STUDY REGARDING THE ASSESSMENT OF FUNCTIONAL RESPIRATORY CAPACITY IN PROFESSIONAL TRACK AND FIELD ATHLETES FROM THE CSM BACĂU 2010

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Abstract
Sports training, its effort and intensity, generate, over time, adaptive modifications in any athlete. In the case of professional track and field athletes, especially middle distance runners, one of the fastest modifications can be observed in the respiratory function. In the case of middle distance running events, the effort requires faster burnings, in other words, the gaseous exchanges and external breathing are really intensified.
This study tried to observed these aspects in a group of athletes belonging to the CSM Bacău 2010, a group composed of middle distance runners (male and female), and pole vaulters. The investigation of the respiratory function was conducted using spirometry methods, at the Bacău County Hospital.
Key words: *track and field athlete, respiratory function, high performance*

INTRODUCTION

The main source of energy for muscle contraction is oxidation of food substances, a process that requires a constant oxygen uptake. This problem is solved by the body through the respiratory function, through which the oxygen in the air is transported up to the cellular level.
When we are dealing with a prolonged effort, the respiratory function is permanently subjected to new adaptations in regards to ensuring the necessary quantity of oxygen for the metabolic processes at a cellular level, but also in regards to the elimination of the resulted carbon dioxide. The effort determines immediate modifications of the respiratory function, represented by an increase in the respiratory rate and amplitude, and late modifications, as a result of the systematic training. All of these lead to an increase in the respiratory management, in the vital capacity, and also to a faster use of oxygen in the tissues.
According to *Margaria, 1966*, the maximal oxygen consumption is one of the most relevant parameters when making a comparison between trained athletes and untrained people. Thus, while the maximal oxygen consumption can reach, depending on the athletic event, sports branch, and experience, 4000 - 5000 ml/sec in untrained individuals, it usually reaches values between 1500 and 1800 ml/sec.

AIM, HYPOTHESIS, AND RESEARCH METHODS

Considering these aspects, our study aimed mainly to evaluate the respiratory function in the track and field athletes belonging to the Bacău 2010 City Sports Club.
Our hypothesis was as follows:
Determining the respiratory function modifications appeared in the professional track and field athletes can be an important indicator for future elaborations of training plans.
In conducting our research, we studied the professional literature, we used the experiment method (observational), the tests method (spirometry), and the mathematical method, for analyzing the data.

RESEARCH SUBJECTS

The subjects of this study are represented by 8 track and field athletes (4 male, *Table 1*; and 4 female, *Table 2*), belonging to the CSM Bacău 2010, specialized in middle distance running, and pole vaulting. The following tables present the above mentioned subjects.

Table 1 Male track and field athletes working at the CSM Bacău 2010

Name Initials	Birth year	Height (cm)	Weight (Kg)	Event	The best result	Place won at the 2012 National Championships	No. of years of track and field experience
V. C.	1985	182	72	800m	1.47	1st place - N.C. Seniors Bucharest	10
				1500m	3.41		
M. A.	1991	181	68	800m	1.50	5th place - N.C. Youth Bucharest	6
				1500m	3.57		
B.P.	1991	172	68	400m	49.2	2nd place - N.C. Youth	7

				800m	1.51	Bucharest	
L. I.	1996	180	66	800m	1.57	4th place - N.C. Juniors II Bucharest	7
				1500m	4.05		

Table 2 Female track and field athletes working at the CSM Bacău 2010

Name Initials	Birth year	Height (cm)	Weight (Kg)	Event	The best result	Place won at the 2012 National Championships	No. of years of track and field experience
S. L.	1991	172	54	Pole vault	3.81m	1st place - N.C. Seniors Bucharest	7
S. P.	1994	168	53	800m	2.09	2nd place - N.C. Juniors I Bucharest	6
				1500 m	4.26		
N. D.	1996	174	50	800m	2.25	-	1
H. A.	1995	163	47	Pole vault	2.00	-	1

DEVELOPMENT OF THE RESEARCH

The investigation of the respiratory function was conducted using spirometry methods, at the Bacău County Hospital. The athletes were tested at the end of September 2012, two months after the competition season has ended, and one month after the training program has started again. The investigated parameters are presented in Table 3.

