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INTERDISCIPLINARY STRATEGIES IN ORDER TO OPTIMIZE THE RESULTS OF CONTACT SPORTS

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Abstract

Problem statement in the context of performance sports, along with normal physiological reactions, there is competitive stress, which varies in relation to the type of sport practiced. Purpose of study: to test sports subjects at the beginning and end of the application of the intervention program. To test the biochemical and physiological condition of athletes and to modulate the reactivity of athletes to the stress of competition. Methods we proposed a training scheme that includes assessing the hormonal status of athletes by non-invasive methods, such as salivary and urinary determination. Research designs: the subjects of the study were juniors aged 14-16 from sports clubs in Satu-Mare County and Cluj-Napoca. Sampling: were urine and saliva samples were taken before and after training. These were in average volumes of 1 ml. Findings and Results: the statistics were processed with GraphPad Prism 5 software, with the student t test for unmatched values associated with Welch's correction. For biochemical markers that have been dosed the statistical significance is $p < 0.05$ with a probability > 95%. Discussion: biochemical parameters for saliva and urine were assayed by immunochemical and spectrophotometric methods. It has been shown that specific training in this case contributes to the biochemical reaction of adaptation to stress (coping). Conclusions this approach is applicable in planning pre-competitive training to target the level of positive and negative emotions (functional and dysfunctional) in association with a level of stress.

Keywords: Biochemical analysis, contact sports, hormonal changes, training

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1. Introduction

The interdisciplinary approach in exploring motor functions and bringing them to the level of sports performance, showed the multidimensionality of the psychophysiological act associated with both physical effort and sports performance. From a psychophysiological point of view, in the context of performance sports, along with normal physiological reactions, there is competitive stress, which varies in relation to the type of sport practiced, age, sex, environment, type of training, psychological character of the athlete. coach or even with the major objective of the competition (Şalgău, 2011). The human body, subjected to psycho-motor pressures associated with the achievement or improvement of dynamic stereotypes essential to sports activity, presents from a psychological and biological point of view a series of physiological changes framed as adaptive reactions in the field of biological stress syndrome (Alkadhi, 2013; Buynitsky & Mostofsky, 2009). The human body, subjected to psycho-motor pressures associated with the achievement or improvement of dynamic stereotypes essential to sports activity, presents from a psychological and biological point of view a series of physiological changes framed as adaptive reactions in the field of biological stress syndrome. Stress is a concept with wide implications in psychology and sociology, often erroneously used by Selye's definition in 1943. The author defines stress as the sum of nonspecific responses to any request of the body, distinguishing between specific adaptive reactions and nonspecific, the latter being responsible for the biological stress syndrome (Derevenco et al., 1992).

The adrenal glands play a role in the behavioral regulation of stress indirectly

Hormones modulate adaptive behavior in competition, especially through: glucocorticoids, catecholamines, and sex hormones, which act on specific receptors in the prefrontal cortex, hippocampus, amygdala, or hypothalamus (Argus et al., 2009).

Biochemical and physiological changes are due to competitive stress being naturally interconnected. (Toma et al., 2019).

On the other hand, physiological variations of some biochemical markers (hormones, minerals, enzymes, glycemia, etc.) or functional (blood pressure, heart rate, respiratory rate, electrical function of the myocardium, regulation of gastrointestinal secretions, salivary, pancreatic, aerobic / anaerobic muscle metabolism, etc.) are also observed in the absence of competitive stress. Physiological reactivity to effort leads to the body's adaptation to the new requirements of physical activity, marked by biochemical and functional variations as mentioned by Taffala and Evans (1997) and Marcora (2009).

Some research makes a clear distinction between exertion physiology and exertion psychology, as shown by Dijksterhuis et al. (2011). The authors demonstrate using special simulators that mental effort does not overlap biochemically and / or functionally with physical effort. However, parallel research shows that there is a dependence between mental effort and physical effort and the link between the two types of effort is made through stress-specific hormones such as corticosterone, catecholamines or testosterone (Fibiger et al., 1984; Smit et al., 2005).

