Health of Healthy People. Historical Heritage of Academician N. M. Amosov Concerning the Issues of Nutritional and Physical Training and Detraining of an Organism

Olga Ivanovna Ustinova

Medical Institute “REAVIZ”, Chapaevskaya str. 227, 443001, Samara, Russian Federation

Abstract: The academician Nikolay Mikhailovich Amosov (1913 - 2002) studied the methods of overcoming people's detraining in order to strengthen their health and extension of their life. Strong irritants (hard circumstances) train organism's functions increasing the reserve capacity. Weak irritants (easy circumstances) detrain them. Prevention of diseases is not just protection from harm, but also functions training. In order to become healthy, one needs to make his own regular and considerable efforts. It is important for the loading not to exceed the organism's capability (overtraining); detraining is also dangerous for health. If we train a certain integral function, on which the state of the whole organism depends, the results of training influence all particular functions. N. M. Amosov identified such generalizing function - it is physical work supported by respiratory control, cold training and restriction in food while keeping it balanced.

Key words: N. M. Amosov · Health · Detraining · Training · Cold training · Restriction in food

INTRODUCTION

N. M. Amosov (1913 - 2002) - academician, cardiologist surgeon, cybernetic researcher; he was a Member of the Board of the International Association of Surgeons, the International Society of Cardiovascular Surgeons, the International Society of Medical Cybernetics; the author of over 400 scientific publications, 19 monographs, works on gerontology, problems of artificial intelligence. Through his personal example, he promoted and stated healthy living. All his life was the evidence of importance of using the training for improving the organism's abilities and prolongation of life. This topic is timely for the modern world, which is evidenced by the research of many scientists [1-8]. Despite having bad heredity, congenital heart disease and several necessary heart surgeries, N.M. Amosov demonstrated great performance capabilities. His achievements, long active life (he continued making surgeries until he was 79 and he died at the age of 89) and selfless devotion in the sphere of maintaining and strengthening health, are worth the most careful study.

Body of the Work: The human is a self-regulating system, which is the second complex one after society and it is difficult to influence on it with a purpose [9]. He is integrated in the society with the opportunity to live and work. And he requires health for this. Health is the fulfillment of normal physiological programs by the self-regulating system of the organism; disease is its unstable performance, which occurs as a result of external affects or defects of own programs. Organism gets disturbed from and returns to equilibrium according to a certain program. Disease program is the order of changing normal programs under the influence of a pathological irritant. Depending on its intensity, a program of recovery is initiated by the organism, which consists of sequentially activated programs: 1. the compensation program (usage of existing standards of the organism reserves); 2. the adaptation program (ability to restructure when reserves are exhausted); 3. the active defense program (additional reserves are initiated when adaptation is not possible any more - it is the transition to disease). Each of these elements can be strengthened by training. N. M. Amosov identified six levels of regulation systems in the organism [10] - from the chemical non-particular one to the central
nervous system and reticular formation. These systems ensure maintaining stability of the internal environment. The range, the flexibility and the reliability of regulation are ensured by reserves. The factor of organism's reserves is strengthened by training. N.M. Amosov raised the issue of creation of a science about mechanisms of disease and health [11]; he offered to strengthen health not with medicines, but with activity; considered the mechanisms of training and detraining of operating protein structures, which are universal for all types of cells. When the external irritant becomes weaker, the function also decreases and the demand for synthesis of new protein molecules, which ensure this function, reduces. The mass of protein, which has been generated earlier when the function was more intensive, decays at the same rate. Decay goes ahead of synthesis, thus atrophy occurs; the function's capabilities decrease; organs cannot resist the increased power of the irritant as they do not have sufficient reserves. This is the mechanism of disease development because of detraining. Training means reverse processes: the better the training is, the higher is the value of the function (Figure 1). With different levels of training of the structure (low, medium, or high) and depending on the irritant's intensity, N.M. Amosov distinguished three modes of cells' operation: 1. the normal mode - stable, not restricted in time and which ensures medium intensity of activity; 2. the forced mode (initiated by emotions and hormones) - the intensity of the irritant is high and the energy reserves are rapidly consumed; 3. the pathological mode - the reserves have exhausted and as the intensity of the irritant increases, the function goes down - it means a disease. Training is most efficient if the intensity of the irritant is at the level when the function value reaches the margin of the forced mode. Strong external irritant brings a detrained cell to the pathological mode, i.e. to a disease. For a trained cell, it is normal intensive operation (Figure 1).

