Journal of Sports Science 6 (2018) 246-250
doi: 10.17265/2332-7839/2018.04.004

Analysis of Speed Thresholds in Youth Amateur Football Players Divided by Roles Using GPS Technologies

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Abstract: Ability to accelerate, decelerate, recover and sprint again, is a crucial ability for team sports, athletes are forced in repeating this actions several times during matches. The objective parameters that influence resistance to sprints are their duration and recovery. The aim of this study was to analyze performance of young under 18 football players on high intensity running thresholds with the use of GPS 20 Hz (K-Sport Universal, Montelabbate, Italy). We have analyzed three football matches of Marche Amateur under 18 Championship (Italy) during 2017 season, using 10 GPS, one for each players except the goalkeeper. In order to better define a more accurate PPM (players performance model), the players that have been substituted were removed from analysis, using only data from full match to build database. Total of detection is 26, with an average of 8.6 players for match divided by role. Our result according with literature shows that in total distance, the role that obtained higher value was external midfielder and forward traveled more distance in sprint.

Key words: Speed thresholds, GPS, performance analysis, amateur, roles comparison, football.

1. Introduction

In modern football, the ability to repeat sprints for the major part of a match, is essential for the performance and especially for the outcome of the game itself. The ability to accelerate, decelerate, recover and sprint again, is a crucial ability for team sports, where athletes are forced in some circumstances to repeat several times in a match this sequence. The objective parameters that influence resistance to sprints are their duration and recovery [1]. From a physiological point of view, the parameters that mainly affect this capacity are the anaerobic power and ability to use blood lactate of athletes. In fact, athletes with a high anaerobic power are able to produce higher level of mechanical work during match; however, the buffer capacity remains decisive for sprints resistance. Until now, it has been difficult to evaluate this capacity with traditional methods, recently technology, in particular the GPS and video tracking systems which have been useful for a better evaluation of physical performance during trainings and matches. The sprint is a running movement that exceeds the speed threshold of 5.0-6.7 ms^2 for an average duration of 2-4 seconds; with speed thresholds exceeding 20 km/h. In sports like football, most of the sprints occur over very short distances often less than 10 meters [2]. Player must express in a short time their accelerative and declarative potentialities, in order to win the inertia of his body as quickly as possible, since technically the positive performance against the direct opponent is obtained mainly in the first or second acceleration meter. Therefore, the techniques for overcoming the inertia constituted by body mass and therefore providing an initial speed as high as possible are very important. Therefore, the first 2-3 steps following a congruous action at the beginning of the gesture are fundamental. As regards the performance model of the players during

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Table 1 Activity of football players during time.

Type	Percentage (%)
Standing	5.7 ± 2.3%
Walking	58.8 ± 4.7%
Running (9-18 km/h)	26.2 ± 3.6%
High intensity (18-25 km/h)	8.7 ± 1.6%
Sprint (> 25 km/h)	0.6 ± 0.3%

Table 2 Sprint performance of football players divided by role.

	FB	CB	CC	EM	FO
Sprint (meters)	233 ± 98 m	131 ± 66 m	163 ± 85 m	285 ± 111 m	242 ± 106 m
N.Sprints	29.5 ± 11.7	17.3 ± 8.7	23.5 ± 12.2	35.8 ± 13.4	30 ± 12

Table 3 Acceleration and deceleration performance of football players during matches divided in first half and second half.

Actions	First half	Second half	Decreasing (%)
Acceleration (2.5/4 ms^2)	56 ± 12	50 ± 13	12%
Deceleration (-2.5/-4 ms^2)	67 ± 14	56 ± 14	20%

the matches are shown in Table 1 [3].

High intensity running and sprint are only the 9-10% of total effort, but crucial for create important actions and goals. A study from Di Salvo et al. [4] show (Table 2) that professional football players that reach higher distance and number of sprint are the EM (external midfielders), followed by FO (forwards) and FB (full backs). The sprints constitute 3-6% of the total distance covered during a match and 0.6-0.3% of the actual playing time. They also result in 96% shorter than 30 m and for 49% shorter than 10 m, the average total numbers of sprints are 27.2 ± 7.0.

