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**SUBSTANTIVE OPINION ON RESEARCH PROJECT**

**in the field of influence of the normobaric environment on selected functional parameters of the autonomous nervous system, cardiovascular system and cognitive functions in healthy people**

**1. Adopted research assumptions:**

Normobaric chambers have found their place in the area of biological regeneration in recent years. These are rooms in which the following conditions are maintained: pressure 1500 hPa, oxygen concentration 37%, carbon dioxide 1.079%, hydrogen concentration 0.44%. The stay in the chamber lasts 2 hours. During each session, the body receives a large dose of oxygen combined with carbon dioxide, dilating the cerebral vessels and acting on the cardiac conduction and stimulation system, and molecular hydrogen – an effective biological antioxidant. The normobaric chambers produced by EKONSTAL Sp. z o.o. Sp. kom., are associated with extensive impact on the human body, being acknowledged as a proper tool to support the physical condition, body resistance and overall well-being as well as overall health condition. These chambers are currently the only ones available on the domestic market that have a CE certificate and all the required approvals for use. Supporters of the normobaric chambers emphasize the following elements of the therapeutic impact of a 2-hour session in a normobaric chamber:

- reduces intensity of inflammatory processes;

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- accelerates the process of angiogenesis, i.e. the growth of new blood vessels;
- stimulates epithelial regeneration;
- has a stimulating effect on skin cells – fibroblasts. In this way, it stimulates the production of collagen and elastin, which provide the skin elasticity;
- slows down the aging of the body;
- reduces swelling in the area of damaged tissues;
- increases the activity of osteoblasts and osteoclasts – cells responsible for bone health;
- improves the blood circulation;
- increases the physical and mental fitness of the body and the ability to remember;
- improves the oxygenation of cells and thus accelerates the natural regeneration of the body.

In the light of numerous and various opinions present both in the scientific literature and in popular media, regarding the effects of normobaric chambers, it was decided to carry out research objectifying data on the impact of staying in a normobaric chamber on the above-mentioned processes.

The subject of the research was the analysis of physiological parameters, covering a broad spectrum of the human body functioning: cognitive functions, biochemical parameters of blood, autonomic nervous system activity, cardiovascular and respiratory system function and physical performance, after a 2-hour session under the conditions prevailing in the normobaric chamber. It was recognized that such a wide range of the research would allow an objective assessment of the actual impact of the normobaric chamber and would order some information chaos about its practical application.

## **2. The characteristics of the studied group and evaluation of the correctness of the selection of the research methods:**

The study was conducted in a group of 22 healthy volunteers aged 37.5 years. Other anthropometric parameters were the following: average height 175 +/- 10.6 cm, body weight 81.5 +/- 22.5 kg, BMI 26.1 +/- 5.8. All the subjects were healthy, did not take any drugs, in the period preceding the study (3 days) they eliminated stimulants and used a similar diet to stabilize the metabolic rate. It was also recommended to maintain a comparable mode and rhythm of life at the same time, with a similar

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amount of sleep and activity hours, avoiding extreme physical efforts and emotionally charged situations. These recommendations were supposed to affect the homogeneity of the research group and the standardization of measurements.

The study was carried out twice: before and after a session in the normobaric chamber.

The applied research methods allowed for a comprehensive and systemic approach to the assessment of human body functions in the fullest – possible to be performed in non-invasive conditions

- in a holistic view. Considering the cognitive as well as practical aspect of the research, the area of application of normobaric chambers, where the main attention is given above all to the holistic influence of hyperoxic and hypercapnic normobaria – I consider this selection of research methods extremely complex, based on the most modern tools and measurement systems currently available, used in physiology applied in the best world research centers.

### 3. Completed research procedures:

The studies were carried out in a normobaric chamber Type: V12OK1 produced by the company EKONSTAL Sp. z o.o. Sp. kom.

The applied research methods were the following:

- psychological tests assessing cognitive functions (e.g., TMT) and fatigue (FSS) which is the determinant of sleep quality;

- body composition tests, including: fat content, intra- and extracellular water content and an assessment of the basic metabolism (BMR);

biochemical blood tests, including markings of inflammatory enzymes, NO synthases. The biochemical parameters tested were the following: NOS-2, NOS-3, ccl6 protein, catalase, MDA (reactive oxygen species), NT3 leurotrophin , NT4, BDNF, SOD dysmutase;

study of the autonomic nervous system function using the Task -Force Monitor system. This system permits non-invasive testing of all circulatory parameters at rest during an active and passive verticalization test. The spectral heart rhythm analysis (HRV) enables

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non-invasive assessment of the sympathetic and parasympathetic autonomic nervous system activity, as well as the parasympathetic-sympathetic balance during rest and during active and passive verticalization, as well as sensitivity of the arterial baroreceptors. The most important measured and analysed circulatory parameters were the following: RR, HR, sBP, dBP, mBP, SV, SI, CO, TPR, EDI, LVET, TFC. All the parameters presented allow to obtain an image of the cardiovascular activity and the efficiency of the regulating reflex mechanisms stabilizing the blood pressure;

- arteriographic examination – assessing the elasticity and stiffness ratio of the arterial vessels;
- basic spirometric examination and ergospirometric examination allowing, among others, to assess the work of the respiratory and circulatory system under physical effort and the level of effort at which metabolism changes to anaerobic transitions.

#### 4. Evaluation of the preliminary statistical analysis:

A statistical analysis was performed professionally based on recognized statistical methods in experimental research.

The results of the initial analysis (only those results are listed where statistical significance of the observed changes were obtained) indicate:

- improving the quality of sleep and consequent reduction of fatigue and statistically significant improvement in cognitive functions;
- weight reduction, BMI reduction, reduction of percentage and absolute body fat content while increasing the water content;
- improving tolerance of effort in standing and sitting positions;
- weakening the component of the sympathetic autonomic nervous system, and thus changing the parasympathetic-sympathetic balance, which may have a cardioprotective effect in the conditions of effort and rest;
- improving the efficiency of the orthostatic reaction in conditions of active verticalization, which may improve postural control in the conditions of changing the position and prevent unexpected falls;
- in the range of the marked biochemical parameters, the level of NOS-2 nitric oxide synthase was increased, the level of the ccl6 protein was increased, the level of the reactive form of MDA oxygen was reduced

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and the level of dysmutasis increased, suggesting improvement of the local tissue flow and reduction of the risk of oxidative stress; increasing the level of neurotrophins (NT4, NT3 and BDNF), which may explain the improvement of cognitive functions;

however, no significant changes were observed in the improvement of spirometric parameters and physical fitness (ergospirometric test).

#### **5. Initial conclusions based on the results obtained:**

Exposure to the conditions in the normobaric chamber modulates the body weight by reducing fat mass, improves the quality of sleep and efficiency in solving cognitive tasks, which was also confirmed by a higher concentration of neurotrophins, has an anti-inflammatory effect, reduces oxidative stress, improves the efficiency of orthostatic reactions (which can have special significance for the elderly), modulates the parasympathetic-sympathetic balance, acts cardioprotectively. The mentioned effects largely confirm the expected effects of the normobaric environment listed at the outset. However, it is necessary to extend the conducted research to selected clinical groups or groups practising professional sport.

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