

The physical effort required from professional football players in different playing positions.

GAETANO ALTAVILLA¹, LORENZO RIELA², ALFREDO PIO DI TORE¹, GAETANO RAIOLA³

¹MIUR Campania, ITALY

²MIUR Veneto, ITALY

³University of Salerno, ITALY

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Abstract

The purpose of this study is to examine the physical effort required at professional football players (Italian Championship) in relation to the examination of a series of friendly matches at different times of the year, compared to their role, using the technology of GPS, for finalizing the training to improve the sport performance. The activities of players were monitored using GPS technology with a sampling rate of 10 Hz. The total distance covered, distances with different speed and accelerations were analyzed in relation to five different roles: (CD) central defenders, (FB) full-backs, (M) midfielders, (AM) advanced midfielders and (A) attackers. Players activities were monitored using GPS technology with a sampling rate of 10 Hz. Total distance covered, distance at different speeds and accelerations were analyzed in relation in five different roles: (CD) central defenders, (FB) full-backs, (M) midfielders, (AM) advanced midfielders and (A) attackers. The maximum covered distance (over 10 km) during a friendly match was reached by the third (FB), midfielders (M) and advanced midfielders (AM); The same ones have covered, too, the greatest distances in high-intensity running (> 16 km / h); instead, the attackers and central defenders covered the distance in high power. The full-backs (FB) and Advanced Midfielders (AM) have produced high acceleration and deceleration compared to other roles, while midfielders (M) have developed greater metabolic power. Finally, the end-of-season results were compared with the data gained at the beginning of the year and important differences between the various roles were noted.

Key Words: GPS, training, energetic cost, metabolic activity, sports performance. .

Introduction

The rhythm play has become more speedy in modern football in the last recent years and players can run faster, perform technical skills with higher speed and better make tactical decision (Alizadeh et al, 2010). Soccer is an high-situational sport with an high agonistic engagement such to require the development of all the conditional capacities (Gaetano & Rago, 2014) and we play a sport to acquire general and specific motor skills (Tiziana et al., 2017, D'Isanto, 2016, D'Isanto & Di Tore, 2016, Di Tore et al, 2016). Among the different physical qualities needed are the ability to perform straight-line sprint and positive and negative acceleration with rapid changes of directions, often referred to as agility (Gunnar & Pettersen, 2015). Physical demands during a football game differ from each playing position. Coaches and anyone involved in training prescription for football player should take in account for these positional variations in distance covered in order to design position-specific physical drills (Rago et al., 2017). To achieve the best run of form by athletes in the team sports, it must be through a targeted workout methodology, rather than through the practice of the game (Raiola & D'Isanto, 2016ab). The assessment in sport has to considered the technological aspects in virtual vision of exercise and sport science (Cirillo et al., 2016). In the last years it has seen a massive entrance of pervasive computing among sport-related technologies (Altavilla, 2016), in fact, physical parameters detection during training through GPS technology is a portable and cost-effective procedure for monitoring workloads (MacLeod et al., 2009). The GPS can also provide immediate responses to the coaches right after the end of the training session. Overall, the physical fitness assessment strategy with GPS is a commonly used method in sports, especially by professional analyst performance. Physical demands imposed on professional football players have been widely documented in recent years (Rampinini et al., 2007; Bradley et al., 2009; Dellal et al., 2011). Explosive actions are elements of success in soccer; sprint times is often only 2-4 seconds and sprints occurs approximately every 90 seconds (Mathisen GE & Danielsen KH, 2014). A football player, on average, covers about 10 km during a match; however, due to the intermittent nature of the game, the total covered distance represents an insufficient parameter to comprehend the overall physical requirements, while the high speed covered distance seems to be a better performance indicator and has been correlated with the standards of the competition (Di Salvo et al., 2009). Physical requirements detected with the GPS in different football matches involve professional players in the Italian league of serie B. Training's loads were monitored via GPS, recording

specific data during the initial stage of preparation and during the agonistic phase of the championship. The aim of this study is to examine the physical needs of professional football players during 20 friendly matches compared to their playing position, comparing the performance result during the agonistic phase with that of initial preparation and with the average of the championship.

