



FACTORS WHICH AFFECT THE OPERATIONAL PHYSICAL PERFORMANCE OF SERVICEMEN

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Minimizing the importance of the human body and its possibilities for adapting to the conditions of an armed struggle, with the emphasis being increasingly placed on the technological revolution and in the military field, may be a disadvantage for carrying out the assigned missions. This adaptation of the human body is conditioned by the positive influence of individual factors or of factors independent of the purely physical component.

This article addresses a number of factors that may influence the operational physical performance of servicemen, factors that, neglected, may lead to the failure to perform the received military tasks. The role of the information presented in this material is to raise awareness that the accomplishment of the objectives in the missions carried out by the military, is not conditioned only by the specific training, technology and the act of execution, but also by the cumulative approach of these factors.

Keywords: factor; operational; serviceman; internal; external; physical.

Accepting the fact that war is an integral part of society and human evolution, being an abnormal way of regulating social demands and resettlement, a reality from which one of the parties involved will be directed towards reaching a compromise between its existence and territorial, economic, social cessations, it leads to its approach and treatment almost like any phenomenon specific to humanity. As far as can be seen, today's war knows no borders, and it takes place in all possible environments. If until recently it was fought only in the ordinary natural environments (earth, air, soil), now it knows, due to the technological revolution and its expansion, an important expansion in both the virtual and the cosmic environment.

The technological expansion and evolution, the development of highly sophisticated systems, even in the military field, is conditioned by the presence of the key factor, the one without which all these could not be possible, at least until now: *man*. At the same time, *man* is the factor whose contribution materializes, unfortunately, in the existence of wars. *Man* in the military environment, being an organism with multiple physical and mental peculiarities, with multiple qualifications and specialized in "weapons", is under a bombardment of individual or environmental stimuli with different intensities.

The exposure to these stimuli for a long time can lead to impairment and disruption of the military and combat capabilities of the *man* working in the military, the serviceman. This disturbance can be found, as a purpose, in the failure to meet the received objectives and missions.

Influences of individual and environmental factors on the operational physical performance of servicemen

Involving fighters in the conduct and carrying out of military actions, as well as in the combat environment (for example: excessive heat, extreme cold, humidity and heavy or long-lasting rain, altitude, deep water, night, etc.) are causes or elements that lead to the occurrence and onset of effects on the servicemen. These effects can be both beneficial, as they can contribute to the development and acquisition of a better adaptation of the fighters to the requested conditions, and detrimental, by affecting the physical, intellectual and emotional capacities of the servicemen, thus reducing their fighting possibilities, leading to the chances of non-fulfillment of missions.

In order to create an overview of the number of factors that appear and influence the operational performance of the military, it is necessary to present in a synthetic way those relevant to the military field (Table no. 1).

All these factors can influence the behavior of the fighters, behavior being defining for the

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accomplishment of the mission. The factors that I focus on in this paper can be divided into two categories: individual and environmental. In general, the effects of these factors can be

20-80 years, at the same time with an increase of the body fat. Moreover, after the age of 55-65 years, there is an acceleration of muscle degeneration. The influences that the age has on the muscularity

Table no. 1
PHYSICAL AND MENTAL STRESS FACTORS¹

Physical stress factors	<p>Environmental</p> <p>Heat, cold, humidity, dust, vibration, noise, explosions, smoke, poisons, chemicals, energy-directed weapons, radiation, pathogens, physical work, reduced visibility (bright lights, darkness, fog), difficult or difficult terrain, high altitude.</p>
	<p>Psychological</p> <p>Sleep deprivation, dehydration, malnutrition, poor hygiene, muscle fatigue, deficient immune system, lack of physical training, illness or injury, sexual frustration, substance use (smoking, caffeine, alcohol, drugs etc.), obesity, poor physical condition, age.</p>
Mental stress factors	<p>Cognitive</p> <p>Information (too much or too little), sensory overload, ambiguity, uncertainty, unpredictability, time pressure or long wait, difficult decisions, organizational dynamics and unexpected changes, difficult choices, incorrect functionality recognition, work above one's level of qualification, previous failures.</p>
	<p>Emotional</p> <p>New to the unit, isolated, lonely, fear and anxiety caused by different types of threats (death or injury, failure or loss), resentment, anger, anger produced by frustration and guilt, inactivity, boredom, lack of loyalty, spiritual confrontation or temptation which leads to loss of faith, interpersonal conflict, longing for home, loss of confidentiality, victimization and harassment, exposure to combat, thought and the need to kill.</p>

countered by a physical and mental effort of the fighter combined with the external intervention of some help or support elements. The factors I will consider in this analysis are *age, gender, nutrition and hydration, heat, cold*.