In order to prevent a cell from disease, it must be normally provided with energetic and building materials and periodically receive training irritants from outside. Considering the capabilities of maintaining normal regulation of an organism, N.M. Amosov concluded that the main causes of human diseases are neither the external environment, nor the society, nor the weakness of human nature, but overeating, physical detraining, mental overstresses and lack of cold training (p. 59). The important points for increasing the training are: 1 - gradual approach; 2 - multiple repetitions; 3 - control of the maximum loading; 4 - exercises for endurance and for maximum loading; 5 - overtraining is dangerous, as the ability of a cell to training is not unlimited. The main method of increasing the total reserve capacity is exercises targeting improvement of reserves of the cardiovascular and respiratory systems (gas exchange subsystems) and for maintaining the function of muscles and joints. “Standard healing gymnastics does not provide required loading and, therefore, it is not efficient” (p. 120). Nutrition must be functional and training (sufficient, but limited). In [12], N.M. Amosov said: “Every direction has its own spheres. For medicines - it is diseases, for physical culture and restriction in food - it is health. When you got ill, you need treatment, when you have recovered - you need training (p. 163). In [13], it is said about increasing the reserve capabilities of the cardiovascular system by training during different age periods. The importance of regulation of the processes of fatigue and recovery is also notable. Fatigue initiates recovery processes in the operating organs - it must be striven for. Training loading must not exceed the organism's capability, as full recovery is impossible then (overtraining). During training, all organs and tissues are trained; the viability of the organism is improved. Neuro-reflex and humoral mechanisms ensure comprehensive nature of the influence. With aging, it is necessary to restrict the intensity of recreational training and use submaximal modes. Training is a universal means of supporting health, longevity, prevention of diseases, improvement of organism's functions [14]. “The law of gain in weight at loaded function (the law of training and operational hypertrophy) is universal - it concerns any
tissues” (p. 155). At that, functional reserves increase (reserve capacity), which are determined as “ratio of maximum function in a forced mode to its average value, which corresponds to daily external irritants” (p. 157). Strong irritants (hard circumstances) train functions and the weak ones (easy circumstances) detrain them. N.M. Amosov calls the sources of organ pathology: 1. genetic weakness (congenital reduction of adaptive properties); 2. affect of external hazards; 3. detraining of organs; 4. “wear of matrices and accumulation of disturbances” as a result of aging, diseases, or long-running excessive functioning; 5. disturbance of the stability of the internal environment - it is a consequence of effect of the four previous factors. Restoring an organism from pathology is eased with improved adaptive capabilities. They need to be trained. [15] addresses the issues of physiology of physical exertion, the role of physical activity in prevention of cardiovascular system diseases, loading tests for assessment of its functional state, training programs for prevention and rehabilitation of diseases. “Survivability of physical exertion reflects the functional state of an organism and, first of all, the state of the cardiovascular and respiratory systems” (p. 9). At maximum dynamic loading, the oxygen debt and physiological hypercopia increase. They serve stimulus for maintaining lung ventilation at a high rate. Oxygen consumption value is the index of the level of exchange processes (metabolism) in an organism; it can increase by more than 50 times. At that, the activity of functions of all organs increases rapidly, the heart contraction rate grows slightly reducing the systolic discharge. At a rhythmic physical activity, the systolic arterial tension increases and after 1 or 2 minutes sets at a stable level, which depends on the loading intensity. After the work has ended, it goes down below the initial level. Diastolic arterial tension does not change. Vascular resistance in the contracting muscles considerably reduces due to the increase of blood circulation and the diameter of vessels, which results in considerable decrease of the peripheral pressure. A strong need in tissue respiration occurs: the concentration of hemoglobin in blood increases, extra erythrocytes are brought into the blood stream from the repository, which provides the required volume of oxygen content in blood. “Oxygen consumption is the aggregate indicator, which reflects the functional state of the cardiovascular and respiratory systems” (p. 24). For example, training improves the adaptive capabilities of the organism. In the battery of cardiologic studies, loading tests, such as squats, tests with steps, etc. start holding a prominent place. Each of them takes into account the heart contraction rate and, often, the value of arterial tension before and after the exercises. Tests with minimum loading are used by sports medicine mainly. For common people, the submaximal loading tests are important. N.M. Amosov provides contra indications and lists as well the clinical signs, which are the basis to cease loading testing (Table 1).