Material and methods

Participants

Twenty Italian professional footballers were selected to in friendly matches analysis. The measurements were made during 10 pre-season friendly matches of 90 minutes before the start of 2016-17 (n = 10) and 10 friendly matches during the 90 minute championship season in the 2016-17 season (n = 10). Ten elite men's soccer players have been tested for their role (Mean \pm standard deviation; age: 27,8 \pm 3,1 years; height: 177.8 \pm 4.3; Body weight: 74.1 \pm 4.1) that they played 90 minutes in friendly matches. Positional roles were: central defenders (CD), full-backs (FB), midfielders (M), advanced midfielders (AM) and attackers (A), instead the goalkeepers were not included for analysis. All players were fully informed of all the experimental procedures before giving their verbal consent to participate.

Procedures

In the last years GPS has been widely used in football, as it provides a valid and reliable method for estimating physical workloads (McLellan et al., 2011). The GPS allows you to study physical variables such as metabolic power, frequency and acceleration intensity. The collected data were acquired during friendly matches. Players activities were monitored using K-Sport GPS technology with a sampling frequency of 10 Hz. Before of the start of friendly matches, the GPS units were switched on and placed on the posterior of the readers using a wiring to prevent accidental movements. At the end of friendly matches all the data was downloaded to a Sony Vaio VPCSA laptop and processed with the Dell 13.2 Statistics Software. The validity and reliability of the GPS for analyzing the matches are attested in numerous studies. On all, see it Randers et al., 2010.

Statistical analysis

Main objective of the analysis was to ascertain whether the differences in the distance covered and for the energy expenditure were significant to the point of suggesting specific training plans in relation at the role of the players. The analysis refers to the following categories: Covered total distance (mt), Energetic cost, Distance covered in high speed (> 16 km / h), Distance covered in high acceleration (> 2 m / s²), Distance covered in high deceleration (< -2 m / s²), Distance covered in high power (> 20 W). The values (and relative percentages) were grouped according to the following game positions: Central Defenders (CD), Full-Backs (FB), Midfielders (M), Advanced Midfielders (AM), Attackers (A). The data were collected in two different moments: pre-season phase and agonistic phase. The analysis covered basic statistics and percentages for the categories considered. All statistical analyzes were conducted using Dell's statistical software 13.2.

Results

The total distance covered by the 10 players tested during the pre-season phase was 9143.4 \pm 1098 mt, with FB, M and AM covering a distance greater than CD and A, the midfielders (M) in particular produced the highest metabolic power (both in pre-season and in agonistic phase). In table 1 also shows the distance covered at different speeds with respect to the playing position. Instead, the total distance covered by the 10 players tested during the agonist phase was 9956.8 \pm 775.3 mt, with FB, M and AM covering more and more distance than CD and A, showing an increase in total distance covered by about 9%.

Role of players	Central Defenders (CD)	Full-Backs (FB)	Midfielders (M)	Advanced Midfielders (AM)	Attackers (A)	Averages pre-season	DS	Averages Serie B
Distance covered (mt)	8997,16	10073,93	9588,9	9976,51	7080,51	9143,4	1098	10654
Energetic cost (caloric expenditure)	50,7	56,19	59,87	55,55	40,92	52,6	6,5	58
Distance covered in high speed > 16 km/h	1066,28	1815,7	1414,75	1876,13	1082,56	1451,1	346,1	1917
Distance covered in high acceleration > 2 m/s ²	566,79	548,36	653,29	505,36	516,62	558,1	52,4	650
Distance covered in high deceleration < -2 m/s ²	458,34	447,56	550,92	464,46	434,35	471,1	41,2	638
Distance covered in high power > 20 W	2277,25	2840,22	3197,62	2787,03	1799,75	2580,4	488,4	2982

% distance covered in high speed > 16 km/h	11,85	18,02	13,36	18,81	15,29	15,5	2,7	18
% distance covered in high acceleration > 2 m/s ²	6,3	5,44	6,17	5,07	7,3	6,05	0,8	6,1
% distance covered in high deceleration < 2 m/s ²	5,09	4,44	5,2	4,66	6,13	5,1	0,6	5,9
% distance covered in high power > 20W	25,31	28,19	30,2	27,94	25,42	27,4	1,8	28
Metabolic power	9,09	10,08	10,74	9,92	7,77	9,5	1,0	11,5
% equivalent distance	21,34	20,1	21,78	19,9	24,45	21,5	1,6	21
Number of high-speed accelerations > 2 m/s ²	81	117	124	88	82			
Distance covered > 20 Km/h	364	865	397	768	577			

