual players.

Thus, the distance covered by the players is not an indicator that reflects the level of the team or the Arab Cup 2021. The differences are considered relative, both for the total covered distance and for the high intensity (>15 km/h). Players from Arab teams, however, tend to cover less ground than those in European and Latin American competitions, reflecting a slower playing style.

At the level of match results, players from the winning teams tend to cover a sprint distance (>25km/h) compared to their opponents. However, this primarily reflects the greater tendency of teams to take the lead in counter-attack and not a significant gap between the players of the competitions analyzed from the perspective of running abilities.

However, other research has shown that the vast majority of goals are preceded by a sprint with at least one maximum intensity to score. Thus, the aggregated data examined in this study is probably not the most appropriate to reflect the importance of players' fitness during crucial moments in a match. Hence, further research is needed to analyze the data in more detail.

But a significant relationship was observed between players' position and distances covered, both for total distance and for those run at high intensity. The strongest relationship was also recorded between the attacking playing position and the high-speed sprinting. There are also important differences in the overall distances covered and the running speed between the playing positions.

In a future study, it would be interesting to study longitudinally the evolution of the different variables during the season in order to analyze the periods corresponding to a state of significant fatigue or overtraining in Arab players, this will allow us to effectively assess the physical level.

5. Practical applications

The observations of soccer players' motor and speed actions, which frequently determine the outcome of the match, help in the development of training requirements. The information presented here comes from elite professional athletes that participated in the FIFA Arab Cup 2021, one of the most prestigious competitions in the world.

The results of this research provide crucial information on the function of sprinting in elite Arab football and indicate the different profiles of sprinting efforts according to players' positions on the pitch. The information obtained in this method provides the basis for developing and carrying out speed training regimens that take into account the total running distance, sprint number, and top speed recorded for players at various positions on the field.

However, everyone involved in football player coaching, development, and training must understand the physical demands imposed on the players during competitive matches.

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Depending on the position they play, coaches should train players differently. This is due to the significant differences in physical activity across the different positions.

Coaches must understand the situational and independent aspects that affect the potential outcome and intensity of competitive matches (e.g. circadian rhythms, level of opposition, score-line, tactical organisation and game venue).

The amount of high intensity work required for each position is different so the training for each positional role should be different.

Specific turning exertions and accelerations/decelerations should be included as part of players' physical sessions to maximize their performance for these movements.

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