# CONTRIBUTIONS CONCERNING THE ROLE OF SPORTS PHYSICAL ACTIVITIES IN THE DEVELOPMENT OF HUMAN BALANCE

# CONTRIBUŢII PRIVIND ROLUL ACTIVITĂŢILOR FIZICE DE TIP SPORTIV ÎN EVOLUŢIA ECHILIBRULUI

***Antoaneta Creţu*[1],**
***Carmen Gherghel*[2]**

**Key –words: balance, posture, center of mass oscillations**

**Abstract**: The modern researches concerning the human balance reveal that the real balance could not exists in the biological system, in the meaning of a null deviation from a fix point. The main interest in the present research is focalized on the opportunity to establish the tendency of the recorded data. Through these recorded data we can identify the middle values of the main parameters of postural stability in two of the three faces – statistic normality and exceptional normal as sport performers.

**Cuvinte cheie: echilibru, postură, oscilaţiile centrului de masă**

**Rezumat:** În privinţa echilibrului uman, abordările moderne argumentează faptul că echilibrul real, în sensul unei deviaţii egale cu zero faţă de un punct fix, nu poate exista în sisteme biologice. În lucrarea de faţă interesul major este acordat posibilităţii de a stabilii tendinţa datelor înregistrate în vederea identificarii poziţiei centrale a valorilor principalilor parametrii ai stabilităţii posturale în două dintre cele trei ipostaze: normalitate statistică şi normalul de exceptie (incluzând sportivii de performanţă).

## *Introduction*

Balance in biomechanics refers mainly to the internal forces generated by muscular contraction. The stability of a human being is not perfect, permanently there are oscillations of weight center projection, as the command and balance control system is based on feed-back corrections of some errors, including the aware changes of body segments positions or of the body, which will determine the change of position of the body weight center and, implicitly, the quality of balance. (Gagea A., 2006)

In the human evolution, balance has had countless opportunities to adjust to effects induced by earth gravity or other external forces. There are good reasons to consider that human beings accomplished this adjustment process a long time ago, fact which may constitute one of the reasons for which balance in orthostatism has represented a special scientific interest.

In sports activities the external forces can be very big and, in this situation, the required conditions to maintain balance of the entire body should be regarded as a function of an ensemble of complex regulation phenomena for which scientific concepts are only partly accessible.

[1] Prof. PhD – Faculty of Physical Therapy, UNEFS, Bucharest
[2] Junior lecturer - Faculty of Physical Therapy, UNEFS, Bucharest

Modern approaches reveal the fact that real balance, in the sense of null deviation from the fixed point, cannot exist in biological systems.

In this research, the major interest is directed towards identifying the central tendency of values and labeling the main parameters of postural stability in two out of the three situations: statistic normality and exceptional normal (including sport performers).

Gagea A., (2006) considers that a body is in balance as long as the projection of its weight center falls within the support area, and balance labeling can be made in three categories: stabile balance, unstable balance and lack of balance.

According to Sbenghe T., (2002), balance is defined as "a complex process which interests the reception and organization of sensorial input as well as the program and execution of movements, elements which provide erect posture, that is, permanent maintenance of gravity center within the support base".

***Purpose***

Knowing the way in which body balance is achieved, as well as the elaboration of certain modalities of its evaluation, has a major role. It represents a means of understanding and emphasizing the functioning of systems which interfere in posture control. In sports activity, it represents a way of assessment and training of motor qualities, especially for those who practice high performance sports which require increased balance level. It also represents an aid in clinical diagnosing (neurology, traumatology, etc.), in order to notice the presence of possible balance disorders, and in assessment of applied treatment efficiency. Last but not least, it can be used to identify elderly people with balance disorders in the past or with predispositions for such disorders.

***Hypothesis***

It is estimated that the dynamic recordings of static balance have the tendency to group around a central value, which can represent the reference for diagnosis and selection.

***Research methods***

The testing was made with the help of POSTUROTEST software. This type of testing belongs to the test category that regards sensorial organization (SOT), method also encountered under the name of computerized posturography. It is a postural stability test which provides information about motor control or balance function in various environment conditions. The connections between all components of the system providing balance are tested – eyes, somato-sensitive system and vestibular system; it measures an individual's reaction to environments in which the amount of information sent by eyes and somato-sensitive system is varied.

