

NATIONAL

UNIVERSITY OF PUBLIC SERVICE

Doctoral Council

Ret. col. dr. Iván Szalkai, former army doctor

**Maintenance of working and combat capability
under extreme circumstances**

Official assessment and authorial review

Budapest

2017

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Supervisor:

Prof. Dr. Kóródi Gyula, PhD

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1. **Statement of the Scientific Problem**

Our armed forces, during the fulfilment of its international obligations, is increasingly probable to face new panthognomic factors in its operational environment, currently as well as in the near future. Our missions, operating in crisis areas, have already encountered the stress-increasing effect of extreme weather, increased demand of task fulfilment and independent decisions. These factors influence the biological and psychological abilities of the body to properly adapt and react the environment.

The above-mentioned effects on the human body may appear in the following forms:

- Decreasing capability of resistance to stress
- Decreasing adaptability of the circulatory system
- Slowing of certain important mental processes
- Disturbance of fluid balance

Decrease in the adaptability of the body may result in not only more difficult resistance to stress, but may endanger our soldiers. One of the characteristics and consequences of increased stress is the hypoxic state. Accordingly, its observation and treatment shall be of high priority. Hypoxia and the changes in the body induced by its effects are of utmost importance regarding the proper functioning of the human system.

2. **Reasons of the choice of topic**

Due to the actuality of the problem, in addition to the already applied and widespread methods, two factors seem to be noteworthy:

- Measurement of biological stress reaction, which could be a starting and check point regarding the training of individual soldiers.
- Introduction of a method which, used in the location of deployment, increases the individual's ability of adaptation to

environmental effects, and which enables the enhancement of adaptation with regard to mental and physical performance. Due to the currently common asymmetric warfare, stress situations, state of constant alertness, immediate decision-making, the ever-present possibility of hostility and successful reactions to these come into prominence.

During military training and preparation both physical and psychological methods are applied for enduring and treating stress reactions. However, it is uncommon to encounter a solution influencing the energetic system of the body as well as taking effect through it, which renders combating chronic stress possible, and increases the combat capability of troops.

Effects influencing troops involved in asymmetric warfare:

1. Anxiety-related factors stemming from the uncertainty of the situation (it cannot be predicted, where the terrorist action or attack comes from, when does it happen or what types of weapons will be used). The sight of barbaric acts intentionally committed by the enemy, the psychological burden of fear of experiencing such acts, as well as misunderstandings arising from cultural differences only exacerbate the situation.
2. Stress factors generated by the state of constant alertness.
3. The necessity of immediate physical performance demanded by sudden reaction.
4. Shift in the composition of injuries; increase of the amount of explosion-related injuries, which result in loss of limbs as well as the late development of post-traumatic stress disorder. According to different sources, the ratio of explosion-related injuries suffered during the wars in Iraq and Afghanistan was between 50% and 81%.
5. Hazards and feelings of frustration stemming from the culturally alien environment.
6. Feeling of anxiety and depression caused by the distance between the soldier and his/her family and friends.

3. Research Aims and Hypotheses

For the training of soldiers to fight under extreme physical and psychological conditions, for the development of self-control and enhancement of durability, it is necessary to

1. Develop a device, which makes the ascertainment of the reactions given by an individual with a non-invasive method (regarding the autonomic nervous system and mental functions). This device has to be easily applicable, mobile and small in size.
2. Ensure the ability of the mentioned device to detect problems before the appearance of visible changes and symptoms. Our goal was not the creation of a diagnostic application, but the recording of the actual functional state of the individual.
3. Develop a substance with complex effects and without side-effects, which might increase the durability of the human system, and its research with
 - people maintaining normal life
 - people maintaining a life with regular exercise (athletes)as well as observing the mechanism of action in case of the substance.
4. Demonstrate the applicability of the substance under military circumstances
 - in prevention, during training
 - during combat activities
 - in rehabilitation, especially in case of Post Traumatic Stress Disorder

In accordance to the objectives of the research, I expect the following scientific results:

- The frequency of hand tremor changes parallelly to brain activity, which is influenced by the neuron network of the brain.

Measuring it renders it possible to infer the actual mental condition and tiredness.

