MOTOR QUALITIES IN THE NAVAL PENTATHLON

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Abstract: *By paying special attention to combat training of soldiers, it is highlighted the need for multidisciplinary training through elements of theoretical, technical, tactical training, training skills in various fields, specific to combat actions, such as shooting with different categories or types of weapons, first aid, rescue from drowning, underwater swimming, solving technical-tactical situations in different environments, moving over different distances or crossing watercourses with improvised means. All these can be achieved and verified during specific training or in sports-applicative competitions, on the stable foundation of a well-trained fighter. The basis of this preparation can only be a high level of physical and mental capacity. Educating the character of the military, improving their potential, is achieved against the background of good effort capacity and training through specific exercises, and these objectives can be achieved within military physical education classes and through training allocated for sports competitions.*

Research objectives:

- *Highlighting the naval pentathlon as a basis for training future professional soldiers;*
- *Highlighting the need for scientific planning in order to obtain the necessary physical and mental capacity for professional soldiers;*

Methods:

- *Study of specialized literature;*
- *Measurement and testing of effort parameters specific to naval pentathlon samples;*

Results and conclusions:

Using the above-mentioned methods, information necessary for the optimal organization and conduct of military and sports training for the development at a higher level of physical and mental capacity of servicemen was obtained, using training means specific to the naval pentathlon. The information obtained from the research shows the major importance of a physical training as complex as possible to achieve maximum performances both in naval pentathlon sports competitions and in combat actions specific to professional fighters in the naval forces;

Key Words: naval pentathlon, training, motor qualities.

RESEARCH CONTENT

Endurance. In the literature we often come across two terms that seem to have the same meaning: endurance and endurance. Their interpretation may be different, but often only one of the terms is encountered, being used with both meanings.

Endurance is defined by specialists in the field as the possibility of a subject to perform for a long time an effort of medium intensity, under stable conditions in terms of body parameters (F.C., T.A., gas exchange level). Endurance, according to specialists, also refers to physical, intellectual and emotional aspects.

Resistance it is defined as an individual's ability to perform high-intensity effort for a short period of time. The high intensity of the effort involves the accumulation of a significant oxygen debt, under these conditions the phase of anaerobic lactacid effort is installed. Resistance is considered to be the body's ability to withstand an effort whose intensity leads to a significant increase in lactic acid levels.

According to T.O. Bompa (2014), "*resistance refers to the time it takes an individual to execute a work of a certain intensity. The main limiting factor while affecting performance is fatigue."* Endurance is influenced by other motor qualities but also by efficiency in the execution of various motor actions, the physiological potential of the athlete and the ability to highlight psychological skills necessary to sustain effort. The level of development of resistance is marked by the functional capacity of the cardiovascular and respiratory systems (cardiorespiratory resistance).

Among the factors that can negatively influence the manifestation of resistance, there are also identified: central nervous system, willpower, aerobic and anaerobic capacity, speed reserve. In Romanian literature, the term endurance is used for both notions. Thus, endurance is divided into several categories, depending on the duration and intensity of effort, having as main indicators the heart rate correlated with the maximum oxygen consumption and the level of lactic acid accumulated in the blood. A high level of aerobic endurance provides the athlete with a solid foundation for the development of specific endurance, favoring the later onset of signs of fatigue and maintaining for a longer time in effort the stable state ("*stady state*") (Bota C., 2000), characteristic of the second phase of acute fatigue. The development of aerobic endurance is due to increased

mitochondria and improved activity of oxidative enzymes, as an adaptive response to specific training effort (Boreham C., et al., 2006).

