



WARM-UP BEFORE PHYSICAL EFFORT – ITS NEED AND IMPORTANCE IN THE ACTIVITY OF MILITARY PHYSICAL TRAINING

Col.Adv.Instr. Alin PELMUȘ, PhD*

After defining and presenting the types of warm-up, the article highlights the need and importance of performing such an action effectively before carrying out any type of physical effort and especially that specific to military activity. Throughout the article, it is emphasized that a well-planned warm-up, with a relevant content and in harmony with the specific objectives of the training or sports competition, substantially reduces the risk of injury and clearly improves motor performance. Also, the article includes in its final part a warm-up protocol that can be used successfully in the area of military physical training, in which military instructors have the opportunity to develop diversified physical exercises, beneficial for achieving superior performance.

Keywords: warm-up; physical effort; training; musculature; blood flow; breathing; temperature; performance.

Warm-up, in the opinion of some specialists, represents the transition from rest to effort, and others understand this action as the totality of the measures that lead to the installation before effort of an optimal state of sensory and kinesthetic psycho-physical training.

Physiologist Jurgen Weineck stated in 1998 that "By warm-up we mean all the measures that allow obtaining an optimal state of physical and mental preparation before a training or a competition. Warm-up plays an important role in preventing injuries"¹.

So, the purpose of warm-up is represented by the installation of better initial conditions for the manifestation of the neuro-muscular performance capacity, of the organic and psycho-intellectual functions, of a better mental disposition and of the prevention of accidents. Thus, by warming up the body for effort, the coordination between the respiratory, circulatory, locomotor systems and the central nervous system is intensified. As in any activity that requires physical effort and before the military physical education lesson or session or sports training, as well as before sports and military-application competitions, the body must be prepared in order to raise the functional level of large somatic and vegetative systems.

Therefore, for the transition from the state of rest to that of intense physical effort, the body

needs a certain time of adaptation, so that at the moment of effective entry into the effort stance, it is at an optimal capacity for functioning. From this point of view, the importance and need for warm-up before exercise is unanimously recognized, as it aims to increase circulation and respiration in muscles, tendons and the nervous system.

As it is well known, any physical training session consists of three parts: the warm-up, the actual training or the fundamental part (with general and specific objectives depending on the established purpose) and the recovery of the body after the effort. The warm-up is of major importance because, if it is not performed efficiently, the fundamental part of the training cannot be performed at maximum capacity, which leads to the non-fulfillment of the set objectives.

In the literature in the field, we find several types of warm-up that are performed before engaging in physical effort. They may be characterized as follows:

- active – in which motor acts and actions are performed before the physical education lesson/sports training session or individual physical training and before the sports competition;

- passive – it completes the active warm-up with hot showers, massages, ultraviolet exposure, the application of ointments, all with the role of producing vasodilation, so peripheral skin heating;

- mental – a form of training in which participants imagine (through representations) the set of exercises they have to perform, which helps

*"Carol I" National Defence University"

e-mail: pelmusalin@yahoo.com

the psyche to adjust to the intense activity that follows;

- mixed – the combination of the three forms mentioned. This is actually very effective in sports, being used with optimal results in gymnastics, swimming, athletics, sports with a certain applicability in the army. In the practice of performance sports there have been attempts to supplement active warm-up by using external heat sources (passive warm-up), but these procedures have proven to be ineffective. Also, from the specialized studies performed it became clear that the active warm-up increases the circulatory flow in the muscles 6 times more intensely as compared to rest, while the different forms of massage increase it 1.5 - 2.5 times, depending on the procedure. Certainly, only through active or mixed warm-up can good muscle training be achieved, simultaneously with the improvement of superior nervous activity.

Depending on the purpose, the specialists consider that the warm-up can be:

- general warm-up – which aims to bring the body to a higher functional potential through exercises that produce the warming of a large muscle mass;

- specific warm-up – which is performed through exercises that produce the warming-up that prepares the body for the execution of specific actions and redirecting the blood to the muscles that will come into action².

In this sense, we can state that for a good preparation of the body for effort, a general warm-up should be performed that includes active exercises (walking and running variants, stretching and relaxation exercises) followed by the sports discipline specific warm-up for which we prepare during the session or that we have to practice during the sports competition.

General warm-up. The effects of general warm-up on the body are manifested by: increased central temperature (internal organs and brain) and peripheral (extremities, muscles, skin), as well as increased circulation and breathing (preparation of the cardio-respiratory system). At an optimal temperature, all physiological biochemical reactions take place faster and with increased efficiency. Studies conducted so far show that each increase in body temperature by 1 degree Celsius intensifies metabolic processes by about 13%, this

increase in metabolic rate being very important even since the warm-up period (for example, this physiological indicator increases, compared to rest, 20 times in a cross-country race and 200 times during a sprint race).