- Working and combat capabilities are affected by the autonomic nervous system, especially by the condition of circulation, sensitivity to stress and mental condition, especially the use of memory. The measurement of these parameters (tremor, HRV analysis, speed of neural pathway conduction, speed of reflexes and time required for the use of working memory) sufficiently represents the working and combat capability of the individual. Combat capability is sustainable and increasable by improving the mentioned parameters.
- Kaqun water is a tool suitable for the treatment of anomalies caused by chronic stress and their consequences, as well as sustaining combat capability.
- Kaqun water, with the use of the required equipment, can be produced and applied in camps.

4.Methodology

1. Literature-based research, aimed at finding and proving the theoretical and practical basics of the methods of measurement intended for application, the connection between stress and the autonomic nervous system, especially in case of chronically present stress. Reveal the biological and pathological mechanism of stress for instrumental examination and for the planned method aiming to combat stress.
2. Collection and analysis of the results of the research conducted on substance intended for examination and the applicability of the mentioned substance on troops serving under increased stress, as well as proving the neuro-biological mechanisms of action.
3. Conducting research on a larger control group with chosen indicators and the instrument, statistical evaluation of the research, drawing conclusions. The stress sensitivity of the chosen group and its reactions to the applied method were measured with the Kellényi-Szalkai-tremometer, which is used specifically for

screening tests with regard to hand tremors, pulse analysis, measuring of reaction time and measuring of cognitive perception.

4. In light of the current combat circumstances, the optimal conditions and possibilities of the selected substance have to be analysed, as well as the possibility and technical solutions of its application in camps and temporary stations. Indications and predictable results have to be established.

Results of the literature-based research

1. Stress. Since the publication of Selye's works in the 1930's, the processes behind stress and combat against them have been a subject of continuous medical research, the PubMed refers 757000 publications. Our research is concerned in chronic stress (60513 publications), and its military applications (805 publications, of which 3 deal with the application of hyperbaric oxygen therapy). The therapy using oxygen dissolved in water is not mentioned, which indicates the uniqueness of our conception and research. According to Selye's analysis, chronic stress may result in disturbance in hormonal balance, the weakening of immune functions and ulceration of the stomach and the duodenum. Constant, chronic stress reaction may severely damage the neural structure of certain areas of the brain due to production of cortisol. The most convincingly documented stress-induced structural change is the shrinking and reorganisation of apical dendrite trees, which is accompanied by decrease in number of dendritic spikes and synapses and the change of post-synaptic density. These cell morphological changes probably contribute to the development of cognitive problems caused by stress.
2. The role of the neural network of the brain in the development of stress is a well-researched field. The connection between the neural network and the essential tremor is a recent discovery (4 articles). Energetically, the brain uses 0,5–1% of its required energy during the transmission of a certain stimulus generated

by the environment. In contrast, in resting state, it uses 60-80% of the energy consumed by in order to maintain internal activity. The praecuneus is the most prominent consumer of the brain, requiring 35% of the daily glucose usage. This also shows the dependence of the organ on oxygen as well as its vulnerability to the lack of the chemical element.

3. The connection between stress and the autonomic nervous system is known. Instances of research of the HRV analysis can be found in literature. It can be used for measuring the individual's reaction to an external stimulus. Our HRV analysis has been supplemented with the examination of stress-index, the flexibility of veins and blood pressure.
4. Oxygen and hypoxia. Human body utilizes oxygen primarily through breathing, but under sufficient pressure it also can dissolve in plasma. The primary role of oxygen is aiding mitochondrial metabolism by aiding breakdown of sugar and ATP generation. In case of hypoxia, anaerobic catabolism begins, which provides the system significantly less energy. With the gain of electrons oxygen generates free radicals, which have an important role in the maintenance of the human immune system (aspecific stimulus, pathogen-destroying substances of macrophages). In addition, reactive nitrogen radicals possess vein-expanding and primary transmitter properties. Within the system, the balance between generated free radicals and antioxidants is maintained. The system reacts to hypoxia with decreasing the generation of HIF1, which resets metabolism. Metabolism of glucose and glutamine, the maintenance of pH level, the catabolism of fat and sugar change. Sufficient level of oxygen plays an important role in maintaining functionality of musculature as well as providing energy for the brain in resting state and in stress situations. Summarily, it has an exceedingly important function in maintaining the combat capability of soldiers under extreme circumstances and/or in chronic stress situations.
5. Hyperbaric oxygen therapy. This therapy is the closest to our research. Over its course, the patient is placed in medium of

pressurized oxygen, or receives it through a mask, thus the body enters a hypoxic state. The therapy is successful regarding the healing of surface wounds, improving the working of immune system and the effectivity of antibiotic treatment. It can be applied successfully in case of ischemia/reperfusion treatment, since the regeneration of veins is increased. Certain authors report its successful usage in case of PTSD, which they explain with increased generation of stem cells. Initially, the amount of CD34 (blood-generating stem cells) doubles, later becomes eight times that of the original, without change in the number of leukocytes. One of the considerable side-effects of hyperoxia is the rise of the number of free radicals and the beginning of oxidative stress as a pathologic process. The positive effects can be measured as long as the therapy proceeds.

