Revista Românească pentru Educație Multidimensională
ISSN: 2066-7329 | e-ISSN: 2067-9270
Covered in: Web of Sciences (WOS); EBSCO; ERIH+; Google Scholar; Index Copernicus; Ideas RePeC; Econpapers; Socionet; CEEOL; Ulrich ProQuest; Cabell, Journalseek; Scipio; Philpapers; SHERPA/RoMEO repositories; KVK; WorldCat; CrossRef; CrossCheck

2020, Volume 12, Issue 1, pages: 311-319 | doi:10.18662/rrem/215

Theoretical Aspects on Studying Energy Potential, Neuroregulatory Factors and Particularities of Muscle Tissue Structure in Forming the Fighters Force Qualities

Victor MANOLACHI[1]

[1] PhD, associate professor, State University of Physical Education and Sport, Chisinau, Republic of Moldova,
victor_manolachi@mail.ru

Abstract: The present article presents the existing visions in the specialized literature regarding the study of the energy assurance potential of the muscular system, to the factors that influence this system according to the structure of the muscles in forming force qualities of the fighters of different styles. At the same time, the analysis of the literature reflects the limited character of these visions, which are not related to the achievements of the contemporary theory of the functionality of the fighters' body systems, ensuring the level of development of their force qualities. The knowledge system regarding the nominated aspects existing in sports wrestling is not based on the fundamental and specific factors of the formation of different functional components, ensuring the level of development of maximum force, force in speed and resistance in speed and, of course, not even on the scientific argumentation of the functional formation of a series of essential force components, which, in the end, reduces the effectiveness of the fighters training process.

Keywords: *force qualities; force training; fighters of different styles; training activity; knowledge system.*

How to cite: Manolachi, V. (2020). Theoretical Aspects on Studying Energy Potential, Neuroregulatory Factors and Particularities of Muscle Tissue Structure in Forming the Fighters Force Qualities. *Revista Romaneasca pentru Educatie Multidimensionala, 12*(1), 311-319. doi:10.18662/rrem/215

Introduction

The level of manifestation of the force qualities is closely related to the potential of the energy systems, the neuroregulatory factors and the specific of the muscle tissue structure (Vasilieva, 1984; Matveev, 1977). The power and volume of the anaerobic alactacid energy system (ATP - adenosine triphosphate, Pcr – phospho-creatine) are extremely important in manifesting maximum and explosive forces in physical activity, the duration of which does not exceed 10-15 sec (Karpman, 1980; Matveev, 1977).

The reserves of adenosine triphosphate in muscles, which can be used in intensive speed-force efforts, are already exhausted after 3 seconds of exercise. Further, the high intensity effort, realized on the account of the ATP, which comes from the decomposition of phospho-creatine (Pcr), usually does not last more than 10 seconds (Vasilieva, 1984; Vorobyova et al. 1981; Oks, 1969) although, under the influence of the training, the concentration of ATP and Pcr in muscle can increase considerably, and consequently both power and duration of effort can increase, due to these energy resources and with the help of neuroregulatory factors that act on the structural units of the muscles.

Thus, in short-term motor actions, the maximum and explosive force correlates to a considerable extent with neuroregulatory factors and muscle structure.

The purpose of the research consists in the analytical determination, starting from the data of the specialized literature in the field, of the essential opinions of the scholars and of the specialists regarding the theoretical aspects of studying the energy potential, the neuroregulatory factors and the particularities of muscular tissue structure in forming the fighters force qualities of different styles.

Objectives:

1. To analyze the specialized bibliographic sources in the field of different styles of fights, in order to describe the opinions of the researchers and specialists regarding the theoretical aspects of studying the energy potential of the muscular tissue, of the processes of neuroregulating the muscles in training fighters of different styles.

2. To determine the most important bibliographic sources where are accessibly exposed contemporary means of testing (Bube et al. 1969) the level of force training of the fighters of different styles, related to the diversity of motor actions performed by them, and which ensure the

effectiveness of the competitive activity. To propose your own views on the analyzed subject.

Research organization

Research results and discussions. Anaerobic glycolysis and aerobic energy resources are important for the manifestation of endurance in the force regime during the effort of different duration (Bernstein, 1966; Karpman, 1980; Matveev, 1977). Activation of a large number of motor units of the muscles, characteristic for the manifestation of the resistance in force regime in a specific time interval for the sparring in the sports fights, requires a large volume and a fast development of the anaerobic glycolysis processes. If, in the case of untrained persons, the maximum power of anaerobic glycolysis is recorded after 15-20 sec of intensive effort, then, in the case of high category athletes, who apply the appropriate training means, this interval can be reduced up to 5-8 sec. (Karpman, 1980; Matveev, 1977). This, of course, contributes to the intensification of the effort, to the increase of the level of manifestation of the force qualities.