As mentioned, in the sport training session, in the physical training lesson or in sports competitions, warm-up aims to stimulate and accelerate circulatory and respiratory functions, so that, at the beginning of the projected effort, to ensure a high absorption capacity oxygen, which corresponds to the adaptation to the type of effort. It is known that cardiac and respiratory flow are essential parameters in any effort, but especially in endurance, which we find in many military activities.

The main condition for increasing the speed of blood circulation in physical effort is the intensification of cardiac function. At rest, the heart has a flow rate of 4-6 liters/minute of blood. During the warm-up, the amount of blood sent by the heart in the unit of time must be doubled, so that, in the intense efforts of athletes, the cardiac output can reach values of 35 liters/minute. The cardiac output depends, in turn, on the activity of the entire vascular system, on the function of the muscle pump, on the aspiration function of the thorax etc. In order for the circulatory system to be mobilized to the necessary extent, it takes at least 3-5 minutes of sustained physical activity. Simultaneously with the acceleration of blood circulation, during the performance of physical exercises there is an intensification of respiratory function. The value of pulmonary ventilation can increase during physical exertion 10-15 times, changing the frequency and amplitude. Thus, considering the fact that the respiratory flow while resting is 8 liters/minute, we estimate that in medium intensity efforts it is 30-40 l/min, and at high and very high efforts it can reach 100-150 liters/minute, even 200 liters/minute (supramaximal effort)³.

As such, by warming up the cardio-respiratory system, the following reactions occur in the human body:

- the adaptation time to the effort to be made is reduced;
- the stable state is reached after 4-5 minutes;
- cardiac output and respiratory rate increase, especially in endurance effort;



- it facilitates the transport and use of oxygen in the blood by the muscles involved in the effort and not only;

- the maximum oxygen volume (VO_{2max} = oxygen consumption expressed in milliliters/kilogram body/minute) reaches after 3 minutes an approximate value of 3 liters for non-trained and 6 liters for trained people;

- the artery-venous difference decreases by better oxygen extraction, and the venous blood is poorer in oxygen, a beneficial reaction for the body;

- it helps to eliminate, overcome the "deadlock" during the effort.

Warm-up is not only intended to intensify the circulation and breathing beforehand, but also to warm the musculoskeletal system. Regarding the locomotor system, warm-up reduces the risk of accidents (ruptures, cracks). The joints better support the load from the effort due to the fact that the high temperature amplifies the production of synovial fluid. Thus, the articular cartilage has better nutritional conditions, thickens and better absorbs pressure forces. Also, the increase of the intra-muscular temperature contributes to a better irrigation with blood, by opening the capillaries and, therefore, to a better nutrition and oxygenation of the muscles, as well as an activation of the anaerobic enzymes involved in the energetic-genetic processes.

Classical physiology held that raising the temperature of the muscle was enough to increase athletic performance. Subsequently, it was demonstrated experimentally that a stay of 20 minutes in the sauna before exercise has only a minor effect on efficiency, compared to increasing the results by 4-6%, in the case of warm-up by running. According to "van'T Hoff's law", the speed of chemical reactions in a given system increases in parallel with the increase of the system temperature, with every 10 degrees Celsius, the speed of these reactions accelerates 2.7 times. In the body, the increase in temperature after exertion is only 1.02 degrees Celsius, but enough to accelerate by 30-50% the speed of biochemical reactions. On the other hand, a warming muscle is more excitable and therefore contracts and relaxes faster. During this time, warm-up largely removes the possibility of muscle fibers breaking, an accident known in sports as "clacking"⁴.

To stimulate and maintain warming, an important contribution is made by the use of adequate equipment, which certainly influences it. Adequate equipment helps to reduce time of the body to adapt to exercise. Given that the normal body temperature at rest is 36,5 degrees Celsius and that at this temperature all metabolic functions are optimally regulated, it is necessary to specify that the intramuscular temperature, especially of the muscles at extremities, is lower by 2-5 degrees Celsius or more. This lower muscle temperature can be partially avoided with the help of the equipment, but not completely. The preparation of the body for effort executed in adequate equipment, consisting of a special material specific to the sport, favors the increase of heat production that levels the temperature differences. In this way, after warming up, the temperature of the muscles increases, allowing the execution of movements with high amplitude and speed. At the same time, the chemical processes at the muscular level are influenced, which contributes to the activation of the fermentative processes, which, in turn, influence the speed and duration of the chemical reactions necessary for the muscular contractions. Raising the temperature of the muscles creates favorable conditions for the release of oxygen by hemoglobin and its faster passage to the tissues.

