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Data Comparison between Elite and Amateur Soccer Players by 20 Hz GPS Data Collection

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Abstract: The athletic component in football is nowadays one of the most important factor to determinate the performance. This consideration is part of our study, which aims to evaluate and quantify the difference between the workload of an amateur footballer and an elite one. All this is allowed by match analysis made by GPS evaluation method for amateur and video tracking for elite. The examined teams were playing in 7th Italian league, and we used 10 GPS to track 6 games, 5 for each team. For every team and every game were analysed a forward, a central midfielder, a wide midfielder, a central defender and a full back (Age 25.3 ± 4.2, Weight 74.5 Kg ± 5.3, Height 1.76 cm ± 5.2). In our study, we used a 20 Hz GPS (thanks to Advanced Research Group in Sport, School of Health and Sport Science with K-Sport Universal, Italy) to detect performance data, and then we compared the outcome with matches performance data from elite players gather from scientific literature. Data analysis shows that elite players reach higher values in almost all parameters taken into account. In particular, they obtained higher value in meters per minutes, High Speed Distance (> 16 Km/h), High Metabolic Power Distance (> 20 W/Kg) and in high and very high and acceleration (2 m/s, 3 m/s, > 3 m/s) and deceleration (-2 m/s, -3 m/s, > -3 m/s). This study can be useful to select and catalogue player performance model, in order to better understand the real value of a player, and to help coaches and teams to identify talent, at least in physical values.

Key words: GPS, soccer performance, athletic data, match analysis, amateur player, elite player.

1. Introduction

We know from literature that footballers travelled on average a distance of 11 Km per game, with changes of intensity every 3 to 5 seconds characterized by moments of high energy engagement (30% of commitment, about 200 high-intensity actions per game) and low engagement moments (70% of commitment) [1]. Football is therefore considered an aerobic/anaerobic alternate sport, where maximum sprints, directional changes, elevations, contrasts are performed, with more or less short recovery phases. The player performance model (PPM) is multidisciplinary and dynamic. Then PPM is a set of complex interactions, formed, as mentioned, by various components at the same time, and it must be dynamic and adaptable to the match situations, in fact, it varies for instance from the category or from country to country, according to the game styles and the characteristics of the athletes involved in the matches [2]. Mohr et al [3] demonstrated that the players travel in the field for most of the time at low speed, making about 11 Km per game and an energy expenditure of 61 KJ/KG, 42% of which is given by the high intensity. Another important aspect in the player performance is number and intensity of sprint, during games. There is a sprint every 90 seconds, each with an average of 2-4 seconds duration, their covered the 0.5%-3% of total playing time. Normally they are in 96% of cases shorter than 30 mt and in the 50% shorter than 10 mt. The players that travel the farthest distance in sprint are the forwards, followed by full back defenders and wide midfielders, while the central defenders and central midfielders are the ones who make the fewest meters. Accelerations and decelerations are another determinant aspect, respectively for accelerations is

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calculated from 2.5 to 4 ms^2 and decelerations -2.5 to -4 ms^2, players produce an average of 100 variation for each match. Are also evaluated the intense accelerations (IA > 4 ms^2) and intense decelerations (ID < -4 ms^2) that are around 10 per game. Their number, obviously decrease during the second half [2]. The studies we saw are been made on professional footballers, which represent the smallest proportion of footballer all over the world. From this, the need to quantify the amateur PPM, which have expected by collective imagination, smaller in athletic effort than in elite players. In order to take a look at an overview of the situation, we compared data from literature (Table 1). These studies are not related with games because the tests were carried out during training, a situation that let us understand more than just some differences rather than a real game model.

2. Materials and Methods

We have been analysed, using K-GPS 20 Hz (from K-Sport International, Italy), six championship matches, from first category Marche, Italy (7th Italian championship series) during 2016 season. We used 10 GPS to track every game, five for each team divided into positions. For every team and every game were analysed a forward, a central midfielder, wide midfielder, a central defender a full back. This was done to give greater specificity and differentiation to performance indicators, in order to define both the peculiarities of the various roles, both obtained relevant and reliable ideal parameters. The GPS have been added inside a specific sport shirt with a pocket placed on its back, in a position that does not cause an impediment to the player. As we said already, 10 GPS where divided 5 for each team, one for every role: as cited central back defender, a full back defender, a central midfielder, a wide midfielder and a forward. The GPS were worn and turned on before warm-up. Data were collected by downloading them all from the GPS devices with a dedicate software (K-Fitness, K-Sport International, Italy). The information files, on ".cvs", were filtered and analysed through the software automatically and directly have been stored in online portal (K-Sport Online, K-Sport Universal, Italy). Through the portal, it was possible to download the Excel spreadsheet containing all the data of the matches. The parameters take under consideration were: TD (Total Distance, meters); Meters Minutes (meters/minutes); High Peak Velocity (Km/h); High Metabolic Power Distance (> 20 W/Kg); High Speed Distance (> 16 Km/h); High Acceleration Distance (2 m/s, 3 m/s); High Deceleration Distance (-2 m/s, - 3 m/s); % Anaerobic Expenditure; Very High Acceleration Distance (> 3 m/s); Very High Deceleration Distance (< -3 m/s); Energetic Expenditure (Kj/Kg).

