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ASPECTS REGARDING THE ADAPTATION MODIFICATIONS RESULTING AFTER THE PHYSICAL EFFORT SPECIFIC TO JUNIORS IN ARTISTIC GYMNASTICS

Abstract of the doctor's degree thesis

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INTRODUCTION

Our scientific research started from the need I felt during my activity, as a male artistic gymnastics trainer, to know all the details of the evolution of children's growing and development trained in this type of performance activity, related to the training programs.

Our aim searched to identify the biological echo specific to male artistic gymnastics on the gymnast's body, from selection to pre-puberty, taken into account the small age when children begin the trainings in this sport.

Training the children according to a perspective vision supposes a more profound knowledge and a more detailed analysis of growing and development laws, so that the training stimuli can be appropriately dosed, without exposing the gymnast's body to accidents and traumatisms.

Part I. THEORETICAL SUBSTANTIATION

Chapter 1. – MALE ARTISTIC GYMNASTICS, EMBEDDED IN OLYMPIC CONTESTS

1.1 Male artistic gymnastics – sportive performance and spectacle

Sportive branch with a very well defined status in Olympic sports bouquet, artistic gymnastics is an important component of man's life in nowadays society, not only from the perspective of the people directly involved, but also of indirect consumers of sportive shows.

Gymnastics is considered to be one of the most efficient activity forms which is the basis of entire human exercise, and at the same time a traditional sport of movements beauty and harmony.

The bigger and bigger popularity earned in countries of the world, as well as the importance offered worldwide for supremacy in the field, transformed artistic gymnastics into one of the most important sportive branches.

Performance artistic gymnastics was separated from other forms of physical exercises practice for centuries, through the variety of technical content, through the increase of the degree of elements difficulty and the outline of a competition system favorable to sportive mastery. Great span competitions offer a show situated at the borders between sports and arts, always having a public capable of appreciating the beauty and complexity of this sport.

1.2 The importance and the actuality of the theme

Male artistic gymnastics is a sportive branch in which reaching performance can be done through a complex demand/solicitation over the body, towards its maximum limits/boundaries, so that spectacular performances, with a high degree of difficulty, could be possible and appreciated appropriately in great span competitions.

Yet practical experience demonstrated that until reaching the worldwide hierarchy, gymnasts have to follow "a path" which is ascendant, marked with periods of progress, of stagnation or slight regression, depending on the particularities of age stages and of the training process.

Our research theme acquires a remarkable importance, aiming to demonstrate and persuade that performance sport, in general, and gymnastics, in particular, do not influence negatively the growing and development, when the training process respects the methodological principles and is scientifically led.

1.3 The aim of the hereby research

Taking into account the place and the importance that the adaptation of the body to effort has in sportive training problems, the aim of the hereby research is based on the outline of modifications and manifestations of the gymnast's body, when he is a junior, owed to the specific effort.

The principal aim of this paper is the one to identify the essential aspects of male artistic gymnastics specific adaptations, regarding the junior's organism. Only understanding and respecting the laws of adaptation processes, possible to be established for this age category, will allow the selection of some efficient training methods and applying them in the gymnasts' training.

1.4 Motivation of the chosen theme

Starting from the idea that performance artistic gymnastics demands the biological limits of the body from very early ages, our interest has been oriented towards the knowledge of the particularities of adaptation modifications owed to specific effort, which, in time, lead to the champion's model.

As a consequence of practicing the activity as a trainer of the male artistic gymnastics sector of no. 7 "Dinamo" Sportive Club, in Bucharest, I felt the need to acquire a detailed knowledge of the evolution of growing and development of all children involved in this type of activity. Because, until the age of selection to be trained in representative lots, gymnasts follow the growing and development stages in parallel with their training in sportive clubs, I considered at least interesting our demarche to identify the aspects specific to early ages, especially of small children I train.

Chapter 2. JUNIORS, AT A DECISIVE AGE FOR TRAINING TO BECOME GYMNASTS

2.1 Sportive classification in male artistic gymnastics

The preparation / training system in gymnastics is built on learning a technical content parted on more sportive classification levels and categories: juniors IV (levels 1 and 2), juniors III, juniors II, juniors I and masters. Each gymnast, in order to gain a classification category, has to obtain a certain number of points, according to the technical program established by the Romanian Gymnastics Federation and transmitted through the Classification curriculum of all clubs and performance sportive sectors.

2.2 Characteristics of the age preceding puberty (6-12 years old)

2.2.1 The rules of the growing and development of the body

Gradual processes which influence the biological structures from the quantitative adding and functional organization, qualitative modification of bio-chemical composition, as well as of slow deterioration , are: "growing", "development", "maturing" and "ageing" (Dragnea A., Bota A., 1999).

Growing and development represent *"a dynamic complex of biological processes the human body is subject to during its evolution until maturing. Growing is a quantitative process of cellular multiplication regarding the weight, the volume and body dimensions, whilst development is a qualitative process of cellular differentiation, consisting in functional modifications and qualitative improvements, which mark a perfection and an adaptation of body parts and systems, a complex evolution and their coordinated integration into a unitary whole."* (Ifrim M., 1986)

2.2.2 Morphological particularities of the organism

Data from specific literature illustrate that normal growing and development of children's skeletons does not have a uniform rhythm, but a certain dynamic, in the process appearing periods of slow growing with variable lengths according to age, life conditions, individual or hereditary particularities. During the morphological functional development, slower development periods alternate with rapid growing, in leaps.

Thus, growing and development processes get slower in early ages, then their rhythm becomes accelerated again, the growing dynamic being modified at the age of 9, because of puberty.

Studies demonstrate that physical activity and regular training do not have an apparent effect on the growing process, yet the daily consume of calories can greatly influence the corporal weight and composition. In this direction, regular practice of physical exercises has an effect the growing of bony density, the decrease of fats in favor of muscles, increasing of total corporal surface. Therefore it can be stated that the age of the growing peak is not modified neither by the practice of regular physical exercise nor by the maturing of the skeleton.

2.2.3 Functional and bio-chemical characteristics of the body

In specific literature there are many data referring to individual's physiological body modifications, most of these information regarding the main functions and organs, specifying that the actual tendency of the human species is a lower of the age of certain changes.

Most of the physiologic functions evolve until maturity, afterwards register a stagnation period, and decrease as the individual grows older. In order to see the evolution of some performances during the child's growing and development period, it's necessary to study movement capacity, cardiac - respiratory functions, aerobic and anaerobic abilities, thermoregulation and functional economy during effort.

2.2.4 Dynamic characteristics

Movement capacity at this age is extraordinary the child has the ability to acquire a considerable movement repertoire, yet presents difficulties in memorizing and fixing new moves. In return, the consolidation and the improvement of fundamental movement habits can be successfully realized through a great number of rehearsals, which will lead to the possibility of learning technical elements specific to some sportive tests or branches.

Movement abilities at children improve while growing and have the tendency of stagnation during puberty. The development of movement is the result of the development of neurological-muscular and endocrine system, but it is also owed to the intense children's movement activity. Studies show that observed girls' stabilization is the result of the estrogen increase at puberty and of the rapport between estrogen and testosterone which favors the fat tissues deposits. A decrease tendency of the performance level is registered, because at puberty, girls adopt a more sedentary lifestyle than boys, this being a very spread social phenomenon.

2.2.5 Psychological characteristics

This age stage is contradictory, characterized by crisis of insolence and stubbornness, recalcitrant behavior, for which it is defined through the term "juvenile crisis" in specific literature. Physical equilibrium and harmonious development ensures to the junior the success in fulfilling the scholar and extra-scholar tasks (Epuran M., Horghidan V., 1994).

The period before puberty is profoundly marked by the fact that the child lives in a special environment, the scholar one, in which the cognitive, communication, interrelation and movement demands are highly increased compared to the preceding stage and are foreboded on the background of biological development. Studies regarding the child's development at this age are, in great extent, centered on the problems of scholar adaptation and of the learning process. Scholar activity contributes to the acquisition of a varied range of behaviors and to the forming of some skills, such as the writing, reading and calculating ones, which are fundamental in the individual's evolution and enrich the adaptation experience of the latter.

Chapter 3. CHILDREN'S AND JUNIORS' TRAINING IN MALE ARTISTIC GYMNASTICS

3.1. Stage I characteristics of training in artistic gymnastics

3.1.1 Generalities

Sportive training supposes the systematic deployment of a long term preparation process, which is applied progressively and gradually, according to the sportsman's possibilities. The main objective of this activity is to optimize the performance ability in order to obtain victory in sportive competitions (Bompa, T., 2002).

It's not about the sportive training outside the competition or the other way round. Sportive training is shaped after contests, and these ones ensure the necessary conditions for the fulfillment of objectives and desired performances.

The main mark of the conception of sportive training is represented by future competitions in which the sportsmen will participate. Depending on the calendar of competitions, different from a sportive branch to another, the structure of sportive training is established and the planning documents are completed, on the basis of some diagnosis and prognosis of the trained individual's evolution operations.

3.1.2 The objectives and the content of stage I

Using as guidelines the opinions of Dragnea A. and Teodorescu S. (2002) regarding the objectives and the content of training stage I, we will make a few statements related to their customization to male artistic gymnastics:

- *Children's harmonious physical development emphasizing the main muscular groups frequently used in male artistic gymnastics*

In artistic gymnastics the exercises used to obtain a harmonious physical development follow:

- the development of the functional capacity of the organism (cardiac – vascular system, muscular system, respiratory apparatus, nervous system and energetic metabolism);
- strengthening the muscular system;
- mobility development;
- general body movement;
- ensuring a correct posture;
- forming the general movement basis;

- *The development of movement qualities and aptitudes*

Starting from the systematization of movement qualities necessary in feminine artistic gymnastics (Grigore, V., 2001), required to each apparatus, we present a summarizing table of these ones, in particular for male artistic gymnastics.

Movement Quality	**Manifestation forms**	**Apparatus**					
		Sol	**Vaulting horse**	**Rings**	**Leaps**	**Parallel bars**	**Bars**
Speed	Execution speed	X	X	X	X	X	X
	Displacement speed	X			X		
	Reaction speed	X	X	X	X	X	X
Force / Strenght	Explosive force	X			X	X	
	Relative force	X	X	X	X	X	X
Movement, flexibility	mobility Muscular flexibility	X	X	X	X	X	X
Resistence	General resistance Specific resistance	X	X	X	X	X	X
Coordinating capacities	Refinement of kinestezic sense for each apparatus	X	X	X	X	X	X

Table no.7. movement qualities in artistic gymnastics

- *Gradual training of gymnasts to participate in competitions*

The result of the training process is appreciated through participating into competitions. Children's participation into contests at this stage of sportive training is dependent of the preparation level acquired in the instruction process, with the aim to get the children accustomed with the discipline of competition, respecting the regulation, with the emotions of competitions, with the use of knowledge acquired during the preparation process. It is aimed to educate the initiative, the sense of responsibility and the desire to become a well-known sportsman.

- *Education of civilized behavior in all circumstances of sportive life, of love for the colors of the sportive colors, of the desire to sportive success*

Sports represent a social environment completely new and different for children, compared to the scholar and the familial ones which are familiar. In the case of performance sports, the results appear after a long and severe work, developed according to well established rules, therefore the demands and the exigencies of sportive activities have to be explained taking into account the psychical characteristics and the child's capacity of understanding at this age.

- *Scheduling training depending on the structure of the scholar year*

The particularities of sports branch, as well as the structure of the scholar year are the main factors in scheduling the sportive training.

Thus, scheduling the basis sportive training contains a structure of approximately 4 middle-structures, each of 6-8 weeks. The duration of each stage is established depending on the number of necessary trainings, on the main objectives and on the particularities of artistic gymnastics.

3.2 Sportive training – Assembly of stimuli for influencing the performance capacity

Sportive training can be analyzed through specific demands which are addressed to the movement and to the physiological area, representing an assembly destined to the development of performance capacity.

Taking into account the fact that training lessons suppose repeated physical efforts, it is easy to understand that these ones consists in permanent adaptation demands which converge towards the form of the trained sportsman and towards the sportive form corresponding to performance results in contests.

Apart from the physical demands, sportive training involves concomitantly resting pauses, in the lack of which the physiological echo of the efforts could not be sensed. In order to practice in optimal parameters, it is necessary that the training stimuli to be alternated with pauses which can ensure the complete or partial recovery of energetic resources. Avoiding exhausting the resources of the body, which leads to stopping the practice, to accidents, it is possible through appropriate pauses, as length, and nature (active or passive),

with the type of effort and the subjective sensations of tiring. Thus, the relation between effort and the energy consume – recovery gets a significant in sportive training.

SECOND PART
PRELIMINARY RESEARCH REGARDING THE BIOLOGICAL EFFECT OF PHYSICAL EFFORT ON THE GYMNAST'S BODY

4.1 Physical effort, used as training stimulus

The state opposite to pause, realized on the basis of knurled muscular contractions, in which the basis conditions are overwhelmed through movement, owed to physical effort.

Bio-chemically speaking, effort is a transformation of chemical energy into mechanical energy. From this perspective, effort causes a series of troubles in organism, which affects the main functions, the adaptation of parts and systems being dependent on the nature.

Biologically speaking, physical effort, especially the sportive one, may be regarded as a stimulus, an appropriate biological turn-on which forces the organism to respond through electrical, mechanical, thermal and biochemical manifestations. This stimulus, when it is well dosed and correctly administered to individual characteristics, leads to obvious quantitative and qualitative morphological modifications.

In sportive training, effort is considered to possess a double value, specific method and way of a whole preparation process, of continuous learning, resulting in the necessity of repeated rehearsals in different manners, with different tasks and objectives from stage to stage.

4.1.1 The typology of effort from the physiological point of view

Being given the great diversity of types of physical efforts, the correct appreciation of their classification, from the physiological point of view, imposes the emphasis of more *criteria*.

In this purpose, in this sub-chapter we present the classification realized by Bota C. (2000), as being the broadest, in our opinion.

4.1.2 Parameters of physical effort

In the majority of studies which treat the problems of physical effort, these ones are analyzed from two perspectives, respectively from the *size* and *orientation*.

Size is not analyzed only from the outside through parameters such as volume, intensity, density, etc, but also from the inside, based on the complex reaction of organism to the activity.

Orientation of effort refers to the anaerobe or aerobe energetic sources necessary or the realization of effort, which can be known in order to ensure an efficient preparation, which leads to the improvement of energetic resources / stocks.

4.1.3 Energetic parameters of physical effort

From the physiological perspective, *energy can be defined as being the capacity that a body system possesses to perform an activity or a mechanical thing*.

The body does not create energy, it transforms it. In this purpose, physical activity can be perceived as an energetic transformation, respectively of the potential chemical energy, contained in the alimentary strata, in mechanical energy and heat.

Due to the fact that energetic resources have a significant importance in sportive activity in general and in the performance one in particular, it is absolutely necessary their knowledge, as well as the one of the main ways and modalities to produce energy at the muscular level, as Bota C. sustains (2000).

There are different types of organic substances (carbohydrates, proteins and fats) which, apart other roles, also fulfill important energetic functions. Researches illustrated that the direct energetic source which provides the necessary energy to the various biological processes, including to the muscular contraction, is the *adenozinic-triphosphoric acid* (ATP).

This substance contains a molecular complex and three phosphates united through two phosphate-macroergic bounds. These ones store a large amount of energy.

4.1.4 The physiological mechanism of muscular contraction

The movement acts and actions performed by each individual, with the purpose to adapt to the modifications of the external or internal environment, are realized through the medium of some contractions of the skeleton muscular contractions.

Muscular contraction is the mechanical manifestation of the response to the stimulus, incarnated in the length of the fiber or the creation of an internal tension, being the effect of the nervous command arrived at the level of the movement base and transmitted to micro-fibers.

4.2 The description of the male artistic gymnastics specific effort

In order to be able to create a broader image of the complexity of male artistic gymnastics specific effort, we considered necessary to analyze the demands afferent to this sport based on the general classification methods of the physical efforts.

- *According to the character of the performance,* is it a **sportive effort**;
- *According to the type of muscular contraction,* the effort in male artistic gymnastics is a **combined effort**;
- *According to the character of the movement structure,* we can talk about a preponderantly **unrepeated effort**, with repeated phases;
- *According to the presence of pauses during the effort,* we appreciate that male artistic gymnastics is based on a **discontinued solicitation**;
- *According to the number of warming up,* it is considered that the gymnasts sustain a repeated effort;
- *According to the purpose,* we can talk about **training effort** and **competition effort**;
- *According to the similarities between training and competition effort,* in the gymnasts' preparation lessons can be found not only **unspecified efforts**, but also **specific efforts**;
- *According to the intensity,* there is **sub-maximal** and **maximal effort**;
- *According to the demanded systems of the body,* it is a **neurological-muscular effort;**
- *According to the used energetic substratum,* we refer to an **aerobe effort** globally, with alactic-acid anaerobe phases (jumps) and lactic-acid ones.

4.2.1 Biological and functional solicitations

Optimal solicitation can be appreciated through the characteristics of physical and biochemical efforts, as well as through the degree of individual's psychical solicitation.