Table 3 Investigations of the respiratory function

No.	Parameter	Description of the parameter
1	FVC	FORCED VITAL CAPACITY / EXPRESSES THE MAXIMAL VALUE OF AIR THAT CAN BE INSPIRED AND EXPIRED
2	FEV1	FORCED EXPIRATORY VOLUME IN ONE SECOND/ THE MAXIMAL VALUE OF AIR THAT CAN BE EXPIRED IN ONE SECOND
3	FEV1%	FEV1 EXPRESSED AS A PERCENTAGE OF THE VITAL CAPACITY (VC)/ THE STANDARD INDEX FOR EVALUATING AND QUANTIFYING THE AIR FLOW
4	PEF	PEAK EXPIRATORY FLOW/ THE MAXIMAL FLOW GENERATED DURING EXPIRATION, PERFORMED WITH MAXIMUM POWER, AFTER A COMPLETE INSPIRATION
5	FEF 25-75	FORCED EXPIRATORY FLOW BETWEEN 25 AND 75% OF THE VITAL CAPACITY, MEASURING THE AIR FLOW HALFWAY THROUGH AN EXHALE
6	FEF 25%	EXPIRATORY FLOW AT 25% OF THE FORCED VITAL CAPACITY
7	FEF 50%	EXPIRATORY FLOW AT 50% OF THE FORCED VITAL CAPACITY
8	FEF75%	EXPIRATORY FLOW AT 75% OF THE FORCED VITAL CAPACITY
9	PIF	PEAK INSPIRATORY FLOW
10	FET	THE NECESSARY TIME TO EXHALE AS MUCH AIR AS POSSIBLE; IT SHOULD NOT BE LESS THAN 6 SECONDS; IT MEASURES THE EXHALING LENGTH FOR SEVERAL SECONDS
11	EV	"EXTRAPOLATED VOLUME," USED TO DETERMINE WHETHER A HESITATION IS EXCESSIVE
12	FIVC	OBSTRUCTION OF THE EXPIRATORY AIRWAYS, RESTRICTIVE PULMONARY DISEASES

RESULTS OF THE RESEARCH

The following tables (4 and 5) present the results recorded in the spirometry test. Table 4 presents the values of the investigated parameters, their reference values, and the percentage of the recorded values in comparison with the reference ones, for the four male athletes.

Table 4 Results of the spirometry test - M

No.	Name	INVESTIGATED	Recorded	Reference	% of the recorded

	Initials	PARAMETERS	values	values	values in comparison with the reference values
1.	V. C.	FVC - L	5.20	5.77	90%
		FEV1 - L	5.15	4.80	107
		FEV1 %- %	99.0	83.9	118
		PEF –L/s	10.16	10.17	100
		FEF 25-75 – L/s	6.26	5.04	124
		FEF 25% - L/s	9.08	9.45	96
		FEF 50% - L/s	6.43	5.92	109
		FEF 75% - L/s	3.82	2.54	150
		FIVC - L	4.99	5.77	86
		FIV1 - L	4.86	4.80	101
		FIV1% - %	97.4	83.9	116
		PIF - L/s	5.18	10.17	51
2.	M. A.	FVC - L	5.68	4.53	125
		FEV1 - L	5.51	3.82	144
		FEV1%- %	97.0	84.2	115
		PEF –L/s	7.68	7.68	100
		FEF2575 – L/s	6.36	4.25	150
		FEF25% - L/s	7.43	7.19	103
		FEF50% - L/s	6.28	4.91	128
		FEF75% - L/s	4.72	2.35	201
		FIVC - L		4.53	
		FIV1 - L		3.82	
		FIV1% - %		84.2	
		PIF - L/s		7.68	
3.	T. A.	FVC - L	4.66	5.17	90
		FEV1 - L	4.64	4.46	104
		FEV1%- %	99.6	86.0	116
		PEF –L/s	9.58	9.31	103
		FEF2575 – L/s	7.36	4.97	148
		FEF25% - L/s	8.85	8.49	104
		FEF50% - L/s	7.32	5.70	128
		FEF75% - L/s	5.20	2.71	192
		FIVC - L		5.17	
		FIV1 - L		4.46	
		FIV1% - %		86.0	
		PIF - L/s		9.31	
4.	L. I.	FVC - L	4.17	4.92	85
		FEV1 - L	4.17	4.25	98
		FEV1%- %	100.0	85.8	117
		PEF –L/s	7.77	8.64	90
		FEF2575 – L/s	5.44	4.71	115
		FEF25% - L/s	6.70	7.90	85
		FEF50% - L/s	5.46	5.23	104
		FEF75% - L/s	4.20	2.82	149
		FIVC - L	3.22	4.92	65
		FIV1 - L	2.96	4.25	70
		FIV1% - %	91.9	85.8	107
		PIF - L/s	2.89	8.64	33