Cortisol is a glucocorticoid hormone, secreted mainly by the fasciculated area of the adrenal gland, under the action of CRH (corticotropic releasing hormone), secreted in turn by the pituitary gland, especially under stress but also, in the background, intense physical exertion Staufenbiel et al., 2013). Cortisol secretion is also regulated by higher nervous mechanisms such as the ability to integrate

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emotions, modulate anxiety or the existence of dynamic stereotypes integrated with experience, at the cortical and cerebellar level (Montoya et al., 2012). Cortisol increases blood sugar, mobilizes fat in lipids, amplifies the rate of energy production at the cellular level and contributes decisively to the adaptation of the central nervous system to competitive stress.

2. Problem Statement

Previously published data showed that testosterone is also directly involved in modulating sports performance and resistance to competitive stress, in all age groups, both men and women (Toma et al., 2019) but its variations in biological fluids are much less dynamic than cortisol.

Together with cortisol and testosterone, catecholamines are the third indicator of resistance to stress and the modulation of competitive stress. Catecholamines with an essential physiological role include dopamine, norepinephrine and adrenaline, and their secretion is unevenly distributed in the central and peripheral nervous system but also in the endocrine system (Pan et al., 2018). Thus, the synthesis and release of catecholamines is found in the neuronal, lymph nodes but also in the adrenal medulla, the area of nerve origin of the adrenal gland (O'Neill, 2019). The release of catecholamines into the bloodstream is a rapid process, at the moment, which leads to rapid amplification of motor performance (especially by increasing muscle oxygenation), cardio-respiratory rate, mobilization of energy reserves and causes a wide integration of stressors central nervous system (McMorris et al., 2016). Catecholamines are also released in the urine, their summary determination being a faithful indicator of their blood concentration (Takagi, et al., 2020). In general, competitive stress or intense physical activity amplifies the level of cortisol and catecholamines in biological fluids. Saliva and urine are accurate indicators of blood, the collection of these types of samples being non-invasive.

3. Research Questions

It is assumed that by applying an intervention program through a series of specific training, physiological and biochemical changes will occur in the profile of athletes. We assume that the reactivity of the athlete will be influenced in competitions by the structure of the training.

4. Purpose of the Study

The aim of the study was to establish the role of training in modulating reactivity to competitive stress. The biochemical and physiological state of the athletes will be monitored and outlined. They will participate in the intervention program, through special training, compared to athletes who do only normal training.

5. Research Methods

5.1. Subjects, duration of study

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The study group consisted of 50 juniors, aged 14-16, without chronic diseases and who agreed to participate in the study on 12 months, between December 2016 and November 2017. The subjects practiced contact sports: boxing, judo, aikido, karate, taekwondo, boxing, 3 times per week. Among the subjects, 25 students practice contact sports in the Sports Clubs from Tășnad and Carei, Satu-Mare County and another 25 students from the Sports Clubs from Cluj-Napoca.

5.2. Materials and methods

The design of the intervention was experimental with pre- and post-intervention measurements.

The intervention program consisted of carrying out exercises to improve the concentration of attention as well as the speed of perception.

6. Findings

6.1. Data collection and analysis

Sampling was done according to the training conducted within the group.

The study was conducted over 2 years, and the samples were collected initially at the beginning of the preparation and finally at the end of the intervention program. At that time, the subjects went through all the stages of the experimental design.

Saliva and urine data were collected according to the protocol in 1 ml volumes and in sterile containers. The samples were taken under conditions of maximum hygiene and rigor and then frozen until chemical analysis was performed. Statistical data processing was done using GraphPad Prism 5 software. For all biochemically dosed markers, a comparison was made between the mean of the initial and final values. The data obtained from the determinations were processed with the student's ***t*** test for the unmatched values associated with the Welch correction. Statistical significance was set at an associated P <0.05 (probability> 95%). Data are expressed as mean ± ES (standard mean error).

Salivary cortisol and testosterone:levels were analysed by an enzyme-linked immunosorbent assay (ELISA) based on the antigen-antibody reaction in a 96-well plate. Cortisol and salivary testosterone were pre-treated with specific human anti-cortisol and anti-testosterone antibodies.