6. The unique characteristics of water. Water is an important component of biological structures. Its basic format is the four-molecule cluster structure, which influences both its application and effects. Within the body, water constantly transforms as carrier of proton and electron, due to decomposition of hydrogen. Its basic structure is H_3O , with one proton connected to the water molecule, and which proton is in constant exchange between water molecules. Within the human system, extracellular and intracellular waterspace can be distinguished. Intracellular water can be found in greater amount in the mitochondrion, where energy generation occurs (153 ml/kg), as well as having an important role at the connection of DNA and proteins. Dissolved oxygen contained by water plays an important role in biological processes.
7. Attributes of oxygen dissolved in water (Kaqun technology). Over the course of the processing of water, its measurable oxygen content doubles, its hydrogen content decreases. Its pH level becomes approximately 7,5-8 (peroxide becomes more stable in a slightly alkaline medium), gains a reducing effect. Oxygen contained by the water is absorbed already in the oral cavity and the stomach, thus circumventing connection to haemoglobins. This oxygen, in bounded form, enters the

extracellular water space. According to our measurements, it raises the oxygen level of tissues at an extraordinarily fast rate. Thermal conductivity of the Kaqun water is lower than that of ordinary water, which signs the change of cluster structure. Effects of the water: enhances the function of NK-cells, increases the amount of CD34 stem cells in circulating blood, increases the level of Vitamin C in plasma, decreases the level of HIF1 α in cells.

8. Results of research conducted with Kagun water aimed at establishing and checking hypotheses:
 - increases physical performance
 - enhances the function of the cellular immune system and the content of free radicals in leucocytes.
 - Release of a considerable amount of free radicals can be detected in case of termoperoxidase reaction, which as a non-specific stimulus can have an important role in the activation of cellular immune system, in increasing the flexibility of veins and in the regeneration of chronic wounds.
 - The ability of the Kaqun water to resist external effects have been tested. It can be carried, cooled, is suitable for making protein-cocktails, but it can not be boiled.
 - Having been tested on a phylum of Drosophyla living in the wild, it has increased the median survival of the fruitflies
 - Increase in the level of CD34 progenitor cells.

These effects raise the possibility and necessity of the research of its application regarding chronic stress (fulfilment of military tasks).

Review of our own research

Experiment Number I

The objective of the research is to measure the chronic stress affecting soldiers over the course of operational activity in asymmetric warfare, its effect on the analysed parameters, as well as the efficiency of the applied therapy. The measuring instrument is the Kellényi-Szalkai-tremometer.

Multiple methods have been assessed regarding improvement of the effects of chronic stress, of which the Kaqun water seemed suitable. Accordingly, the experiment was conducted with Kaqun water. The experiment was carried out as a randomized, double-blind research with self- and placebo control groups. Number of ethical permission: IV-R-015-14-4/2012. The control group consisted of 60 people, the possibility of change was given as 20%. A group of people belonging to troops continuously taking part in military operations was found in the age group of middle adulthood. This group is more sensitive to stress, its health condition and loadability is spontaneous or compensated with medicine, thus forming a sensitized community for the experiment. Four groups were formed. Subjects of the research only drank the water, bathing in Kaqun water, in contrast to other experiments, was not applied. The objective was the analysis of only consumed water. Later, a bathing container was developed, and bathing became optional. The groups received the following amounts of Kaqun water: 1.5 litre, 1 litre, 1 litre, 1.5 litre. The control group received 1 litre tap water in bottles of Kaqun water.

