DIAGNOSIS OF EFFORT CAPACITY BY METABOLIC METHODS TO FOOTBALL PLAYERS, JUNIOR II

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Abstract

Football is a sport that requires a strenuous exercise, frequently alternating between effort and recovery phases on a variable time basis.
In football performance, the intensity of the physical effort has increasedand it must be maintained for a longer period of time, depending on the target. The effort characteristic to football game falls within the metabolic zones of higher aerobiosis (anaerobic threshold and VO2 max), interpenetrated by anaerobic metabolic zones (tolerance to lactic acid accumulation and power). During a football game, the metabolic systems are exerted as follows: 70% aerobic system, 15-20% anaerobic lactacid system and 10-15% anaerobic alactacid system (Cazorla G., 2002). The research premise starts from the idea that, by knowing/diagnosing the level of higher aerobic zone, we can influence the specific training preparation in order to increase exercise capacity during the game and achieve top performances. The research purpose is to know the level of higher aerobic exercise capacity for establishing the maximal potential of junior II football players. Setting the level of higher aerobic exercise capacity during training can provide football coaches with information/predictions regarding the team's performance during the game, which represents the research hypothesis. The subjects are athletes registered at two football clubs entered in the Municipal Championship of Bucharest. For measurement/assessment, there are used the following specific tests: 5-minute endurance test, 240m endurance-speed test and maximal aerobic velocity (MAV)..

Keywords: *Football, junior II, 5-minute endurance test, 240m shuttle run test, MAV*

JEL classification: L83

1. Introduction

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.

The data provided to coaches by MAV, as maximal aerobic velocity for reaching maximal oxygen consumption, are very important to improve the higher aerobic endurance zone specific to football game. For the game of football,

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specialists in ergo-physiology recommend a mixed-type of higher endurance training: VO2 max at a central level and peripheral AA (Amino Acids – Anaerobic Alactacid), with intensity means of 1.2-1.4 of MAV, and for AA, 5-15 sec (Guedj et al., 2006). The lower limb muscles involved in the specificity of football game consume 80% of VO2 max (Maglischo, 1982). As regards maximal oxygen consumption, there are reported levels of work intensity between 150 and 200% of VO2 max (Costill et al., 1994). Through this preamble, we want to highlight the particular importance of improving the higher aerobiosis zone which characterizes much of the specific effort, underlining what few coaches know, that stimulating the zones of anaerobic threshold and maximal oxygen consumption, with an effort/break ratio of 1/1, also improves the lactic tolerance zone (endurance-speed).

In our research, we use an internal parameter, the heart rate (HR), which is a good indicator of the increase in VO2 max, with the specification that there is only a slight gap between HR variations and maximal oxygen consumption in the transitory steady states. The relationship between HR and O2 debt or the power of exercise (HR/VO2 or W) is almost linear, because of the HR comprised between 20% and 70% of HR reserve. There is also a zone (35% to 55% of VO2 max) for which the increase in the heart rate compared to the increase in power is slightly lower, which can be translated as a better cardiac output. At a percentage of 60% - 80% of maximal HR, the increase in the heart rate is a little bit smaller and can be described as a threshold (Conconi), which is either different or below the aerobic and anaerobic lactic thresholds (Guedj, B.E., 2006).

2. Materials and methods

2.1 Purpose: To know the level of higher aerobic exercise capacity in order to establish the maximal potential of football players – junior II.

2.2. Hypothesis: Determining the level of higher aerobic exercise capacity during training can provide football coaches with information/predictions regarding the team's performance during the game.

2.3 The research subjects, 36 in number, are athletes registered at two football clubs entered in the Municipal Championship of Bucharest (School Sports Club 1 – CSS1 ranked 4th and FC Dinamo Club – ranked 1st).

2.4. Description of tests and devices used:

1. Test 1 – 5-minute endurance: it consists in intensive continuous running for 5 minutes. The athlete must cover a distance as long as possible until the end of the 5 minutes of running, when the travelled distance is recorded;
2. Test 2 – 240m endurance-speed – 2x(10m+20m+40m+50m): it consists in speed running, under the shuttle run form, on the distance of 10m and return, 20m and return, 40m and return, 50m and return. The test is applied twice, and the best time is recorded.