Saliva samples were diluted 5 times with 0.1 M pH phosphate buffer (TFS) pH = 7.4c and processed according to specific methods. The samples were diluted 5 times with phosphate buffered saline and then subjected to the determination protocol characteristic of each hormone (Toma, et al., 2019), as described in a previous paper.

Analysis of urinary catecholamines: the urine samples, after being diluted 5 times, were subjected to a spectrophotometric determination, at 530 nm, of the total concentration of catecholamines in the urine, with a prevalence of adrenaline and dopamine. Other authors (Madrakian et al., 2006) used the method of determination which was based on the oxidation of catecholamines with potassium periodate followed by the coupling of the reaction product with 4-aminobenzoic acid.

The blue color resulting from this reaction was measured spectrophotometrically and shows that it is directly proportional to the concentration of catecholamines in the sample. It can be seen in figure 1, bellow.

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6.2. Interpretation of results

In figure 1., below we have salivary cortisol concentration in junior boys in the initial and final testing stage

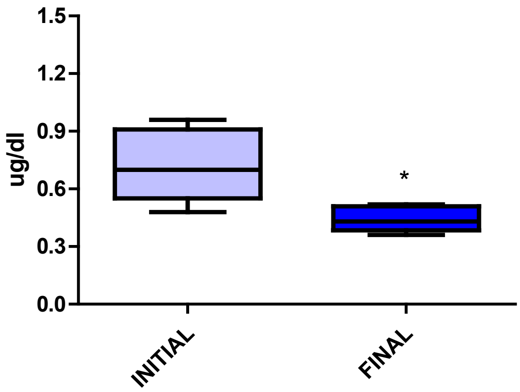

Figure 1. Data are expressed as mean ± ES. Statistical significance is at P <0.05 (*), P <0.01 (**), P <0.001 (***)

In figure 2 we can follow Salivary testosterone concentration in junior boys in the initial and final testing stage.

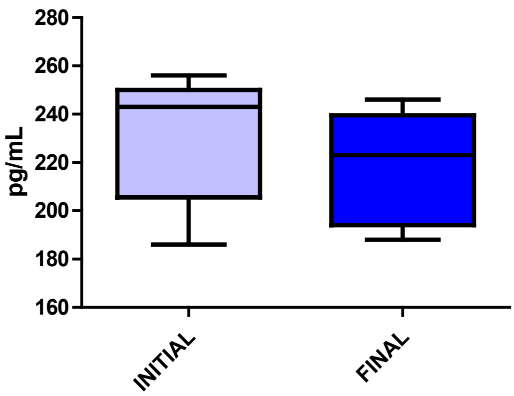

Figure 2. Data are expressed as mean ± ES. Statistical significance is at P <0.05 (*), P <0.01 (**), P <0.001 (***)

In figure 3 it is about Concentration of urinary catecholamines in junior in the initial and final testing stage

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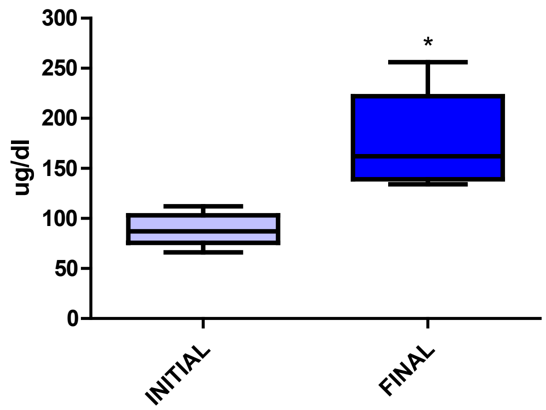

Figure 3. Data are expressed as mean ± ES. Statistical significance is at P <0.05 (*), P <0.01 (**), P <0.001 (***)

The results of biochemical analyzes in saliva and urine from juniors showed an independent variation of cortisol, testosterone and catecholamines.

Salivary cortisol levels decreased significantly (P <0.05) in the final harvest stage (0.44 ± 0.02 µg / mL) after 12 months of training, compared (initial phase) to 0.72 ± 0.08 µg / mL determined in the initial phase of activity.

Testosterone did not show statistically significant variations but only a decreasing trend in the final harvesting stage, after 12 months of training.