At least, it was possible to create the appropriate discussion, by comparing the examined category with the data reached form elite players, obtained from literature [4].

3. Results

In Tables 2-4, we observe the comparison of the data we have found with data from literature.

From the data found, it is evident that the professionals are most effective on almost all aspects.

Table 1 Comparison of different studies between elite and amateur players.

Studies	Parameters	Elite Players	Amateur Players
Wells et al. (2012)	VO_2 max	56.5 ± 2.9 $ml \cdot kg^{-1} \cdot min^{-1}$	55.7 ± 3.5 $ml \cdot kg^{-1} \cdot min^{-1}$
	Average RST (30 m)	6.69 ± 0.36 s	7.02 ± 0.25 s
Haugen et al. (2015)	VO_2 max	62 ± 2 $ml \cdot kg^{-1} \cdot min^{-1}$	± 61 $ml \cdot kg^{-1} \cdot min^{-1}$
	Accelerations (20 m)	± 2.7 s	> 2.8 s
Rampini et al. (2009)	VO_2 max	58.5 ± 4 $ml \cdot kg^{-1} \cdot min^{-1}$	56.3 ± 4.5 $ml \cdot kg^{-1} \cdot min^{-1}$
	Average RSA (20 m + 20 m)	7.17 ± 0.09 s	7.41 ± 0.19 s

Table 2 Comparison between amateur and elite football players.

Category	TD	Meters Minutes	High Peak Velocity	High Metabolic Power Distance (> 20 W/Kg)
Amateur	8.743 Km	91.68 m	28 Km/h	2014 m (22.80 % of TD)
Elite	10.950 Km	120 m	31 Km/h	2839 m (25.9 % of TD)

Table 3 Comparison between amateur and elite football players.

Category	High Speed Distance (> 16 Km/h)	High Acceleration Distance (2 m/s, 3 m/s^2)	High Deceleration Distance (-2 m/s^2, -3 m/s^2)	Anaerobic Expenditure %
Amateur	1048 m (11.76% of TD)	427 m (4.87% of TD)	448 m (5.12% of TD)	36%
Elite	1.996 m (18% of TD)	411 m (3.75% of TD	599 m (5.4% of TD)	27%

Table 4 Comparison between amateur and elite football players.

Category	Very High Acceleration Distance (> 3 m/s^2)	Very High Deceleration Distance (< -3 m/s^2)	Energetic Expenditure
Amateur	144 m	138 m	48 KJ/Kg
Elite	188 m	180 m	61 KJ/kg

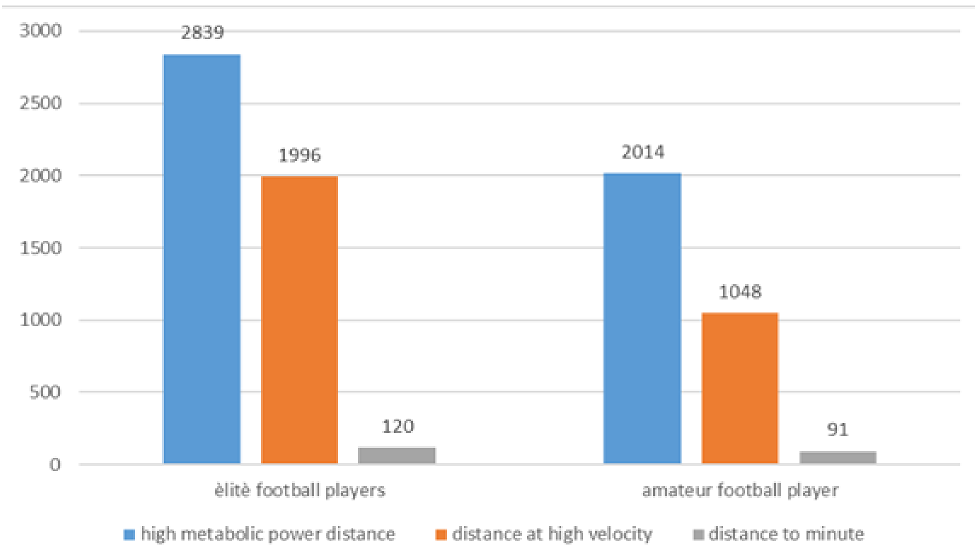

Fig. 1 Comparison of High performance parameters between categories (meters).

Although the due considerations need to be made: the differences on total distance are almost blank. On quantitative level, the differences are almost blank, as well as with the maximum velocity peak. The major differences (Figs. 1 and 2) are found on parameters related with high intensity. The elite players:

- On TD travelled 2207 meters more than amateurs,
- On Meters Minutes reached a higher value than amateurs,
- On High Metabolic Power Distance travelled 825 meters more than amateurs, with an increase of + 3.1% of TD,
- On High Speed Distance travelled 948 meters more than amateurs, with an increase of + 6.24% of TD,
- On Very High Deceleration Distance travelled 44 meters more than amateurs, and 151 meters more on High Deceleration Distance,
- On Very High Acceleration Distance travelled 42 meters more than amateurs,
- On Energetic Expenditure reached a higher value then amateur,
- On High Peak Velocity reached a higher value then amateur.