One of the first factors I address is *age*. We all admit that getting older leads to negative, sometimes irreversible, changes in physical effort and functional physiological possibilities, and daily tasks become increasingly difficult. We will all experience the negative impact of age on the locomotor activity (for example, on movement constancy, the speed of movement, the speed with which we perform different movements, the biomechanics of movement) or on our ability to lift weights and work with them. Moreover, muscular strength and endurance are two extremely important motor qualities for military actions, which may limit the operational physical performance of the servicemen.

In terms of stamina, Jansen et al., in the "Skeletal muscle mass and distribution in 468 men and women aged 18 - 88 yr" study, indicated that the muscular strength is maximum in the age range 20-30 years, and this decreases with values between 10-15% of the muscular mass of the whole body, between

of the human body can be found in the diminution of the "muscle mass, the area of the muscular cross-section, the composition of the type of muscle fiber (nn – the human musculature is composed of two types of fibers, either white or red), to the reduced number of capillaries, changes in innervation and neural conduction, protein content in myofibrils"².

In terms of resistance, a capacity of the body with an essential role in supporting the carrying out of combat actions for long periods of time, it supports decay rates with values between 5% and 20% per decade, starting from the age of 25 years. These differences in values are due primarily to the level of physical activity performed (either centralized or in free time), lifestyle, genetic inheritance but also possible medical causes that have occurred throughout life.

The second factor to which my attention is directed is the *gender* of those who take part in missions, given the lack of discrimination between men and women. In the case of this factor also, the physical performance for the military environment must be approached differently and analyzed from the point of view of muscular strength and endurance, both for men and women.



The impact of gender on the muscular strength is evident mainly due to the structure and composition of the body. It is acknowledged that there is a difference in muscle mass between women and men, with women having about 60% of men's muscle mass, but also a higher amount of adipose tissue than men. It should also be borne in mind that "women are 40 to 60% weaker in the upper body and about 25-30% lower in the body than men"³. These differences can be found, from the point of view of the various motor skills that a military man performs or usual military tasks, in a deficit or even the impossibility of transporting military materials and equipment, in the absence of the physical possibilities of rescuing injured comrades. Leyk et al. showed in the study „Recovery of hand grip strength and hand steadiness after exhausting manual stretcher carriage" that out of a total of 2.000 men and women, approximately the same age, at the handgrip test, 90% of women developed a maximum hand strength, in a proportion of 95% lower than of men, even if the force can be developed equally on the muscular unit in men and women.

Considering the resistance and due to the same structures and composition of the human body, the major differences tend to be to the disadvantage of women, being found in the "highest percentage of body fat among women" (nn – it means adding an additional task for the effort); in lower blood volumes and hemoglobin levels leading to increased heart rate compared to submaximal workloads; in the size of the hearts that are smaller in women (again, the heart rate increases – additional matter)⁴. The combination of the smaller heart size, blood volume and hemoglobin level leads to a reduction in maximal oxygen uptake, which supports physical exertion. With all these elements leading to a definite conclusion, women's endurance capacity cannot be neglected, knowing that thorough training and lifestyle can offset these disadvantages, military women can make efforts comparable to those of men.

The conduct of military actions is based on the accomplishment of a common and individual effort of the servicemen, both psychically and physically. The physical and mental support for the servicemen during effort, is provided by *nutrition and hydration*, the third factor addressed by me. Physical effort, assuming energy expenditure,

is possible through the supply of nutritional and energy substances. This fact is possible as a result of the nutritional process.

Nutrition⁵ can be introduced in the category of factors with positive or negative influence on the performance of the missions: positive because it stimulates and supports the physical and mental effort, implicitly the military performance; negative, due to the impossibility of energy support in achieving an effective physical effort. The quality and quantity of the food at hand, the feeding of the servicemen in a rational manner, according to the mission to be fulfilled, contributes to the fulfillment of the tasks set out. Also, due to lack of food or, on the contrary, overeating, the military will reach a state of energy and nutritional insufficiency or obesity, elements that will ultimately materialize in the occurrence of harmful effects on the body. The lack of energy support can be caused by reduced time for food consumption, insufficient amount of food and water, reduced appetite due to stress factors.

The energy costs of the military participating in the training are higher than of the civilians, a fact demonstrated by the study "Energy requirements of military personnel"⁶, according to which the need and energy consumption of the military was between 2.300-7.100 kcal, the average being 4.620 kcal. According to this study, the energy consumption of the military in the operational units is about 20% higher than that of the support units.

At the same time, it is shown that these energy expenditures are higher in some areas of the field, in the days with activities planned throughout the 24 hours, depending on the duration of the missions and their intensity.