Table no. 3 Using the main functions in endurance efforts with different intensity and duration (Neumann, 1994, quoted by G.Marinescu 2002)

Functional system	Measured values	ASD (1-2 min)	AMD (>2-10min)	ALD I (>10-35min)	ALD II (>35-90min)	ALD III (>90-360min)	ALD IV (>360min)
Blood circulation	Heart rate (b/min)	185 – 200	190-210	180 -190	175-190	150-180	120-170
Oxygen consumption	%VO_2max	95 - 100	95-100	90-95	80-95	60-85	50-60
Energy exchanges	%Aerobic %Anaerobic	50 50	80 20	85 15	95 5	98 2	99 (1)
Power consumption	KJ - min^1 KJ (total)	160 160 – 320	120 320-1200	110 1200-3700	105 3900-8400	80 8400-25300	75 >27000
Metabolism	Free fatty acids (mmol.l^1)	0,5	0.5	0.8	1.0	2.0	2.5
	Lactate (mmol.l^1)	18	20	14	8	4	2

ASD – short-term endurance; AMD – endurance of medium duration; ALD – long-lasting endurance. The athlete's maximum ability to use oxygen (VO2 max.) in endurance effort (Bota C., 2000) is the most appropriate indicator for measuring aerobic performance. At the same time, the intensity of the effort is correlated with the heart rate. It can have different values, individualized, depending on the level of training of the athlete or the sport practiced. The differences between these values give a much more accurate parameter: the *intensity of the request*, much more enlightening in the scientific conduct of training (Alexe N., 1993).

For the development of aerobic effort capacity, it is recommended to use a stress intensity located at the limit of the anaerobic threshold (lactate level below 4 mmol / l), corresponding to a pulse of 140-150 b / min (Makar P., Bielec G., 2013).

Muscular endurance and cardiorespiratory endurance

Muscular endurance is manifested in exercises that involve performing mechanical work in the form of several repetitions with a large weight, but which do not put much strain on the respiratory and cardiovascular systems. Fatigue in this case is induced by the proper functioning of the neuromuscular system that is directly involved in performing movement (Zatsiorsky V M., Kraemer W., 2006). Performance indices in muscular endurance are closely correlated with muscle strength. Cardiorespiratory endurance is dependent on the level of development of the cardiovascular and respiratory systems and involves the presence of the phenomenon of energogenesis, which is performed in the presence of O2, necessary for active muscles during effort. The volume of O2 that can be captured, transported and recovered at tissue level is the limiting factor of aerobic effort capacity. The maximum consumption of O2 (VO2 max.) is influenced by dimensional aspects of the organs responsible for oxygen capture and transport (lung size, heart size, alveolo-capillary and capillary-tissue dimensions, amount of hemoglobin in the blood) and functional capacities of the cardiorespiratory system (maximum pulmonary ventilation, O2 utilization coefficient, maximum cardiac output, systolic volume).

Endurance periodization in the naval pentathlon

For the period of a training macrocycle specific to the naval pentathlon, endurance development training can register a volume that will gradually increase for the preparatory period of approximately 3-4 months, when the development of aerobic capacity will be pursued (Ene-Voiculescu, V., 2008). The means of work used can be selected from the diversity of athletics, swimming and rowing structures.

The intensity of training will be lower during this period, compared to volume, and will gradually increase and remain close to the maximum level throughout the next training period, in which we will meet an introductory part for the development of specific endurance. The objective will be the further development of aerobic endurance and specific endurance (Ene-Voiculescu, V., 2009). This phase of training will be of particular importance in carrying out at optimal parameters the intensive training specific to the competition period.

The next period of specific training, before the most important competition, will be characterized by a decrease in the volume and duration of training against the background of increasing intensity to the maximum level, corresponding to the peak of sports form. The last period of 4-6 weeks coinciding with the transition period will have all the parameters of effort decreasing to ensure complete recovery of the body (Boreham C., et. all., 2006).

For naval pentathlon trials, aerobic endurance has a high weight in the "crosscountry amphibious" event, where the average time to complete the test is between 10.20 and 10.40 min. The endurance is of medium duration and the energy contribution in this sample is mainly aerobic (70-75%), 25% being represented by anaerobic endurance, and a percentage of about 4% having ATP, CP support. (Table no. 4 - Use of the main functions in endurance efforts with different intensity and duration).