Tab. 1 - Data detected in pre-season

Players have run, in the agonistic phase, averaged 585 ± 58 in high acceleration (Table 2). Fullbacks (FB) and the Advanced Midfielders (AM) made more accelerations than central defenders (CD), midfielders (M) and attackers (A). The same have run, in average, 517 ± 75 in high deceleration and have been always those who made more decelerations.

Role of players	Central Defenders (CD)	Full-Backs (FB)	Midfielders (M)	Advanced Midfielders (AM)	Attackers (A)	Averages agonistic season	DS	Averages Serie B
Distance covered (mt)	9510,8	10735,2	10586,6	10294,2	8656,8	9956,8	775,3	10654
Energetic cost (caloric expenditure)	53,5	61,5	53,75	58,7	49,1	55,3	4,4	58
Distance covered in high speed > 16 km/h	1785,8	1946,05	1990,3	1998,9	1119,4	1768,1	333,3	1917
Distance covered in high acceleration > 2 m/s ²	586,9	628,2	486,9	656,5	566,8	585,1	58,2	650
Distance covered in high deceleration < - 2 m/s ²	475,02	648,9	458,9	552,8	451,1	517,3	75,1	638
Distance covered in high power > 20W	2750,4	3381,4	2975,5	3218,8	2094,1	2884,02	449,3	2982
% distance covered in high speed > 16 km/h	18,8	18,1	20,8	19,4	11,8	17,8	3,1	18
% distance covered in high acceleration > 2 m/s ²	6,2	5,8	5,08	6,4	6,6	6,01	0,5	6,1
% distance covered in high deceleration < 2 m/s ²	4,99	6,04	4,8	5,4	5,2	5,3	0,4	5,9
% distance covered in high power > 20W	28,02	31,5	31,03	31,3	24,2	29,4	2,8	28
Metabolic power	9,5	10,6	11,6	10,2	8,8	10,1	0,9	11,5

% equivalent distance	21,2	23,5	20,7	22,7	24,2	22,1	1,0	21
Number of high-speed accelerations > 2 m/s ²	117	127	116	123	107			
Distance covered > 20 Km/h	865,5	575,8	893,5	846,8	338,8			