In male artistic gymnastics we can talk about a smaller solicitation if the sportsmen prove to possess special movement abilities and show their desire to learn new technical elements, with a high difficulty degree, yet the "patterns" sometimes used by the trainers during preparation, as a consequence of their own practical experience, prevent them from exploit at a superior level the movement capacities.

On the other hand, a smaller solicitation can appear when dosing the effort in training lessons, especially in physical preparation, is unsuitable, meaning a smaller number of exercises, series or rehearsals, performed with low intensity In conclusion, it is necessary to grant a serious attention to the gymnast's functional re-activity to training stimuli, as well as the maintenance

of a performance reserve, which could ensure sportive longevity and the obtaining of remarkable results at superior classification categories.

4.2.2 Dynamics and biomechanics solicitations

Artistic gymnastics is characterized through a wide movement repertoire and high technical degree, which supposes a multilateral and complex solicitation of the gymnast's body at the level of all its segments. This movement repertoire is owed not only to the big number of technical elements, but also to the six apparatus, like in the case of male artistic gymnastics. As a consequence, we can talk about a multi-task test which requires the complete organism. In order to obtain superior performances is it not enough to master this movement repertoire, this also has to be improved during the preparation process until it becomes an automatism (Avramoff, E., 1989).

Experts consider that the most representative particularity of gymnastics is complexity, because this sportive branch is based on series of elements performed in a specific rhythm and tempo for each segment and element, with great precision, forming, in the end, a whole, complete contest exercises. Furthermore, effort complexity increases with the number of body rotations around its own axes, with disruptions of contacts with the apparatus and continuation of this contact after certain moves, during flight phases, with projection of weight center at various heights, depending on the apparatus.

From the movement qualities point of view, we can talk about their combination, because there is no apparatus to require only a unique pure quality.

Effort complexity in gymnastics is also determined by the differentiated biomechanical characteristics of this sport, which influence the physical demands of the body.

4.2.3 Marks of biomechanical side of movement

Knowing and understanding the biomechanical principles and the forces which act during technical elements performance in male artistic gymnastics, are the foundation of the elaboration of necessary learning methodical instructions, forming the premises of a correct execution. In this regard, in the thesis there are explanations of some notions such as: **rotation movements, holding reaction, inertia, angular moment, angular speed, vertical moment.**

4.2.4 Psychological demands

Psychologically speaking, artistic gymnastics, unlike the other sportive branches, present characteristics specific to effort psychical tension, that is why gymnasts are submitted to physical and psychical stress during the preparation process.

At the level of psychical area, regarding the effort in male artistic gymnastics, we are interested at the same extent in psychical sense, cognitive, affective and volitional processes.

From the range of psychical cognitive processes, artistic gymnastics demand the attention in performing elements with a high degree of difficulty and risk, memory in chaining the specific movement actions and elements series, thinking and imagination in unfolding the exercises on apparatus and in making efficient decisions in case of a technical mistake or failure.

As for the affective processes, we can notice that fact that gymnasts prove to have a good affective equilibrium, with a high emotional control, especially during contests, resistance to frustration, especially when they fail performing an element or an entire competition.

It can be stated that specificity of artistic male gymnastics contributes to the qualitative progress of more elements of psychological-movement behavior.

4.2.5 Training dynamics in gymnastics preparation

Effort dynamics during training process consists in a controlled game of solicitation volume, intensity and complexity, realized through the gradual modification of effort parameters from a mezzo-structure to another, or even from a micro-structure to another, depending on the aim.

- *Effort volume* in artistic gymnastics is determined by the big number of elements and tests, and by the specificity of this sport.
- *Effort intensity* is given by: the difficulty degree of technical elements and series, number of rehearsals in time unity, cardiac frequency value, number of apparatus approached in a preparation lesson, the time given for each apparatus and the entire training time.
- *Effort complexity* increases at the same time with the increase of the technical elements degree of difficulty, with the movements amplitude, with the increase of performance tempo, with segments or all body supplementary actions, on different orbits and directions, with both segments simultaneously or alternatively, chaining two or more elements of the same or different degrees.

As already shown, volume, intensity and complexity are interrelated and impose conditions one for another, that is why they have to be rigorously established inside each micro-structures, as well as inside each lesson.

Through its parameters – intensity, volume, duration, complexity – any type of physical effort requires energy from the body, leading to an unpleasant general or local state, translated through the appearance of the tiredness phenomenon.

When solicitations are superior to the functional possibilities of the body, there can appear different undesirable pathological states with negative effect on sportive performance. When solicitations are set between the values of the functional capacity of the body, there appears the physiological and neurological-psychical *tiredness*.

The effort during preparation lessons have to be demanding for the organism, they have to produce a certain state of tiredness, which can be removed through pause. Thus, effort and *recovery* become two major components of sportive preparation, amongst which there is a significant dependency, imposed by the physiological laws and by training principles.

Chapter 5. – BIO-POSITIVE ADAPTATION, AS A RESPONSE TO TRAINING SPECIFIC STIMULI

5.1 Essential aspects of effort adaptation

Physiologically speaking, adaptation supposes organic and functional modifications determined by intrinsic and extrinsic solicitations. This appears as a consequence of a series of efforts performed during a longer period of time, yet it is reversible, it can progressively disappear, through the interruption of training process and it can be renewed when necessary.

Adaptation represents a long-term process, appeared after different types of solicitations and manifesting itself at the level of the muscular, respiratory, metabolic and cardio-vascular systems through remarkable performances and great tiredness resistance.

5.1.1 Characteristics of adaptation

The physical effort performed with persistence, according to the necessary techniques and parameters, determine a high level of physical condition and a big resistance to demanding activities. Yet these adaptations are closely related to the level of initial physical condition.

Starting from the knowledge of adaptation characteristics, it is possible to select more efficiently the training means which act “high-aimed” on sectors directly involved in a sportive activity or another. Furthermore, this favors the identification of the most pertinent ways of dosing physical effort to

ensure reaching the objectives without endangering the growing and development processes started physiologically, at various ages.

5.1.2 Types of adaptation

The adaptation of the body to effort influences the entire organism and plays an important part in establishing the parameters of physical effort. Adaptation processes influence corporal development with somatic and functional components, movement capacity, effort capacity and psychical processes, these ones being shaped, in the opinion of Bota C. (2000) in various forms:

- *From the morphological point of view* – this adaptation refers to modifications of corporal and muscular weight, the volume of cord, the density of capillary veins, the density of mitochondria;
- *From the functional point of view* – this adaptation consists in functional improvements of the solicited organic systems, of which the most significant are: energy transfer systems, gaseous exchanges, circular system, endocrine system;
- *From the point of view of positive or negative effects of installed modifications: - bio-positive adaptation; - bio-negative adaptation;*
- *From the point of view of morphological-functional parameters involved in effort, we differentiate:*
  - *specific adaptation* – determines modifications in the systems and the body parts which are mainly solicited;
  - *unknown adaptation* – determines modifications not only in the mainly solicited organs, but also in the indirectly solicited ones.

  According to the sportive practiced activity, specific literature describes a general and a specific adaptation:
  - *general adaptation* appears at the level of some organic functions because of the solicitation of some big muscular groups;
  - *specific adaptation* appears at the level of the practiced sport and is produced at the level of mainly solicited to effort segments.

  Short-term adaptation is an immediate reaction of the body to solicitation, appeared after a unique effort and it is addressed strictly to the organ or the system involved.

  Long-term adaptation does not exclude the necessity of short-term/duration adaptation, which serves as an initial stimulus for ulterior modifications produced by rigorously organized / supervised trainings in order to obtain the highest performances.

Late modifications are owed to systematic practice of physical effort during the training process, with a long duration. These modifications represent *"the print that training makes on sportsman's body"* (Georgescu M., 1982), which reflects in the differences between trained and untrained.

5.1.3 Characteristics of adaptation in male artistic gymnastics

Adaptations specific to male artistic gymnastics apply to all apparatus and systems of the body which have been previously mentioned.

Regarding the morphological modifications owed to specific effort, we consider that the latter produces long duration adaptations on a few of the dimensions of the body. These are obvious after a few years of specific practice, being visible at ages before puberty. From the morphological parameters of the gymnast's body, the following caught our attention:

- **the corporal weight;**
- **the circumferences of segments and their volume;**
- **the types of physique.**

Referring to **the modifications of cardiac-respiratory system,** induced by practicing gymnastics during long periods of time, we emphasize the fact that specificity of effort is not mainly addressed to this apparatus, but to the neurological-muscular one, reason for which physiologists did not notice remarkable modifications compared to other sports, at this level. In exchange, the adaptation of the locomotive system bears the mark of intense and complex solicitations, specific to each gymnastics apparatus.

5.1.4 Sportive shape – the superior state of adaptation of organism to effort

Training is a complex process, organized and planned on different stages. In these stages, the sportsman reaches a certain level of preparation. Obtaining superior sportive performance is the result of an adaptation of organism to various types of effort and training methods, during the preparation periods. Reaching the sportive shape is a complex phenomenon, which cannot be instantly realized, but progressively and cumulatively, through passing through more training states.

The most significant particularity of the sportive shape is given by its multi-phases character: to obtain, to improve in significant contests, to lose or become out of shape in an organized manner. Phases are determined by the laws of adaptation phenomena of organism and influence the complete programming, planning and supervising process of the training.

It can be estimated that it is necessary to elaborate an appropriate strategy to reach the highest peak of sportive shape, in such a manner to obtain the best results in competitions. This is possible taking into account the sportsman's individual particularities, his motivation and the preparation conditions.

Starting from the general training objective to obtain the sportsman's body superior adaptation through progressive solicitations of lessons, we underline the importance of assigning some appropriate effort parameters

(presented in the 4th chapter of this thesis), so that it constituted the adequate stimulus for the body and produced quantitative and qualitative modifications, for each gymnast.

In this context, we consider that our demarche discloses the constant and prominent significance of knowing the specific effort in male artistic gymnastics, so that the training stimuli contributed to reaching objectives, to the installation of bio-positive adaptations and do not threat in any way the sportsmen's health.

Male artistic gymnastics demands planning and programming demarches of sportive training to take into account not only the physiological limits of the sportive form, but also the performance objectives aimed during the training, for each classification category.

Respecting the laws of installation of adaptation processes and the permanent reactivity of young gymnasts to applied stimuli dictate / impose the establishment of preparation periods and eventually their modification, these documents not being some kind of "menus" which have to be followed as such. The trainers' flexibility and craftsmanship manifested in this direction, bring real advantages in the harmonious development of the body and its optimal functionality, without influencing negatively the growing and development processes specific to each age.

THIRD PART
RESEARCH REGARDING THE ADAPTATIVE MODIFICATIONS DUE TO PHYSICAL EFFORT SPECIFIC TO MALE ARTISTIC GYMNASTICS

Chapter 6. – Premises, aim, objectives and hypothesis of the research

6.1 Premises of the research

- The problems in the case of the specific effort in male artistic gymnastics is a secondary matter fort specialists, compared to feminine artistic gymnastics;
- Biographical physiological and ergo-physiological resources refer mainly to adaptation modifications of adults' bodies and approaches in a more restrained area the problems of the biological echo of physical effort at early ages (when accumulations are the most consistent);
- The training of children in perspective supposes a more profound knowledge and a more detailed analysis of growing and development laws, so that the training stimuli could be appropriately dosed, without exposing the gymnast's body to accidents or traumatisms.
- The smaller and smaller number of children who continue practicing performance sports until the superior classification categories poses the problem of the investigation of the training process in relation with growing and development processes specific to childhood, especially to ages before puberty;
- Taking into account that there are sportsmen who, after they renounce to the performance sportive activity, accuse different injuries, it is obligatory to give a special attention to direct and collateral effects of training stimuli, so that the stage preparation does not interfere negatively with growing particularities.

6.2 Aim and objectives of the research

Our aim is **to investigate the morphological and functional modifications** owed to the effort specific to male artistic gymnastics for juniors, given the early age when the child begins the practice in this sport.

Beginning with the particularities of the specific effort in male artistic gymnastics and its complexity, we are interested in the extent in which the training stimuli act in the physiological area, less "visible" in morphological area, compared to the "marks" on the movement area, as the modality through

which the biological processes can be used at their maximum capacity, without disturbing the growing processes.

We consider that determining the values of the main functional parameters of the sportsman's organism through specific techniques and methods may found the starting point in **outlining a morphological-functional model of a gymnast**, whose characteristics respect not only each age features, but also the rigors of performance artistic gymnastics.

As research **objectives**, we suggest:

- Setting the nature of adaptation modifications installed until the junior age (functional, morphological);
- Identifying certain functional and morphological differences between gymnast and untrained;
- Establishing the extent in which we can talk about late adaptation modifications to 10-12 years old gymnasts;
- Comparative analysis between the growing and development of the organism of the gymnast's and of the untrained child, at the same age;
- Identifying risk factors to which children might be exposed through forcing them into preparation, as a consequence of comparative study of the gymnasts' and untrained children's biological evolution.

6.3 Hypothesis of the research

- Specific, complex, intense and with high volume effort, will induce the installation of some immediate and late adaptation modifications at movement level and somatic-functional, yet from an age before puberty.
- Morphological and functional adaptations after a rigorous stage preparation, constitutes significant effects of physical effort specific in relation with the growing and development laws, at ages before puberty.
- Morphological and functional modifications assembly which characterizes the gymnast's body at an age before puberty, differentiates this one from the untrained child, ensuring him with a superior effort resistance ability.
- Quantitative and qualitative accumulations regarding the gymnasts' members force, manifested in dynamic and static conditions, are owed to specific effort and to preparation programs applied in gymnastics' trainings.

Chapter 7. – ORGANIZATION AND METHODOLOGY OF THE RESEARCH

7.1 Organizational manner of the research

7.1.1 Place and duration of the research

Our research took place in the male artistic gymnastics sector of Club No.7 "Dinamo" Bucharest, in collaboration with the S.C. Medisport SRL, with the National Research Institute of Problems in Sports, and with no.24 General School in Bucharest.

The experiment consists in an applicative, psycho-pedagogical intervention which had as a goal to identify that biological echo that the effort specific to male artistic gymnastics induced on the gymnast's body, from the selection till the age before puberty. Thus, the selection process took place in September and October 2002, and tests which emphasized the adaptation modifications were applied from March till June 2008.

7.1.2 Sample of individuals

In order to confirm or infirm the hypothesis stated hereby, a sample of 22 individuals was investigated, their ages being from 10 to 12 years. They formed an experimental and a control group.

The experiment was built of 11 sportsmen, registered to the male artistic gymnastics sector of Club No.7 "Dinamo" Bucharest, having a practical experience of 5-6 years. The gymnasts are being trained by a group of teachers, of which Marton Monika, Cristea Valentina, Urzică Marius, Velea Victor.

The control group was formed of 11 untrained children, from No.24 General School in Bucharest, which were not practicing any performance sport, the only systematic activity being the one during the physical education and sports classes, contained in the specialty Scholar Curriculum. From this group, 5 kids are in the 4^{th} grade, tutor Tudor Natalița, and 6 of them 5^{th} grade, tutor professor Voinescu Mariana.

7.1.3 Stages of the research

1. Study of the specialty literature related to the theme of the research;
2. Underlining the premises, setting the goal, the objectives and the formulation of hypothesis;
3. Conception and elaboration of the intervention which consisted in the rigorous training planning documents;
4. establishing the sample of children to be investigated, respectively the experimental and the control group for the research itself;

5. choosing work methods, the means and the tests;
6. Applying the planned program according to the patterns in sportive training practice. This consisted mainly in applying in training lessons the means from the content of the elaborated planning documents. This stage constitutes the experiment itself and consisted in training the selected gymnasts during the first training stage;
7. Selecting and establishing the evaluation system;
8. Morphological and functional testing of the subjects in order to identify the adaptation modifications;
9. Processing and interpreting the obtained data;
10. Formulating the conclusions.

7.2 Methods used during the research

The research methods used contained not only *methods of collecting the data* (the bibliographical study, the pedagogical observation, the experiment, the test), but also *statistic-mathematic processing methods* (statistic indexes: arithmetical average, median, module, standard deviation, standard average error, amplitude, variability; Student test, ANOVA test).

7.2.1 Methods of collecting the data

- *Bibliographic study*

Bibliographic study which consists in the research and consulting of some studies, monographs, articles, papers, etc. was useful to me to find information related to the chosen subject, offered by the specialists in the field.

- *Pedagogical observation*

I used this method during all the experiment during trainings, competitions, testing, to register the subjects' bodily reactions to the effort.

- *Experiment*

The experiment unfolded for the elaboration of the hereby paper has a character of checking hypothesis, but at the same time a creative character to define and elaborate some rationalized systems and means of some objective and relevant control tests for the identification of eventual adaptation modifications owed to male artistic gymnastics specific effort.

7.2.2 Tests applied to identify adaptation modifications

- *Somatic evaluation*

Somatic evaluation aims at the measurable parameters of the human body and was used in comparative study on the morphological evolution of the gymnast and of the untrained child, the somatically parameters were taken into account.