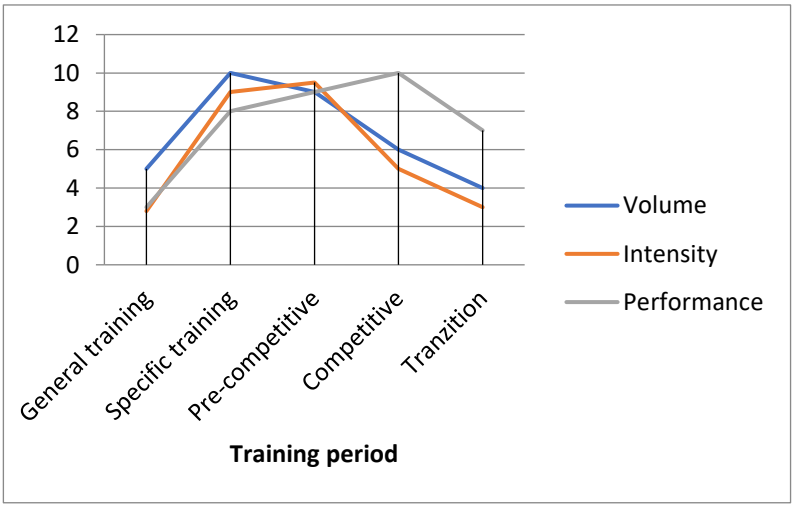

Fig. 2 Periodization of endurance (After C. Boreham et al., 2006)

Training for the development of possibilities to endure the level of such effort will be oriented towards the development of maximum aerobic power and anaerobic alactacid capacity (Bompa T O., Buzzichelli C.,).

The "seamanship" test, with an average duration between 3.45 - 4.10 min., can be classified as the characteristic effort of short-term endurance (Ene-Voiculescu, V., Seamenship race, 2007), but the limiting factors of performance in this case are represented by glycogen reserves and the body's ability to wash lactate or the ability of the muscle to withstand the high level of lactic acid (Table no. 4, Features of effort depending on the sample).

Table no. 4 Characteristics of effort depending on the sample (adapted from Neumann, 1994 quoted by Marinescu Gh., 2019)

EVENT PARAMETERS	OBSTACLE RUN	AMPHIBIOUS CROSCOUNTRY	LIFESAVING	SEAMANSHIP	UTILITY SWIMMING
DURATION OF EFFORT (MIN. SEC)	01.45-02.00	10.20-10.40	1.05-01.15	03.45-04.10	1.05-1.15
ENERGETIC % ATP,CP/ anaerob/aerob	S.A.L 10/65/25	S.A. 4/25/71	S.A.L 25/65/10	S.A. 7/40/53	S.A.L 25/65/10
POWER DURATION	20-60 sec	4 - 10 min	20-60 sec	4-10 min	20-60 sec
LACTAT	18mM/l	5-12mM/l	12-18mM/l	12-18mM/l	12-18mM/l
FACTORS OF FATIGUE	Muscle glycogen, lactic acid	Myoglobin, mitochondria, VO_2 usage, motivation	ATP,CP, glycogen, lactat	Glycogen, lactat,	ATP,CP, glycogen, lactat
DEVELOPED FUNCTIONAL QUALITIES	Endurance Speed III	Endurance of medium duration	Endurance Speed II	Short-term endurance	Endurance Speed II
Oxygen consumption $VO_{2\ max}$	95-100%	95-100%	95-100%	100%	95-100%
HEART RATE b/min	185-200	190-210	185-200	190-200	185-200
TRAINING CATEGORY	C.A.L. P.A.M. tip II	P.A.M VO2 max	P.A.L C.A.A.	P.A.M. Short intervals Anaerobic threshold	P.A.L C.A.A.

The trials of utility swimming, rescue swimming and obstacle course are similar in terms of required endurance, this being of the type speed endurance type II and III. (Table no. 3 - Use of main functions in endurance efforts of varying intensity and duration).

Lactic acid in endurance effort characteristic of naval pentathlon.

The effort specific to naval pentathlon samples engages large lactic acid accumulations (Table 4 Effort characteristics depending on the sample): 5-12 Mmol/l in the

"crosscountry amphibious" sample, respectively 12-18 Mmol/l in the other four events. The current easy possibilities of measuring the level of lactic acid accumulated in the blood as a result of specific effort in training and competition, favor the direction of naval pentathlon training according to the time and intensity of work and also allow the efficient application of the principle of individualization. The correlations of lactic acid with heart rate, representing the body's response to exercise from a metabolic and physiological point of view, have streamlined the energetic monitoring of training (Bota C., 2000).