The statistic hypothesis was verified through several methods. The Anderson-Darling test was used to verify if a data sample came from people with a certain distribution. The Analysis of Variance method (ANOVA) is one of the variation method group, used to study if there are or are not statistically significant differences between the result averages obtained by the two groups at the analyzed test. Mann-Whitney test is a non-parametric one used to test the statistic hypotheses referring to a characteristic measured for two lots of subjects.

***Contents***

The improvement of movement parameters is achieved by continuously improving the reflex-conditioned connections and dynamic stereotypes, by forming a number, as varied as possible, of motor engrams which are at the basis of maintaining balance. However, this is meant less for the morphological and biochemical structures of the body, regarding especially the functional improvement under the aspect of movement coordination.

Within the study, under lab reproducible circumstances, we have complexly investigated 62 subjects divided into two lots: a non randomized sample of 31 subjects belonging to the statistical population named: "healthy young people, practicing consequent and moderate sports" (yet not at performance level) and a sample of 31 "target shooters" (performance sportives) with long experience in sportive training and competitions.

The test consists in maintaining position on a platform (POSTUROTEST) looking at a certain target. The pressure sensors on the platform record the body weight movement (swing) while the tested person maintains balance.

This was meant to investigate postural stability and it started by informing the subjects about the testing conditions. Each subject received indications about the position required for investigation: standing with legs slightly spread, legs on the platform with toes at the same level, arms hanging relaxed next to the body, forward look; a position as relaxed as possible, which should be maintained for 30 seconds.

The stabilometric evaluation allows a balance test with visualization, by comparison, of the movement of body center inside the ellipsis, lateral and antero-posterior oscillation values, oscillation velocity, swinging area, Fourier transformations and Romberg index. The oscillations are measured from the initial balance position to the final balance position, after suspending one of the sensors, the information from the visual analyzer are modified (the patient closes his/her eyes). The analyzed aspects were the mass center oscillations with and without visual control. The mass center is considered to be a controllable variable in the analysis of postural oscillations.

***Results***

The tested groups are from statistically different types of people – students at the National University of Physical Education and Sports and high performance sportives and in this case the entrance measurements and the functional blocks "conditions" are different, becoming independent variables. Under these circumstances, we have tried to establish which of these independent variables are relevant in establishing the boundaries for balance scaling and labeling. The obtained data were recorded in personal files (fig.1) which contain the values of mass center oscillations in anterior, posterior, left and right plan, values measured in millimeters.

