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THE RELATIONSHIP BETWEEN COMPETITION STRESS AND BIOLOGICAL REACTIONS IN PRACTICING PERFORMANCE IN ATHLETICS

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Abstract

Purpose. Among the factors conditioning sport performance in athletics, competition stress it is one of the most "active" with high bio-psychic effects, especially in competition season. We set highlighting certain biological reactions determined by induction of "start condition", as competition stress factor to athletes, specialized on medium or long events.

Methods. The research implied 10 subjects with different "age" in athletics and in specialty of the event practiced. The athletes were subjected to two tests, in two different days, in a week that finalized with an important competition. (testings made with 7 days, respectively one day before).

Results. The analyses of the values to the variables subjected to research (lactic acid, hemoglobin, glucose and magnesium) show modifications in competitional stress situations, at the subjects researched, in the purpose of rising some of the values to some variables and the decrease of other values, to other variables.

Conclusions. The stress in the competitional season determines biological modifications to the professional athletes, specialized on medium-long events.

Key words: sports performance, stress, competition, athletics, biological reactions.

Introduction

Reaching designed sports performance depends in any discipline of athletics on many factors (Fig. No. 1), which may enhance or limit the expression of the various skills of the athletes involved. Among these factors, stress is one of those that have strong effects on the athletes' behavior both in training but especially in competition.

Due to the specific effort and complexity of the stimuli involved, athletes react differently to the influences exerted by stress, especially close to competition or during the actual start, knowing that "the highest stress level varies according to the specifics of each discipline and each may cause a different degree of stress", some high performance athletes seeks this type of stress in order to outdo themselves. "(R. Thomas, 1993).

These reactions to stress can be mobilizing, leading to an increase in athlete combativity or they can be "destructive", leading to a demobilization of the athlete, an inability to concentrate and actively participate, a lack of adaptation to the specific conditions of the competition.

According to some authors, not every solicitation implies stress, but only those whose duration or intensity exceeds the capacity of individual adaptation (M. Epuran, I. Holdevici, F. Toniţa, 2001).

The synthesis of various studies and research papers in sports psychology and biochemistry concerning athlete behavior, especially in competition, showed that an athlete's skills and capabilities may be influenced by stress:

- either through its influence on "the increase of vigilance directly reflected by an increase in the level of activation of the nervous system" (A.F. Sanders, 1983), activation is not always responsible for
- improving sports performance (R. Martens, R.2004).
- either through their personal perception of stress-provoking situations.

Stressful and anxiety states (in our opinion, complementary process of competitive stress in sports) occur for most athletes especially before and during competition (given the social, professional and emotional "stake" involved in achieving good results).

Knowing that nowadays people have the capacity to memorize certain stressful states and activate responses to stress as a result of circumstances interpreted as cognitive elements (as may activate an entire complex of stress generated reactions just by remembering and mentally re-living specific stressful situations - D. Marza, 2005), sport psychology professionals recommend that approach in terms of competition control on the level of competitive stress modeling aim some time before these special conditions (M. Niculescu, 1999).

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As reflected in the title of this article, our research focuses on the biological component of stress which affects high performance athletes. A theoretical approach on the biological changes resulting from stress in humans, has no purpose in this article, as long as previous research has clarified the fact that stress affects many parts of the nervous and hormonal system, which:

- triggers secondary mutations of the functions and activity of most bodily organs "(S. Shivapremananda, 1997);
- „increases thyroid hormones production, stimulating mental processes and actions of most endocrine glands" (A.C .Guyton, Jh.E.Hall, 2006) which in our view affects the majority of biological processes and reactions that are activated in the body at that time.

The competition, a unique event with an exceptional financial and social stake which requires the activation of all bio-psychic resources of the athlete (Ş.Tüdös, 2000) is, by its specificity, a stressful event, which can have positive or negative effects on the behavior of the subject involved.

Hypothesis

Physiological changes caused by competition stress typical for the „start mood" on athletes specialized in middle and long distance run events are emphasized by biological parameters in the competition stage.