The highest lactate values are present in medium and short endurance efforts (executed at VO2 max.), in which the energy source is obtained to a large extent through the process of anaerobic glycolysis. Depending on the intensity and duration of effort, lactic acid accumulating in blood and muscles registers two critical thresholds: aerobic and anaerobic, which is an important benchmark in requesting a certain energy source (Bădescu V., 2006).

The anaerobic threshold occurs when aerobic metabolism is fully charged and the balance between lactate accumulation rate and the possibilities of its removal are lost, favoring accumulation (Kenney W., Wilmore J., Costill D., 2015). The removal of lactic acid starts le muscle level, preventing for a while its accumulation in the blood by carrying out the following phenomena:

- improving the efficiency of aerobic metabolism of the working muscle;
- metabolism of lactic acid into active muscle fibers;
- diffusion of lactic acid to muscle fibers not engaged in effort;
- elimination of lactate from the blood through the contribution of the heart and liver.

The anaerobic threshold occurs when lactate removal activity by these systems and organs is exceeded by the accumulation rate. The anaerobic threshold is individual but can be raised through specific training. It is known that athletes with a higher percentage of slow-twitch fiber will produce less lactate during exercise.

Strength in the naval pentathlon. Aspects of strength development

Strength development should be the first concern for any coach aiming to improve an athlete's performance (Bompa T O, 2014). The level of strength development will influence, among other factors, the process of formation and improvement of sports technique and its tactical capitalization (Alexe N., 1993). In the naval pentathlon, strength interests us mainly from a physiological and methodological point of view to improve performance, but biomechanical aspects are equally important for improvement. Strength training brings changes to the body such as: muscle hypertrophy, increased muscle endurance, increased muscle strength and strength (Hagerman P., 2008). Muscular endurance in different forms of manifestation is found in all naval pentathlon events (Table no. 3 - Use of main functions in endurance efforts with different intensity and duration). For naval pentathlon, extreme situations are to be avoided, where the development of strength can interfere with the development of other conditional motor qualities. An excessive development of maximum strength will negatively influence the manifestation of speed and endurance. The interference is also valid from the perspective of an excessive development of resistance that will influence the performance of the other two qualities (Ardelean T., 1990).

Concomitant endurance and muscle strength training can make it difficult for the body to adapt simultaneously to both motor qualities. The emphasis on the inference of these two simultaneously trained qualities is largely influenced by the intensity of the specific training for each of them. The optimal solution, specialists say, is sequential programming of training for strength and resistance, and in this sense it is recommended to train in a first phase of strength followed by muscular endurance, another order in training planning being less efficient (Zatsiorsky V., Kraemer W., 2006). The development of strength in the naval pentathlon will aim to optimize the execution of specific motor actions, throughout the trials, in order to obtain maximum performance.

The naval pentathlon trials are mostly acyclical, and the optimal combination of strength, speed, endurance qualities in training will contribute to obtaining a high level of sports performance (Anderst W, J., Eksten F., & Koceja D.M., 1994). During the tests we will encounter manifestations of these combinations in the form of: acceleration and deceleration power, detachment power, landing power, medium or long-lasting muscular resistance, speed-resistance (Bompa T.O., 2014). The naval pentathlon requires careful

preparation for the development of specific strength. In the obstacle course, strength is required in many forms for the execution of detachments or landings followed by continuing running, climbing high obstacles, climbing in arm strength or throwing. The combination of strength and endurance is common in naval pentathlon events. This is necessary for overcoming water resistance when swimming, swimming equipped with a gun, transporting the dummy through the water, rowing with an inflatable boat and rowing in the seamanship event, performing jumps over various successive obstacles.

The importance of strength development as the first phase of training also arises from the need to ensure good stability of the body in the execution of motor actions. Thus, strength training plays an important role in injury prevention for all types of training lessons. Strength training should be oriented in a first phase towards strengthening the stability of joints and spine, by developing responsible muscle groups, ligaments and tendons. Muscle development through strength training must ensure a permanent balance between agonist and antagonist muscles, which will help achieve good motor coordination.