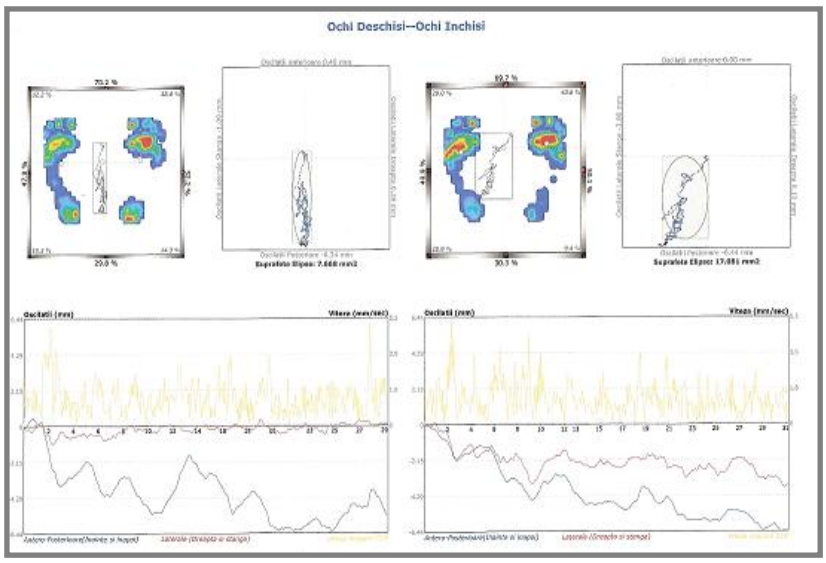
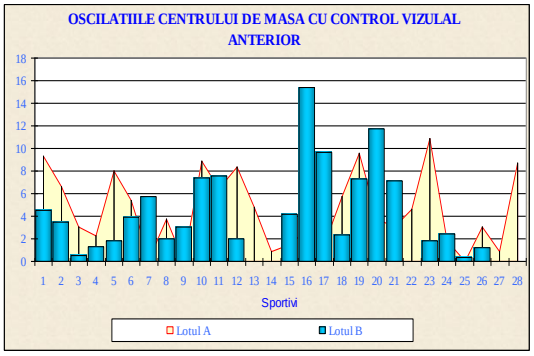
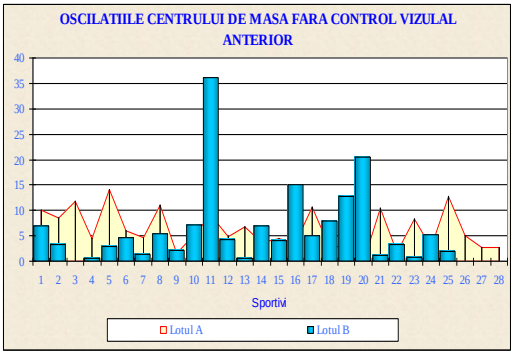
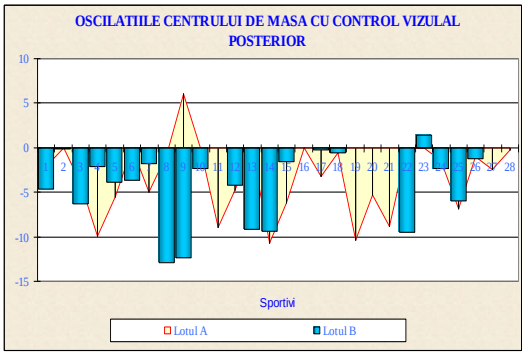


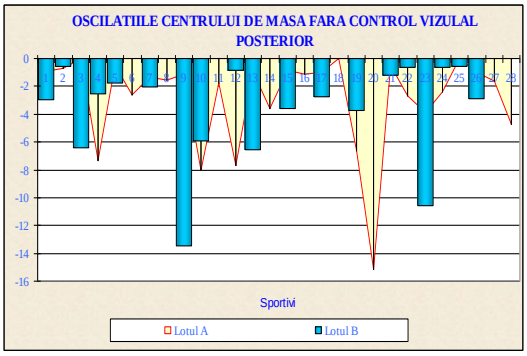

**Fig. 1 – Mass center oscillations file**

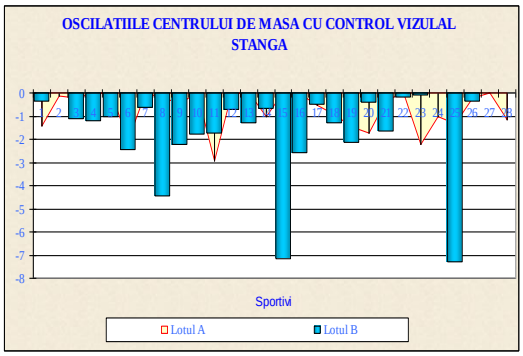
In the beginning, we analyzed the distribution of results applying the Anderson-Darling Normality statistical test in order to detect deviations from normality. Generally, all natural phenomena are distributed, or have normal distributions, when they are assessed under normal circumstances. The normality of phenomenon distribution in the domain of physical education and sports is provided by respecting nominal conditions, without the influence of any disturbing factor, be it intended or accidental. In labeling distribution as being normal, we have considered the shape, which can have three variants: normal distribution is symmetrical, normal distribution has only one maximum and normal distribution has (arms with) only one inflexion. The lack of concordance of shape with normal distributions can suggest the presence of some factors with hidden influence which could be difficult to notice. The absence of normality characteristics does not always lead to the rejection of normal distribution labeling.