Food deficiency for a short period of time can lead to muscle pain, reduced muscle strength, lack of proper recovery, and weakness⁷. The insufficient quantity of food has as an immediate consequence the drastic decrease of the possibilities of achieving an aerobic effort, due to the lack of nutritional and energetic resources, but also the reduction of the mental and cognitive performances and capacities. In the long run, the lack of food, obviously, is found in the reduction of the total muscular strength, of the aerobic and anaerobic resistance, fact demonstrated by the study "Nutritional and immunological assessment of Ranger students with increased caloric intake"⁸.



These elements lead to the awareness of the importance of the food of the military and their performance, the energy balance being a requirement between the demands to which they can be exposed and what they are offered. "A strategy for the health and performance of the military starts from the availability of food, their consumption and a correct diet, related to the effort they make"⁹.

Next to food is an essential element of our survival, an element without which life on earth would not be possible: water. This is vital in everything we do, including in the conduct of military action. It is known that without nutritional and energetic contribution, people can survive even 30 days, while without fluid consumption, the survival time is very short, only a few days. In the absence of water, performance is greatly diminished, being the element for which there are no alternatives. The 3% reduction in the amount of water in the body substantially reduces physical and cognitive performance, leading to the emergence of thermal stress¹⁰, an element that materializes in the overheating of the human body, this being the cause of diseases and in some situations, even death.

During the preparation and carrying out of the missions, water is the main source of hydration and has as an important purpose the replacement of the electrolytes lost due to the physical effort made: magnesium, potassium, sodium, calcium. Dehydration requires water consumption to restore the body's acid-base balance, but the effects of water and the rehydration process can be enhanced, accentuated and not replaced, by artificially enriched liquids or naturally with electrolytes. These liquids can be a fast source of energy, when the quantity of food is reduced and it is desired to obtain a rapid energy boost, in a special way, during the missions of long duration, idea demonstrated by Montain and Young (2003), in the study "Diet and physical performance. Appetite"¹¹.

The water consumption during the military actions is different, this characteristic being given by the environmental conditions. If a natural environment with high temperatures does not require and does not substantially influence the consumption of food, then that of water yes. High temperatures cause abundant sweating, which is a major waste of water in the body.

Also, the cold and the low temperatures, are causes for the increase of the nutritional and energetic expenses by approximately 30%, value indicated by Hoyt and his collaborators, in the study "Energy balance and thermal status during a 10-day cold weather US Marine Corps Infantry Officer Course field exercise"¹². Dehydration can also occur when temperatures are low, due to the lack of water sources, frozen foods that contain less water than those in the basal state, inadequate clothing or even breathing.

The supply of water, regardless of whether the missions take place in cold or hot areas, can be achieved either by the water transport or by the improvisation of some means of procuring and capturing the water. If the missions are carried out in snowy areas, the supply of water will not be a problem but it is required, as for the source of water captured with improvised means, means of filtration and treatment against pathogenic factors.

If we look at the missions carried out by the Romanian Army in recent years, in the theaters of operations, we can see that the servicemen must carry out actions, inevitably, in environment conditions that are often completely unfriendly. Actually, these traits of the environmental conditions are enhanced by the heat and the cold, the following factors that I am going to talk about and that can influence the physical performance of the military.

Carrying out missions for a longer period of time, in the absence of temperature control of the temperature of the military body "can cause symptoms of exhaustion, fatigue, weakness, dizziness, confusion and fainting"¹³, which, together with their other physiological deficiencies, can lead to serious or serious illnesses or death.

The air temperature that creates thermal comfort for people is between 22° and 25°. In this interval, the activities carried out by people are carried out in the best conditions, without the heat factor influencing their cognitive and/or physical performances. Moreover, the thermal stress is conditioned by "outdoor temperature, air movement, relative humidity of air, average radiant temperature, metabolic temperature and clothing (through its insulation and impermeability effect)"¹⁴.

Warming the body negatively influences the cognitive performance directly proportionally

to the increase of the temperature. The logical reasoning can be kept for a period of "2 hours at 29.5° Celsius; whereas at 42° Celsius, cognitive performance remains acceptable for up to an hour"¹⁵. The monotony and repetitive nature of the activities are elements that contribute to the faster installation of the negative effects of heat on the human psyche.

Another negative effect of heat on the servicemen is found in the diminution of psychomotor performance (coordination, balance, dexterity, etc.). Psychomotor skills are diminished to "temperatures above 30° Celsius, the maximum exposure limit without affecting performance is 32° Celsius, regardless of the duration of the task"¹⁶. Moreover, "exposure to an ambient temperature of 32°-35° Celsius, for 6 hours, determines a symptomatology characterized by weakness, dizziness, restlessness, irritability, loss of appetite, nausea and vomiting (...) with negative physiological effects and psychological important"¹⁷.