In order to compare the biological evolution of the 2 groups of children the following anthropometric measurements were used:

- corporal height;
- corporal weight;
- thoracic perimeter in inhaling, exhaling and pause;
- bi-acromion diameter;
- bi-trochanter diameter.

- *Evaluation test of the stability of the spine on the conditions stimulator*

Evaluation of **the anterior-posterior equilibrium** of the scapular belt and **the thorax-lumbar equilibrium** of the spine was realized on the conditions simulator Ergosim, at the Medisport Center, Bucharest.

Ergosim, used in specialized laboratories as multi-functional systems, serves on the one hand to the objective evaluation of the force and neurological-muscular control, and on the other hand constitutes a training method of some movement capacities. It is opportune for the performance sportive activity, as well as for the physical therapy activity. For these reasons, it has been applied at the center Medisport for the evaluation of the stability of the spine and for the investigation of jumping ability at the level of the distal link of the triple extension of the inferior limb.

In our experiment, the tests consisted in:

Test 1

- Movement task: arms draughts forwards, up to the level of thorax, from facial sitting on the massage table, arms up, the bar held with both hands;
- Effort task: 10x with full / maximal intensity;

Test 2

- Movement task: arms draughts backwards, up to the level of blades, from facial sitting on the massage table, arms up, the bar held with both hands;
- Effort task: 10x with maximal intensity;

Test 3

- Movement task: knees draughts to the chest, from dorsal sitting with 90 degrees hip flexion on the pelvis, the Ergosim device applied at the ankles level;
- Effort task: 10x with maximal intensity.

  For each test, the computerized system calculated the average curve of the 10 rehearsals on the entire action field, offering this curve as a test result. Reference elements were movement amplitude, mechanical work, power, maximum force and average force.

The obtained data were interpreted according to the methodology offered by Medisport Center and permitted the evaluation of the stability of the spine.

Detention test

- Movement task: ankles extensions to various speeds imposed by the apparatus, from dorsal sitting position, device applied to the level of the leg;
- Effort task: 10x with V0=0m/sec. (stage 0), 10x with V1=1m/sec. (stage 1), 10x with V2=2m/sec. (stage 2).

Isometric force test on Formax apparatus

In order to determine **the isometric force** at the level of the muscles of the superior limbs, the system **Formax** was used.

Testing the isometric force at the level of superior limbs, in Formax system was sustained both in the experimental and in the control groups, in the Laboratory of sportive performance technology and the biology of effort – Bio-motor Compartment of The National Institute of Research in Sports Problems in Bucharest.

Isotonic force test

Test a

- Movement task: draughts of the superior limbs, up to the level of the hips, through bending the elbows, simultaneously, on vertical, down and up, from sitting on a chair, facing the apparatus, arms up, the device of the apparatus grabbed with both hands;
- Effort task: 10x.

Test b

- Movement task: draughts of the superior limbs, up to the level of the hips, through flexing / bending the elbows, alternatively, starting with the right arm, on vertical, up and down, from sitting on a chair, facing the apparatus, arms up, the devices of the apparatus grabbed with both hands;
- Effort task: 10x.

For this two tests, an ideal movement model was elaborated the force of which was established to 20% from the bigger value of the isometric force registered with the FORMAX. The break was set for all subjects to 40%, and the movement length was established taking into account the particularities of each subject.

Furthermore, during these exercises, there were placed electrodes to register the surface electro-mio-graphics values.

Surface electro-mio-graphics (EMG)

Surface EMG represents an investigation modality for the muscular contraction function. Through this technique there are achieved the studies of the potentials of action of different movement units muscular fibers (UM). Studying the electric activity of the contracting muscle offers information on the structure and the function of the movement unit.

To acquire electro-mio-graphics signals, **the detection electrodes** were applied on the following muscular groups: **pectineus, deltoid, biceps, brachii triceps,** simultaneously on the right and on the left side of the body.

7.2.3 Statistics and mathematics processing of data

To process and interpret the data, the following **statistics indexes** were calculated:

- **Arithmetical average** is a synthetic indicator, which was used in our research to identify the central tendency of the values, and, at the same time, a reference standard for placement of parameters, for each gymnast and for each untrained child of the subject groups.
- **Median** represents the value of the characteristic situated at *the half of the (increasing and decreasing) result range of measured results*. Because the median is not influenced by the extreme values of the characteristic range of data, as the average, we considered opportune calculating this statistics indicator to estimate more precisely the central tendency of the data range.
- **Standard deviation** – calculating this indicator offered information regarding the uniformity of our investigation subject groups. As resulting from the already known statistics studies, a uniform group is characterized through a reduced dissipation of the data around the average – small value of the standard deviation, while a group is considered non uniform when the dissipation of the data around the average is big – big value of the standard deviation.
- **Amplitude** – this statistics indicator was interpreted closely to the standard deviation in order to identify the extreme values which are greatly differentiated from the central data tendency and which could induce errors in the interpretation of the data dissipation.
- **Coefficient of variability**, represents a measure of the relative dispersal, indicating the homogeneity degree of the measured characteristics.

The interpretation of the homogeneity level of the sample submitted to our research was realized taking into consideration the value of coefficient, thus:

- if $C_v < 10$ % the sample is homogenous;
- if $10\ \% < C_v <= 20\ \%$ the sample is relatively homogenous;
- if $C_v > 20$ % the sample is not homogenous;

Checking the statistics hypothesis imposed the application of the Student and ANOVA tests.

- **"Student" t-Test**

The Student test was applied to validate or invalidate the null hypothesis to analyze the data obtained when measuring the following: heights, corporal weight, thorax perimeter in pause, in profound inhaling, in forced exhaling, thorax elasticity, bi-acromion and bi-trochanter diameters, anterior-posterior equilibrium of the scapular belt, thorax-lumber equilibrium of the spine, the jumping capacity.

- **Anova Test**

With the help of this analysis method we study if there are significant statistic differences amongst the averages of the results obtained by the gymnasts and the

untrained children from the two groups (usually the experimental and the control group), in the case of the following tests: isometric and isotonic force tests, registering of the electrical signals at the level of the muscular groups: pectineus, deltoid, biceps, and triceps brachii.

7.2.4 Organization of the experiment

The experiment took place from 2002 till 2008 and consisted in systematic interventions in the shape of training programs (annex no.1), projected and planned for gymnasts, corresponding to the age particularities and to the methodological principles.

The content of the training programs, transposed in means systems specific to male artistic gymnastics have been systematically applied, immediately after selection and up to the third classification, which closes the stage I of the sportive training.

At the end of the research, our thesis became a demarche to emphasis the morphological and functional adaptation modifications, possibly installed to gymnasts at ages before puberty, owed to means systems specific to performance male artistic gymnastics.

In this regard, a set of tests was applied to two groups of subjects, an experimental one (gymnasts) and another one a control one (untrained children).

The sportsmen were chosen at the age of 5-6 years old and followed a preparation process with three training lessons a week, of approximately 2 hours, during the first 6 months. Afterwards, the trainings were held daily, from Monday till Saturday, with an increased duration, of 4-5 hours, during the last 4-5 years.

At Medisport Center, in Bucharest, the subjects sustained the tests of evaluation of morphological aspects, of the functional equilibrium of the trunk and of the triple extension of the inferior limb.

At The National Institute of Research for Problems in Sport, in Bucharest, the examination took place in FORMAX system to evaluate the isometric force of the muscles of the superior limbs, the isotonic force of the superior limbs, on the conditions simulator and electro-mio-graphic registrations of the activities of the muscles: pectineus, deltoid, biceps, and triceps brachii. All our demarches were effectuated to validate or invalidate the research hypothesis, being oriented towards identifying the morphological and functional differences between the gymnast's and the untrained child's bodies.

7.2.5 Planning of sportive training in male artistic gymnastics, in juniors' third category

Because the preparation strategy supposed a laborious elaboration of planning documents for each preparation year, we consider that the detailed presentation is opportune only in annexes, to maintain the continuity of the presentation of the research stages.

Chapter 8. – ANALYSIS AND INTERPRETATION OF DATA

8.1 Presentation of data registered in evaluations

In this sub-chapter, there is the collection of raw data registered during the evaluations of the experimental and control group, with the mention that the results of the test of isotonic force and the values of the electric signals registered through electro-mio-graphics can be found in the graphic representations of the subjects' executions.

8.2 Interpretation of data obtained from somatic evaluation

- **Height**

Table no.12. Statistics indicators for height (cm)

Statistic indicators	Experimental group	Control group
Arithmetic average	138,14	141,14
Standard deviation	6,04	4,92

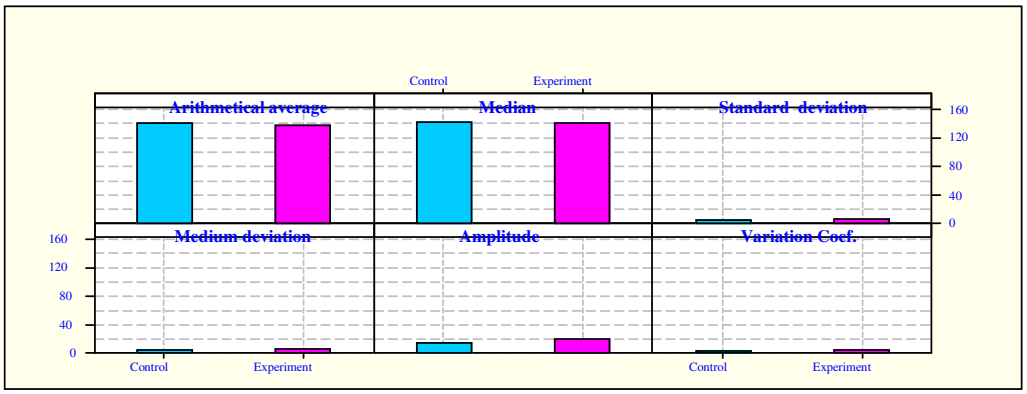

Fig. no. 9. Graphical representation of statistic indicators – height measurement (cm)

- **Corporal weight**

Table no.14. Statistic indicators for corporal weight (kg)

Statistic indicators	Experimental group	Control group
Arithmetic average	31,98	37,66
Standard deviation	3,58	2,66

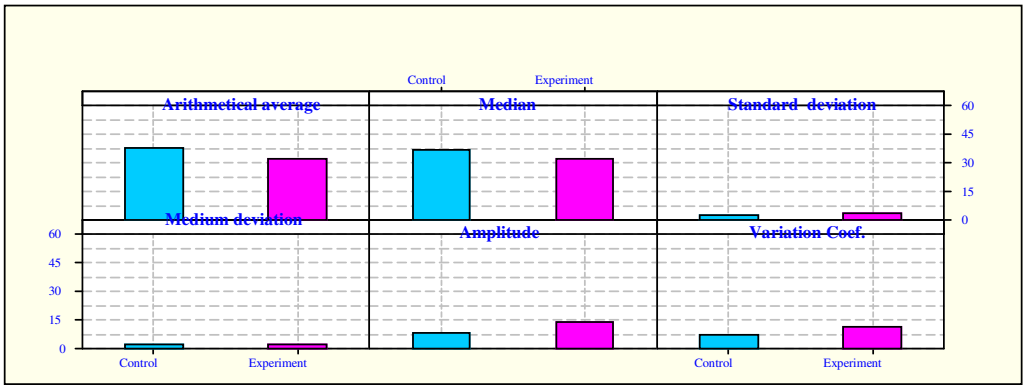

Fig. no. 11. Graphic representation of statistic indicators – weight measurement (kg)

- **Thorax perimeter in pause**

Table nr. 16. Statistic indicators for thorax perimeter in pause (cm)

Statistic indicators	Experimental group	Control group
Arithmetic average	69,05	69,82
Standard deviation	3,64	3,09

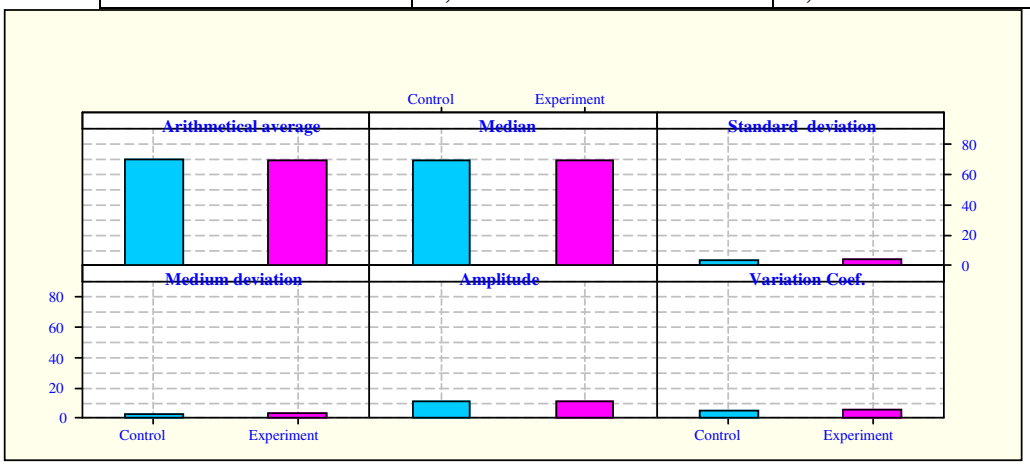

Fig. no. 13. Graphic representation of statistic indicators– thorax perimeter in pause measurement (cm)

- **Thorax perimeter in profound inhaling**

Table no. 18. Statistic indicators for thorax perimeter in profound inhaling (cm)

Statistic indicators	Experimental group	Control group
Arithmetic average	72,27	71,82
Standard deviation	3,14	3,09

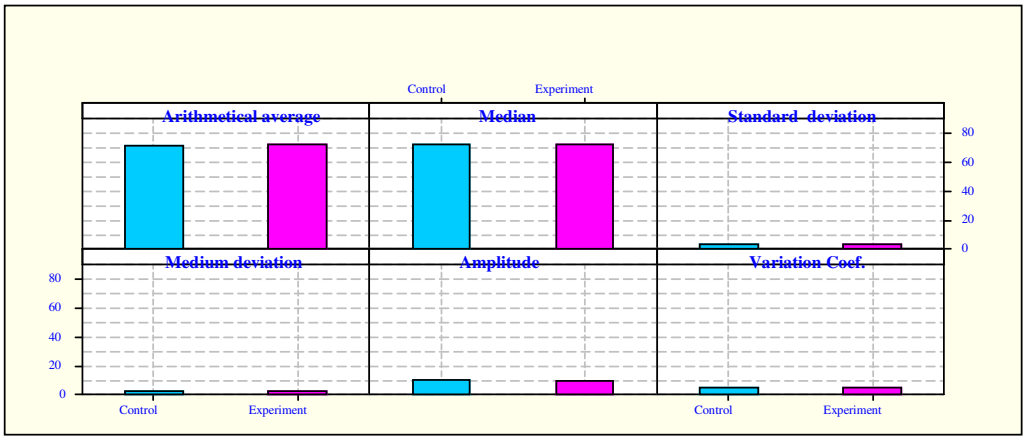

Fig. no. 15. Graphic representation of statistic indicators – thorax perimeter in profound inhaling measurement (cm)

- **Thorax perimeter in forced exhaling**

Table nr. 20. Statistic indicators for thorax perimeter in forced exhaling (cm)

Statistic indicators	Experimental group	Control group
Arithmetic average	66,82	68,91
Standard deviation	3,61	3,73

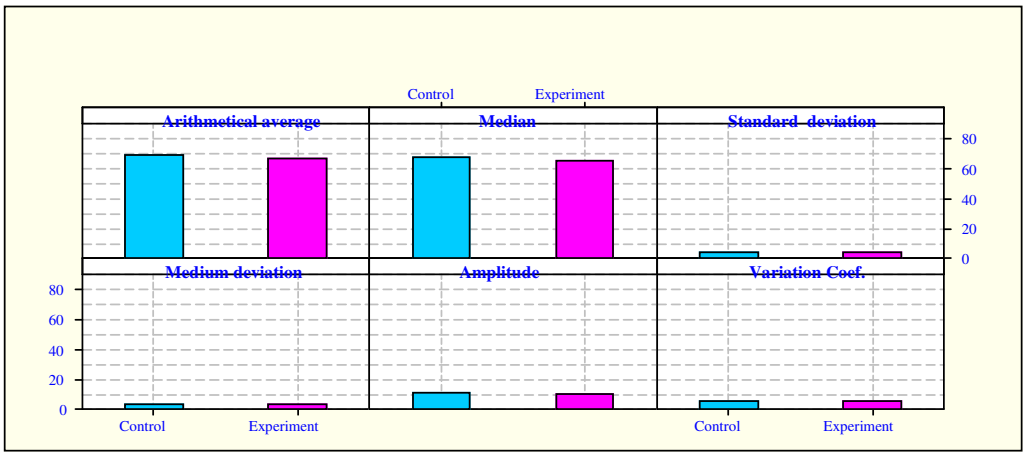

Fig. no. 17. Graphic representation of statistic indicators – thorax perimeter in forced exhaling measurement (cm)

