MINISTERUL EDUCAŢIEI

UNIVERSITATEA NAŢIONALĂ DE EDUCAŢIE FIZICĂ ŞI SPORT

SCOALA DOCTORALĂ

STUDY REGARDING THE ASSESSMENT OF SOME STRESS-INDUCED BIOMARKERS IN PERFORMANCE ATHLETES VERSUS AMATEURS IN AEROBIC AND ANAEROBIC EXERCISE

ABSTRACT

DOCTORAL THESIS

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2023

ABSTRACT

Keywords: physical effort, biomarkers, dietary supplements, performance athlete, amateur athlete, non-athlete

The doctoral thesis is oriented towards the axis of research on motor activities as priority resources for improving the quality of life and increasing human performance, with a major research direction towards the diagnosis and prognosis of the quality of life of the population.

The analysis of some stress-induced biomarkers (be it physiological, biochemical, psychological or mechanical) is an attractive subject of study, because their study can determine the monitoring and implementation of training methods that reduce the overload and the occurrence of injuries and at the same time determines the increase in performance sports.

The research idea started from the fact that there are many gyms or health promotion centers that do not take into account certain aspects related to the recovery of the body after the effort and to perform the exercise according to scientific criteria, in terms of the size and orientation of the effort.

The thesis is structured in 2 parts, comprising a total of 12 chapters preceded by a short introduction in which the relevance of the topic and the motivation for its choice are presented.

The first part of the thesis (4 chapters), represents the theoretical substantiation of the main conceptual aspects that are the basis of the research, theoretical aspects regarding stress and stress-induced biomarkers, the main sources of energy that support physical activity and the link between stress and physical activity. The last chapter of Part I is devoted to theoretical conclusions.

The second part of the thesis is associated with the two studies carried out.

The first Study represented the research on "Identification of the main categories of food supplements and their effects on the body" and is structured in 3 chapters. In the first chapter of study I, the purpose, hypotheses, objectives, tasks and research methods used are presented.

Thus, the research idea started from the premise that due to the existence on the market of food supplements produced by numerous manufacturers, a very permissive legislation as well as the lack of their quality control (information sources with a limited degree of reliability - the Internet), we proposed to identify which are the most effective food supplements used in preventing and combating physiological stress.

The purpose of study I starts from the premise that young people use food supplements in order to support physical effort in the gym or during performance training, and consists in identifying the categories of food supplements and their effects on the body and the hypotheses that have been established for this research are:

H1: There are significant differences between the age group and the consumption of dietary supplements, the type of effort and the category of athlete

H2: Men consume more dietary supplements than women.

To carry out the research, we established the following objectives:

- General objective of study I:

- Identifying the main categories of food supplements used by different categories of athletes.

- The partial objectives of study I consisted in:

- identification of the type of effort provided;
- identification of constitutional type and body shape;
- identifying the reasons for consuming food supplements;
- identifying the way to procure these food supplements.

In order to fulfill the objectives proposed in Study I, we established the following tasks:

- the study of the specialized bibliography regarding food supplements, type of effort and constitutional type;
- designing the questionnaire - establishing relevant questions for the studied issue
- the development and application of opinion questionnaires aimed at highlighting the dietary supplements used by young people and the purpose for which they are used.
- data collection and creation of the database;
- interpretation of the data resulting from the application of the questionnaires
- establishing the target group for the experimental research.

The research methods used in conducting study I were the questionnaire-based survey, the statistical method and the graphic method.

Study I was carried out between November 2019 and May 2020 and consisted of applying an opinion questionnaire to a number of 600 subjects practicing leisure-time motor activities and performance sports in order to identify the reasons why these people use food supplements and the type of substances used as well as the intended effects.

In structuring the questionnaire, we followed 3 aspects:

a) the identification data of the respondents in terms of age, weight and height, gender, level of studies, types of ailments they suffer from and drug treatment if any. Constitutional type and body image differentiated by gender;
b) the category of athlete (amateur or performance) and the type of effort practiced as well as its volume expressed in minutes/session, sessions/week;
c) food supplements, their type, where to get them and the effects sought by using them as well as their dosage.

Results of Study I and their interpretation

To see the consistency of the questionnaire we applied the Alpha Cronbach coefficient. This was .738 which indicates good consistency. After collecting the questionnaires, 517 (254 women, 263 men) were validated, which allowed us to analyze numerous pieces of information and establish various correlations between them.