Raising the temperature has a favorable influence on the athlete's body, contributing to thermoregulation. Maintaining a good functioning of the nerve centers is possible only when the body temperature rises, by warming, to an optimal level, but without reaching values that are too high. In this respect, consequently, during the warm-up, the intensity and volume of the exercises used should not be exaggerated. If, in advance, there was no warm-up and the effort was made directly, the heat dissipation would remain after its production, because perspiration appears, in this case, after a certain time from the beginning of the effort, which represents an imbalance between heat production and release and is unfavorable to the athlete's performance. By warming, perspiration occurs, which demonstrates that the thermolysis mechanism has been set in motion and, therefore, the thermal equilibrium is in a dynamic state, being able to intervene more promptly when a thermal homeostasis disorder occurs.⁵

Warm-up gradually prepares the central nervous system (CNS) for the transition from rest to the state of maximum excitability, which is accompanied by a higher level of activity of all organs and systems. Through the whole complex of excitation types it triggers, especially the kinesthetic excitations, the warm-up produces a state of mental relief, and by metabolizing appreciable amounts of andrenergic catecholamines (adrenaline and noradrenaline), which are metabolized during specific exercises, athletes partially relieve nervous tension and irritability on the day of the competition (decreases mental tension in the starting state).

It also increases the reaction rate of the effectors by a percentage of about 20% and activates the reticulated bulb-pontine formation with a role in maintaining alertness, increased attention, good coordination and accuracy. Consequently, warm-up also stimulates the psychological processes that create within the performer a greater desire to work.

Specific warm-up. The specific warm-up mechanisms in training follow the general warm-up and must prepare the participant for the execution of the main exercises in the lesson or competition. In specific warm-up, more than in general warm-up, it is especially important to raise the local muscle temperature which happens late, even if the central temperature is high. Only a specific warm-up can ensure an optimal blood flow in the muscles that perform the fine movement, that of coordination. However, specific warm-up is not only the creation of the necessary condition for good coordination, but also an amplitude of metabolic processes in somatic and vegetative effectors, through a better

of the body for effort) and 3rd sequences (selective influence/analytical processing of the musculoskeletal system) of the 7 or 8 sequences, depending on the structure of the lesson.

Preparing the body for effort, which lasts 5-7 minutes (for a 50-minute lesson) or 7-8 minutes (for a 100-minute lesson), has as objectives: the gradual stimulation of the major functions of the body; ensuring a state of excitability appropriate for the following activity; educating spatial-temporal perceptions. Its content is represented by: front and formation exercises; walking and running variants; movement games. *The selective influence/analytical processing of the musculoskeletal system* with a duration of 6-7 minutes (50-minute lesson) or 10-12 minutes (100-minute lesson) has as objectives: increased segmental muscle tonicity and trophicity; education of global or partial body attitude; preventing or correcting certain physical attitudes or deficiencies. Its content is represented by exercises – grouped in series – free, with a partner, with objects, executed simultaneously or at own pace⁶.

Regarding the sports training sessions and sports and military-applicative competitions, the warm-up is usually carried out, following certain clichés specific to the respective sports branch.

Irrespective of the type of physical activity, the effectiveness of warm-up depends on the following factors: age; training state (for beginners a soft warm-up is recommended); time of day (in the morning warm-up will be longer than in the evening); the specifics of the effort; ambient temperature.



redistribution of blood to the muscles involved in the effort that will follow. On the other hand, it activates the sensory part through specific motor centers and areas, increases nerve conductivity and beats the nervous ways as traces of specific warming.

Specific warm-up works according to the following basic principle:

Regarding the military physical education lesson, the warm-up is placed in the 2nd (preparation

In my opinion, in any military physical training session, the warm-up of the body should last between 15 and 35 minutes, depending on the duration of the session and the objectives set. It is imperative to keep in mind that the optimal interval between warm-up and effort is 5-10 minutes, even if the warming effect persists between 20 and 30 minutes and that, after 40 minutes, the functional and metabolic values return to the level of rest period.



In addition to the classic sports branches, in the army, the physical training and sports activities have a certain specificity, depending on the topic approached, namely: varied terrain running and forced marching with the armament and equipment; close fighting; obstacle course crossing; long-distance patrols on foot or on skis during which shootings are performed with infantry weapons, throwing grenades, passing contaminated districts wearing the gas-mask on the face; applicative-military swimming (with the equipment and armament provided) etc. These are just a few examples, but each military branch has its own peculiarities regarding physical effort, which leads us to the conclusion that warm-up plays a very important role in these activities, even if every military is trained to be "ready for action" at any time, without prior time for warm-up. However, on the basis of general aspects of the effort specific to physical training and sports in the army, we can specify that blood circulation and breathing are the main task of warm-up. In contrast, most military physical actions require the coordination of neuromuscular activity, which means that warm-up cannot be effective without repeated execution of the specific movements of that action.