Increasing the volume of the anaerobic glycolysis process can lead to a considerable increase in the force resistance. In the case of untrained persons, its manifestation in the energy processes is recorded after an effort with a duration that does not exceed 30-40 sec, in the case of the trained athletes, it can be increased up to 50-60 sec and even more, remaining significant within 3-5 min (Karpman, 1980; Matveev, 1977).

The force resistance depends, to some extent, on the possibilities of the aerobic energy assurance system in that part, which is conditioned by the speed of the aerobic oxidation process of the glycogen (Matveev, 1977). By special training, it can be reduced several times the time of obtaining the maximum value, in a concrete activity, of the oxygen consumption, from 5-6 min in the untrained persons up to 1-2 min in the trained ones. Obviously, in ensuring the work capacity of the fighters, increasing the share of economic aerobic sources will delay the process of fatigue, contributing to the manifestation of a higher level of force qualities.

The capacity to mobilize the functional possibilities and the power of the aerobic energy assurance system indirectly influence the level of manifestation of the force qualities. This occurs on account of the intensification of breath and the increased oxygen consumption during the breaks between the fighting matches and during the short breaks during the fight, determined by the actions of the referees.

Intensive breathing during the breaks between fighting matches, the speed of manifesting the ability to mobilize the functional possibilities of the aerobic energy system, which lead to increased oxygen access, contributes to the conversion of lactate into pyruvate and the series of subsequent reactions leading to formation of ATP, because lactate is a very effective fuel source in muscle fibres with a large amount of mitochondria (Karpman, 1980; Donskoy, 1975).

Fatigue, which occurs at high lactate concentrations, is a consequence of increased concentration Hydrogen ion (H +), which increases the level of acidity in muscle cells and affects the mechanism of muscle contraction (Matveev, 1977; Vasilieva, 1984; Vorobyova, Gubar, Safyannikova, 1981). Intensive breathing and increased oxygen consumption are opposed to fatigue, contributing to recovery reactions during the fight (Matveev, 1977; Oks, 1969).

The analysis of the factors that condition the level of the force qualities and, of course, the tendency towards a selective influence on them is missing in the specialized literature regarding the problems of force training of athletes specialized in fights. The recommendations are reduced only to the means and methods of force training, which contribute to the development of a certain type of force qualities: maximum force, force-speed, resistance in force regime, as well as to the development of these qualities in the general and special physical training process, taking into account their manifestation in the competitive activity.

In such an approach, the numerous anatomical and physiological components disappear from the field of view, which condition the level of the force qualities, determining their role and importance, the means and methods of selective influence in order to obtain a balanced training effect as a whole.

The anatomical factors that influence the level of the force qualities are reduced to the volume of the muscle mass, to the correlation between different types of muscle fibres, to such properties of the muscles, such as excitability, extensibility, elasticity. Equally important for manifestation and development of force qualities are also the neuroregulatory factors, ensuring a high speed of transmission of the nerve impulse by motoneuron, activation and synchronization of motor unit activity of the muscles and groups of muscles involved in a concrete motor action - antagonists, synergists, stabilizers (Karpman, 1980; Matveev, 1977; Oks, 1969).

An incontestable interest is the dependence on the role of the mechanical muscle and ligament receptors, the particularities of the spread of the action potential in the nerve tissue, the speed of its passage along the

nerve axon, the frequency of nerve cell discharge (Oks, 1969). Basically, all the neuroregulatory components of muscle activity and the development of force qualities are subject to systemic development in order to ensure the level of force training, which contributes to the successful training and competitive activity in sports fights. The training of the motor units, the intensity of the impulses of the muscles, the balanced intramuscular coordination, the dynamism of the activation processes, the interaction of the antagonists, the synergies, the stabilizers and the use, for the purpose of the increase of the force, of the elastic energy of the extended muscles and of the connective tissues, reduction of the force retention manifestation of the effect of the activity of muscle and ligament mechanoreceptors - all these processes are to be developed (Vasilieva, 1984; Vorobyova, Gubar, Safyannikova, 1981; Donskoy, 1975; Matveev, 1977).