- **Thorax elasticity**

Table no. 22. Statistic indicators for thorax elasticity (cm)

Statistic indicators	Experimental group	Control group
Arithmetic average	5,64	4,73
Standard deviation	1,31	0,65

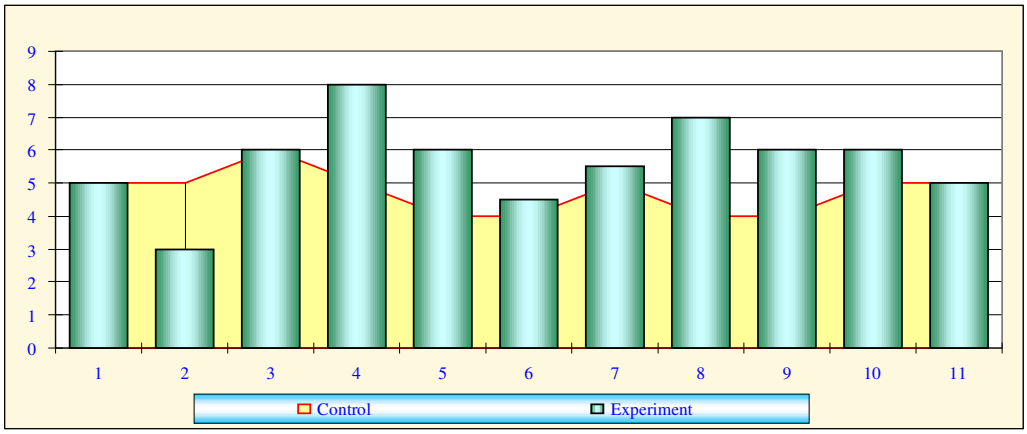

Fig. no. 20. Graphic representation of values obtained by the two groups – thorax elasticity measurement (cm)

- **Bi-acromion diameter**

Table no. 24. Statistic indicators for Bi-acromion diameter (cm)

Statistic indicators	Experimental group	Control group
Arithmetic average	32,50	32,64
Standard deviation	1,75	1,63

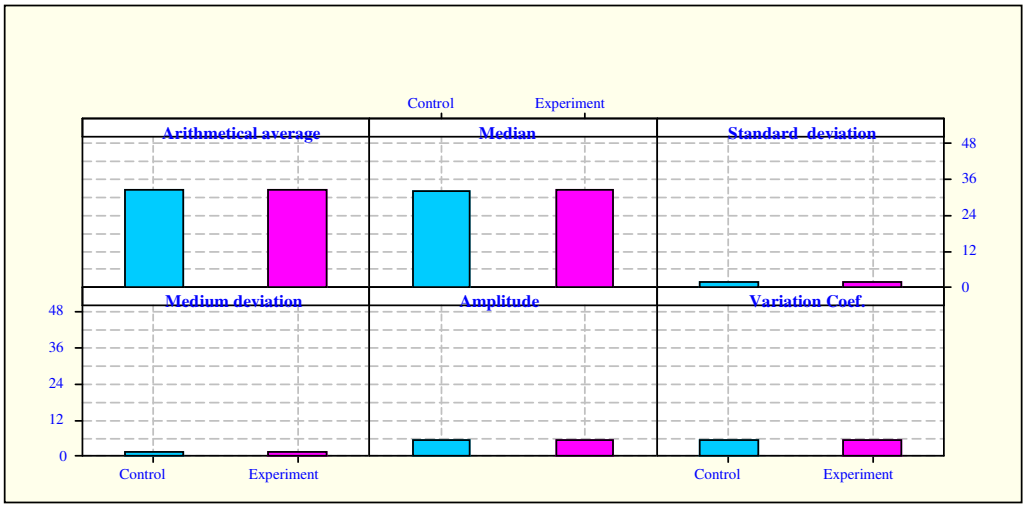

Fig. no. 21. Graphic representation of statistic indicators – Bi-acromion diameter measurement (cm)

- **Bi-trochanter diameter**

Table nr. 26 Statistic indicators for bi-trochanter diameter (cm)

Statistic indicators	Experimental group	Control group
Arithmetic average	25,64	27,18
Standard deviation	1,29	1,25

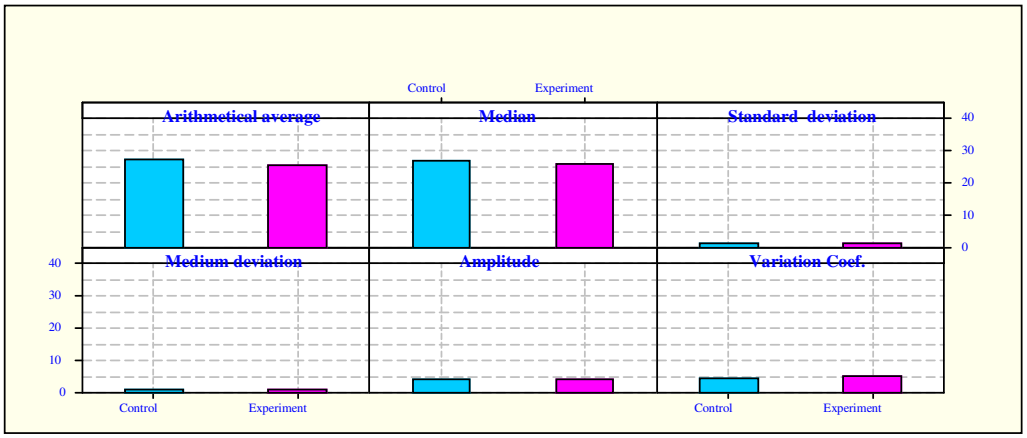

Fig. no. 23. Graphic representation of statistic indicators – bi-trochanter diameter measurement (cm)

8.3 Interpretation of data obtained from evaluating the functional of the trunk and the effort capacity

- **Anterior-Posterior equilibrium of scapular belt**

Table no. 28 Statistic indicators for thorax anterior-posterior rapport

Statistic indicators	Experimental group	Control group
Arithmetic average	0,74	0,51
Standard deviation	0,10	0,15

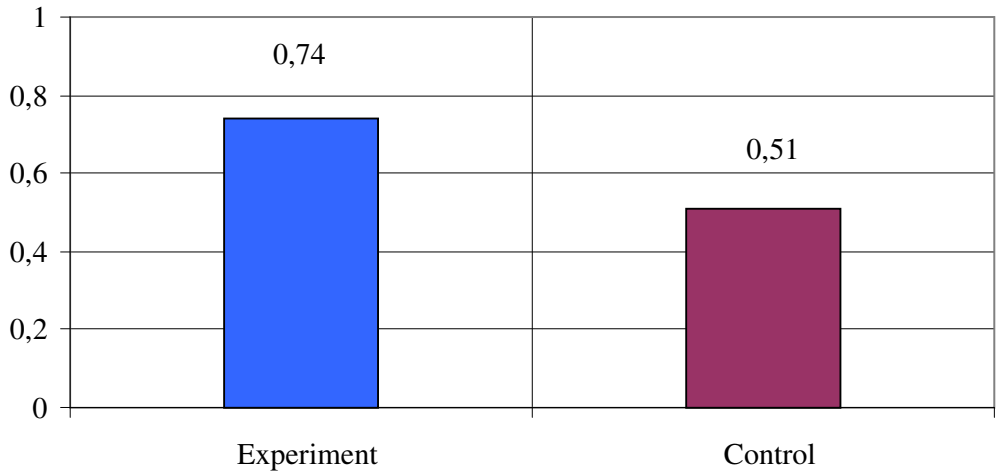

Fig. no. 25. Values of arithmetic averages obtained by the investigated groups - anterior-posterior equilibrium of scapular belt

- **Thorax - lumbar equilibrium of the spine**

Table no. 30. Statistic indicators for the thorax-lumbar risk rapport

Statistic indicators	Experimental group	Control group
Arithmetic average	0,86	0,55
Standard deviation	0,12	0,05

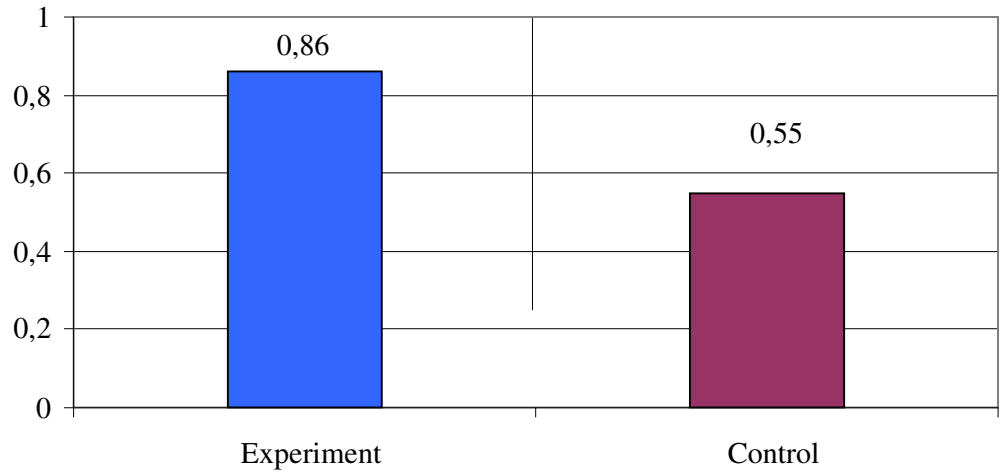

Fig. no. 26. Values of arithmetic averages obtained by the investigated groups - thorax-lumbar equilibrium of the spine

➢ **Jumping capacity**

- **Ankle extension at stage 0 (power – W)**

Table no. 32. Statistic indicators for ankle extension at stage 0

Statistic indicators	Experimental group	Control group
Arithmetic average	39,66	25,41
Standard deviation	7,55	5,42

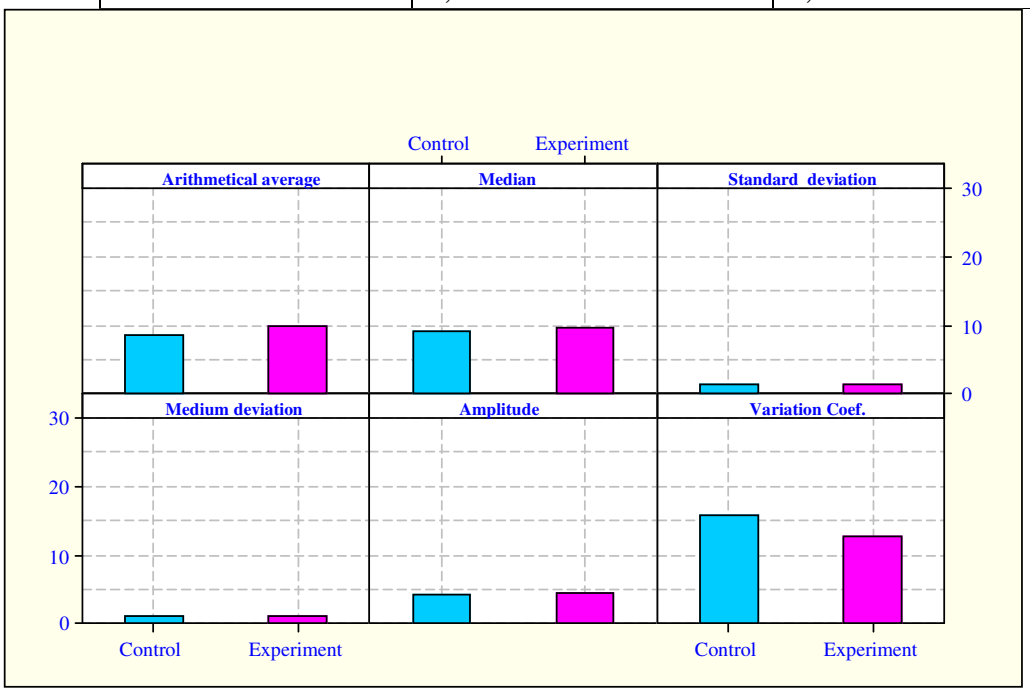

Fig. no. 27. Graphic representation of statistic indicators – jumping capacity at stage 0

- **Ankle extension at stage 1 (power – W)**

Table no. 34. Statistic indicators for ankle extension at stage 1

Statistic indicators	Experimental group	Control group
Arithmetic average	50,16	34,51
Standard deviation	13,34	10,15

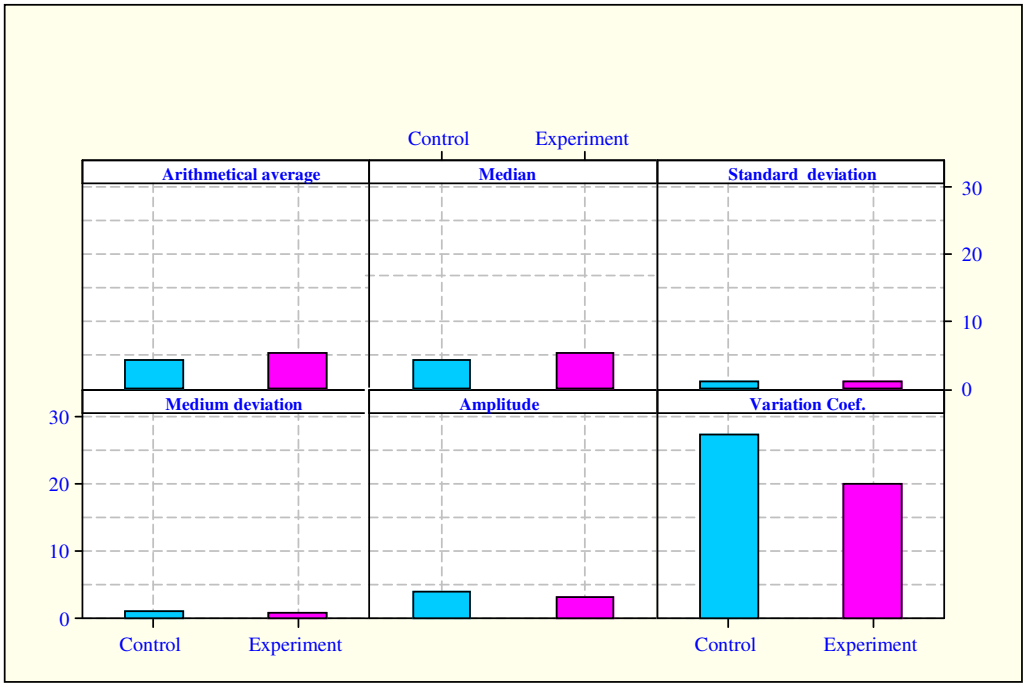

Fig. no. 29. Graphic representation of statistic indicators – jumping capacity at stage 1

- **Ankle extension at stage 2 (power – W)**

Table no. 36. Statistic indicators for ankle extension at stage 2

Statistic indicators	Experimental group	Control group
Arithmetic average	36,45	16,68
Standard deviation	4,95	7,27

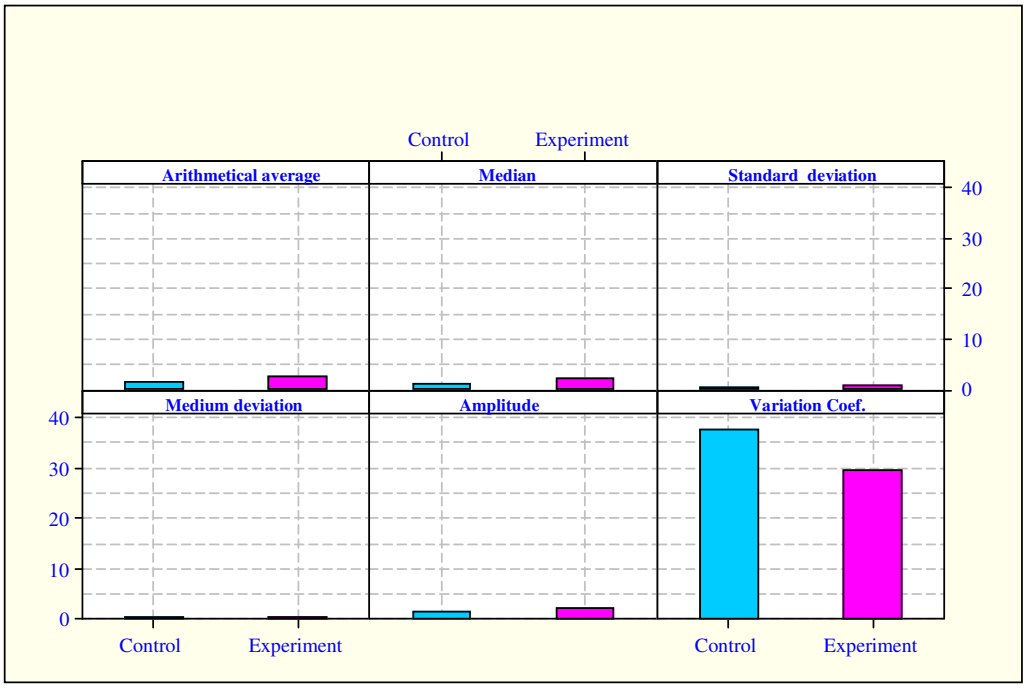

Fig. no. 31. Graphic representation of statistic indicators – jumping capacity at stage 2

➢ **Isometric force test on Formax apparatus**

- ***Translator at the level of the head***
- Table no. 38. Statistic indicators for **isometric force test on Formax apparatus - translator** at the level of the head

CONTROL - EXPERIMENT

TESTING	Arithmetical average	Median	Standard deviation	Medium deviation	Standard error	Dispersion	Amplitude	Coef. Variation coef.
Control	27.10	29.50	5.49	4.68	1.73	30.10	15.00	20.24
Experiment	32.18	32.00	4.49	3.83	1.42	20.16	14.00	13.95

ANOVA TEST

Test Hypothesis			Calculated values			F Tables
H_0	H_i	?	df_1	df_2	F calculat	F critic
$m_1 = m_2$	$m_1 \neq m_2$	0.05	1	19	**5.44**	4.38

Calculated F >= critical F. Statistically, the results of the 2 tests are very different Hypothesis rejected null (H0).