The appropriateness of using various training methodologies is compared: 1 - long-running continuous loading of medium level; 2 - short intensive loading interleaved with rest periods; 3 - long-running highly intensive loading. It was revealed that the 3rd type of loading is unacceptably exhausting. The 2nd type of loading becomes more exhausting with every cycle. The maximum efficiency was shown by the loading at 60-75% of the maximal aerobic power. It was also revealed that the maximum training effect and the effect of high quality recreation is ensured by the following cycle: 3-5 minutes of exercises engaging a large number of muscle groups with 3-5 minutes of breaks for easier loading, which turned out to be more favorable for recreation, than complete rest. “The initial level of loading of non-trained people must not result in increasing heart rate by more than 30 contractions a minute if compared to the pulse rate in calm state (p. 142). Training regime, gradual approach to increasing loading and close medical control are important. “Failures in the training mechanism, detraining or overtraining equally lead to worsening functional state of the heart and the whole blood circulatory system (p. 11) [16]. Regular training, which aids recreation processes, switches the organism to economic operation mode of the cardiovascular system, lungs and other organs and actively resists aging. “We have received data confirming that portioned application of so-called “contraindicated” exercises is most efficient for health improvement” (p. 23). The harder an exercise is for an organism, the better it is trained. It is important to make physical exercises a permanent factor of the way of life. For tens of thousands years, humans survived in the wild nature and demonstrated high endurance, “just like any wild animal,... therefore, the current fragility of human nature is not caused by genes, but by current living conditions” (p.4)
Hypodynamia is the main disease of the civilization and it is defeated by extensive practical implementation of preventive and rehabilitative programs of physical training. The most important task is the development of methods of determining the physical condition, which is well correlated with the overall "level of health of a human as an indicator determining his performance capability, resistance to any disease and ability to come through a disease" (p. 186). "Application of portioned physical loading combined with dietary restrictions can give a good effect in prevention and treatment of the majority of chronic diseases. This area is directly related to the key problems of medicine of our century" (p. 192) [17]. "Medicine saves some people and shortens the lives of others…detrains and makes them helpless against diseases" (p. 12) [18]. The reserve capacity, which impersonates the health of a human, “is not gained through medicines, but through training, exercises and loading, as well as through work, resistance to cold, heat, hunger, fatigue” (p. 15). To overcome Hypodynamia, detraining of musculoskeletal, gastrointestinal and all other systems of an organism, N.M. Amosov suggests "the mode of restriction (the author's remark - in food) and loading”, which includes three main points: 1. Food with minimum fats; at least 300 grams of vegetables and fruits every day; the weight is important - it must not be less than: "the stature minus 100". The subjective sense of hunger or fullness depends on not only the ratio of “inbound - outbound energy”, but also the "training" of the food center for conscious restriction in food; hunger is always useful… The "greedy" persons' need in food... will always exceed the organism's spending and the person will start getting fat” (p. 42). Often, the menu is selected by usefulness, but not by taste. This is the cause of many diseases. 2. Physical culture - “is necessary for everyone, both children and particularly elder persons” (refer to recommendations [16]). “Make it a rule to do exercises at least 20-30 minutes a day. It is some 1000 movements; one should better use dumbbells weighing 2-5 kg. The physical exercises should be desirably complemented with walking, e.g. on the way to the work and back - one kilometer to and one kilometer from it” (pp. 15-16). 