Unfortunately, in the literature that reflects the level of knowledge in the field of force training of athletes specialized in fights, the problems regarding the development of neuroregulatory capacities that influence the level of force qualities are not practically approached.

It should also be mentioned that the skeletal muscles are organs of the human body, whose main function is to reduce contractions (Oks, 1969). In the structure of the skeletal muscle, the muscle fibres, the connective tissue, the nerve cells, the vessels are distinguished.

The volume of human muscle tissue constitutes about 40% of the body mass. Under the influence of sports training, the muscle tissue hypertrophies and its volume can increase, accounting for 50-55% and more of the body mass (Vorobyova et al., 1981). The general term for the motor neuron (motoneuron), its axon, and all the muscle fibres, which it innervates, is the motor unit of the muscles (Oks, 1969). In the motor unit, the motoneuron axon is divided into multiple branches, each of which connects with a separate muscle fibre. In different muscles, there is a different amount of muscle fibres in the motor units. In small muscles, which ensure precise and soft movements, the amount of fibre in the motor units cannot be more than 10-20. In large muscles, which provide strong movements, the amount of fibres in a motor unit can be 800-1000 (for example, in the biceps muscle of the shoulder) or even 1500-2000 (in the gastrocnemius muscle). All the muscle fibres innervated by a motoneuron contract simultaneously, at the same time different motor units can be contracted both simultaneously and in a different sequence, depending on the motor load, by the required force level. The quantity of the motor units, which can be involved in the realization of the motor act, their activation, is conditioned by the frequency of the motor potentials of the action (Matveev, 1977; Oks, 1969).

Each muscle fibre, motor unit or muscle is surrounded by connective tissue of different density: muscle fibre - of thin connective tissue, the motor unit – of denser tissue, and all muscle - of dense connective tissue. At the end of the muscle, all the connective tissue tightens and transforms into ligaments - a dense, compact connective tissue that fixes the bone muscle.

The force quality of man depends on the structure of the muscle tissue, namely the type of muscle fibres that form the motor units of the muscles. Muscle tissue is not homogeneous and consists of muscle fibres of different types. Depending on the structure, the particularities of the activation, the fermentative activity, the energy assurance mechanisms, we distinguish fibres rapidly contracting, which are of two types - FRCa and FRCb, and fibres slowly contracting - FSC (Oks, 1969).

Fibres rapidly contracting (FRCb) have a several time speed (according to data, from 3-4 to 10) higher and a contracting force greater than those that contract slowly. These fibres are also distinguished by their high energy production capacities on the basis of anaerobic glycolysis and exclusively by their high production potential of a maximum and explosive force (Karpman, 1980; Oks, 1969).

The peculiarity of these fibres, which allows a high level of manifestation of the qualities of speed and force, the production of ATP in glycolysis, is explained, in large part, by the large dimensions of the fibres, by their large quantity in each motor unit and by an amount relatively small of the motor units in muscle tissue. This contributes to the rapid activation of a large number of motor units (Karpman, 1980; Oks, 1969)

The speed, force and anaerobic potential of FRCb muscle fibres increase considerably under the influence of a special training, in case of applying an appropriate methodology (Donskoy, 1975; Oks, 1969). At the same time, the size and volume of FRC fibres, increase the surface area in the cross section of the muscles.

The fibres slowly contracting are distinguished by an extensive capillary network, which provides blood supply, a high glycogen concentration and an activation of the oxidative ferments, a high concentration of myoglobin (Karpman, 1980; Oks, 1969)

According to all CM indices, muscle fibres several times exceed the possibilities of FRCb fibres (Oks, 1969)

FRCa muscle fibres occupy an intermediate position, combining in itself the structure and features of FRCb fibres and CM fibres, acceding to the first ones in terms of contracting speed and force, and others - in terms of oxidative capacities (Karpman, 1980; Oks, 1969). The correlation between

the muscle fibres of different types in a human being is largely genetically conditioned. If, on average, in a common human being a correlation approximately equal is observed of RC and CM muscle fibres, then in some people the fibres of a single type may prevail (Bernstein, 1966; Vasilieva, 1984).

There are known cases when the amount of certain fibres in some muscles can reach 80-90% and more (Oks, 1969). Naturally, the people whose muscle tissue prevail RC fibres are predisposed to an activity characterized by speed and force and to an intensive development of maximum and explosive force, and the people where CM fibres predominate - to an activity that requires resistance, a potential of the aerobic energy assurance system and an increase of these capacities.