Moreover, the accelerator and deceleration always referring to time and distance traveled are part of the player's performance model. Recently another study has been published [3] (Table 3) which discriminates the two half of matches with regard to the times and meters traveled in acceleration and deceleration, breaking them down for the various roles. In reference to the roles it was noted that the attackers make 27.50% and 30.4% average accelerations (2.5-4 ms^2) less than what recorded by the defenders and midfielders; 25.46% less average decelerations from (-2.5 to -4 ms^2) and 50.16% less high decelerations (< -4 ms^2) compared to midfielders, while midfielders make 37.75% more high decelerations than the defenders.

Studies previously carried out and then confirmed by a recent study report blood lactate values during a high level football match of 8-12 mmol/L. This recent study reports the values of blood lactate for roles where it is stated that the goalkeepers have values equal to 9.3 ± 2.2 mmol/L, the CB (central backs) 9.8 ± 2.7 mmol/L, the FB 9.1 ± 3.0 mmol/L, the M (midfielders) 9.6 ± 1.7 mmol/L, and finally the FO 9.6 ± 2.3 mmol/L. Other authors add that the blood lactate values in the blood, during a match, vary between 4.2 and 11.9 mmol/L, with a peak value of 7.9 mmol/L; the average values after intense periods of play are estimated at 6 mmol/L in the first half and 5 mmol/L in the second half [5]. All these data are in agreement with other studies [6] which indicate lower blood lactate values in the second half compared to the first, correlated with the reduced distance traveled and the lowest intensity reached. Taking a step back and reconnecting to sprint, we cannot talk about speed thresholds. In a football game of any level, players travel several meters at different speeds that are identified as thresholds. According to some authors the high running intensity is made to coincide with speeds starting from 13.1 up to 16 km/h (HIR—high intensity running). From 16.1 to 20 km/h we will have a very high running speed (VHIR—very high intensity running). Speeds above 20 km/h are indicate like sprint [7].

Table 4 shows data from professional players regarded total distance and sprint distance; midfielders cover a greater total distance, while forwarders run more distance in sprint than other roles. The highest number of sprints made during the official races are charged to the fullbacks and the external midfielders, it should also be reported that there is a decrease in the speed thresholds between the first and second time.

2. Means and Method

The aim of this study was to analyze performance of young under 18 football players on high intensity running thresholds with the use of GPS 20 Hz (K-Sport Universal, Montelabbate, Italy). There were analyzed three football matches of Marche Amateur under 18 Championship (Italy) during 2017 season, using 10 GPS, one for each players except the goalkeeper. In order to better define a more accurate PPM, players that have been substituted were removed from analysis, using only data from full match to build database [8]. Total of detection is 26, with an average of 8.6 players for match divided by role. 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. The GPS were worn and turned on before warm-up. Data were collected by downloading them all from GPS devices with a dedicate software (K-Fitness, K-Sport International, Italy). The information files, on ".cvs", were filtered and analyzed 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 taken under consideration were TD (total distance, meters); D_HI (high intensity > 16 km/h); D_S4 (16-21 km/h); D_S5 (21-25 km/h); D_S6 (sprint, > 25 km/h); High acceleration distance (D_> 2 m/s); High deceleration distance (> -2 m/s). Data collected were divided in full match, first half (T1) and second half (T2), in order to figure it out the differences in performance during different periods of matches.

3. Data Analysis and Discussion

Data from full match show (Table 5) that the position that obtained higher values was EM, recording higher values in every parameters took in consideration. In the second position was FO that produced more high intensity effort with less total distance travelled. Other roles show very close data. Role that recorded worst high intensity value was CB. Talking about SD, the role that shows a less value was FB. Tables 6 and 7 show data from T1 and T2.

Table 4 Average of total distance and sprint distance divided by role.

Role	Total distance	Sprint distance
CB	10,425.9 ± 808 m	199.4 ± 65.6 m
FB	10,655.5 ± 860.0 m	241.3 ± 69.9 m
CM	11,501.3 ± 901.2 m	220.9 ± 76.2 m
EM	12,029.5 ± 977.5 m	235.4 ± 85.0 m
FO	10,942.7 ± 978.5 m	290.4 ± 75.2 m

Table 5 Average data from full match divided by role.