Tab. 2 – Data detected during the agonistic season

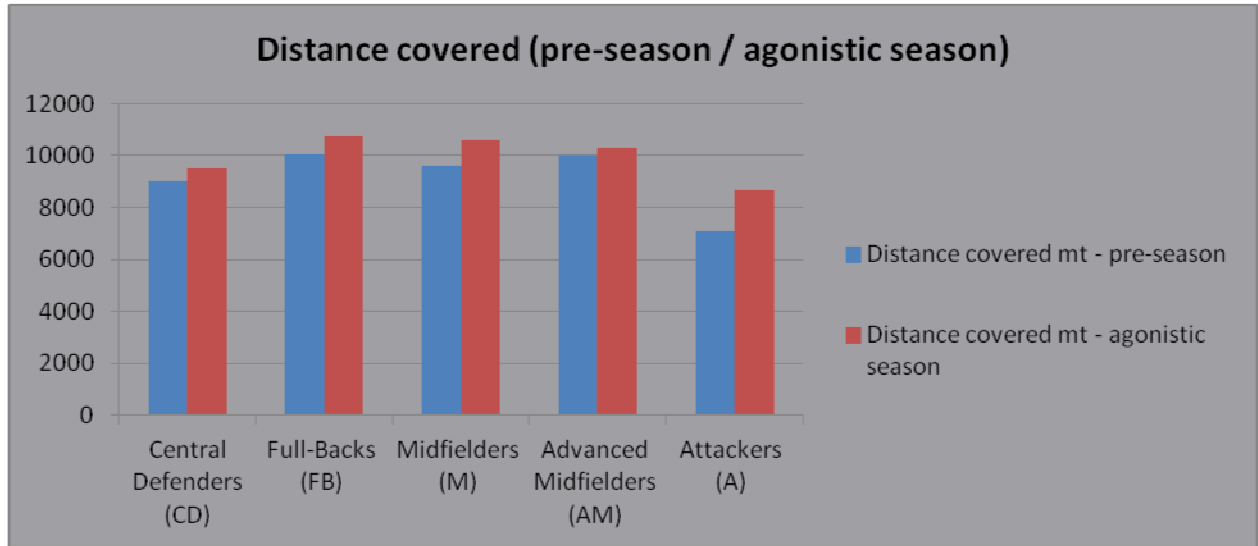


Fig. 1 – Comparing data pre-season and agonistic phase

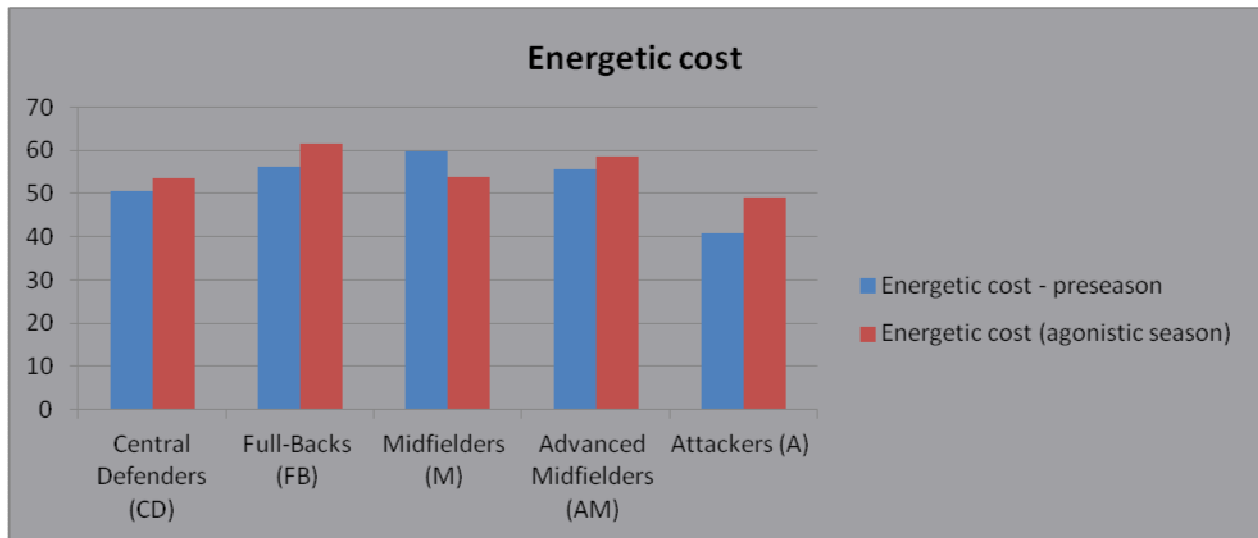


Fig. 2 – Comparing of the energetic cost in the pre-season and during the agonistic season

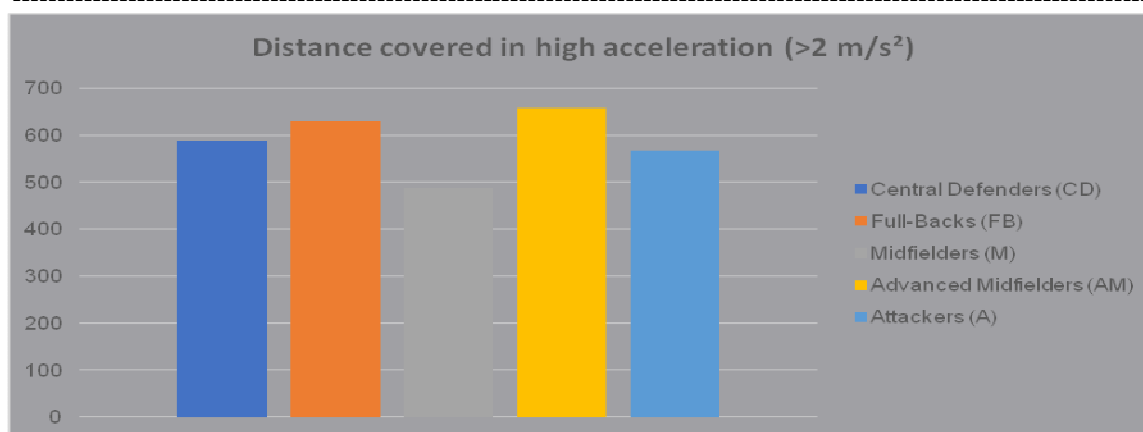


Fig 3 – Distance covered in high acceleration (> 2 m/s²) in relation to roles of the players