Thus, following the application of the questionnaire and the analysis of the data, we can state the following:

- the large number of subjects participating in the research allows us to validate the data;
- subjects between the ages of 18-62 participated in the research, the largest category being the 18-22 year old (N=221);
- both female and male subjects, both amateur and performance athletes, participated in the research;
- most subjects (N = 330, i.e. 63.8%) fall within normal limits in terms of body mass index (BMI);
- at the level of the entire sample, there are statistically significant correlations of various intensities between BMI and age, body image and constitutional type;
- the most used food supplements are: Whey Protein, Gym Beam, PRO Nutrition, Creatine, Vita Sun, Animal Pac, Carnitine, BCAA amino acids, Vitamax, vitamin and mineral complex;
- there are significant correlations between the various types of food supplements, but there is no significant correlation between the level of completed studies and the use or not of food supplements;
- male subjects consume more food supplements, compared to female subjects, ***which confirms hypothesis 2 of the study***
- there are significant differences depending on the age group and the consumption or food supplements, the type of effort (anaerobic and aerobic) and the athlete category, ***which confirms hypothesis 1 of the study***
- most amateur athletes take protein to increase muscle mass (N = 40);
- there are statistically significant differences (p-value < 0.05) depending on the type of athlete and the way of procuring food supplements;
- depending on the sport practiced, there are significant differences regarding the use of vitamins as food supplements, there are no differences depending on the performance sport practiced and the use of proteins as food supplements, but there are significant differences (for 90% of the sample!) regarding when using amino acids as food supplements.

The second study, the evaluation of stress-induced biomarkers in different categories of the population, started from the premise that the lack of adequate recovery after effort as well as an unbalanced diet can lead over time to the appearance of diseases, injuries, chronic fatigue that can lead to overload syndrome.

The aim of study II is to identify some biomarkers that can be modified by physiological stress in different types of effort (aerobic – anaerobic) in different categories of the population (performance athletes, amateur athletes and non-athletes); identifying correlations between these biomarkers and body composition. In this sense, the hypotheses from which I started in the research of study II were:

H1: *The type of effort and physical condition of subjects influence the value of physiological stress biomarkers*

H2: *Body composition influences changes in stress biomarkers at different harvest times*

In carrying out the research, we established as the general objective of study II the identification of modifiable biomarkers in aerobic and anaerobic effort in different categories of the population, and the partial objectives of study II consisted in:

- determination of body composition using the TANITA BC1000 body analyzer;

- aerobic and anaerobic exercise test;

- the determination of urinary amylase from urine and from capillary blood - glucose, lactate;

- measuring heart rate at rest (FC0), after anaerobic exercise (FC1) and after aerobic exercise (FC 2);

- indirect determination of maximum heart rate (FC max), oxygen consumption (VO2) of mechanical work and power.

In order to fulfill the objectives proposed in the experimental research, we established the following tasks:

- the study of the specialized bibliography regarding biomarkers of physiological stress, type of effort and body composition;
- establishing subject groups (performance athletes, amateur athletes - fitness, non-athletes);
- establishment of the lactic acid anaerobic exercise test and the aerobic exercise test;
- data collection and creation of the database;
- interpretation of data resulting from sports tests and urine analysis (urinary amylase) as well as blood glucose and lactate.

The research methods used were:

a) Survey method - The questionnaire applied in this stage refers to the health status of the study participants as well as information about the food supplements they consume or not.

b) Measurement method and evaluation with the help of tests - By means of this method we performed biochemical tests (urinary amylase, blood sugar, blood lactate) as well as physical tests for anaerobic lactic acid and aerobic exercise.

c) Statistical method - In order to process the collected data, we used 2 software for processing statistical databases: Statistical Package for the Social Sciences (SPSS) version 22 and Power BI.

d) The graphic method

Study II was carried out between October 2022 and December 2022 and consisted in establishing the subjects of the research (performance athletes - CSM Tg. Mureș participants in the National Men's Basketball League - Mozart, n = 15; amateur athletes - athletes who frequent gyms , n=15; non-athletes - students from the BFK specialization within UMFST "G.E.Palade" from Tg. Mureș, n = 16). Control tests were established both for anaerobic lactic acid exercise (squat 2*15 sec with a 10 sec break) and for aerobic exercise (queen step test - 3 minutes). Biological samples (capillary blood glucose, blood lactate, urinary amylase) were collected at three different times (M0 – rest, M1 – after the first exercise test, M2 – after the second exercise test). Each research participant underwent a body analysis using the Tanita BC1000 body analyzer. Heart rate was measured in all 3 moments and then HR_{max} and $VO_{2max}1$, $VO_{2max}2$, power (P) and mechanical work (W) were indirectly determined.