Full match							
Role	D.T	D_HI	H_ACC	H_DEC	D_S4	D_S5	D_S6
FO	8,228 ± 329	1,236 ± 427	379 ± 90	342 ± 88	601 ± 207	315 ± 156	121 ± 83
CM	8,913 ± 914	937 ± 302	357 ± 95	340 ± 109	518 ± 222	158 ± 59	67 ± 12
EM	9,480 ± 529	1,326 ± 350	436 ± 114	419 ± 83	842 ± 218	348 ± 131	143 ± 68
CB	7,735 ± 386	745 ± 301	332 ± 61	291 ± 32	412 ± 126	157 ± 79	58 ± 45
FB	7,592 ± 779	742 ± 71	342 ± 75	323 ± 85	342 ± 146	221 ± 31	65 ± 30
Avg.	8,462 ± 900	1,029 ± 396	373 ± 92	346 ± 88	567 ± 248	245 ± 132	95 ± 64

Table 6 Average data from T1 divided by role.

T1							
Role	D.T	D_HI	H_ACC	H_DEC	D_S4	D_S5	D_S6
FO	4,320 ± 261	661 ± 205	215 ± 49	191 ± 52	334 ± 111	173 ± 76	61 ± 49
CM	4,528 ± 256	498 ± 166	220 ± 25	204 ± 28	307 ± 121	89 ± 33	27 ± 6
EM	4,885 ± 442	780 ± 220	240 ± 63	233 ± 56	471 ± 124	211 ± 88	98 ± 71
CB	4,175 ± 429	445 ± 221	195 ± 41	175 ± 25	244 ± 91	101 ± 73	34 ± 42
FB	3,765 ± 260	482 ± 114	169 ± 48	162 ± 70	209 ± 113	119 ± 48	45 ± 40
Avg.	4,393 ± 477	586 ± 226	212 ± 49	196 ± 49	325 ± 138	143 ± 81	55 ± 52

Table 7 Average data from T2 divided by role.

T2							
Role	D.T	D_HI	H_ACC	H_DEC	D_S4	D_S5	D_S6
FO	3,908 ± 275	575 ± 253	163 ± 54	151 ± 48	267 ± 117	141 ± 95	60 ± 43
CM	4,385 ± 875	439 ± 172	137 ± 79	136 ± 82	211 ± 139	69 ± 39	40 ± 15
EM	4,594 ± 311	546 ± 224	196 ± 62	186 ± 51	371 ± 136	137 ± 86	45 ± 41
CB	3,559 ± 404	300 ± 131	137 ± 42	116 ± 32	168 ± 74	55 ± 27	23 ± 6
FB	3,827 ± 566	260 ± 157	173 ± 52	161 ± 26	132 ± 101	102 ± 52	20 ± 10
Avg.	4,068 ± 614	442 ± 221	161 ± 59	149 ± 54	242 ± 136	102 ± 73	40 ± 31

Table 8 Percentage of average decreasing between T1 and T2.

% Avg. decreasing							
Role	D.T	D_HI	H_ACC	H_DEC	D_S4	D_S5	D_S6
FO	-11%	-15%	-32%	-26%	-25%	-22%	-2%
CM	-3%	-13%	-60%	-49%	-45%	-28%	+34%
EM	-6%	-43%	-22%	-25%	-27%	-54%	-115%
CB	-17%	-48%	-42%	-50%	-45%	-81%	-48%
FB	+2%	-85%	+3%	-1%	-57%	-15%	-118%
Avg.	-8%	-32%	-31%	-31%	-34%	-39%	-38%

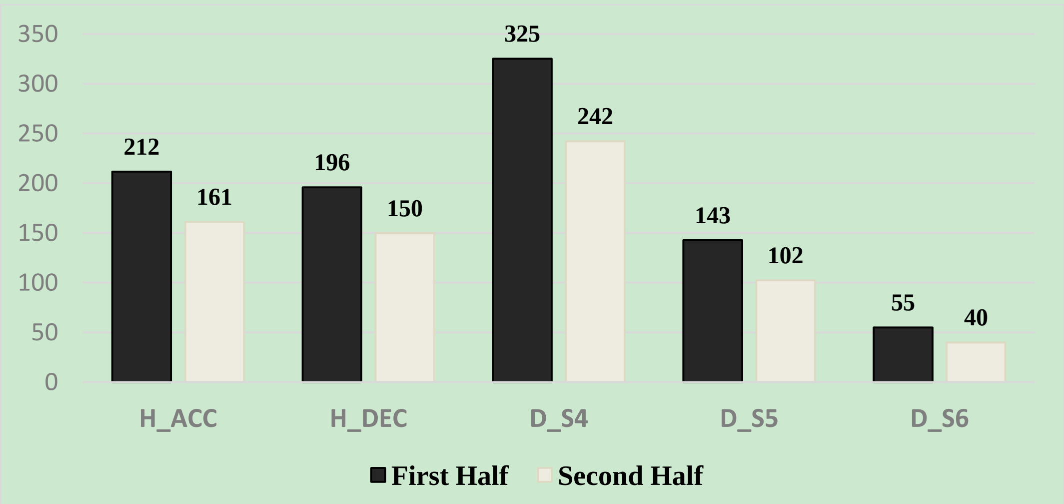

Fig. 1 Comparison between first and second half from high intensity actions.