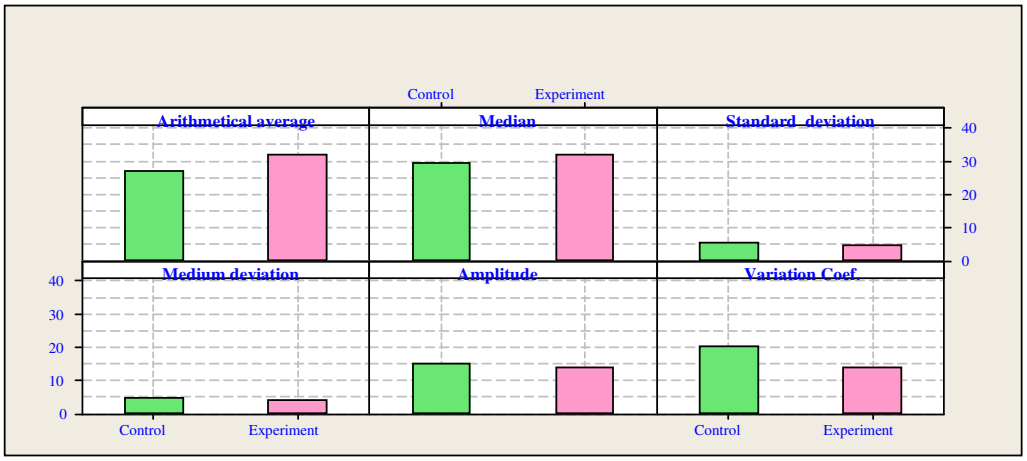

Fig. no. 33. Graphic representation of statistic indicators – isometric force (translator at the level of the head)

- ***Translator at the level of the hip***

Table no. 39. Statistic indicators for isometric force test on Formax apparatus – translator at the level of the hip

CONTROL – EXPERIMENT

TESTING	Arithmetical average	Median	Standard deviation	Medium deviation	Standard error	Dispersion	Amplitude	Variation Coef.
Control	24.80	25.00	4.83	4.40	1.53	23.29	12.00	19.46
Experiment	29.64	30.00	4.90	3.55	1.55	24.05	18.00	16.55

ANOVA TEST

Test Hypothesis			Calculated values			F Tables
H_0	H_1	?	df1	df2	F calculat	F critic
$m_1 = m_2$	$m_1 \neq m_2$	0.05	1	19	**5.17**	4.38

Calculated F >= critical F. Statistically, the results of the 2 tests are very different. Hypothesis rejected. null (H0).

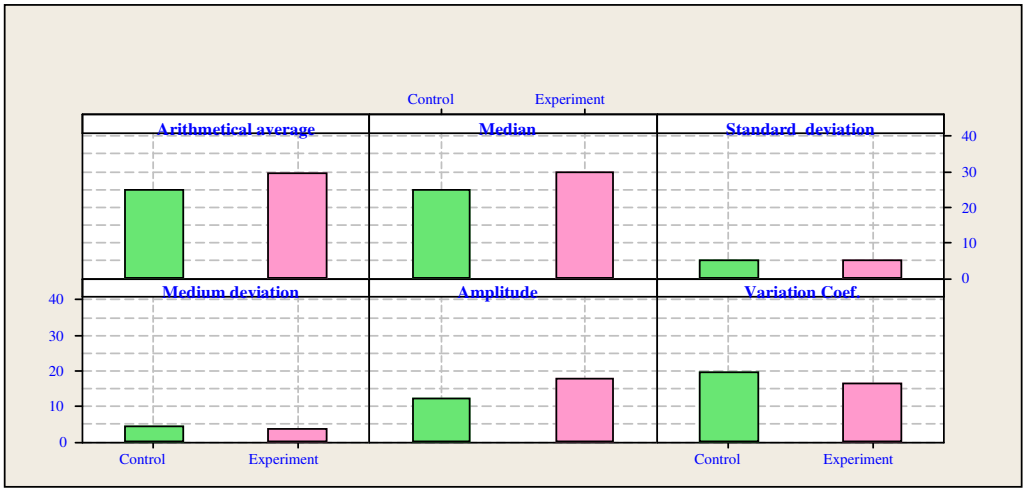

Fig. no. 35. Graphic representation of statistic indicators – isometric force (translator at the level of the hip)

- ***Translator at half distance between head and hip***

Table no. 40. Statistic indicators for isometric force test on Formax apparatus - translator at half distance between head and hip

CONTROL – EXPERIMENT

TESTING	Arithmetical average	Median	Standard deviation	Medium deviation	Standard error	Dispersion	Amplitude	Variation Coef.
Control	22.70	22.00	3.23	2.44	1.02	10.46	10.00	14.24
Experiment	27.18	30.00	4.85	4.17	1.54	23.56	15.00	17.86

ANOVA TEST

Test Hypothesis			Calculated values			F Tables
H_0	H_1	?	df_1	df_2	F calculat	F critic
$m_1 = m_2$	$m_1 \neq m_2$	0.05	1	19	**6.06**	4.38

Calculated F >= critical F. Statistically, the results of the 2 tests are very different Hypothesis rejected null (H0).

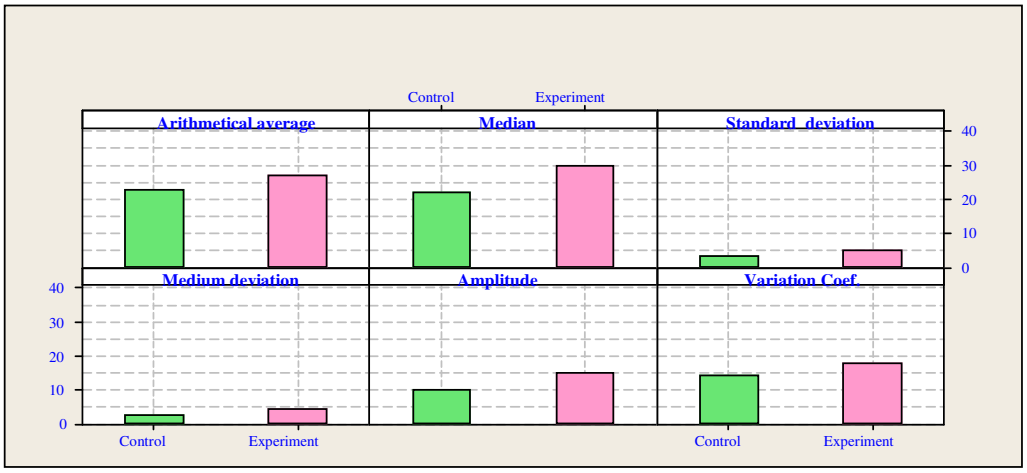

Fig. no. 37. Graphic representation of statistic indicators – isometric force (translator at half distance between head and hip)

➢ **Isotonic force test on conditions simulator**

○ ***Isotonic force left superior limb - simultaneous draughts***

Table no. 41. Statistic indicators for isotonic force test - force left superior limb- simultaneous draughts

CONTROL-EXPERIMENT

TESTING	Arithmetical average	Median	Standard deviation	Medium deviation	Standard error	Dispersion	Amplitude	Variation Coef.
Control	1.22	1.24	0.15	0.13	0.05	0.02	0.49	12.57
Experiment	1.38	1.42	0.16	0.13	0.05	0.02	0.53	11.43

ANOVA TEST

Test Hypothesis			Calculated values			F Tables
H_0	H_1	?	df_1	df_2	F calculat	F critic
$m_1 = m_2$	$m_1 \neq m_2$	0.05	1	19	**5.23**	4.38

Calculated F >= critical F. Statistically, the results of the 2 tests are very different Hypothesis rejected null (H0).

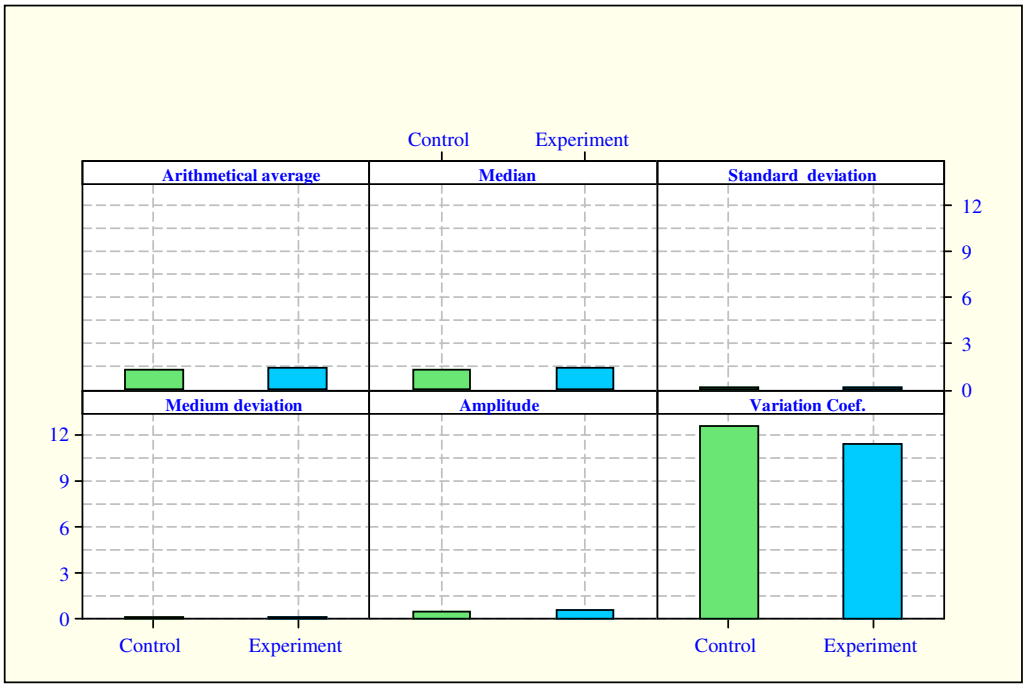

Fig. no. 39. Graphic representation of statistic indicators – Isotonic force left-simultaneous draughts

- ***Isotonic force left superior limb - alternative draughts***

Table no. 42. Statistic indicators for isotonic force left superior limb-alternative draughts

CONTROL – EXPERIMENT

TESTING	Arithmetical average	Median	Standard deviation	Medium deviation	Standard error	Dispersion	Amplitude	Variation Coef.
Control	0.86	0.91	0.15	0.11	0.05	0.02	0.50	17.59
Experiment	1.00	1.02	0.13	0.11	0.04	0.02	0.34	12.73

ANOVA TEST

Test Hypothesis			Calculated values			F Tables
H_0	H_1	?	df_1	df_2	F calculat	F critic
$m_1 = m_2$	$m_1 \neq m_2$	0.05	1	19	**5.04**	4.38

Calculated F >= critical F. Statistically, the results of the 2 tests are very different null (H0). Hypothesis rejected

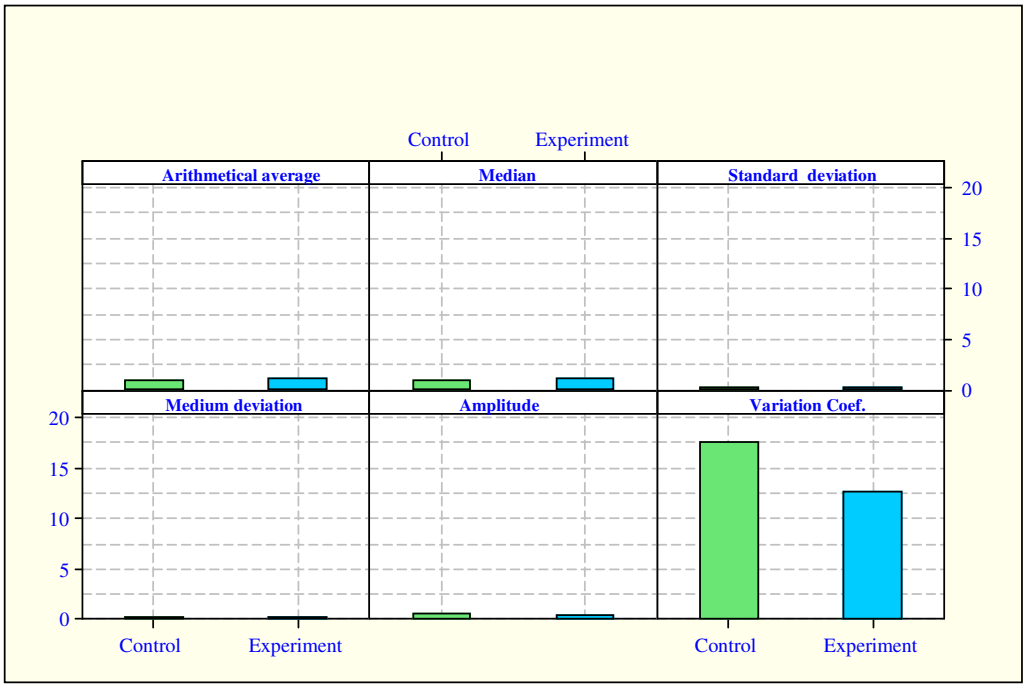

Fig. no. 41. Graphic representation of statistic indicators – isotonic force left-alternative draughts

- ***Isotonic force right superior limb - simultaneous draughts***

Table no. 43. Statistic indicators for isotonic force right superior limb-simultaneous draughts

CONTROL – EXPERIMENT

TESTING	Arithmetical average	Median	Standard deviation	Medium deviation	Standard error	Dispersion	Amplitude	Variation Coef.
Control	1.16	1.21	0.16	0.13	0.05	0.02	0.50	13.53
Experiment	1.31	1.34	0.14	0.12	0.05	0.02	0.47	10.99

ANOVA TEST

Test Hypothesis			Calculated values			F Tables
H_0	H_1	?	df_1	df_2	F calculat	F critic
$m_1 = m_2$	$m_1 \neq m_2$	0.05	1	19	**5.77**	4.38

Calculated F >= critical F. Statistically, the results of the 2 tests are very different null (H0). Hypothesis rejected

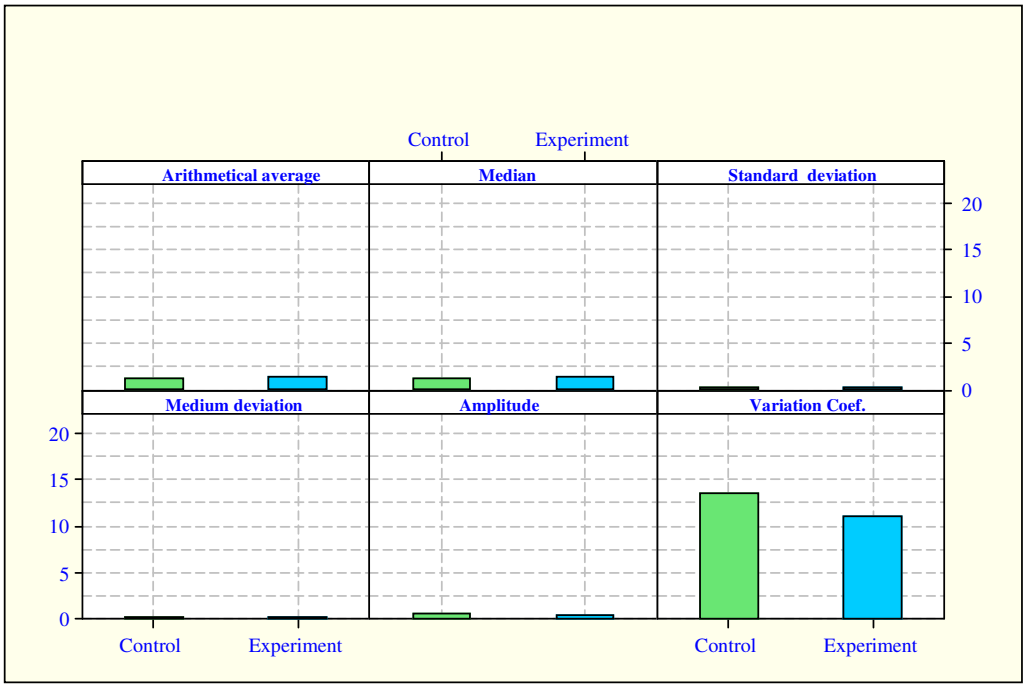

Fig. no. 43. Graphic representation of statistic indicators – Isotonic force right - simultaneous draughts

- ***Isotonic force right superior limb - alternative draughts***

Table no. 44 Statistic indicators for isotonic force right superior limb - alternative draughts

CONTROL – EXPERIMENT

TESTING	Arithmetical average	Median	Standard deviation	Medium deviation	Standard error	Dispersion	Amplitude	Variation Coef
Control	0.99	1.04	0.11	0.09	0.04	0.01	0.34	11.27
Experiment	1.12	1.05	0.16	0.14	0.05	0.03	0.47	14.28

ANOVA TEST

Test Hypothesis			Calculated values			F Tables
H0	H1	?	df1	df2	F calculat	F critic
m1 = m2	m1 # m2	0.05	1	19	**4.50**	4.38

Calculated F >= critical F. Statistically, the results of the 2 tests are very different Hypothesis rejected null (H0).