3. Results

From the variety of data obtained from the measurement and assessment, we chose, for their relevance, the following items: distance travelled in test 1, expressed in metres, MAV (km/h) obtained in test 1, and time achieved in test 2, expressed in seconds.

In Table 1, there are shown the results obtained by the athletes from CSS1 in tests 1 and 2, and each player's position in the team.

Table 1. Summary table with the results obtained in the two tests by the athletes from CSS1

Item no.	Surname and name	Position in the team	Distance travelled in test 1 (m)	MAV expressed in test 1 (km/h)	Time achieved in test 2 (sec)
1.	T.G.	Right midfielder	1400	16.8	48
2.	G.S.	Left midfielder	1370	16.44	45
3.	M.M.	Center-back	1360	16.32	47
4.	T.C.	Central midfielder	1340	16.08	49
5.	R.I.	Central midfielder	1340	16.08	47
6.	D.V.	Central midfielder	1340	16.08	46
7.	D.S.	Left-back	1330	15.96	50
8.	C.I.	Right midfielder	1320	15.84	45
9.	V.M.	Central midfielder	1320	15.84	52
10.	B.C.	Central midfielder	1320	15.84	48
11.	S.A.	Striker	1300	15.6	45
12.	M.I.	Striker	1280	15.36	47
13.	Z.L.	Striker	1280	15.36	48
14.	M.C.	Right-back	1280	15.36	47
15.	B.N.	Left midfielder	1280	15.36	48
16.	A.C.	Striker	1260	15.12	49
17.	G.G.	Center-back	1240	14.88	49
18.	D.D.	Goalkeeper	1230	14.76	47

Table 2 shows the results obtained by the athletes from FC Dinamo Club in tests 1 and 2, and each player's position in the team.

Table 2. Summary table with the results obtained in the two tests by the athletes from FC Dinamo Club

Item no.	Surname and name	Position in the team	Distance travelled in test 1 (m)	MAV expressed in test 1 (km/h)	Time achieved in test 2 (sec)
1.	N.D.	Central midfielder	1430	17.16	43
2.	A.F.	Central midfielder	1430	17.16	46
3.	M.G.	Center-back	1400	16.8	43
4.	O.N.	Center-back	1400	16.8	50
5.	P.A.	Right-back	1380	16.56	44
6.	P.D.	Left midfielder	1370	16.5	43
7.	B.S.	Right midfielder	1360	16.32	45
8.	M.L.	Central midfielder	1360	16.32	45
9.	M.A.	Center-back	1350	16.2	45
10.	D.B.	Left-back	1350	16.2	47
11.	B.R.	Left midfielder	1340	16.08	47
12.	S.D.	Right midfielder	1340	16.08	47
13.	R.M.	Central midfielder	1340	16.08	46
14.	G.I.	Center-back	1320	15.84	47
15.	P.C.	Striker	1300	15.6	45
16.	P.I.	Striker	1280	15.36	43
17.	A.C.	Goalkeeper	1260	15.12	49
18.	M.V.	Goalkeeper	1240	14.88	46

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 .

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**

As regards the MAV value expressed in test 1 (Table 3), it is noticed that: arithmetic mean of the MAV expressed within the 5 minutes for the CSS1 athletes is 15.73 km/h, and for the FC Dinamo athletes, 16.17 km/h; the difference between the two means is 0.44 km/h in favour of the athletes belonging to FC Dinamo => the athletes from FC Dinamo Club have a higher MAV value expressed in test 1 than the athletes from CSS1 (Figure 2). Standard deviation for the CSS1 athletes is ±0.545 km/h, and for the FC Dinamo athletes, it is ±0.639 km/h. The coefficient of variance for the athletes from CSS1 is 3.46%, and for the athletes from FC Dinamo Club, it is 3.95% => the results obtained by the athletes tested for this parameter have a high degree of homogeneity.