In this context, I consider that in many of the military physical activities, which require the use of many motor skills in the same activity, such as walking on rough terrain, running in various terrain (speed or endurance), sliding on snow/ice, jumping (length, height, depth), throwing, shooting, crawling, climbing, you can follow a warm-up model similar to that developed by *Ian Jeffreys*⁷ (RAMP warm-up protocol).

The acronym "RAMP" means: Raise – increase in muscle temperature, blood flow, muscle elasticity and neuronal activation; Activate – activation of the muscles in preparation for the next session (fundamental part of the session/sports competition); Mobilize focus on the types of movements that will be used during the activity; Potentiate – gradual increase of stress on the body in order to prepare the sports competition/fundamental part of the training session⁸.

I would say that in the military it is necessary to use such a prototype warm-up program in order to meet the four directions/phases mentioned that serve to improve performance and reduce or prevent injuries. Thus, a warm-up that is based only

on a slow run, followed by a few static stretches, should not be a habit in the activity of military instructors, but on the contrary, given the multitude of information available today, it is necessary to use modern means in order to meet the desired objectives.

Therefore, *in the first phase (raise)* two types of protocols are used, namely movement development protocols (exercises are performed from the running school and the jumping school, aiming at the progressive increase of the execution speed) and skills development protocols (which involves performing at low intensity the motor skills specific to the fundamental part of the training or sports competition (these may increase over time and must be correlated with the objectives of the activity)). *In the second phase (activation and mobilization)*, practically the muscle groups are activated and the joints are mobilized, taking into account the movements and the fundamental requirements imposed by the activity (sports) to be carried out. In this phase, instructors are encouraged to develop numerous exercises that activate and mobilize key muscles and joints through intervals of movement, useful means in establishing a variable workout, in eliminating monotony and improving performance (muscle stretching exercises, mostly dynamic stretching; balance, moving from different gymnastics positions to positions that will be adopted in the next activity, different types of squats and push-ups, joint mobility exercises, especially spine mobility - flexion, extension, bending, rotating, etc. Depending on the objectives of the following activity, these exercises can be performed using your own body weight, with a partner or with auxiliary objects that make the movements difficult – elastic bands, light dumbbells, sticks, weapons and some military equipment, etc.). *The third phase (potentiate or performance)* is based on exercises performed in order to effectively lead the participants to improve performance in the fundamental part of the training session or in the sports competition. Developed using the principle of post-activation potentiation, this warm-up phase transits unidentifiably into training/sports competitions, which means that it begins to incorporate acts and motor actions specific to that activity using increasing intensities. The main objectives of this phase are both the use of an intensity of effort at a level comparable to that



in which participants are about to evolve, and the improvement of subsequent performance through the effects of post-activation potentiation⁹.

In conclusion, warm-up before any physical effort is absolutely necessary and of overwhelming importance. A carefully planned warm-up, with a content designed in accordance with the objectives of the training or sports competition, reduces the occurrence of injuries and improves motor performance.

NOTES:

1 <https://www.csid.ro/diet-sport/sport/de-ce-este-importanta-incalzirea-inainte-de-sport>, accessed on 23.10.2020.

2 <https://www.fitness-scandinavia.ro/blog-post/incalzirea-warm-up-si-rolul-acesteia>, accessed on 23.10.2020.

3 <http://www.sfatulmedicului.ro/Sanatate-prin-sport/necesitatea-si-importanta-incalzirii>, accessed on 24.10.2020.

4 <http://www.sfatulmedicului.ro/Sanatate-prin-sport/necesitatea-si-importanta-incalzirii>, accessed on 25.10.2020.

5 *Ibidem*.

6 *Regulamentul educației fizice militare*, Technical-Editorial Center of the Army Publishing House, Bucharest, 2013, p. 17.

7 Senior Lecturer PhD Ian Jeffreys/Faculty of Life Sciences and Education/UK is an internationally renowned British trainer, educator and writer, considered an expert in

the development of speed, agility, and shaping up for team sports. He elaborated a unique system (Gamespeed) for speed development and his warm-up protocols (RAMP) were adopted by a large range of trainers and organizations, <http://staff.southwales.ac.uk/users/1162-ijeffrey>, accessed on 29.10.2020.

8 <https://humankinetics.me/2019/03/04/what-is-the-ramp-warm-up>, accessed on 29.10.2020.

9 <https://www.scienceforsport.com/warm-ups>, accessed on 31.10.2020.

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