Following the experimental research (Study II) I managed to create 3 different population groups in terms of fitness level (performance athletes, amateur athletes, non-athletes) on which stress tests were applied and various biological samples were taken, resulting in a very generous database. This allowed us to use various statistical analysis

both horizontally (between different biological sampling points) and vertically (between groups and within each group). Thus, after analyzing the data, we can state the following:

- After analyzing the data we can conclude that most of the data have a normal distribution (Kolmogorov – Smirnov test), which allows us to make some correlations between the data.
- both female and male subjects participated in the research, both non-athletes, amateur athletes and performance athletes;
- most subjects fall within normal limits for body mass index (BMI)
- at the level of the whole sample there are statistically significant correlations of different intensities between body mass index (BMI), body fat (BodyFat), visceral fat level (VFatL), physical activity level (PAL), physical appearance (PhysRate), total body water (TBW).
- There are changes in physiological stress biomarkers between groups and between different collection times: of blood lactate after the 2nd exercise test between the group of performance athletes and amateur athletes (p-value = .016) and performance athletes and non-athletes (p-value =0.18); of blood glucose at time 2 between performance athletes and amateurs (p-value=.055), of amylase after the 2nd effort test between performance athletes and amateur athletes (p-value = 0.22).***This confirms hypothesis 1 of the study***
- there are statistically significant data to confirm the influence of body composition on biomarkers of physiological stress and on effort parameters (Skeletal mass, (SMM) influences the values of oxygen consumption ($VO_{2max}1$), resting heart rate (HR0), blood lactate2 and urinary amylase2; body fat (Body Fat) influences blood glucose2 and heart rate (HR1)); The level of physical activity determined by body composition (PaL) has influence on physiological stress biomarkers (amylase0, blood lactate2) as well as on effort parameters (HRmax, $VO_{2max}1$ and $VO_{2max}2$, Mechanical work (W) power (P). ***This it confirms hypothesis 2 of the study***
- There are changes in heart rate between different measurement times.

ELEMENTS OF ORIGINALITY OF THE WORK

In carrying out these studies, we completed a rich activity of information and documentation through traditional methods (direct information, the use of bibliographic works from the libraries of UNEFS Bucharest and UMFST "G.E.Palade" from Tîrgu Mureș), as well as through modern methods based on information technology (studying search sites, querying international databases using keywords).

In order to achieve a more complete presentation of the issue addressed, I searched for the most relevant and recent bibliographic sources that present the current state of the issue addressed.

Carrying out a questionnaire (opinion study) on the food supplements used by performance and amateur sports subjects gave us a more accurate picture of the type of food supplements used, the age categories that consume the most food supplements.

The use of the Tanita 1000 body analyzer and the Gmon software, on different population categories, allowed us to create a generous database that will later be exploited by publishing some articles.

Establishment of specific aerobic and anaerobic exercise tests suitable for different population categories.

Taking biological samples and analyzing them on different population categories (performance athletes, amateur athletes and non-athletes) allowed us to create a picture of the influences on the existing relationships between various physiologically modifiable biomarkers compared to the body composition of the subjects. Of course, further research in this direction is needed.

In the processing of the information we managed to combine two data analysis programs (SPSS and Power BI) which allowed us to establish levels of statistical significance and to make various correlations and connections between the data.

The interdisciplinarity of the theme forced us to create an interdisciplinary research team, collaborating with specialists in the field of physiology, biochemistry, nutrition, informatics and last but not least, with specialists in the field of motor activities.

Among the limitations of the experimental research, we can mention the number of subjects (n=46), which does not allow a generalization of the research.

Regarding the dissemination and practical utilization of the research results, the dissemination was achieved by publishing some articles based on the obtained results.

The practical application consists in finding noninvasive collection methods usable in performance physical activity and not only, which will allow us to correlate training parameters with changes in physiological stress biomarkers or fitness biomarkers of performance or amateur athletes