In urinary catecholamines, the data increased significantly from one (P <0.05) from a concentration value of 88.8 ± 7.4 µg / dL in the initial collection stage, to a value of 176.8 ± 21.8 µg / dL in the final stage, at the concentration urinary tract, see table 1

Table 1. Summary of the values of the biochemical markers determined in juniors in the initial and final stage of training program

	Cortisol salivar µg/dL (Junior boys)		**Testosteron salivar pg/mL (Junior boys)**		**Catecolamine urinare µg/dL (Junior boys)**	
Etapă	Inițial	Final	Inițial	Final	Inițial	Final
Media	0.724	0.444	230.8	218	88.8	176.8
ES	0.085	0.029	12.25	10.63	7.42	21.82
P	< 0.05		> 0.05		< 0.05	

The correlation analysis showed a negative correlation coefficient (-0.708) in relation to the variation of salivary cortisol. For salivary testosterone a positive correlation coefficient (0.161) and for urinary catecholamines a negative correlation coefficient (-0.467). P associated with the correlation analysis did not have values less than 0.05. Data are expressed as mean ± ES. Statistical significance is at P <0.05 (*), P <0.01 (**), P <0.001 (***).

6.3. Discussions

Through this biochemical testing study, we wanted to highlight the role of training in changing the ability of athletes to adapt to physical exertion and competitive stress.

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By dosed biochemical parameters, by immunochemical or spectrophotometric methods, from saliva and urine, in the group of athletes aged 14-16 years, neuroendocrine reactivity was demonstrated. This is the way in which the training specific to contact sports contributes to the adaptation to stress through the biochemical reaction (substantiation of coping).

We can say that there is a directly proportional relationship between cortisol variation and sports performance, as demonstrated by Radzi et al. (2018).

The data from this study showed that a decrease in this specific stress hormone indicates the modulating effect of training. At the same time, there is a general integration of stressors and the development of the capacity for internalization by the individual.

From other articles published by Toma et al. (2019) revealed data that demonstrated the dynamics of salivary testosterone in high-performance alpine skiing. Testosterone also showed variations in the age and degree of preparation of the subjects, and less with the athlete's expectations of his own performance or that of his competitors.

In this study, the trend of decreasing testosterone in juniors was noted. This shows that in contact sports, testosterone is not directly involved in modulating adaptive behavior to competitive stress. We can also say that instead cholesterol is directly involved in the presence of competitive stress to change adaptive behavior.

In terms of testosterone dynamics, in the tests performed on athlete athletes, we can also mention the authors Joksimovic et al. (2018) who demonstrated the same thing.

Other studies have shown that this hormone varies in sports with isotonic contraction, long-distance running and adult age groups. In children, however, testosterone reactivity was low.

The increase in the concentration of urinary catecholamines in juveniles demonstrates: a way of adapting to competitive stress, mediated by the catecholamines dopamine, noradrenaline, adrenaline, (mostly monoaminergic); an increased reactivity of the metabolism in sports activity.

Coping in the studied age group, 14-16 years is less based on cognitive analysis of situations and the attempt to cognitive internalization of stressors (McMorris, 2017; McMorris et al., 2016; Vakhitov et al. (2016). Moreover, it is mainly based on rapid, forceful reactions, which involve engaging the entire metabolism at a high rate of metabolic consumption.

7. Conclusion

The intervention program carried out through constant training, according to an application scheme established according to the preparation stage of the competition calendar, for 14-16 year olds determined the increase of the capacity to adapt to stress. This increase was marked by a decrease in salivary cortisol but did not influence the dynamics of urinary catecholamines. Instead, they grew as personal expectations and those of those around them increased.

In conclusion, we can say that constant training at 14-16 years old, in the conditions of performance sports, prevents the appearance of distress. The dynamics of the determined parameters suggest that the constant training maintains the eustress (capacitive stress).

In this study: the hypothesis that the training structure can influence the athlete's reactivity to competitive stress was confirmed; It was also confirmed the hypothesis according to which following the application of the intervention program, through specific training, the biochemical and physiological profile of the athletes can be established.

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