Discussion

The physical profile of football players is highly variable, having implications for the interpretation of high-intensity running (Gregson et al., 2010). This study is based on the use of GPS technology to determine the physical demands in match. They have been differences between the game positions, total covered distance and high intensity activity were noted, suggesting the need to develop specific training programs in relation to the role done from the players (Figures 1,2,3). Over the last few years, GPS technology has become a very useful tool to monitor training workloads in team sports (Larsson, 2003), contributing to a more accurate vision of physical commitment. This technology has permitted the correlations between Metabolic Power and Yo-Yo Intermittent Recovery Test Level 1 ($r = 0.60$), especially in elite players, the relationship between Vo₂max and MP (Metabolic Power) is evident; In fact, when improves the performance in Yo-Yo IRT1 also improves the Metabolic Power > 20W / Kg (Castagna, 2012). The distance covered in friendly matches by Italian professional players monitored with GPS devices was on average about 10 km. Positional differences were detected in the total distance covered, as AM, M and FB exceeded the average 10 KM threshold. This is also a feature of other studies conducted on European professional footballers (Italian, Spanish and English), where midfielders have covered more distances, while central defenders (CD) cover smaller distances (Bradley et al., 2009; Dellal et al., 2011). The advanced midfielders (AM), the midfielders (M) and fullbacks (FB) have performed a large number of movements at high speeds (> 16 km / h), while the attackers (A) and central defenders (CD) have performed a significantly smaller number of high-speed movements (> 16 km / h), but they have performed more movements in high acceleration (>2m / s²). Overall, this should have practical consequences on training schedule, as CD and A need to stimulate their ability to produce frequent high intensity accelerations. The high intensity covered distance has traditionally been identified as a key indicator of the physical performance during the matches (Mohr et al., 2003) and was related to the state of training (Krustrup et al., 2003). Accelerating and decelerating skills play a key role in professional football, as they represent highly challenging energy activities. The huge request for acceleration and deceleration phases in football as in basketball, many of which with variations of trajectory above 30°, this leads to thinking on the usefulness of using of the on-line run; therefore, the on-line run, should be limited to player retrieval, as neuromuscular commitment is reduced. It is easier to brake in shortly than to restart; the power\strength that is developed in braking is of about four times higher than that is developed in acceleration. The metabolic power of the braking has a low cost of energy, muscles seem more suitable to curb rather than accelerate (di Prampero, et al., 2005). This led to the need to redefine the concept of high intensity exercise on base on current metabolic power rather than on speed (Osgnach et al., 2010). For example, significant differences have been found between the high intensity covered distance and the equivalent metabolic power estimated during professional soccer formation activities (Gaudino et al., 2013). The development of strength and resistance in team sports must always be linked to the coordination of the action from to do and at the repetition of these actions with short intervals of time, so that metabolic engagement is always high.

Conclusion

The data was obtained on 20 friendly matches and not by official matches. The sampling frequency of the GPS (10 Hz) compared to 1 Hz allows to increase the accuracy of the measurements, especially with regard the effort to high speed (Cummins et al., 2013). Advanced Midfielders (AM) and Fullbacks (FB) have showed great physical requirements during the game, both in terms of total covered distance and in terms of distance covered at high speed, high acceleration and deceleration; while the midfielders (M) produced a high metabolic power (11.6), higher than the reference average (Italian championship of serie B). The results of this study demonstrate that physical needs are influenced by player gaming positions and must be used to program specific training plans based on their role. It is important has clear the specific work to be done for each role and at

various times of the year in order to get meaningful team improvements and this can be postponed to a subsequent study, where the different training plans will be analyzed for each role.

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