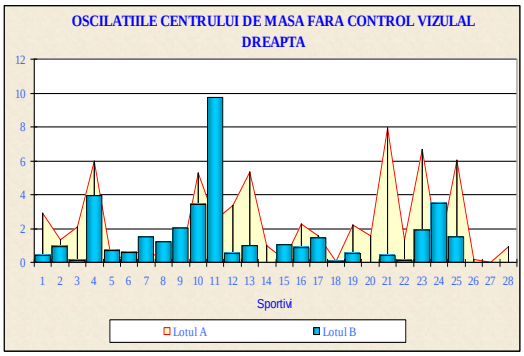


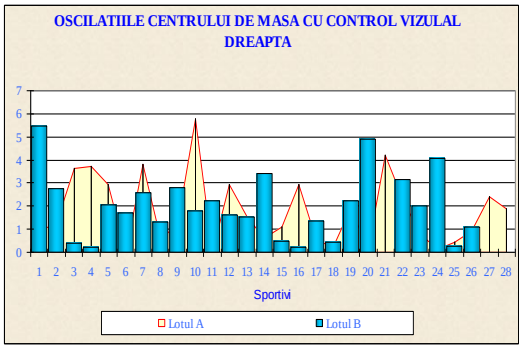



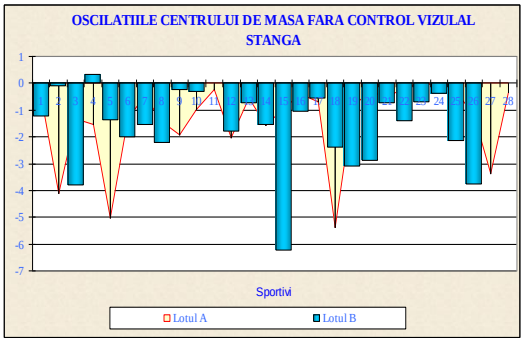



The results of mass centre oscillations: the following have a normal data distribution (P-value > 0,05):

- in anterior plan, with and without visual control, the U.N.E.F.S, sportives lot;
- in the case of mass center oscillations in lateral-right plan with visual control, high performance sportives lot;

Data distribution is not normal (P-value < 0,05):

- in anterior plan with and without visual control, high performance sportives lot;
- in the case of obtained results by the two lots for mass center oscillations posterior, lateral-left plan, with and without visual control;
- in lateral-right plan, with and without visual control, for the U.N.E.F.S. students lot;
- in the case of testing with eyes closed in lateral-right plan, the sportives lot.

***Conclusions***

Maintaining balance in orthostatism is an important motor activity in keeping an individual's autonomy. From documentation, it is revealed the existence of mainly four control mechanisms which permanently regulate postural stability in orthostatism. These mechanisms are represented by:

- instantaneous muscular and joint reaction depending on their properties and modulated at spinal level;
- muscular activity triggered by detection of body oscillations based on information received at periphery;
- muscular anticipatory activity determined by the existent internal model;
- cognitive intervention of the nervous system' superior centers.

For the category of mass center oscillations with visual control, Anderson-Darling Normality Test shows a normal data distribution (P-value > 0,05) in anterior plan, U.N.E.F.S. students lot and in lateral-right plan, high performance sportives lot. In the case of mass center oscillations without visual control, Anderson-Darling shows a normal data distribution (P-value > 0,05) in anterior plan, the U.N.E.F.S. students lot and in lateral-left plan, the high performance sportives lot.

The difference of results noticed in anterior plan may have a plausible explanation in the fact that high performance sportives, in order to obtain performances, resort to solutions to ameliorate position stability in the area of vestibular and visual analyzers, phonotypically developing the ability to maintain balance in positions specific to the sports event. The mass center oscillations with visual control in lateral-left plan, statistically processed with MANN-WITHNEY test show that between the two lots there is a statistically significant difference (P-value < 0,05).

From biomechanical point of view, the force used to maintain balance in orthostatism is much more inferior to the maximum force an individual can develop. The position and velocity of mass center in orthostatic balance are situated in the comfort and safety area, defined as stability limit. Thus, postural oscillations can be associated with compensatory strategies which allow keeping certain essential motor functions such as maintaining the head in a fixed position while making a movement. The statistic results of the main indicators confirm the hypothesis according to which the dynamic recordings of orthostatic balance have the tendency to group around a central value.

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