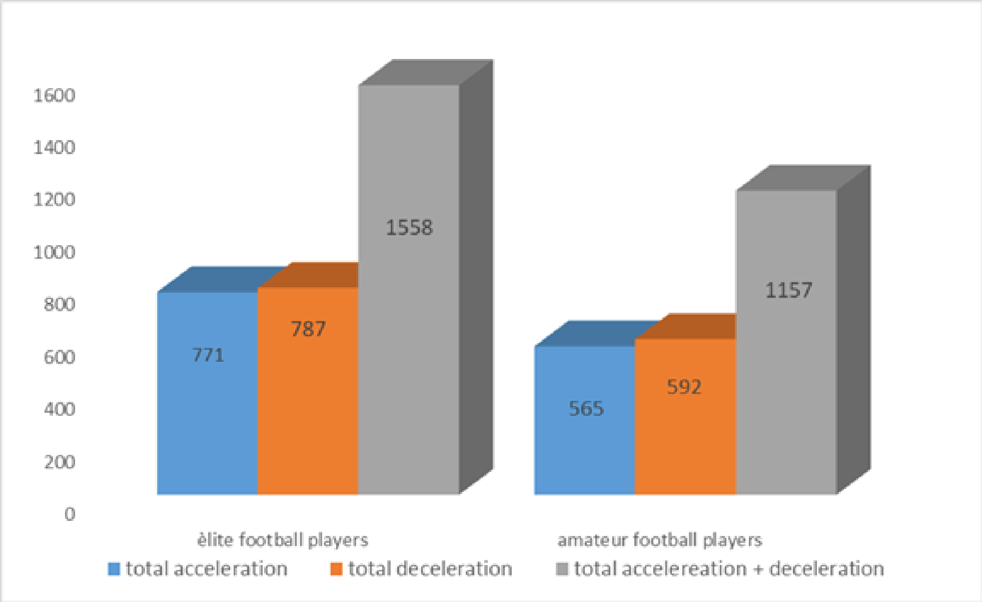

Fig. 2 Comparison of acceleration and deceleration between categories (meters).

On the other side, the amateurs recorded in average: Higher value in % Anaerobic Expenditure; Higher values in High Acceleration Distance.

4. Discussion and Considerations

Our initial assumptions were partially contradicted by the data obtained. In fact, in this study, we have seen how the real difference between an amateur footballer and an elite is on the quality rather than on the quantity, and obviously with quality we mean all those parameters referring to the high intensity. Of course we do not get into consideration about the technical nature of footballers since it is not the purpose of this study. Although one can easily imagine how the lower technical and tactical skills in the amateur championships greatly affect the different athletic component. Interesting observations can be made by analyse the data.

The greatest energy expenditure (+ 13 KJ/Kg) of elite may be due to the greater covered metabolic power distance (+ 825 m), the latter due to the greater total acceleration and deceleration (+ 34%) 17% of anaerobic expenditure produced by elite can tell us how they are more efficient in understanding when it is the right time to "speed up", being therefore more effective in getting energy from aerobic glycolysis.

The difference in the very high acceleration distance (> 3 m/s^2) is higher in elite, but it is really small (42 meters). Professionals carry a very short distance (44 meters) at very high deceleration (< -3 m/s^2) than amateurs, probably due to the greater distance covered by high-speed elite (948 meters difference).

The difference in total distance (+ 2.207 m) may seem remarkable, but in reality it is not so much since some of the players we have monitored have travelled up to 10.7 Km per game. So theoretically, considering only this parameter could safely face a professional championship.

5. Conclusion

The purpose of the study was to investigate the physical performance indexes of amateur players through the use of the GPS system 20Hz, and to compare the obtained data with values of elite footballers from literature. Elite players show higher values in almost all parameters. No significant differences have been observed on peak of speed, while the Energy and Anaerobic expenditure values are lower in elite. This data demonstrates that elite players can manage better the physical efficiency on field. This can be correlated with a better tactical and technical preparation, that helps elite to understand the moments of matches and figuring out when to accelerate and when to produce a low intensity aerobic run, in order to saves energy for crucial moments. This study can be useful to select and catalogue PPM, in order to better understand the real value of a player, and to help coaches to identify the talent (at least in physical values). These studies could be perfected, with a full season monitoring of the amateur championship, in order to detect, an amount of data, less affected by errors and fortuity. This situation would allow us to detect athletic differences during the various phases of the season, considering above all that such studies do not exist in the scientific literature. Therefore, it is necessary to focus more on data in order to allow better contextualization and accuracy of results when compared with professional. In order to determine exactly performance models for these categories, further studies are needed. It will be interesting to compare athletes, dividing positions and minutes played, to determine the real performance parameters for each roles.

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