3. Mental control - strengthening the will, positive emotions; if possible, excessive comfort should be avoided. "The level of training determines the contours of external affects and own tension, beyond which the norm ends and the pathology starts” (p. 33). N.M. Amosov suggested training, first of all, the five basic functional subsystems: 1. “Gaseous exchange and blood circulation” (p. 38). This subsystem maximally influences on the regulatory systems through the feedback. 2. “Nutrition and metabolism” (p. 40) - ensures procurement of the organism with energetic and construction materials. 3. “Thermal control” is meant for “maintaining stable temperature at different weather conditions; it is trainable as any other function” (p. 40). 4. “Connective tissue, cell protection and blood” (the system of immunodefense) (pp. 43-44). 5. “Reproductive organs” (p. 44). “The aggregate reserve capacity of virtually all regulatory systems are not only the most important characteristic of the health state itself, but also equally important for determining the degree of the organism's susceptibility to diseases” (p. 49). Because of insufficient carbonic acid, which is the most important regulator of the function of internal organs, “spasms of bronchi, vessels and intestinal tract occur, which can result in breast pang, hypertonia, bronchial asthma, gastric ulcer, colitis” (p. 51). The system of health improvement by K.P. Buteyko ensures training of respiration targeting accumulation of carbonic acid. In order to control health, K.P. Buteyko suggested the test of expiratory capacity. The standard delay of the expiration is 60 seconds; he treated the capacity being less than 60 seconds as a deviation and introduced 5 degrees of the pathology: “1st degree - 50 seconds, 2nd degree - 40 seconds; 3rd degree - 30 seconds; 4th degree - 20 seconds, 5th degree - 10 seconds. Less than 5 seconds was defined as the “life margin”. Mastering proper respiration technique is a reliable way to health improvement. “It is impossible to orient training efforts to each individual structure of an organism... there is only one solution - to select and train a certain integral function determined by the nature. From the function, the effect of training will spread down by the stages of structures to particular functions” (p. 172). N.M. Amosov separated such generalizing function in our organism - it is the “physical work supported by respiratory control, restriction in food and cold training” (p. 172). During physical work, “the stress hormones disintegrate sooner and, thus, the drag of immune reflex to an infection is reduced... the stronger mental processes are, the more physical work is required for neutralization of their harmful effect on the regulation of internal organs” (p. 173). N.M. Amosov stated that muscular work encourages the nervous and endocrine systems to function with increased capacity, i.e. they are training. “In old age, training is hard: the rate of synthesis of muscular protein is slowed down. Therefore, training needs to be extended twice as much” (p. 32) [19].
CONCLUSION

In his final book [20], N.M. Amosov summarized his long research and considerations regarding achievement of health by training organism's functions;

- Neither the nature, nor the society, but only the human himself is to blame for his diseases.
- To become healthy, one needs to make his own permanent and considerable efforts and nothing can replace them.
- The extent of efforts is determined by motives and the motives - by the significance of the goals and the will.
- Excellent performance of the cardiovascular and respiratory systems, the alimentary canal and the thermal control system is ensured only by their training.
- Organism's reserves are genetically programmed, they can be increased by training and they disappear at detraining.
- The less food an organism receives, the more perfect is its metabolism; it is important to cover the organism's demand in fully-fledged amino acids, vitamins, microelements, but not just in calories.
- The mode of physical loading and restriction in food is the way of life that ensures health.

The author encloses gratitude to N.B. Kalugina for highly intelligent technical support.

REFERENCES