Taking into account the above, the process of developing the qualities of force must be linked to the individual structure of the muscle tissue. The athletes in whose muscle tissue the RC fibres predominate are distinguished by high possibilities of increasing the maximum and explosive force. In contrast, in athletes whose muscle tissue is distinguished by a large amount of CM fibres, there are great reserves for increasing the force resistance in cases of predominance of aerobic metabolism and reduced possibilities regarding the development of maximum and explosive force. The force-speed training is able, to some extent, to increase the capacities of CM fibres, the concentration of ΔTP and Pcr in them, activate anaerobic glycolysis, to cause hypertrophy of muscle tissue. At the same time, these changes are incomparable with the adaptive resources of RC fibres.

A similar picture is also characteristic for RC fibres. An intensive aerobic training contributes to the increase of the resistance of these fibres on account of the extension of the capillary network, of the increase of the degree of activation of the oxidative ferments. However, such training disrupts processes that provide a maximum and explosive force level (Donskoy, 1975; Karpman, 1980; Kots,1982; Matveev, 1977; Oks, 1969).

Conclusions

1. Fatigue, which occurs during intensive physical efforts with insufficient energy assurance and high lactate concentrations, is a consequence of increased ion concentration of hydrogen, which raises the level of acidity in muscle cells and disrupts the mechanism of muscle contraction. Intensive breathing and increased oxygen consumption reduce the development of fatigue, contribute to the recovery reactions during the fight.

2. In the specialized literature there is no analysis of the factors that condition the qualities of force and, of course, the tendency of selective influence on them. The recommendations are reduced only to means and methods of force training, which contribute to the development of a certain type of force qualities (maximum force, force-speed, resistance in force regime) and to their development in the process of general and special physical training, taking into account their manifestation during the competitive activity.

3. In the specialized literature devoted to the study of the force training of the athletes specialized in wrestling, unfortunately, the problems of developing the neuroregulatory capacities that influence on the training of the force qualities are not practically addressed.

4. The process of developing force qualities must be correlated with the individual structure of the muscle tissue. The athletes in whose muscle tissue the RC fibres predominate are distinguished by the high possibilities of increasing the maximum and explosive forces. In other athletes there are great reservations regarding the increase of the resistance of force in case of predominance of the aerobic metabolism and small possibilities regarding the development of the maximum and explosive force.

5. Thus, the training oriented towards the force-speed qualities of the fighters of different styles can increase, to some extent, the contracting capacities of the CM fibres, the concentration in them of the ATP and the Pcr, the activation of the anaerobic glycolysis and the hypertrophy of the muscle tissue. However, these changes cannot be compared with RC fibre resources.

References

Bernshtejn, N.A. (1966). Ocherki po fiziologii dvizhenija i fiziologii aktivnosti. Moskva, FiS, [Bernstein, N.A. (1966). *Essays on the physiology of movement and the physiology of activity*. Moscow: FiS]

Bubje H., Fuk G., Shtjubler H., Trogsh F. (1969). Testy v sportivnoj praktike. Moskva, FiS. [Bube, H., Fook, G., Stübler, H., Trogsh, F. (1969). *Tests in sports practice*. Moscow: FiS]

Donskoj D.D. (1975). Biomehanika. Moskva: Prosveshhenie. [Donskoy, D.D. (1975). *Biomechanics*. Moscow: Enlightenment]

Karpman V.L. (1980). Sportivnaja medicina. Moskva, FiS. [Karpman, V.L. (1980). *Sports medicine*. Moscow: FiS]

Matveev, L.P. (1977). Osnovy sportivnoj trenirovki. Moskva, FiS. [Matveev L.P. (1977). *The basics of sports training*. Moscow, FiS.]

Oks S. (1969). Osnovy nejrofiziologii. Moskva, Mir. [Oks, S. (1969). *Fundamentals of Neurophysiology*. Moscow, Mir]

Vasil'eva V.V. (1984). Fiziologija cheloveka. Moskva. FiS. [Vasilieva, V.V. (1984). *Human physiology*. Moscow: FiS]

Vorob'eva E.A., Gubar' A.V., Saf'jannikova, E.B. (1981). Anatomija i fiziologija. Moskva, Medicina. [Vorobyova, E.A., Gubar, A.V., Safyannikova, E.B. (1981). *Anatomy and physiology*. Moscow: Medicine]