It is recommended that muscles be divided into specific (used in the sport practiced) and non-specific, and training programs should target both categories (Zatsiorsky V., Kraemer W., 2006). The development of abdominal muscles and muscle groups such as trunk extensors will be pursued to ensure the stability of the pelvic girdle and avoid injuries specific to landings from height in the case of the obstacle track or at other times of the other naval pentathlon trials.

Force periodization. The periodization of force must be oriented towards a gradual evolution of demands. The general training will include exercises aimed at an anatomical adaptation of the athlete to the specific strength effort that will follow. General exercises involving as many muscle groups as possible will be used in this regard, preparing the muscles and the entire joint assembly for the intense demands during the specific training period**.**

Speed in the naval pentathlon. Aspects of speed development

Speed is considered to be a very important motor quality in sports, depending on it is the ability of the athlete to move or perform specific motor actions quickly. As is well

known, speed is dependent on certain factors, the most important of which are: heredity, reaction time, ability to overcome external resistance, level of technical mastery, willpower and concentration, elasticity and muscle coordination (Bompa T.O., 2014). Speed is a component of motor ability with strong genetic conditioning, its level of development being dependent on it. The age of 18-25 years of athletes in the naval pentathlon narrows down the area of factors that through training can bring improvements to this motor quality.

For the most part, certain forms of speed in the naval pentathlon are dependent on the level of learning of movement and the level of development of other motor qualities. The rapid execution of movements can be influenced by the level of strength development, thus increasing the ability of the athlete to overcome external resistance and implicitly to increase the acceleration of movement (Lentz D., Hardy A., 2003). This, together with the improvement of the technique, helps to quickly perform specific skills. The conclusion is that the improvement of speed in the naval pentathlon can be achieved by developing the motor qualities of strength, endurance and by improving coordination. Equally important will be in increasing speed performance, the ability to concentrate of the athlete and his willpower (Verkhoshansky, T., & Tatyan, V., 1983). Thus, there is a need to introduce specific lessons in training that will mentally require athletes in order to mobilize and harmonize the nervous processes involved in increasing speed performance.

Mobility

Mobility is considered by specialists a quality or motor aptitude that can influence sports performance (M. Epuran, 1990). The optimal amplitude execution of skills is dependent on the level of mobility development, which also influences the ease and speed of movements. Mobility brings extra safety in the execution of skills specific to naval pentathlon trials, and its improvement can be achieved through training. Due to scarring or specific training effort, muscles may shorten. The role of mobility training is to prevent this shortening and to bring extra elasticity to muscles, ligaments and tendons, thereby influencing sports performance and preventing injuries.

Studies show that exaggerated flexibility can weaken joint stability, which brings additional energy consumption in the execution of skills in certain sports, while favoring

the appearance of injuries (Saunders P., et. all., 2004). The development of mobility for athletes in the naval pentathlon must be at a level that ensures the flexible execution of specific motor skills. Exercises to develop the necessary mobility can be performed in all forms, within the selective influence of the body or after the end of training, in the recovery part of the body after effort (Grigore V., 2001).

CONCLUSIONS

Making a comparison between sports training and combat training, or between the performance athlete and the professional fighter, highlights the need to manage as efficiently as possible the resources with which the physical training of the military is worked. Sports training for naval pentathlon competitions of students from the Naval Academy and successful participation in competitions are the basis of combat training of future professional soldiers.

There are many similarities between sports training and military training. The differences between competition and fighting, however, are major. Thus, regardless of the performance obtained in the competition, the athlete will have the opportunity and motivation necessary to continue. This is not always the case in combat actions, where poor performance is often associated with significant losses at the strategic, logistical level, or loss of life. We can consider, however, the preparation and achievement of maximum performances in the naval pentathlon a necessary stage in the combat preparation of all military personnel in the naval forces, and the scientific means and methods of preparation for naval pentathlon competitions, guidelines in knowing and forming the character of future fighters.

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