1. Examination: Analysis of Hand Tremor. The examination was carried out with a handpiece containing a 2D acceleration meter, and software processing applying FFT analysis. The theoretical base of the examination, in addition to the local motor coordination systems, is the neural network of the brain, in which the cerebellar, the cortical and motor coordinating systems can be found. Or tremors, the vibrations between the functional (5-20 Hz) were analysed according to their frequency. This frequency decreases proportionally to age and, according to examinations, to use of the brain. The frequency, with suitable forms of therapy and within certain limits, can be increased. Examination results: in the groups consuming 0.5 and 1.5 litres of Kaqun water, significant increase was observed. In contrast, in the control

group and the one consuming 1 litre, significant decrease was detectable. The group drinking 1 litre started from a considerably higher frequency than the rest. If a person with higher starting values is chosen from each group, considerable rise of frequency could be detected. Consequently, Kaqun water increases the frequency of functional hand tremor, which can be interpreted as a sign of increased brain functions. This interpretation is supported by other examinations.

2. Analysis of the autonomic nervous system under circumstances of chronic stress (literature-based research), and the effect of Kaqun water on the functions of the autonomic nervous system. Analysis of the effects of the autonomic nervous system on circulation (HRV) is widespread among military healthcare researches. This research analysed the following:

- Time period between R-R peaks and its variance
- Change of stress index
 - i. change in the flexibility of veins
 - ii. change in systolic and diastolic blood pressure.

Results:

Systolic pressure significantly decreases in every group consuming Kaqun. Decrease of the diastolic pressure is significant in the group drinking 1.5 litre, while it has trend-like tendencies in the other groups. The vegetative index (quotient of time period between R-R peaks and its standard deviation, above the value of 5 signs increased stress sensitivity) is significant in the groups of 1, 1.5 and 1 litres, it does not have a result in the group of 0.5 litre. The coefficient showing the speed of vein expansion shows trend-like decrease from a lower value (accelerating expansion), the control group shows increase from higher starting value. Nevertheless, its result is still worse than that of the rest.

3. Measuring of reflexes: decrease of time require for reflex reaxtions in all of the treated groups. Normal value stabilized on 10%+. Standard deviation, which is practically an indicator of capability to concentrate and neural exhaustion, was also analysed. The concentration capabilities improved in all of the treated groups.

4. Measuring of cognitive time (time required for using memory). Cognitive abilities improved in all of the treated groups. Similar improvement was observable in with regard to decrease in standard deviation.

Pre-experiment Number II

The analysis is the pre-study of a longer research plan, but is mentioned here due to its significance. This is the introduction of Kaqun water into the medico-social support of veteran soldiers suffering from PTSD. Four people took part in the experiment, all of them struggling with serious PTSD-symptoms for years (chronic pain, heavy movement, insomnia, psycho-social problems of integration, obesity, drug addiction). After two weeks of bath treatment, as well as consumption of Kaqun water, their pain has improved, their need for medication decreased, they were able to sleep for 4-5 hours a day, their body weight and integrational problems lessened. These results raise the possibility of using the Kaqun water in the regenerative processes of neural traumas. Therefore, a new method would appear at the field of military rehabilitation.

Summarised: the conducted experiments proved that application of the Kaqun water improves functions of the circulatory system, as well as that of the central nervous system, rendering it possible to for troops in situation of chronic stress to recover and keep its capability of fulfilling tasks both on a physical and mental level.

Complex conclusions: Based on our own and previous researches, the Kaqun water is capable of lessening the functional symptoms induced by chronic stress in case of troops stationed in camp conditions in a state of constant combat readiness in asymmetric warfare, as well preserving combat capability. In details:

1. Preservation of physical and psychical abilities of troops, as a supplement to the currently used physical and psychological training methods.
2. During deployment, consumption of the water improves physical and mental endurance and decreases felling of exhaustion.
3. Over the course of peacekeeping and anti-terror operations, it increases the physical recreation and makes faster healing of surface wounds possible under camp circumstances. It is applicable in case of ground troops as well as airforce. It is also installable on ships.

4. Faster rehabilitation of injured troops. This can be implemented in two ways: fast recreation of soldiers and staff withdrawn from combat service, along with already existing physical and psychological methods, and increasing the regeneration of injured troops (mechanical injuries, secondary wounds, burning injuries).
5. Supplemental treatment of injured soldiers suffering from PTSD 7, placed in the hinterland. In theory and therapy of PTSD, psychological factors receive most of the attention, the neuro-biological background tends to be de-emphasized. However, the positive effects of the Kaqun water raises the possibility of the micro-traumas of the brain and the neuro-humoral processes of stress having a significant role in the development of the disorder. Most of the people suffering from PTSD received TBI9. Over the course of this deformation the connections between the axons of neurons becomes damaged, which results in defective brain functions. In certain cases, increased activity can be shown with EEG. In this case, Kaqun water has a positive effect on the energetic system of the cell and its genome/epigenome, and aids the regeneration of the cell. Showing of the role of the Kaqun water in DNA methylation raises the possibility of its epigenetic effect. The connection between psychological processes and genetic activity is well-known. Of course, this hypothesis requires further research.