Table 7 shows data from T2, during second half the role that shows higher value was EM.

In order to determinate differences between T1 and T2, here calculated the percentage decreasing of parameters (Table 4 and Fig. 1). Team average recorded: on D.T a -8%, on D_HI -32%, on H_ACC

-31%, in H_DEC -31%, on D_S4 -34%, on D_S5 -39% and on D_S6 -38%. In specific:

On D.T, CB shows higher decreasing -17%, FB shows a rise of 2%;

On D_HI, FB shows higher decreasing -85%;

On H_ACC, CM shows higher decreasing -60%, FB shows a rise of 3%;

On H_DEC, CB shows higher decreasing -50%;

On D_S4, FB shows higher decreasing -57%;

On D_S5, CB shows higher decreasing -81%;

On D_S6, FB shows higher decreasing -118%, CM shows a rise of 34%.

The role that shows a less decreasing value of all parameters was FO (Table 8). In Fig. 1, it showed data comparison of team average between T1 and T2.

4. Conclusions

The aim of this study is to analyze performance of young amateur under 18 football players on high intensity running thresholds with the use of GPS 20 Hz (K-Sport Universal, Montelabbate, Italy). Our result according with literature [7] shows that in TD, roles that obtained higher value were EM and on D_S6 were FO. EM showed even higher value in D_HI. That is correlated with tactical, FO are forced to have acceleration that is more fast, deceleration and sprint, in order to overpass CD. Talking about EM, tactically they need to cover more space than other players and helping team in attacking and defending. Second aim of this study is to determine the differences between T1 and T2, as was obvious we detected a decreasing average of 30% in all intensity parameters. Role that shows higher decreasing was CB and role that shows less decreasing was FO. To better determine the player performance model of high intensity parameters of under 18 football players, it would be useful to cover a full season using GPS system, in order to detect data less affected by case.

References

[1] Girard, O., Villanueva, A., and Bishop, D. 2011. "Sprint Ability Part I: Factors Contributing to Fatigue." *Sports Medicine* 41 (8): 673-94.

[2] Mohr, M., Krustrup, P., and Bangsbo, J. 2003. "Match Performance of High-Standard Soccer Players with Special Reference to Development of Fatigue." *Journal of Sports Sciences* 21 (7): 519-28.

[3] Whebe, G. M., Hartwig, T. B., and Duncan, C. S. 2014. "Movement Analysis of Australian National League Soccer Players Using Global Positioning System Technology." *J. Strength Cond. Res.* 28 (3): 834-42.

[4] Di Salvo, V., Baron, R., Tschan, H., Calderon Montero, F. J., Bachl, N., and Pigozzi, F. 2007. "Performance Characteristics According to Playing Position in Elite Soccer." *Int. J. Sports Med.* 28 (3): 222-7.

[5] Stølen, T., Chamari, K., Castagna, C., and Wisløff, U. 2005. "Physiology of Soccer. An Update." *Sports Med.* 35 (6): 501-36.

[6] Impellizzeri, F. M., Marcora, S. M., Castagna, C., Reilly, T., Sassi, A., Iaia, F. M., and Rampinini, E. 2006. "Physiological and Performance Effects of Generic Versus Specific Aerobic Training in Soccer Players." *Int. J. Sports Med.* 27: 483-92.

[7] Dellal, A., Wong, D. P., Moalla, W., and Chamari, K. 2010. "Physical and Technical Activity of Soccer Players in the French First League with Special Reference to Their Playing Position." *Int. J. Sport Med.* 11 (2): 278-90.

[8] Izzo, R., De Vanna, A., and Vade'i, C. H. 2018. "Data Comparison between Elite and Amateur Soccer Players by 20 Hz GPS Data Collection." *Journal of Sports Science* 6: 31-5.