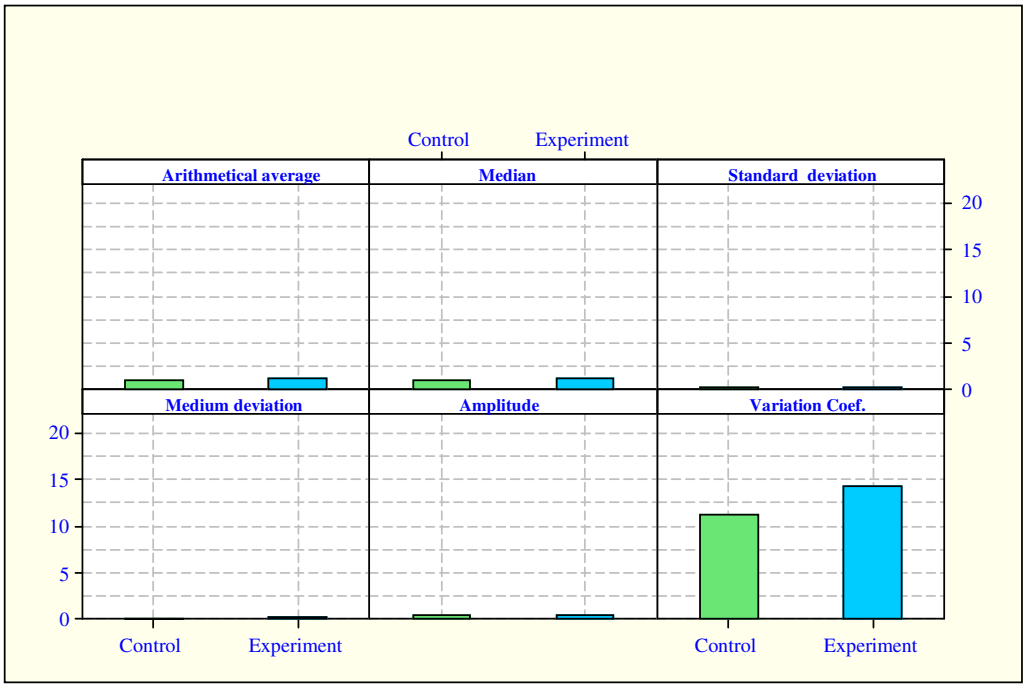

Fig. no. 45. Graphic representation of statistic indicators – isotonic force right superior limb - alternative draughts

➢ Surface electro-mio-graphics (EMG)

- ***Right pectineus – values of electric signals simultaneous draughts***

Table no. 45. Statistic indicators for electric signals registered from the group of right pectoral muscles, in simultaneous arm draughts

CONTROL - EXPERIMENT

TESTING	Arithmetical average	Median	Standard deviation	Medium deviation	Standard error	Dispersion	Amplitude	Variation Coef.
Control	2.75E-05	2.72E-05	1.18E-05	8.24E-06	3.92E-06	1.39E-10	4.11E-05	42.79
Experiment	4.34E-05	3.63E-05	1.96E-05	1.53E-05	6.54E-06	3.85E-10	6.09E-05	45.20

ANOVA TEST

Test Hypothesis			Calculated values			F Tables
H_0	H_1	?	df_1	df_2	F calculat	F critic
$m_1 = m_2$	$m_1 \neq m_2$	0.05	1	18	**4.54**	4.41

Calculated F >= critical F. Statistically, the results of the 2 tests are very different Hypothesis rejected null (H0).

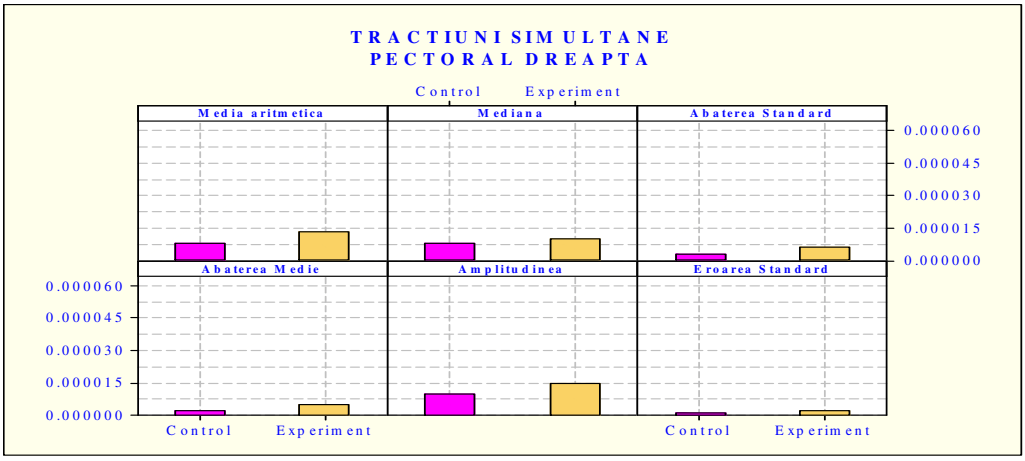

Fig. no. 47. Graphic representation of statistic indicators – right-mio-graphics right pectineus, simultaneous draughts

- ***Right pectineus - values of electric signals alternative draughts***

Table no. 46. Statistic indicators for electric signals registered from the group of right pectoral muscles, in alternative arm draughts

CONTROL – EXPERIMENT

TESTING	Arithmetical average	Median	Standard deviation	Medium deviation	Standard error	Dispersion	Amplitude	Variation Coef.
Control	7.29E-06	6.92E-06	2.56E-06	1.69E-06	8.55E-07	6.57E-12	8.66E-06	35.16
Experiment	1.29E-05	1.12E-05	6.32E-06	5.36E-06	2.11E-06	3.99E-11	1.77E-05	48.91

ANOVA TEST

Test Hypothesis			Calculated values			F Tables
H_0	H_1	?	df1	df2	F calculat	F critic
$m_1 = m_2$	$m_1 \neq m_2$	0.05	1	17	**6.18**	4.45

Calculated F >= critical F. Statistically, the results of the 2 tests are very different Hypothesis rejected null (H0).

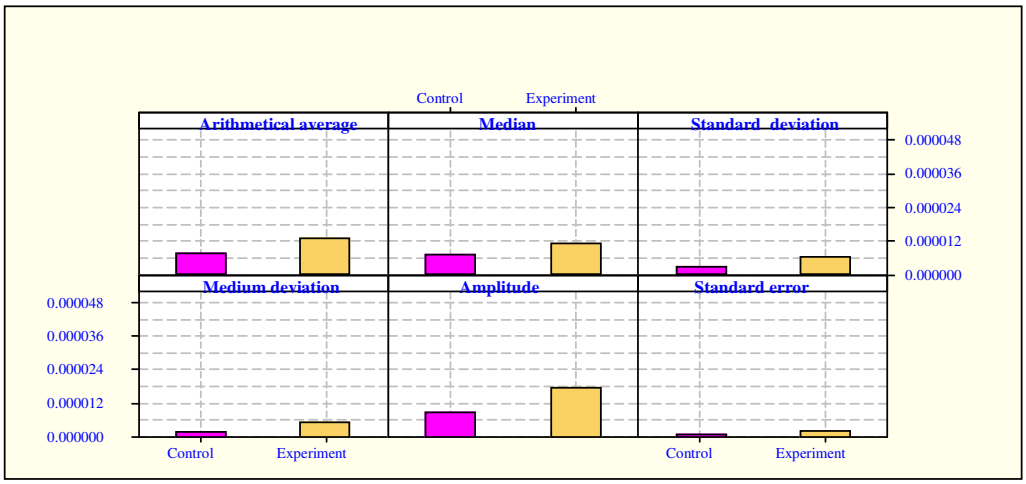

Fig. no. 49. Graphic representation of statistic indicators – right-mio-graphics right pectineus, alternative draughts

- ***Left pectineus - values of electric signals simultaneous draughts***

Table no. 47. Statistic indicators for electric signals registered from the group of left pectoral muscles, in simultaneous arm draughts

CONTROL – EXPERIMENT

TESTING	Arithmetical average	Median	Standard deviation	Medium deviation	Standard error	Dispersion	Amplitude	Variation Coef.
Control	1.07E-05	9.57E-06	3.86E-06	2.81E-06	1.29E-06	1.49E-11	1.25E-05	36.00
Experiment	1.67E-05	1.83E-05	6.15E-06	4.96E-06	2.05E-06	3.79E-11	2.01E-05	36.75

ANOVA TEST

Test Hypothesis			Calculated values			F Tables
H_0	H_1	?	df_1	df_2	F calculat	F critic
$m_1 = m_2$	$m_1 \# m_2$	0.05	1	18	**6.49**	4.41

Calculated F >= critical F. Statistically, the results of the 2 tests are very different Hypothesis rejected null (H0).

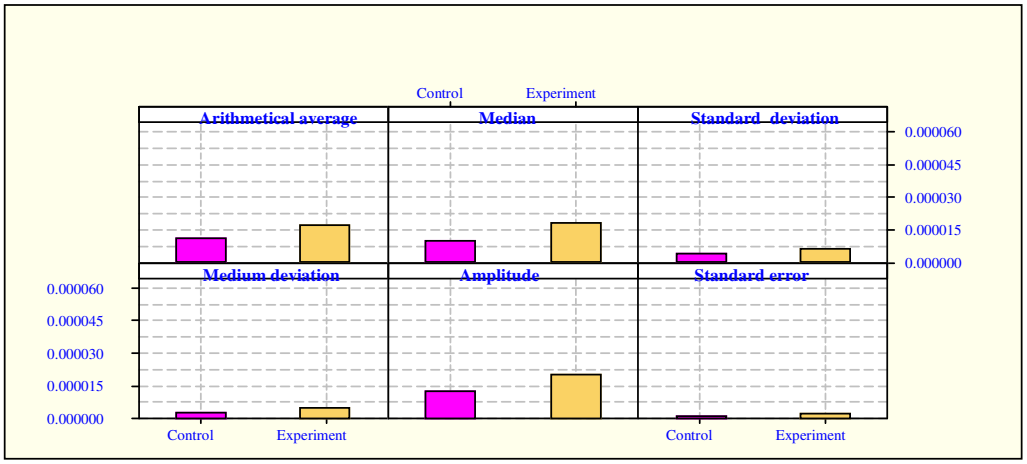

Fig. no. 51. Graphic representation of statistic indicators – electro-mio-graphics left pectineus, simultaneous draughts

- ***Left pectineus - values of electric signals alternative draughts***

Table no. 48. Statistic indicators for electric signals registered from the group of left pectoral muscles, in alternative arm draughts

CONTROL – EXPERIMENT

TESTING	Arithmetical average n	Median	Standard deviation	Medium deviation	Standard error	Dispersion	Amplitude	Variation Coef.
Control	9.03E-06	8.03E-06	2.89E-06	2.39E-06	9.62E-07	8.33E-12	8.06E-06	31.95
Experiment	1.54E-05	1.34E-05	8.44E-06	6.37E-06	2.81E-06	7.13E-11	2.72E-05	54.90

ANOVA TEST

Test Hypothesis			Calculated values			F Tables
H_0	H_1	?	df_1	df_2	F calculat	F critic
$m_1 = m_2$	$m_1 \# m_2$	0.05	1	17	**4.58**	4.45

Calculated F >= critical F. Statistically, the results of the 2 tests are very different Hypothesis rejected null (H0).

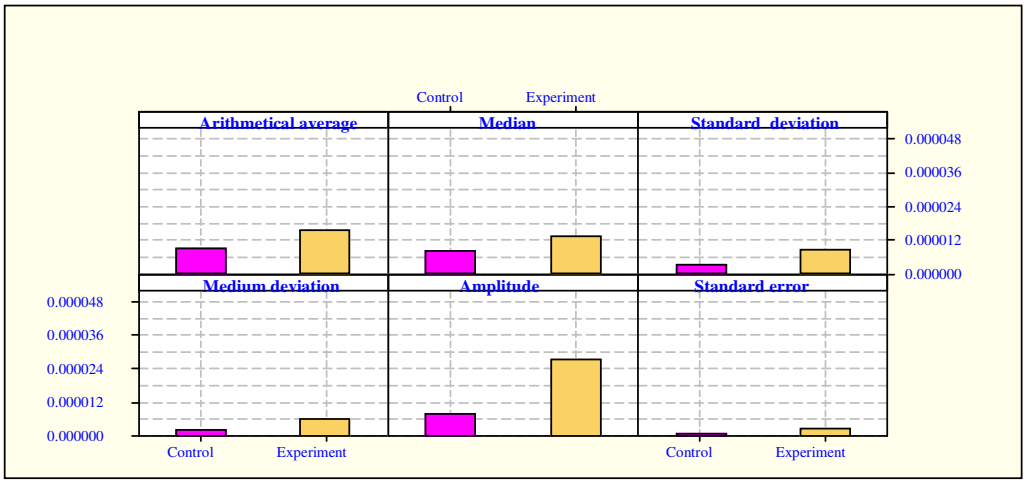

Fig. no. 53. Graphic representation of statistic indicators – electro-mio-graphics left pectineus, alternative draughts

- ***Right deltoid - values of electric signals simultaneous draughts***

Table no. 49. Statistic indicators for electric signals registered from the group of right deltoid muscles, in simultaneous arm draughts

CONTROL – EXPERIMENT

TESTING	Arithmetical average	Median	Standard deviation	Medium deviation	Standard error	Dispersion	Amplitude	Variation Coef.
Control	2.16E-05	2.04E-05	7.92E-06	4.88E-06	2.64E-06	6.28E-11	2.72E-05	36.61
Experiment	3.44E-05	3.21E-05	9.69E-06	7.57E-06	3.23E-06	9.39E-11	3.19E-05	28.19

ANOVA TEST

Test Hypothesis			Calculated values			F Tables
H_0	H_1	?	df_1	df_2	F calculat	F critic
$m_1 = m_2$	$m \neq m_2$	0.05	1	18	**10.03**	4.41

Calculated F >= critical F. Statistically, the results of the 2 tests are very different null (H0). Hypothesis rejected

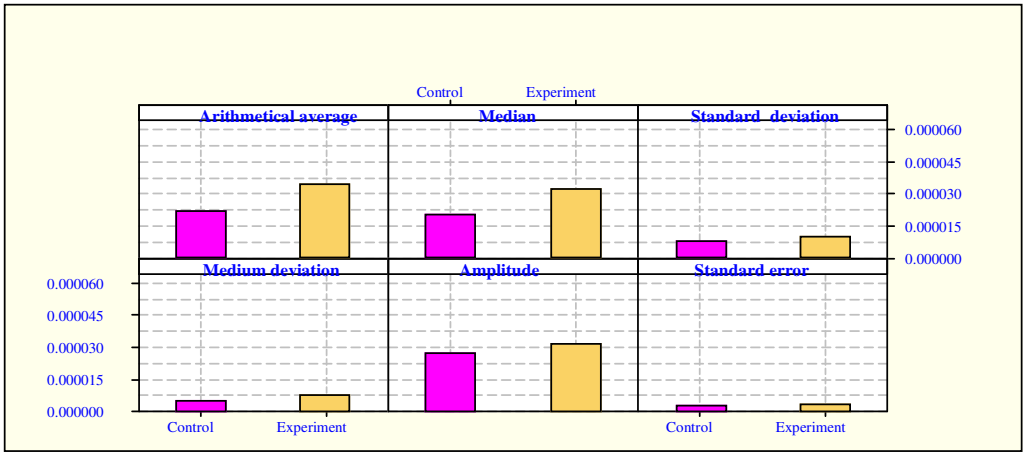

Fig. no. 55. Graphic representation of statistic indicators – electro-mio-graphics right deltoid, simultaneous draughts

- ***Right deltoid - values of electric signals alternative draughts***

Table no. 50. Graphic representation of statistic indicators – electro-mio-graphics right deltoid, alternative draughts

CONTROL – EXPERIMENT

TESTING	Arithmetical average	Median	Standard deviation	Medium deviation	Standard error	Dispersion	Amplitude	Variation Coef.
Control	1.77E-05	1.76E-05	5.27E-06	4.04E-06	1.76E-06	2.78E-11	1.67E-05	29.68
Experiment	3.52E-05	3.47E-05	1.13E-05	1.00E-05	3.76E-06	1.27E-10	3.00E-05	32.05

ANOVA TEST

Test Hypothesis			Calculated values			F Tables
H_0	H_1	?	df_1	df_2	F calculat	F critic
$m_1 = m_2$	$m_1 \# m_2$	0.05	1	17	**17.91**	4.45

Calculated F >= critical F. Statistically, the results of the 2 tests are very different Hypothesis rejected null (H0).

