EXTERNAL AND INTERNAL PARAMETERS OF EFFORT IN MONITORING THE TRAINING OF JUNIOR FOOTBALL PLAYERS USING GP-SPORTS

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Abstract

In the game of football, metabolic systems are exerted as follows: 70% aerobic system, 15-20% anaerobic lactacid system and 10-15% anaerobic alactacid system. Knowing the complexity and speed at which technical and tactical actions are performed during a football game requires monitoring specific effort through modern equipment able to provide real-time information about the values of external and internal effort parameters, the metabolic effort zones which are exerted, etc. All these data allow coaches to identify the strengths and weaknesses of the players/team and to conduct specific preparation in a scientific way. The experiment tested athletes from two clubs listed in the Municipal Football Championship of Bucharest, namely Dinamo Club (ranked 1st) and CSS1 Club (ranked 4th).

Keywords*: Football, MAV, anaerobic plateau, GPSports.*

JEL classification: ***119,120***

Introduction

To achieve remarkable performances during a match, it is not enough to have the motivation and desire to succeed, but it is also necessary to understand the concept of total training, which claims that man is an indivisible whole and each exercise has a global impact on all components of performance (Brunet-Guedj E. et al., 2006). During a football game, metabolic systems are exerted as follows: 70% aerobic system, 15-20% anaerobic lactacid system and 10-15% anaerobic alactacid system (Cazorla G., 2002). It should be mentioned that, for reaching a steady state of maximal oxygen consumption (VO2max), this one goes through several intermediate stable states which are encompassed in the concept of VO2 DRIFT. Coaches should avoid the serious error of working in the slow component of VO2max (Wilmore J. H. et al., 2008).

The metabolic support of effort in the game of football is dominated by aerobic zones (aerobic threshold, anaerobic threshold and maximal oxygen consumption – VO2 max), on which there are grafted the penetrations of anaerobic effort zones (power efforts, lactate peaks and tolerance to lactic acid accumulations); and in terms of cyclicality of the effort, there are encountered acyclic movements grafted on a cyclic effort.

Knowing the complexity and speed at which technical and tactical actions are performed during a football game requires monitoring specific effort through modern equipment able to provide real-time information about the values of external and internal effort parameters, the metabolic effort zones which are exerted, etc. All these data allow coaches to identify the strengths and weaknesses of the players/team and to conduct specific preparation in a scientific way.

Monitoring and assessing the power and capacity of maximal aerobic endurance zone involve knowing the concepts of anaerobic threshold, maximal aerobic power (MAP) or the corresponding maximal aerobic velocity (MAV). (Guedj, B. E., 2006)

In training, besides knowing maximal oxygen consumption, it is much more important to know maximal aerobic velocity (MAV), which represents the speed at which the subject must mobilize to reach maximal aerobic power (MAP). (Cordun, M., 2011)

Methods

The research sample was made up of 18 athletes registered at School Sports Club 1 of Bucharest and born in 1998. Athletes were subjected to two tests (1st testing - 12.08.2014 and 2nd testing - 12.02.2015). The tests used were: 5-minute endurance test and 240-meter shuttle test. Data collection was achieved using GPSports equipment and SPI IQ software.

The research is based on a comparative-ascertaining pedagogical experiment. To monitor the players' effort during the game, we used GPSports device and SPI IQ software (figure 1 and figure 2). The device allows coaches to track in real time the effort provided during the game, to know the metabolic cost during exercise, to divide by zone the effort, covered distances and travel and acceleration velocities, MAV levels, HR etc. (Marinescu, Gh. et al., 2016). As statistical and mathematical methods, there were used: arithmetic mean, standard deviation, coefficient of variation, Pearson's linear correlation coefficient (Popa, M., 2008).

Figure 1. GPSports measurement device

Figure 2. Vest housing the device

Table 1. Results recorded during the game, for the studied parameters, by the athletes from FC Dinamo Club and their analysis