New scientific results:

1. Under my professional guidance improved the tremometer, and made it suitable for mobile screening tests. Accordingly, it is usable for supervising the stress level of and cognitive functions of troops in the area of operation.
2. I have proved that the Kaqun water affects stress endurance, physical fitness, attention and use of memory positively due to its ability to create normal state of oxygen saturation of blood. I verified the positive influencing of the functional, stress and adaptational processes with Kaqun water first.
3. I have developed the application of Kaqun water under camp circumstances. I have constructed a tub which can be connected to water-purifying systems, and developed a container suitable for

producing drinking water, which is able to ensure the bath treatment of 64 people in two shifts, in addition to producing 6000-8000 litres of drinkable Kaqun water.

4. Based on my researches, I have developed a method, which is applicable for treating PTSD. Over the course of therapy with Kaqun water I verified that it increases the number of CD34 stem cells, consequently stimulates the regenerative processes of the body.

Military applicability of the results

Performance of troops under chronic stress decreases considerably, their problem-solving abilities and self-supporting mechanisms weaken, it is not able to fulfil its task correctly. The researches conducted by me render compensation of stress possible with relatively simple methods integrated into the daily supply along with other methods (physical training, methods of psychological support). Application of the Kaqun water encompasses three fields: prevention, healing and rehabilitation. In prevention, it protects soldiers from health problems caused by stress, preserves fighting capability. In acute application it can be useful for treating battlefield neurosis, smaller surface wounds and burns. In rehabilitation, it can be applied for treating severe surface wounds, burnings and PTSD.

In order to make its military application possible, I developed a mobile system composed of 4 containers and containing two bathtubs, which can be dismantled within 2 hours, is able to provide bath treatment for 60 people, and/or producing 8000 litres of drinkable Kaqun water. Required for the device: suitable water, electric battery (capacity used under camp circumstances are sufficient), and bottle-filling device. The water-producing system can be placed in the two containers.

Recommendations

Kaqun water, although international and domestic researches have already begun, still carries many questions. Of these, in connection to this dissertation, the following issues have to be solved:

1. Application of Kaqun water for treating PTSD. Planned research on more subjects in the USA.
2. Effect of Kaqun water on the functions of the central nervous system. Experiment on active brain activity is planned.
3. Physical and chemical analysis of Kaqun water, further analysis of the biological role of water, the role of diamagnetism in intercellular mechanisms.
4. Introduction of Kaqun water in order to aid troops under operational conditions.

Scientific resume

Ret. col. dr. Iván Szalkai, former army doctor

Personal data

Name: dr. Iván Szalkai

Date and Place of Birth: 04/05/1951

Address: 8 Gadó Street, Pécs 7637

Phone Number: 06309851889

E-mail Address: szalkai1@outlook.hu

Degrees:

University of Szeged, Medical Faculty 1975

Jannus Pannonius University, 1997. Certified economist of healthcare

Further qualifications

Kirov Academy of Military Medicine St. Petersburg 1980,
Medical support of ground troops

Dermatology certification, 1983

Workplaces:

1973-1975, Karikás Frigyes Military College, student

1975-1978, 13th Independent Scout Battalion, Chief of
Medical Service

1978-1980, Zrínyi Miklós Military Academy, language course

1980-1988, 9th Mechanised Machine Gunners' Division, Chief of Medical Service

1988-1998, Pécsi Honvéd Hospital, second in command

1998-2007 E-consult Ltd, manager

2007- IHOC Ltd, manager

Linguistic skills:

Russian: Intermediate

English: B1

Educational career:

2007-2012 University of Debrecen, lecturer in the topic of Eastern medicine

2007- University of Miskolc, Head of undergraduate and postgraduate Ayurveda teaching

Society Membership:

Hungarian Dermatology Society

Society of Acupuncture-Using Hungarian Doctors

Hungarian Scientific Ayurveda Society

Miskolc Academic Committee, Gerontological workgroup

Affiliations:

Chairman of the Hungarian Society of Fitotherapy, 1992-1996

Society of Acupuncture-Using Hungarian Doctors, Council member, 2009-

Hungarian Scientific Ayurveda Society, co-President 2017-