Research instruments and procedure.

For testing and evaluation we have used as a research instrument the dry biochemistry analyzer SPOTCHEM (EZ SP-4430 – capillary blood sample processing through an automatic system of centrifugation, pipetting, reactive identification and optical measurement.

The subjects of our research are 10 athletes, specialized in semi-fund disciplines, with ages between 19 and 35, with 5 to 20 years of experience in practicing athletics and which have a minimum of 4 years experience in medium or long events (the average of the specializing discipline being of 7.3 as per table no.1)

Table no.1
Research subjects

Subjects	Age	Experience in athletics	Experience in the discipline
I. Z.	27 y.o	16 years	12 years
C.V.	25 y.o.	8 years	7 years
C. I.	25 y.o.	11 years	8 years
D.C.	23 y.o.	8 years	5 years
V.C.	19 y.o.	7 years	5 years
S.A.	20 y.o.	5 years	4 years
A.G.	21 y.o.	11 years	8 years
B.S.	25 y.o.	9 years	6 years
S.C.	35 y.o.	20 years	14 years
D.S.	20 y.o.	6 years	4 years

The sports performance of the subjects range from good to very good (from national medalists to multiple national and balcanic participants and medalists in various international competitions.

The research was unfolded in 2010 (May-June) following the biological alterations occurring in the samples taken from the above-mentioned subjects (their participation was confirmed with a compulsory written agreement).

Two testing sessions were run, in two different days, in a week when a high level competition has ended (test were done with 7 days and respectively one day before)

Knowing that the biological parameters that competition stress affects on high performance athletes are: Cho (cholesterol), AL (lactic acid), Ca^{+} (calcium), Mg (magnesium), GLU (glucose), T.A.(blood pressure), TG (triglycerides), Hb (hemoglobin), F.C.(cardiac frequency), the present research limited itself to the study of the alterations occurring in the following parameters:

- *AL (lactic acid)* – caused multiple controversies in sports-related researches and is still considered to be the cause of many positive and/or negative effects on the muscular activity of athletes. This parameter was measured in the morning, before breakfast when the athlete woke up. Under stressful conditions the corticoadrenal releases high quantities of glucocorticoid hormones, thus accelerating the degradation processes of glycogen (glycogenolysis) and the increase of the lactate concentration (A.I. Baba, R. Giurgea, 1993);
- *Mg (magnesium)* – was measured in the morning when the athlete woke up. Stress causes alterations of the Magnesium level downward its concentration in the body;
- *Hb (hemoglobin)* – was measured in the morning, before breakfast, when the athlete woke up. According to the specialists this parameter modifies under stress conditions, due to the increase of the level of glucose in the blood;
- *GLU (glucose)* - was measured in the morning, before breakfast, when the athlete woke up. According to biochemists, this parameter modifies under stress conditions, respectively it increases;

The data of the biological parameters tested were harvested twice, during the summer competition season of 2010, as follows:

- *first testing* (T1) – 7 days before the competition (Romanian National Championship, Constanţa, June 4th, 2010);
- *second testing* (T2) – one day before the competition;

The harvest of the data was done in the morning (7:00-8:00) right after the athletes woke up by two specialists: a doctor on the national athletes squad and his assistant.

Sample processing, the usage of the dry biochemistry analyzer and primary result interpretation of biological parameters which interest us were done by a different medical specialist.

Further, there has been a constant collaboration with the doctor during the process of final interpretation of results in order to clarify the medical aspects of the changes occurring as a result of competition stress.

Also, unfolding the research implied collaborating with one of the national athletics squad psychologists which has been constantly close to us, guiding and argumenting our observations on athletes attitudes both i training as well as before the competition.

We also mention that the athletes training between the two testing sessions (last 6 days before the competition) did not include high levels of intensity or volume. Athletes performed standard training, specific to the week before the competition, training which did not require the organism to adapt to new stimuli and which focused on the regular active rest routine, maintaining an optimum level of the general tonus and on the psychological and tactic preparation of the competition.