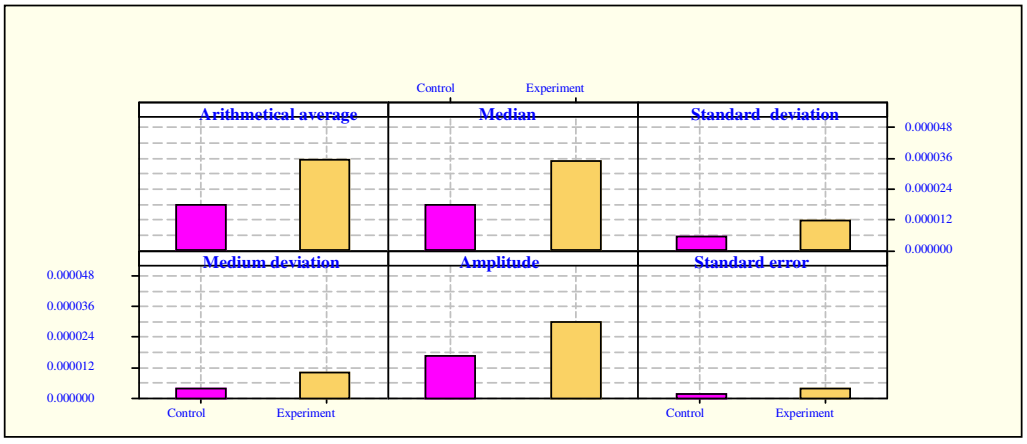

Fig. no. 57. Graphic representation of statistic indicators – electro-mio-graphics right deltoid, alternative draughts

- ***Left deltoid - values of electric signals simultaneous draughts***

Table no. 51. Statistic indicators for electric signals registered from the group of left deltoid muscles, in simultaneous arm draughts

CONTROL – EXPERIMENT

TESTING	Arithmetical average	Median	Standard deviation	Medium deviation	Standard error	Dispersion	Amplitude	Variation Coef.
Control	1.93E-05	2.01E-05	2.73E-06	2.18E-06	9.11E-07	7.46E-12	8.21E-06	14.12
Experiment	3.89E-05	3.94E-05	1.30E-05	9.94E-06	4.34E-06	1.69E-10	3.98E-05	33.47

ANOVA TEST

Test Hypothesis			Calculated values			F Tables
H_0	H_1	?	df_1	df_2	F calculat	F critic
$m_1 = m_2$	$m_1 \# m_2$	0.05	1	18	**19.39**	4.41

Calculated F >= critical F. Statistically, the results of the 2 tests are very different Hypothesis rejected null (H0).

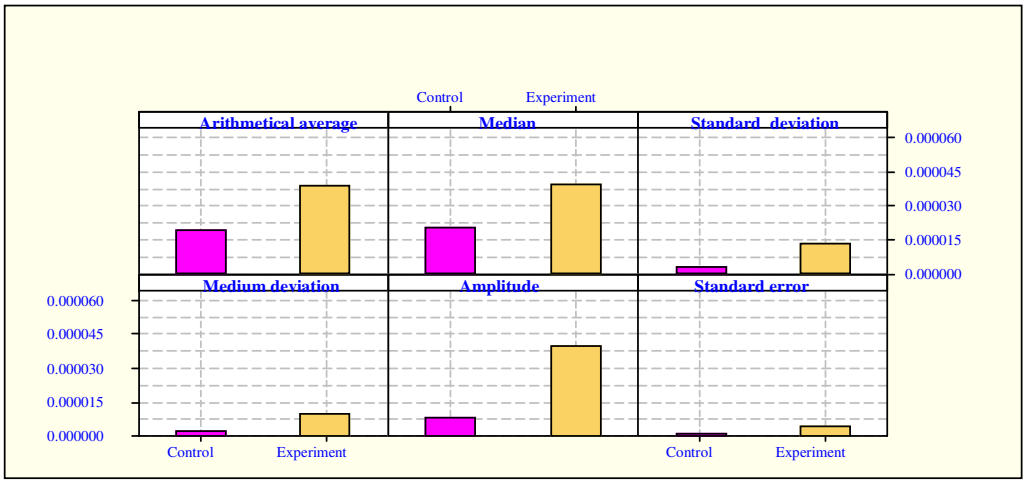

Fig. no. 59. Graphic representation of statistic indicators – electro-mio-graphics right deltoid, simultaneous draughts

- ***Left deltoid - values of electric signals alternative draughts***

Table no. 52. Statistic indicators for electric signals registered from the group of left deltoid muscles, in alternative arm draughts

CONTROL – EXPERIMENT

TESTING	Arithmetical average	Median	Standard deviation	Medium deviation	Standard error	Dispersion	Amplitude	Variation Coef.
Control	1.97E-05	1.75E-05	8.83E-06	6.07E-06	2.94E-06	7.80E-11	2.75E-05	44.85
Experiment	4.05E-05	4.07E-05	1.79E-05	1.44E-05	5.97E-06	3.21E-10	4.92E-05	44.20

ANOVA TEST

Test Hypothesis			Calculated values			F Tables
H_0	H_1	?	df_1	df_2	F calculat	F critic
$m_1 = m_2$	$m_1 \neq m_2$	0.05	1	17	**9.96**	4.45

Calculated F >= critical F. Statistically, the results of the 2 tests are very different Hypothesis rejected null (H0).

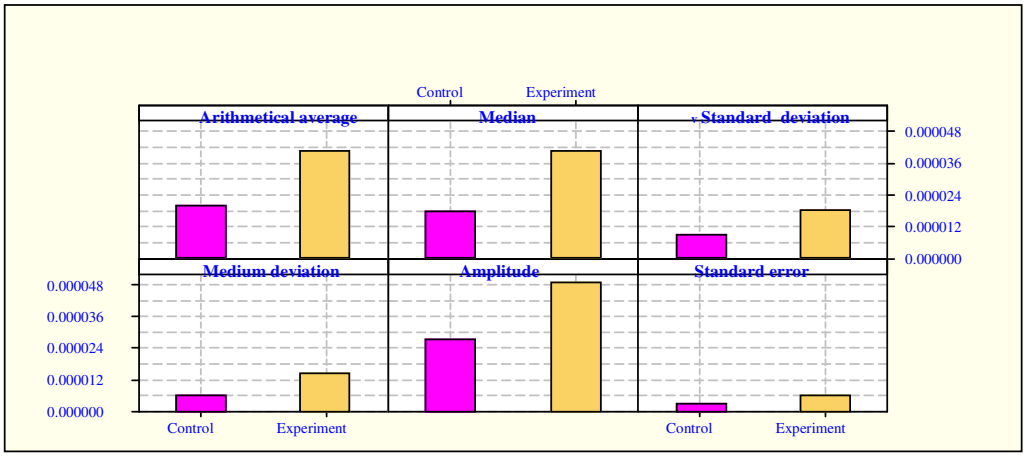

Fig. no. 61. Graphic representation of statistic indicators – electro-mio-graphics left deltoid, alternative draughts

- ***Right biceps - values of electric signals simultaneous draughts***

Table no. 53. Statistic indicators for electric signals registered from the group of right biceps muscles, in simultaneous arm draughts

CONTROL – EXPERIMENT

TESTING	Arithmetical average	Median	Standard deviation	Medium deviation	Standard error	Dispersion	Amplitude	Variation Coef.
Control	1.24E-05	1.26E-05	1.51E-06	1.14E-06	5.03E-07	2.28E-12	4.50E-06	12.21
Experiment	1.68E-05	1.62E-05	5.01E-06	4.06E-06	1.67E-06	2.51E-11	1.61E-05	29.89

TESTUL ANOVA

Test Hypothesis			Calculated values			F Tables
H_0	H_1	?	df_1	df_2	F calculat	F critic
$m_1 = m_2$	$m_1 \neq m_2$	0.05	1	18	**6.40**	4.41

Calculated F >= critical F. Statistically, the results of the 2 tests are very different Hypothesis rejected null (H0).

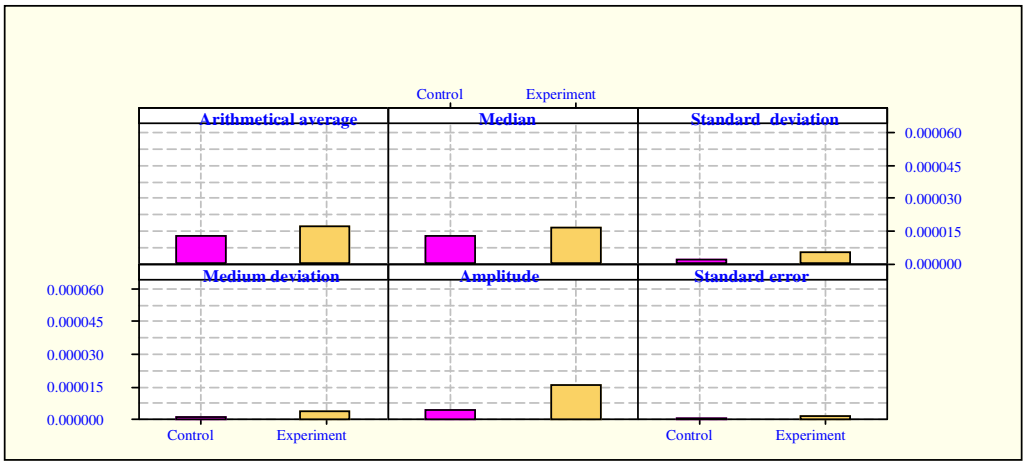

Fig. no. 63. Graphic representation of statistic indicators – electro-mio-graphics right biceps, simultaneous draughts

- ***Right biceps - values of electric signals alternative draughts***

Table no. 54 Statistic indicators for electric signals registered from the group of right biceps muscles, in alternative arm draughts

CONTROL – EXPERIMENT

TESTING	Arithmetical average	Median	Standard deviation	Medium deviation	Standard error	Dispersion	Amplitude	Variation Coef.
Control	1.08E-05	1.05E-05	1.62E-06	1.24E-06	5.39E-07	2.62E-12	5.20E-06	15.03
Experiment	1.53E-05	1.42E-05	5.46E-06	4.63E-06	1.82E-06	2.98E-11	1.61E-05	35.60

ANOVA TEST

Test Hypothesis			Calculated values			F Tables
H_0	H_1	?	df_1	df_2	F calculat	F critic
$m_1 = m_2$	$m_1 \neq m_2$	0.05	1	17	**5.80**	4.45

Calculated F >= critical F. Statistically, the results of the 2 tests are very different Hypothesis rejected null (H0).

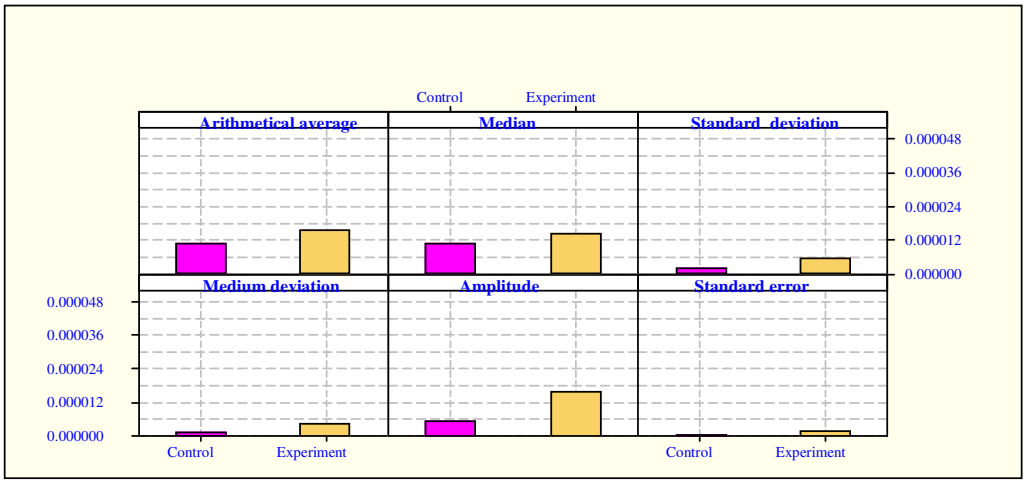

Fig. no. 65. Graphic representation of statistic indicators – electro-mio-graphics right biceps, alternative draughts

- ***Left biceps - values of electric signals simultaneous draughts***

Table no. 55. Statistic indicators for electric signals registered from the group of left biceps muscles, in simultaneous arm draughts

CONTROL – EXPERIMENT

TESTING	Arithmetical average	Median	Standard deviation	Medium deviation	Standard error	Dispersion	Amplitude	Variation Coef.
Control	1.55E-05	1.23E-05	5.71E-06	4.98E-06	1.90E-06	3.26E-11	1.52E-05	36.83
Experiment	2.29E-05	2.20E-05	7.86E-06	5.52E-06	2.62E-06	6.18E-11	2.64E-05	34.39

ANOVA TEST

Test Hypothesis			Calculated values			Tabele F
H_0	H_1	?	df_1	df_2	F calculat	F critic
$m_1 = m_2$	$m_1 \neq m_2$	0.05	1	18	**5.51**	4.41

Calculated F >= critical F. Statistically, the results of the 2 tests are very different Hypothesis rejected null (H0).

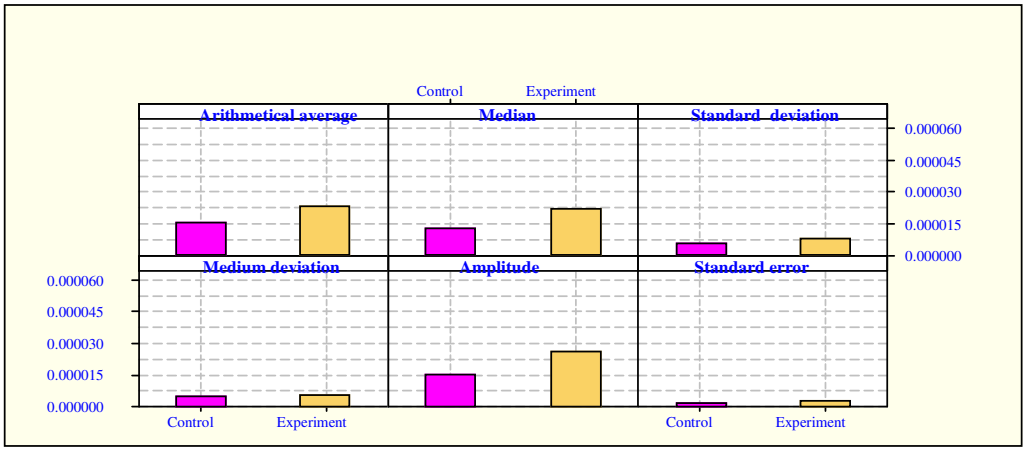

Fig. no. 67. Graphic representation of statistic indicators – electro-mio-graphics left biceps, simultaneous draughts

- ***Left biceps - values of electric signals alternative draughts***

Table no. 56. Statistic indicators for electric signals registered from the group of left biceps muscles, in alternative arm draughts

CONTROL – EXPERIMENT

TESTING	Arithmetical average	Median	Standard deviation	Medium deviation	Standard error	Dispersion	Amplitude	Variation Coef.
Control	1.32E-05	1.21E-05	5.83E-06	4.25E-06	1.94E-06	3.39E-11	1.83E-05	44.04
Experiment	2.62E-05	2.16E-05	1.51E-05	1.19E-05	5.04E-06	2.29E-10	4.90E-05	57.70

ANOVA TEST

Test Hypothesis			Calculated values			F Tables
H_0	H_1	?	df_1	df_2	F calculat	F critic
$m_1 = m_2$	$m_1 \# m_2$	0.05	1	17	**5.83**	4.45

Calculated F >= critical F. Statistically, the results of the 2 tests are very different Hypothesis rejected null (H0).