Item no.	Surname and name of the athletes	HR before exercise (bpm)	Maximal speed recorded (m/s)	Maximal HR recorded during exercise (bpm)	Total distance run during the game (m)	MAV 18 4.8-5.3 m/s (m)	MAV 19 5.3-7.2 m/s (m)	MAV 20 7.2-8.8 m/s (m)	Anaerobic threshold HR > 165 bpm (min)
1	A.F.	88	8.3	192	4100	112	248	11	43
2	N.D.	105	7.9	189	4000	130	176	8	23
3	O.N.	78	7.8	200	3800	164	190	7	31
4	P.D.	90	7.7	198	4000	151	307	10	32
5	M.G.	84	7.7	201	3400	110	238	0	14
6	P.A.	69	7.6	188	3600	150	260	0	43
7	B.S.	67	7.6	200	4400	145	194	0	18
8	M.A.	61	7.5	197	3800	218	183	0	17
9	D.B.	71	7.4	182	8100	105	143	0	2
10	M.L.	130	7.4	196	4300	133	104	0	38
11	R.M.	86	7.3	198	3900	212	391	0	29
12	S.D.	66	7.3	199	7900	249	325	0	38
13	P.C.	80	7.2	198	3800	181	184	0	26
14	P.I.	76	6.9	180	4100	142	75	0	9
15	B.R.	82	6.7	188	3400	147	119	0	6
16	G.I.	97	5.9	191	4300	105	70	0	35
X		83.1	7.3	193.5	4431.2	153.3	200.4	2.2	25.2
Stdv		±17.17	±0.55	±6.602	±1423.94	±42.525	±90.814	±4.106	±13.091
Covar		20.67%	7.53%	3.41%	32.13%	27.73%	45.31%	186.63%	51.94%
Pearson		Maximal HR and MAV for level 19 / **r = 0.517**							

Table 2. Results recorded during the game, for the studied parameters, by the athletes from CSS1 Club and their analysis

Item no.	Surname and name of the athletes	HR before exercise (bpm)	Maximal speed recorded (m/s)	Maximal HR recorded during exercise (bpm)	Total distance run during the game (m)	MAV 18 4.8-5.3 m/s (m)	MAV 19 5.3-7.2 m/s (m)	MAV 20 7.2-8.8 m/s (m)	Anaerobic threshold HR > 165 bpm (min)
1	R.A.	83	8.1	199	6600	267	272	11	44
2	M.M.	93	7.6	196	4530	115	131	8	13
3	M.C.	83	7.6	216	6850	165	186	6	60
4	T.G.	60	7.5	197	2300	62	128	7	14
5	D.V.	79	7	209	4900	219	162	0	34
6	B.I.	60	7	204	4150	144	152	0	31

7	M.I.	120	6.6	206	3800	159	146	0	32
8	B.N.	105	6.5	211	4900	161	181	0	33
9	T.C.	90	6.4	203	4800	83	51	0	43
10	D.S.	88	6.3	205	7000	105	97	0	59
11	V.M.	66	6.3	207	4300	128	96	0	30
12	G.S.	60	6.3	203	3700	97	94	0	28
13	C.I.	84	6.1	190	4100	122	41	0	26
14	M.C.	74	6.1	192	5020	77	39	0	28
15	A.C.	66	6	203	4250	154	98	0	34
	X	80.7	6.7	202.7	4746.6	137.2	124.9	2.1	33.9
	Stdv	±17.34	±0.664	±7.014	±1262.25	±54.353	±62.274	±3.795	±13.333
	Covar	21.49%	9.91%	3.46%	26.59%	39.61%	49.85%	180.71%	39.33%
	Pearson	Maximal HR and MAV for level 19 / **r = 0.453**							

Table 3. Comparison between the average results achieved by the athletes of both clubs studied

	HR before exercise (bpm)	Total distance run during the game (m)	Maximal HR recorded during exercise (bpm)	Maximal speed recorded (m/s)	MAV 18 4.8-5.3 m/s (m)	MAV 19 5.3-7.2 m/s (m)	MAV 20 7.2-8.8 m/s (m)	Anaerobic threshold HR > 165 bpm (min)
Dinamo	**83.1**	4431	193.5	**7.39**	**153.3**	**200.4**	**2.2**	25.2
CSS1	80.7	**4747**	**202.7**	6.76	137.2	124.9	2.1	**33.9**

An analysis of the obtained data is presented in table 3. As regards the arithmetic mean for the parameter HR before exercise, the athletes from FC Dinamo Club have recorded a value of 83.1 bpm, and the athletes from CSS1, a value of 80.7 bpm; the achieved values fall within the real steady-state effort, excepting four athletes who have values comprised between 105 and 130 bpm; this increased basal HR can be attributed to emotionality (figure 3).