Table 5 Results of the spirometry test - F

No.	Name Initials	INVESTIGATED PARAMETERS	Recorded values	Reference values	% of the recorded values in comparison

					with the reference values
1.	S. L.	FVC - L	3.37	4.08	83
		FEV1 - L	3.11	3.49	89
		FEV1%- %	92.3	85.8	108
		PEF –L/s	3.70	7.17	52
		FEF2575 – L/s	3.32	4.00	83
		FEF25% - L/s	3.68	6.74	55
		FEF50% - L/s	3.22	4.61	70
		FEF75% - L/s	2.66	2.22	120
		FIVC - L		4.08	
		FIV1 - L		3.49	
		FIV1% - %		85.8	
		PIF - L/s		7.17	
2.	S. P.	FVC - L	2.79	3.80	73
		FEV1 - L	2.74	3.39	81
		FEV1%- %	98.2	89.9	109
		PEF –L/s	5.69	7.14	80
		FEF2575 – L/s	3.76	4.19	90
		FEF25% - L/s	5.41	6.62	82
		FEF50% - L/s	3.73	4.53	82
		FEF75% - L/s	2.20	2.52	87
		FIVC - L	2.54	3.80	67
		FIV1 - L	2.49	3.39	73
		FIV1% - %	98.0	89.9	109
		PIF - L/s	2.98	7.14	42
3.	N. D.	FVC - L	3.62	3.95	92
		FEV1 - L	3.35	3.49	96
		FEV1%- %	92.5	87.2	106
		PEF –L/s	4.18	7.17	58
		FEF2575 – L/s	3.58	4.13	87
		FEF25% - L/s	4.06	6.64	61
		FEF50% - L/s	3.49	4.51	77
		FEF75% - L/s	2.77	2.61	106
		FIVC - L	3.11	3.95	79
		FIV1 - L	2.89	3.49	83
		FIV1% - %	92.9	87.2	107
		PIF - L/s	2.88	7.17	40
4.	H. A.	FVC - L	2.56	3.48	74
		FEV1 - L	2.56	3.11	82
		FEV1%- %	100.0	90.4	111
		PEF –L/s	4.01	6.69	60
		FEF2575 – L/s	3.68	3.89	95
		FEF25% - L/s	4.01	6.21	65
		FEF50% - L/s	3.53	4.25	83
		FEF75% - L/s	2.89	2.34	124
		FIVC - L	2.41	3.48	69
		FIV1 - L	2.41	3.11	77
		FIV1% - %	100.0	90.4	111
		PIF - L/s	3.68	6.69	55

Tables 6 and 7 present the values of the most important investigated parameters for the male and female athletes.