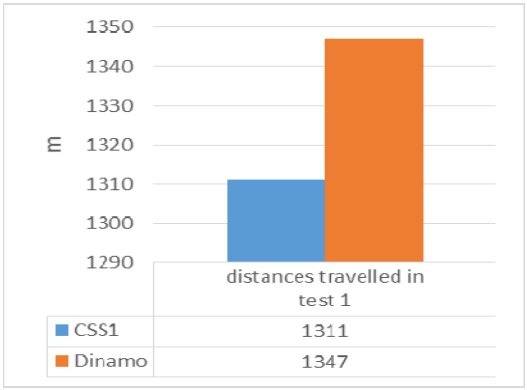

Figure 1. Comparison between arithmetic means of the distances travelled expressed in test 1

As to the time obtained in test 2 ,it is noted that: arithmetic mean of the time achieved in test 2 for the athletes from CSS1 is 47.61 sec, and for the athletes from FC Dinamo Club, 45.61 sec; the difference between the two means is 2 sec in favour of the athletes belonging to FC Dinamo => the athletes from FC Dinamo Club have run faster by 2 sec the 240m (Figure 3). Standard deviation for the CSS1

athletes is ±1.819 sec, and for the FC Dinamo Club athletes, it is ±2.033 sec. The coefficient of variance for the athletes from CSS1 is 3.82%, and for the athletes from FC Dinamo Club, it is 4.45% => the results obtained by the athletes tested for this parameter have a high degree of homogeneity.

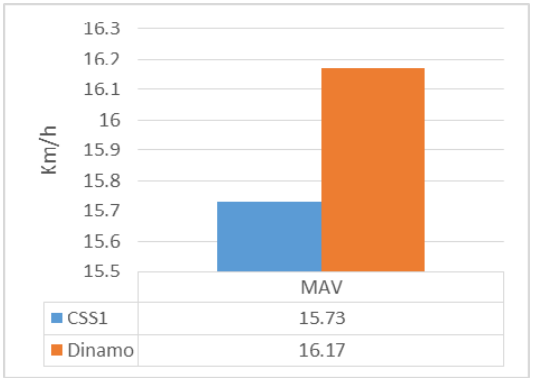

Figure 2. Comparison between arithmetic means in test 1 of the MAV

Analysis and interpretation of the results obtained and presented in Table 3, regarding the degree of association between the two tests, reveal that: for the athletes from FC Dinamo Club, Pearson's correlation coefficient is r = -0.223, and for the athletes from CSS1, r = -0.132 => the degree of association between the two tests is low; but we are interested in highlighting the "hidden" relationships between variables, and therefore, regardless of their size, the correlation coefficients will be taken into account (obviously, if they are higher than 0.1). For the rigorousness of the research, we have applied the coefficient of determination (r2, also called r-squared), which is considered a more appropriate indicator of the effect size, because it takes sensibly lower values than those of the correlation coefficient (Popa, 2008). The values r2 = 0.049 for the FC Dinamo athletes and r2 = 0.017 for the CSS1 athletes show that the size of the coefficient of determination, as an index of the effect size for the correlation, is small.

4. Discussions and conclusions

The results obtained after analysing the collected field data highlight that, in the initial testing, the athletes from FC Dinamo Club are better positioned, from the physical point of view, compared to the athletes from CSS1;

In peripubertal children or adolescents, quality training in the higher aerobic zone is recommended to be associated with speed training, in order to exert type I, IIA and IIB fibres and ensure good cardiovascular and psychomotor development;

For the game of football, specialists in ergo-physiology recommend a mixed-type of higher endurance training: VO2 max at a central level and peripheral AA (Amino Acids – Anaerobic Alactacid), with intensity means of 1.2-1.4 of MAV, and for AA, 5-15 sec;

Measurement of the maximal aerobic velocity (MAV) reached, corresponding to a MAP (which is slightly superior to MAV and inferior for a running race), is extrapolated from VO2 max;

Determining the level of higher aerobic exercise capacity during training can provide football coaches with information/predictions regarding the team's performance during the game – the research hypothesis is confirmed;

Methodically speaking, after the day dedicated to the measurement of maximal oxygen consumption (VO2 max) and the calculation of maximal aerobic power (MAP) or the corresponding maximal aerobic velocity (MAV), in the next training sessions, the athletes must use means with intensities of 80, 85 or 90% of VMA;

Attention should be drawn that a minor error in VO2 max or MAP or MAV, for a scheduled power, will induce a significant error in the maximal aerobic endurance zone, 10 times higher in percentages;

It is worth noting that an improvement in the higher endurance zone (anaerobic threshold, VO2 max) will lead to an improvement in the lactic tolerance zone (endurance-speed).

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