Opposite to heat is cold, the other temperature factor that affects the physical performance of the military. Cold, often disregarded, by its two elements, hypothermia and frostbite, is one of the important risk factors for the military participating in training and missions, in areas with low temperatures permanently or in winter

conditions. Moreover, „the risk of frostbite is low at temperatures of -10° Celsius, the risk at -20° Celsius is considerable and pronounced at -25° Celsius"¹⁸.

„Frostbite is manifested by the inflammation of the affected areas, the creation of an extremely painful point, and in the situation of the external intervention to prevent the action of the cold, the place can become bruised and can lead to the loss of function and even of the respective segment. The spread of the infection and the lack of proper treatment can also cause death"¹⁹.

Particular attention should also be paid to exposure time and wind. This is an aggravating factor of thermal perception, in other words, at an air temperature of 0° Celsius and a wind speed of 15 km/hour, the temperature felt is -4° Celsius. Disregarding them creates premises for frostbite.

Hypothermia (abnormal drop in body temperature) occurs if the body is submerged in very cold water, in the absence of equipment that provides the combined thermal comfort with exposure to low or negative temperatures for a longer period of time. The installation of hypothermia has uncontrollable tremor effects, central nervous system dysfunction, lethargy, confusion, hallucinations, irritability and even coma (Table no. 2). It can lead to death as a result of reduced respiratory rate and heartbeat until

Table no. 2

STAGES AND SYMPTOMS OF HYPOTHERMIA²⁰

Stage	Body temperature	Clinical symptoms	Intervention
Compensated	36°C	Intensification of metabolism, to balance heat loss (slight tremor).	Common measures for thermal protection.
Easy	34°C -36°C	Accentuated tremor, varied individual symptoms.	Local warming of the extremities, hot drinks, light exercise.
Moderate	32°C -34°C	Paroxysmal tremor, various individual reactions.	Warming of the body, hot liquids (if the individual is aware and can swallow); alcohol is excluded.
Severe	28°C -32°C	State of confusion, progressive obnoxiousness of consciousness, disappearance of tremor, increased muscular rigidity, decreased heart and respiratory rate, cardiac arrhythmia, ventricular fibrillation.	Imminent lethal danger, specialized medical help is required, careful manipulation of the victim, no sources of aggressive heating are used, a possible refusal of help from the victim is ignored.
Critical	sub 28°C	Apparent death, accentuated heart rhythm disorders, spontaneous ventricular fibrillation, pulmonary edema.	Emergency specialized medical help (the survival temperature can, in rare cases, go as low as 18 degrees Celsius).



stopping. During the mission, under such conditions, the military equipment must provide them with thermal comfort and, at the same time, provide the possibility of movement, to ensure the thermal transfer from the body to the outside in order to avoid overheating of the body.

Conclusions

The human body is not an inexhaustible resource of energy, it is an actual consumer of physical and mental matter. Its performance is determined by this ratio, between demand and supply, between the requests to which it is exposed and what comes to support the compensation and support of the physical, intellectual and mental effort. However, it is not enough just to create a positive balance, but also to focus on all the parameters and factors that condition the success of a mission.

The carrying out of military operations, for long periods of time, with different intensities of physical and mental effort, has a direct impact in many situations, negatively, on the operational physical performances of the military. Creating appropriate strategies is an essential factual situation in order to reduce the negative effect of these factors on the military body, in which the forecasting of the conditions for carrying out the missions is a central element in the planning and training of the servicemen. Moreover, including in military training programs, training sequences in the field of military physical education that can combat some of the negative effects of the tackled factors, is a viable solution for supporting the actions of the servicemen during missions.

NOTES:

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4 RTO-TR-HFM-080, NATO, *Optimizing Operational Physical Fitness*, Research and technology organisation, 2009, pp. 7-10

5 DEX, *NUTRITION, nutritions*, s. f. All the physiological processes by which the organisms provide the nourishment necessary for growth and development, obtaining the energy to carry out the vital processes, the restoration of the tissues, etc.

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15 R.F. Johnson & J.L. Kobrick, *Psychological Aspects of Military Performance in Hot Environments*, in D.E. Lounsbury, R.F. Bellamy & R. Zajchuk (eds.), *Medical Aspects of Harsh Environments* (vol. 1), Office of The Surgeon General Department of the Army, United States of America, 2002 apud M. Popa, *Psihologie militară*, Polirom Publishing House, Iași, 2012, p. 40.

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