Table 6 the best values - M

No.	Name	INVESTIGATED	Recorded	Reference	% of the recorded

	Initials	PARAMETERS	values	values	values in comparison with the reference values
1.	V. C.	FVC - L	5.20	5.77	90%
		FEV1 - L	5.15	4.80	107
		FEV1%- %	99.0	83.9	118
		PEF –L/s	10.16	10.17	100
2.	M. A.	FVC - L	5.68	4.53	125
		FEV1 - L	5.51	3.82	144
		FEV1%- %	97.0	84.2	115
		PEF –L/s	7.68	7.68	100
3.	T. A.	FVC - L	4.66	5.17	90
		FEV1 - L	4.64	4.46	104
		FEV1%- %	99.6	86.0	116
		PEF –L/s	9.58	9.31	103
4.	L. I.	FVC - L	4.17	4.92	85
		FEV1 - L	4.17	4.25	98
		FEV1%- %	100.0	85.8	117
		PEF –L/s	7.77	8.64	90

Table 7 the best values - F

No.	Name Initials	INVESTIGATED PARAMETERS	Recorded values	Reference values	% of the recorded values in comparison with the reference values
1.	S. L.	FVC - L	3.37	4.08	83
		FEV1 - L	3.11	3.49	89
		FEV1%- %	92.3	85.8	108
		PEF –L/s	3.70	7.17	52
2.	S. P.	FVC - L	2.91	3.80	77
		FEV1 - L	2.74	3.39	81
		FEV1%- %	94.2	89.9	105
		PEF –L/s	5.69	7.14	80
3.	N. D.	FVC - L	3.62	3.95	92
		FEV1 - L	3.35	3.49	96
		FEV1%- %	92.5	87.2	106
		PEF –L/s	4.18	7.17	58
4.	H. A.	FVC - L	2.56	3.48	74
		FEV1 - L	2.56	3.11	82
		FEV1%- %	100.0	90.4	111
		PEF –L/s	4.01	6.69	60

Besides these parameters, the vital capacity (VC) of the athletes was also calculated, according to their height, and weight, using the formulae by *West et al.*:
VC = height (cm) x 25 for M, and:
VC = height (cm) x 20 for F.
VC = weight (kg) x 2.5 for M, and:
VC = weight (kg) x 2.0 for F.
The total lung capacity (TLC) was calculated using *Anthony*'s formula:
TLC = VC x 1.32
The recorded results are presented in Tables 8 and 9.

Table 8 VC and TLC - M

Name Initials	Birth year	Height (cm)	Weight (Kg)	VC according to height (ml)	VC according to weight (ml)	TLC (ml)

V. C.	1985	182	72	4550	180	6006
M. A.	1991	181	68	4525	170	5973
B.P.	1991	172	68	4300	170	5676
L. I.	1996	180	66	4500	165	5940

Table 9 VC and TLC - F

Name Initials	Birth year	Height (cm)	Weight (Kg)	VC according to height (ml)	VC according to weight (ml)	TLC (ml)
S. L.	1991	172	54	3440	108	4540.8
S. P.	1994	168	53	3360	106	4435.2
N. D.	1996	174	50	3480	100	4593.6
H. A.	1995	163	47	3260	94	4303

CONCLUSIONS

The results of the study confirm, through the values of the vital capacity, the fact that the modifications occurred in the respiratory function depend on the type of effort, the athlete's experience, the event, but also on age and gender. Thus, in the technical events (in this case, the pole vault), the athlete is interested in blocking the respiratory movements, this favoring the technique. During moderate intensity efforts (in this case, the 800 and 1500 m running events), the respiratory rate increases, reaching 30-40 breaths per minute. The volume of air that was introduced in the lungs reached 4550 ml in the males, and 3480 ml in the females. After comparing the results recorded in this study with the ones in the professional literature, one can say that the tested athletes' values are within the referenced ones, the late modifications in the respiratory function appearing thanks to the sustained training.

The total lung capacity (TLC) has varied values, between 5676 ml and 6006 ml in the male subjects, and between 4303 and 4593.6 ml in the female subjects, numbers that are larger than the reference values by approximately 10%.

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THE ROLE OF THE FOCUSING IN THE TRAINING OF THE GOALKEEPER DURING THE HANDBALL GAME (JUNIORS I GIRLS)

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