The competition referred to in the present research is the second one in the open-air competition season of the year 2010 and this allowed us to exclude the option of a „relaxed" or „cramped" behavior on athletes (behavior which usually occurs on the first competition from the new season). We also mention that the competition in question was not an objective important one for our subjects.

Statistically, due to the small number of subjects (aspect determined by the entire number of high-performance athletes existing in our country) we calculated: the arithmetic average, the standard deviation (for spreading the values referred to the average, homogeneity), the variability coefficient (homogeneity), the minimum and maximum values as well as the percentages for each biological parameter studied.

Results

To highlight the differences between the two testing sessions while taking into account the small number of subjects (although referring to the numbers specific to high performance athletics in our country, 10 athletes specialized in medium or long athletic events is an optimum number for such a research) we applied to descriptive and comparative analysis of the data (table no. 2)

Calculations have indicated the following:

- referring to the glucose (GLU) values, these stay within standard limits for both tests but there is an increase (table no. 2) on all subjects, with values ranging from 1 to 9 mg % ml. Thus, the difference between the average T1 value and the average T2 value is of *3.9 mg % ml*.
- the values of the variability coefficient (Cv) calculated for the variable GLU on both tests are under 10% (table no.2) which indicates a high level of homogeneity on the athlete squad. Also, the values of the standard deviation (S) calculated for the GLU variable indicate that data spreading is limited, the arithmetic average being a representative one.
- as the standard deviation measures the dispersion of certain values from the average considered value and since the calculated data is small, we consider that the homogeneity of the athlete squad is confirmed also by the values of the standard deviation values (the standard deviation through its significance indicates the level of homogeneity of a group of values - M.Niculescu, 2002);
- the values of the variability coefficient (Cv) calculated for the variables Hg and Mg (table no.2), on both tests, are under 10%, which indicates a high level of homogeneity of the athlete squad. On the other hand, the value of the lactic acid (AL) indicates a medium homogeneity with values between 15% and 30% (16,26% on T1 and 18,71% on T2), the average value however representative enough;
- the values of the standard deviation (S) calculated for the variables Hg, Mg and AL on both tests, indicates a small spreading of data with values between 0.15 and 0.41, which reveals a representative arithmetic average for the values registered on all 10 subjects (table no. 2). Since standard deviation measures the dispersion of certain values from the average considered value and since the calculated data is small, we consider that the homogeneity of the athlete squad is confirmed again form the point of view of magnesium, hemoglobin and lactic acid;
- the values of the variability coefficient (Cv) and of the standard deviation (S) registered by our subjects on the researched parameters indicated a high level of homogeneity of the athlete squad. We consider this to be beneficial for increasing the level of objectivity and precision on future interventions and for the results of our research;
- the value analysis on the *Hb* (*hemoglobin*) variable indicates a 0.1 g% decrease in value on 4 of our subjects, a 0.1 g% increase in value on 2 of our subjects and stable value for the other 4 subjects. The calculations lead to a *0,02 mg%* average decrease on the day before the competition (graphic no.1);
- the value analysis on the *Mg* (*magnesium*) variable indicates a decrease in value on the second test compared to the first one on all subjects (graphic no. 2). These alterations range between 0.01 and 0.10 mg %. The calculations lead to a *0,04 mg%* average decrease on the day before the competition (graphic no.1);

- the value analysis on the *Mg* (*magnesium*) variable indicates an increase in value on the second test compared to the first one on all subjects (graphic no.3). These alterations range between 0.1 and 0.4 mmol/l. The calculations lead to a *0,21* mmol/l average increase on the day before the competition (graphic no.1);

Discussions and conclusions

Data processing and interpretation as well as our personal experience in this area of expertise allow us to synthesize the following:

- the analysis of the biological parameters (Hb, Mg, GLU, AL) in a medium competition stag, on athletes specialized in medium or long athletic events reveals physiological alterations induced by competitonal stress also known as „the start mood". These alterations, in spite of being small on some of the researched variables are clear indicators of competition stress effects on the biological processes of athletes (taking into account the constant and objective testing conditions, confirming thus the research hypothesis);
- if the difference between T1 and T2 appears on just a few subjects, then the stress factor determined by the approach of the competition would not be taken into consideration; however the increase even with a few units of the level of glucose in the blood on all athletes led us to conclude that the proximity of the competition is causing the sanguine glucose changes;
- the increase of 0,21 mmol/l of lactic acid between the two tests, taking into account that the training done during the 6 days between test was only meant to maintain muscular tonus, indicates th fact that switching to „start mood" as a stress factor determined by the approach of the competition, affected the biological component of subjects thus determining notable changes;
- we can affirm that, as long as the recovery was respected, the training was not demanding and sleep was optimum (data collected by discussing with subjects) the increase of the level of lactic acid on the athletes practicing medium or long athletics events is caused by the stress mood determined by the approaching competition;
- the analysis of the GLU (glucose) variable confirms the increase of lactic acid since it is a known fact that these two biological parameters are in a strong dependency relation: the increase of lactic acid determined the increase of glucose in the blood;
- for the purpose of objectivity and a consistent argumentation of our research, future analysis will focus on the effect of stress during competition – on objective important competitions where the demands, interests and motivation of athletes as well as their expectations ar considerable stronger and thus the level of stress and its effects are as well stronger.

Due the particularities of high performance athletes, the specific of medium or long athletic events, the particularities of competition situations and the variation of stressful stimuli (different levels of intensity and duration, abruptness etc) it's not enough to be familiar with stress reactions in a specific moment, as long as other indicators involved in the process which control and orientate the behavior and reactions of athletes in critical or stimulatory situation remain unknown. That is why, researches should be orientated on testing and evaluating athletes specialized on medium or long events on a longer period of time, in different moments of their training or competition activity and from the point of view of the biological as well as psychological component of stress.

Furthermore, our recommendation aims at a future training of athletes focusing on the psychological aspects shaped by the biological reactions on systematic evaluations of biochemical and physiological parameters and also depending on the importance of the competition (either the target objective, implying special tactical situation or either the performance objective implying complex volitional and motivational processes).

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Fig. no.1 – Biological reactions to stress agents proceedings before a sports competition