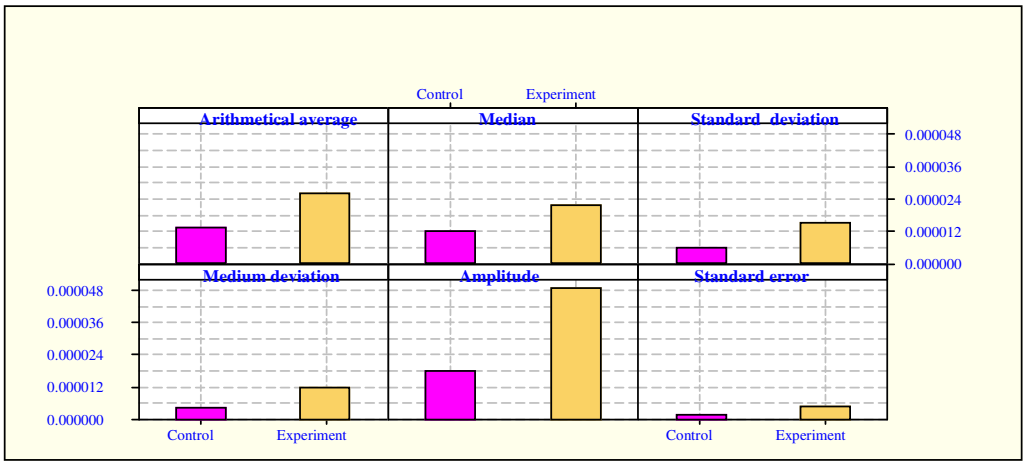

Fig. no. 69. Graphic representation of statistic indicators – electro-mio-graphics left biceps, alternative draughts

- ***Right triceps - values of electric signals simultaneous draughts***

Table no. 57. Statistic indicators for electric signals registered from the group of right triceps muscles, in simultaneous arm draughts

CONTROL – EXPERIMENT

TESTING	Arithmetical average	Median	Standard deviation	Medium deviation	Standard error	Dispersion	Amplitude	Variation Coef.
Control	2.85E-05	2.71E-05	8.03E-06	6.43E-06	2.68E-06	6.44E-11	2.30E-05	28.17
Experiment	4.25E-05	3.66E-05	1.75E-05	1.38E-05	5.82E-06	3.05E-10	5.86E-05	41.04

ANOVA TEST

Test Hypothesis			Calculated values			F Tables
H_0	H_1	?	df_1	df_2	F calculat	F critic
$m_1 = m_2$	$m_1 \# m_2$	0.05	1	18	**4.93**	4.41

Calculated F >= critical F. Statistically, the results of the 2 tests are very different Hypothesis rejected null (H0).

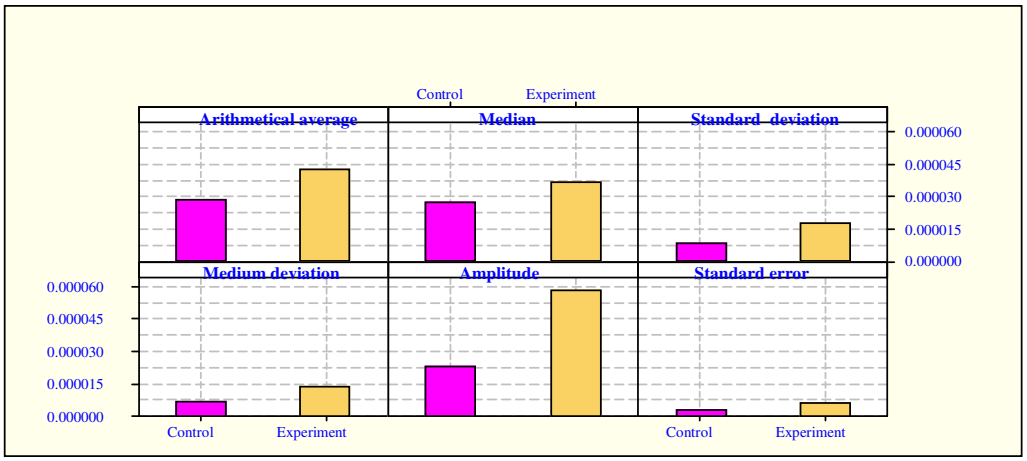

Fig. no. 71. Graphic representation of statistic indicators – electro-mio-graphics right triceps, simultaneous draughts

- ***Right triceps - values of electric signals alternative draughts***

Table nr. 58. Graphic representation of statistic indicators – electro-mio-graphics right triceps, simultaneous draughts

CONTROL – EXPERIMENT

TESTING	Arithmetical average	Median	Standard deviation	Medium deviation	Standard error	Dispersion	Amplitude	Variation Coef.
Control	1.71E-05	1.68E-05	4.44E-06	3.69E-06	1.48E-06	1.97E-11	1.16E-05	25.94
Experiment	2.77E-05	2.57E-05	1.02E-05	9.12E-06	3.41E-06	1.05E-10	2.73E-05	36.97

ANOVA TEST

Test Hypothesis			Calculated values			F Tables
H_0	H_1	?	df_1	df_2	F calculat	F critic
$m_1 = m_2$	$m_1 \neq m_2$	0.05	1	17	**8.17**	4.45

Calculated F >= critical F. Statistically, the results of the 2 tests are very different null (H0). Hypothesis rejected

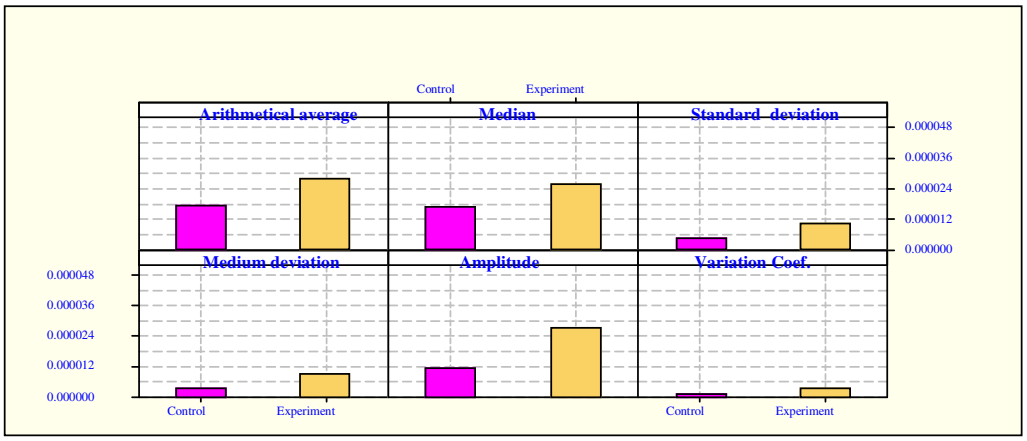

Fig. no. 73. Graphic representation of statistic indicators – electro-mio-graphics right triceps, alternative draughts

- ***Left triceps - values of electric signals simultaneous draughts***

Table no. 59. Statistic indicators for electric signals registered from the group of left triceps muscles, in simultaneous arm draughts

CONTROL – EXPERIMENT

TESTING	Arithmetical average	Median	Standard deviation	Medium deviation	Standard error	Dispersion	Amplitude	Variation Coef.
Control	2.75E-05	2.72E-05	1.18E-05	8.24E-06	3.92E-06	1.39E-10	4.11E-05	42.79
Experiment	4.34E-05	3.63E-05	1.96E-05	1.53E-05	6.54E-06	3.85E-10	6.09E-05	45.20

ANOVA TEST

Test Hypothesis			Calculated values			F Tables
H_0	H_1	?	df_1	df_2	F calculat	F critic
$m_1 = m_2$	$m_1 \neq m_2$	0.05	1	18	**4.54**	4.41

Calculated F >= critical F. Statistically, the results of the 2 tests are very different null (H0). Hypothesis rejected

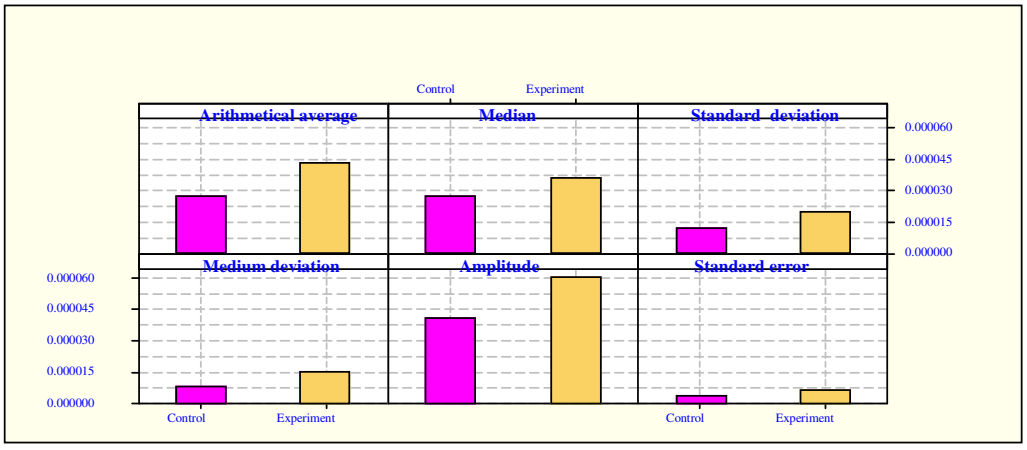

Fig. no. 75. Graphic representation of statistic indicators – electro-mio-graphics left triceps, simultaneous draughts

- ***Left triceps - values of electric signals alternative draughts***

Table no. 60. Statistic indicators for electric signals registered from the group of left triceps muscles, in alternative arm draughts

CONTROL – EXPERIMENT

TESTING	Arithmetical average	Median	Standard deviation	Medium deviation	Standard error	Dispersion	Amplitude	Variation Coef.
Control	1.58E-05	1.60E-05	3.19E-06	2.14E-06	1.06E-06	1.02E-11	1.19E-05	20.20
Experiment	2.63E-05	2.06E-05	1.21E-05	9.87E-06	4.04E-06	1.47E-10	3.61E-05	46.05

TESTUL ANOVA

Test Hypothesis			Calculated values			F Tables
H_0	H_1	?	df_1	df_2	F calculated	F critical
$m_1 = m_2$	$m_1 \neq m_2$	0.05	1	17	**6.32**	4.45

Calculated F >= critical F. Statistically, the results of the 2 tests are very different null (H0). Hypothesis rejected

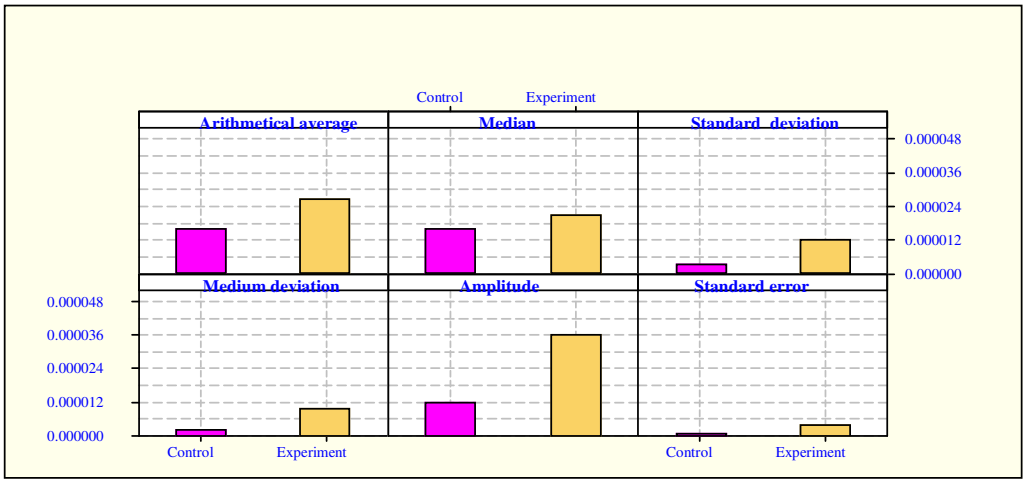

Fig. no. 77. Graphic representation of statistic indicators – electro-mio-graphics left triceps, alternative draughts

Chapter 9. – CONCLUSIONS OF THE RESEARCH

9.1 Theoretical conclusions

This demarche led us to the elaboration of a synthetic picture of the discussed problem which was an important starting point for the following stages of our research. As a result of the study of the bibliographical resources, we stated the following theoretic conclusions:

1. The detailed knowledge of the growing and development processes taking place in the child's organism at the age before puberty, favors a better understanding of the child's reactivity to physical effort, in the case when he is trained in performance artistic gymnastics.
2. In the same time, the effort practicing and dosing modalities in training lessons are conditioned by the individual and age particularities, taking into consideration the fact that at the 3rd category of sportive classification, the gymnasts have to demonstrate in contest the movement aptitudes for which they were selected.
3. Emphasizing the defining elements of the male artistic gymnastics specific solicitations, in biological, functional, movement and biomechanical plan, as well as in the psychological one, ease the identification of adaptation modifications owed to these.
4. The adaptation modifications assembly installed as a consequence of the physical effort appropriate parameters, during the long-term training, confer the gymnast's characteristic type, shaped from early ages, which visibly differentiate this one from an untrained child.
5. Viewed the relative stability of the sportive shape at this age, as well as the importance of the adaptation maximum level in contests, it is necessary to confer a special attention to the dynamics and dosing of

effort, during the artistic gymnastics, during the preparation periods from stage I.

6. The research confirms the fact that, in male artistic gymnastics, dosing of the training means supposes a controlled "game" of solicitation and recovery, which generates adaptation modifications in the gymnasts' bodies and positively influence their performance capacity.

9.2 Conclusions obtained from the experiment

After the comparative analysis between the gymnasts and the untrained children, possible through the interpretation of the results obtained in the somatic evaluation, as in the evaluation of the functional trunk equilibrium and of the effort capacity, the following conclusions were drawn:

1. **growing and development processes** specific to the age before puberty are not negatively influenced by the effort specific to male artistic gymnastics, the sportsmen can be included in the category of normal somatic;
2. gymnasts' height is situated at the level of the average of the population of the same, reason for which we can state that performance artistic gymnastics does not have fatal effects over this parameter, until the age before puberty;
3. gymnasts' weight is reduced, yet this parameter has to be analyzed through the prism of the global corporal aspect of the body which for the gymnasts is an harmonious one, with the big muscular groups well-defined at this age, compared to the untrained children, which are characterized through muscular hypotonia and unaesthetic of the percentage of fats and of the muscles.
4. measuring the anthropometric indexes emphasize the gymnasts' morphological pattern, from an age before puberty, with narrow basin and broad shoulders, with well-defined muscles and a reduced percentage of fats;
5. the somatically exam emphasized the following aspects:
    - gymnasts show a cyphose attitude explained through a better development of the abdominal muscles, of the pectineus, compared to the ones of the back, while untrained children show other types of spine deficiencies;
    - at gymnasts, there is an incorrect position of the scapula, these ones being slightly moved, as a consequence of the pectineus development which are oriented towards the shoulders and the scapular belt;
    - at untrained children, there is a deficit in the development of the back muscles and of the arms which threat the stability of the spine and the maintenance of a correct corporal position;

- at the level of the inferior part of the body, in gymnasts' case there is no type of deficiency, compared to the untrained children to whom there were identified genuvarum şi genuvalgum;
- parting the weight predominantly on the right or the left side, depending on each gymnast's normal dexterity, is the effect of performing technical elements to automatic features, only on one side, which can lead in time to segment and functional asymmetries, for the moment, this modification which cannot be found at untrained children, does not have negative effects on health, yet, in time, if neglected, may bring serious modifications of the spine.

6. We can appreciate that **the effort specific to male artistic gymnastics** does not induce fatal modifications over the growing and the development of the child at an age before puberty, but, on the contrary, it favors the installation of some morphological and functional adaptation, favorable to the effort capacity.
7. Given the fact that the back, the arms and the inferior limb muscles work for **the maintenance of the spine stability**, the equilibrium of the scapular belt and the thorax-lumbar equilibrium, can be obtained only through an appropriate development of the force of this muscular groups, maintaining the functional proportionality reports.
8. A gymnast with **the trunk muscles appropriately developed** can increase his sportive longevity, by maintaining a correct corporal attitude and avoiding accidents. An untrained child with the trunk muscles appropriately developed is less exposed to functional lack of equilibrium of the spine and the deficiencies at this level.
9. Regarding the results obtained in testing **the jumping capacity** on the conditions simulator, it can be appreciated that gymnasts have the possibility to develop an increased force at the level of the triple extension of the inferior limb, while the performance speed on the apparatus is increasing. Untrained children show the same level of jumping capacity, despite the modifications appeared in the performance task.
10. Because of the solicitations specific to male artistic gymnastics, sportsmen present a high level of **jumping capacity** compared to untrained children, this fact being confirmed through test results.
11. Regarding the force developed at the level of the superior limbs, in the case of a static contraction, on Formax apparatus, it can be stated that, no matter the registration angles, gymnasts manifested superior values compared with untrained children's.
12. Referring to the force developed at the level of the superior limbs, in the case of a **dynamic contraction**, on the conditions simulator, it can be appreciated that gymnasts show a superior force not only when

performing simultaneous draughts, but also when performing alternative ones, compared with untrained children.

13. **electrical signals** detected on the groups of muscles: pectineus, deltoid, biceps, triceps brachii, emphasize a high action potential at gymnasts, which develop a greater force with a more reduced resources consume, performing more efficient actions, compared with untrained children.

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