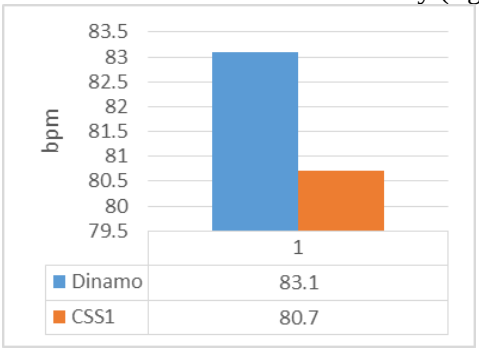

Figure 3. Average HR at the beginning of exercise

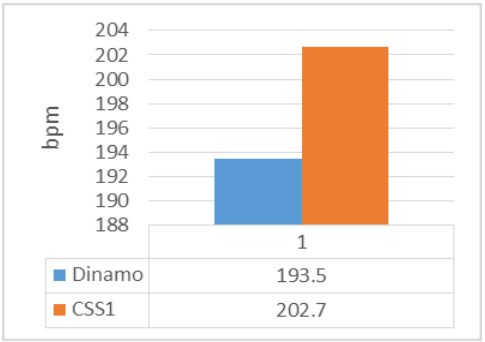

Figure 4. Average peak HR reached during the game

For the parameter Maximal HR recorded during the game, the athletes from FC Dinamo have recorded an average maximal HR of 193.5 bpm, while the athletes from CSS1 have recorded a value of 202.7 bpm; it can be concluded that the achieved values fall within the maximal higher aerobiosis effort (relative steady state/stamina/ ergostasis) (figure 4). Correlating the obtained results with Spiro's formula, it can be noted that this parameter falls within the maximal oxygen consumption zone characterizing the effort specific to football game for both teams.

Analyzing the presented data, it is noticed that: the athletes from FC Dinamo reach an average maximal HR of 193.5 bpm (a more economical maximal HR than that of the athletes from CSS1) and cover a shorter distance by 316 m than the distance covered by the athletes from CSS1, with an average maximal HR of 202.7 bpm. Although the maximal speed reached by the FC Dinamo athletes is superior to that reached by the CSS1 athletes (7.39 m/s with a HR = 193.5 bpm vs. 6.76 m/s with a HR = 202.7 bpm), it can be concluded that the athletes from FC Dinamo run with a higher intensity and a more economical HR than the athletes from CSS1. The athletes from CSS1 cover a longer distance by 316 m, but with a travel speed lower than that of FC Dinamo athletes; this can be explained by the fact that the athletes belonging to CSS1 run more but without technical and tactical efficiency, compared to the athletes from FC Dinamo (e.g.: they release the ball more quickly, are better placed on the field and do not need to cover a longer distance), therefore the quality-quantity ratio is in favor of the players from FC Dinamo. Regarding the metabolic cost, it is noted an apparent paradox: CSS1 maintains the anaerobic threshold for 33.9 minutes (about 41% of the statutory time), with an intensity of 6.76 m/s, seeming to be better prepared than the FC Dinamo athletes, who maintain the anaerobic threshold for 25.5 minutes (about 31% of the statutory time), but with a higher intensity of 7.39 m/s. The intensity of running for the athletes from FC Dinamo (maximal speed reached) represents the qualitative parameter and the explanation of the paradox.

Concerning the athletes' homogeneity, only for two parameters (maximal HR and maximal speed reached) they fall within a low dispersion of results and high homogeneity in both teams (see tables 1 and 2).

Results

The obtained reports provide data about the following items: covered distance, travel speed, acceleration speed, maximal aerobic velocity (MAV), VO_2max, heart rate etc. and their evolution. In the 5-minute endurance test, 1st testing, the arithmetic mean for relative VO2max is 54.9%, while in the 2nd testing, the arithmetic mean has increased to 58.6%; the difference between the two tests is 3.7%, which shows a progress between tests as regards higher aerobic capacity.

Using GPSports device is particularly helpful in the scientific management of training;

Heart rate is a good indicator of higher aerobic capacity/endurance;

The slight gap between heart rate and maximal oxygen consumption is determined by the transitory states of the latter;

For higher endurance, preparation in the "anaerobic threshold" effort zone (intensity: 65% - 80% of VO2 max; 4-6 mmol lactic acid) is efficient in comparison with the "maximal oxygen consumption" effort zone, because the athletes can train for a long time on the accumulation of a substantial amount of lactic acid, but which can be metabolized by the oxygen supply;

Higher endurance training improves the oxidative capacity of red fibers, but also the oxidative component of white fibers;

The use of 5-minute endurance test and calculation of maximal aerobic velocity (MAV) etc. provide information regarding the exercise capacity level of athletes and their limits. Scientific monitoring of training reveals important data about the body's response to specific stimuli and helps coaches to conduct preparation according to the structure and components of periodization.

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