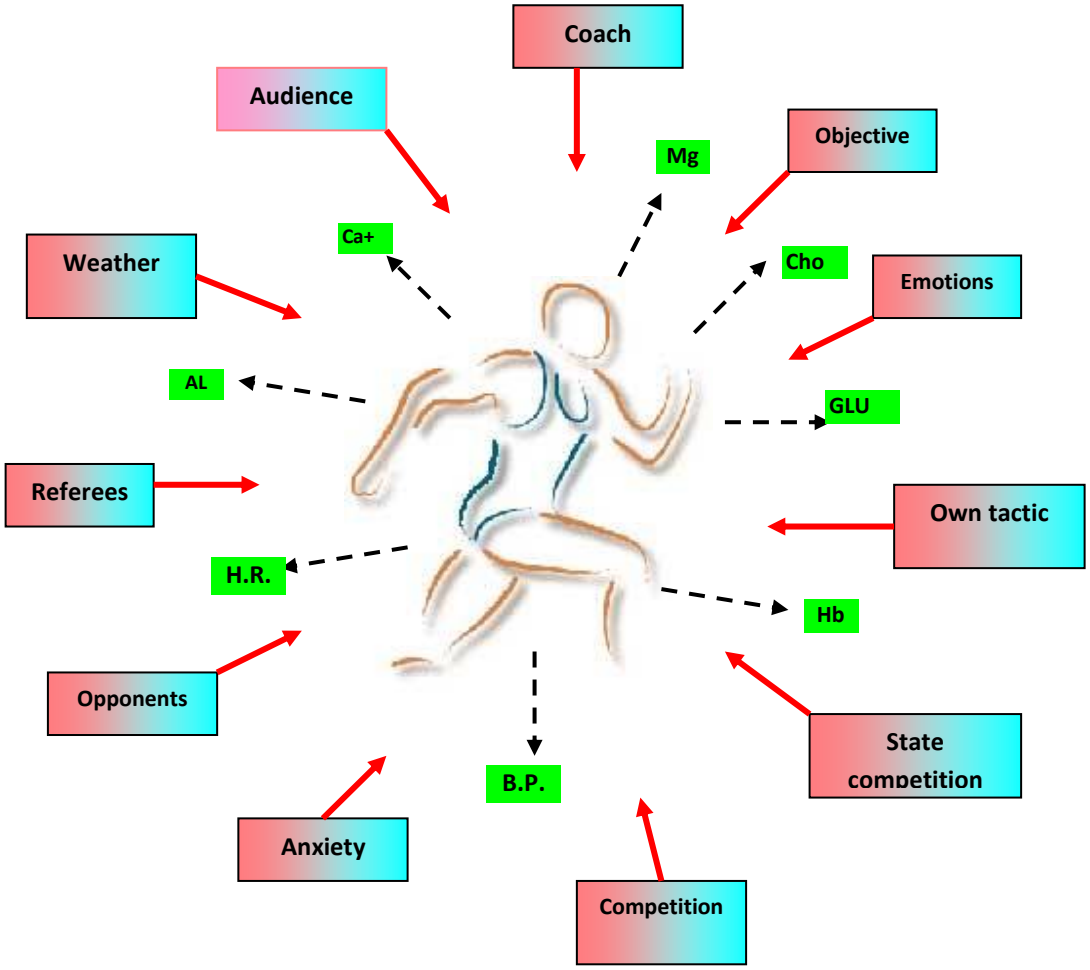
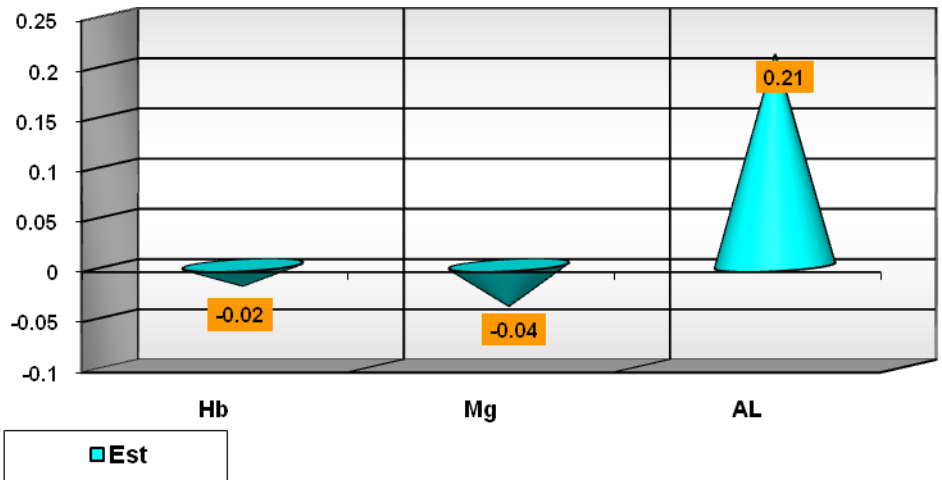


Table no.2 - Research results from the two tests for the three variables

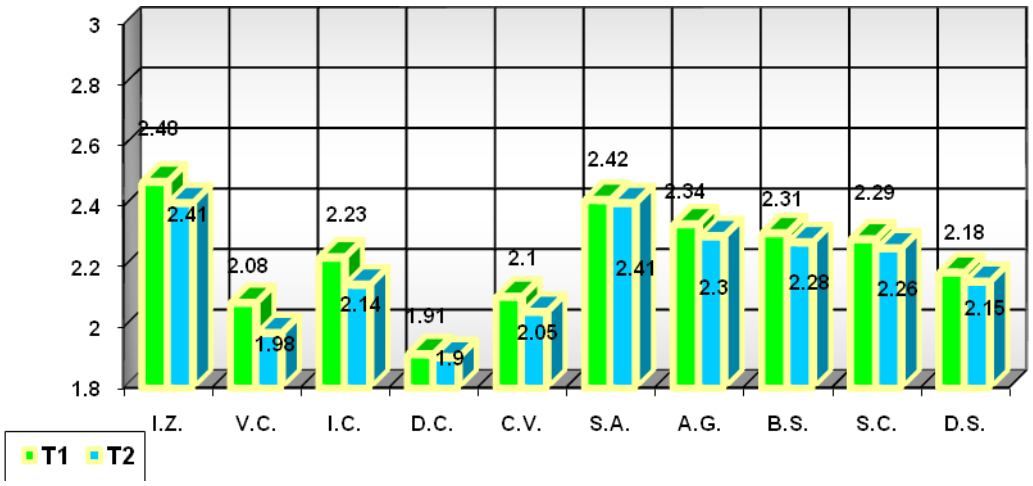
No.	Subject	Hb			GLU			Mg			AL		
		T1	*T2*	*d*	*T1*	*T2*	*d*	*T1*	*T2*	*d*	*T1*	*T2*	*d*
1	I. Z.	15,7	15,7	**0**	73	75	**2**	2,48	2,41	**-0,07**	1,3	1,4	**+0,1**
2	V.C.	15,8	15,7	**-0,1**	75	84	**9**	2,08	1,98	**-0,10**	1,5	1,8	**+0,3**
3	I.C.	15,9	16,0	**+0,1**	74	80	**6**	2,23	2,14	**-0,09**	1,6	2,0	**+0,4**
4	D.C.	15,2	15,1	**-0,1**	78	82	**4**	1,91	1,90	**-0,01**	1,8	2,1	**+0,3**
5	C.V.	16,2	16,2	**0**	86	90	**4**	2,10	2,05	**-0,05**	1,9	2,2	**+0,3**
6	S.A.	15,7	15,6	**-0,1**	77	78	**1**	2,42	2,41	**-0,01**	1,4	1,5	**+0,1**
7	A.G.	16,1	16,2	**+0,1**	85	87	**2**	2,34	2,30	**-0,04**	1,6	1,7	**+0,1**
8	B.S.	15,2	15,1	**-0,1**	80	86	**6**	2,31	2,28	**-0,03**	1,8	2,0	**+0,2**
9	S. C.	16,0	16,0	**0**	82	83	**1**	2,29	2,26	**-0,03**	1,1	1,2	**+0,1**
10	D.S.	15 ,4	15,4	**0**	82	86	**4**	2,18	2,15	**-0,03**	1,4	1,6	**+0,2**
Minimum		15,20	15,10	**-0,1**	73	75	**2**	1,91	1,90	**-0,01**	1,10	1,20	**+0,1**
Maximum		16,20	16,20	**0**	86	90	**4**	2,48	2,41	**-0,07**	1,90	2,20	**+0,3**
Average (M)		15,72	15,7	**-0,02**	79,2	83,1	**3,9**	2,23	2,19	**-0,04**	1,54	1,75	**+0,21**
Std. dev. (S)		0,36	0,41		4,54	4,51		0,17	0,17		0,25	0,33	
Cv %		2,26	2,60		5,73	5,42		7,68	7,97		***16,26***	***18,71***	

T1 – testing nr.1, T2 – testing nr.2, d – difference between T1 şi T2

Graphic no.1 - The average difference at the variables Hb, Mg, AL in the both test



Graphic no.2 - Values of Mg in the two tests for the 10 subjects



Graphic no.3 - Values of AL in the two tests for the 10 subjects