

## ANTHROPOMETRIC-MORPHOLOGIC, PSYCHOMOTOR, ENERGETIC AND TECHNICAL-TACTIC FEATURES OF SAILORS IN OLYMPIC CLASSES

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### Abstract

*Sports sailing Olympic class, in this paper, we approached analyzing some previous research anthropological characteristics sailors in these classes, and attention is paid to antropometric-morphological space, space of psychomotor abilities, energetic components, expressed through aerobic and anaerobic work sailors as well as technical and tactical features sailors in the Olympic classes, the areas that are most often researched and presented in national and international scientific literature. Analyzed areas would have no purpose if they are not placed in the context of the theory of sports training sailors, we work presented theoretical foundations of training status and form of sailors as well as planning and programming of training in the sport sailing. Considering the shortcomings and inadequacy of scientific papers in the cultivated areas of anthropological status of sailors in the Olympic classes in the work we have put forward relevant information to all those who are sailing with, and scientists sent a message and are directed towards the scientific approaches that will lead to work with in practice usable results.*

**Key words:** sailing, Olympic classes, anthropological status, training theory.

### Introduction

To accurately accomplish the goals and objectives of training in terms of the effects work in sailing, it is necessary to monitor and check the anthropological characteristics of subjects while implementing the training process. The totality of all the features and capabilities of sailors should be included in the equation specifications of the sports activities that combine morphological characteristics, psychomotor skills, cognitive abilities, conative characteristics, motivational structure and physiological functional characteristics into an ultimately measured medley of anaerobic-aerobic capacity, what is meant by the term energy sailors, dynamic micro-environment and the entire area of techniques, tactics and strategies sailors. In light of kinesiology professional sailing is a less processed sport, both on a professional and on a scientific level.

Any qualified coach must necessarily know the development features of those with whom he works and customize the conditions under which training is carried out. Each period in the life of sailors has its own characteristics which distinguish it from other development periods. Coaches must know to be able to react to the changes that are also caused by the specificity of a particular period. Whether it is a selected population characteristics, sailors should be seen in relation to the specific development stage where at the moment they belong. Due to the complexity of the sport of sailing, a large number of different sailing classes, as well as the participants of the training process (of different gender and age), are complex to determine the precise structure of anthropological characteristics. However, although difficult, it appears that it is still feasible, but requires a long time of labor.

### *Anthropological characteristics of Olympic class sailors*

During the life of man is developing and growing spending to collapse. All this takes place in three stages: childhood and adolescence (from birth to 18 or 19 years), in the period grown men (from 18 or 19 until the age of 40) and the period of maturity and age that follows 40 years. The period of childhood and adolescence is one in which physical exercise, and involvement in sport ubiquitous. If you are at that age children are involved in sailing will be developed in accordance with the specifics of just sport and aging practicing, learning and perfecting, the change sailing classes depending on their characteristics, preferences and results achieved.

### *Anthropological features*

Anthropological characteristics or features are considered to be organized systems of all qualities and abilities and motor information as well as their relationships. The basic anthropological characteristics of athletes include: health status, anthropometric and morphological characteristics, psychomotor skills, functional skills, cognitive abilities, conative dimension or personality characteristics and social status. Anthropometric characteristics, are part of the anthropological characteristics, and are defined as properties are responsible for the dynamics of growth and development. Anthropometric measures describe the manifest space and are the basis for an explanation, interpretation and definition of latent morphological space (structure) of sailors which can be performed using different methodologies. We like losing one piece of relevant information, as is the case in some of the methodology for determining somatotypes of thought.

We need to avoid the index value from these reasons it is advisable that the latent structure does not interpret or Sheldon Heath-Carter method already factorial approach, typical of the "Zagreb school" and that the process defines the latent structure: longitudinal dimensionality of the skeleton, transversal skeletal dimensionality, circular dimensionality (bulking) and subcutaneous adipose tissue and thus determines the somatotype. This methodology allows for good and interpretable regression procedures to the manifest anthropometric area and the latent morphological pace. A few authors in their studies treated the anthropometric measures and trying to determine the somatotype sailors, the small and unrepresentative samples. Conclude that there was no systematic approach anthropometric-morphologic area sailors, and that this area really bad and sloppy scientific treated.

We shall specify results of some of this research. In the paper authors Pezelja et al. (2015.), the goal was to determine the morphological characteristics U23 Finn sailors and determine the relationship between their morphological characteristics and performance of the championship. With 18 elite U23 Finn sailors (age  $20.80 \pm 1.27$ ) was measured in 16 anthropometric variables. It was found that had an average body height of  $188.09 \pm 5.80$  cm;  $92.07 \pm 5.66$  kg body weight of  $13.1 \pm 4.2\%$  body fat and body mass index  $26.06 \pm 1.76$ . Compared with Laser Standard sailors, U23 Finn sailors had higher values in all anthropometric measures. T-test of independent samples between two groups with different levels of effectiveness (successful group and less successful group of sailors) showed statistically significant differences in two variables: body height and sitting height. Multivariate discriminant analysis found no statistically significant differences between the two groups. The results show that anthropometric measures do not have a significant impact or situational efficiency on U23 Finn sailors. The authors, though it declared in the work, in fact they did not mention the morphology nor define any morphological structure and somatotype, it is unclear where they got such title.

Author Pulur (2011.) dealt with determining the morphological characteristics, psychomotor skills and energetic status sailors on championship in Izmir. The experimental group was made up of 36 athletes (25 men and 11 women), 7 nationalities. Registered are: age, weight, height, skin fold thickness, measured the width and scope, calculated somatotype, test of anaerobic capacity, strength, reaction time, flexibility and respiratory parameters. The average age of sailors was  $22.18 \pm 2.09$ ; a sailor  $23.4 \pm 2.69$ . The average mass of sailors was  $58.36 \pm 06.14$  kg and  $70.28 \text{ kg} \pm 5:33$  with sailors. Height of sailors was  $165.55 \pm 5.77$  cm, and the sailors  $176.60 \pm 5.79$  cm. The percentage of body fat in women was  $17.74 \pm 2.30\%$ , and in men  $8.98 \pm 1.83\%$ . Sailors were divided on the somatotype endomorph and mesomorphic type while men fit into the

ectomorphic mesomorphic type. In conclusion, when morphologic, practical and energetic features sailors and sailors in this study are compared with those from other sports, no results have similar values. The problem of this work is that it is done on a small and unrepresentative sample of respondents with seven different nationalities. Light sailors tend to sail in lighter classes of ships; heavier sailors dominated the heavier classes. Much speculation has been the ideal morphological type. Boysen-Moller et al. (2015.) tried to do profiling of Danish Olympic sailor class. In their work they found that the mean (SD) weight sailors in the Laser 80.3 (2.7) kg, and Finn and Star 93.5 (10.8) kg. Exploring the morphological characteristics of sailors Shepard (1997) found that the percentage of fat mass with sailors than for most athletes of other sports. Sailors had the amount of skin fold measured 8 suspected skin folds, to 3 mm greater than the average 25-year-old male residents of Toronto. Gold medalist at the Olympic Games in Montreal were higher, but not the weight of the other participants. Shephard concludes that "it is wrong to look up one and declare it optimal profile. Although the sports success of the phenomenon of interaction and relationship factors, morphological characteristics are certainly the first of which we take care during the primary selection and ongoing sports training and specialization. The assessment of morphological characteristics contains identifying physical features, assessing and monitoring growth, tracking action training programs to changes in the structure and determine the optimum balance of muscle and fat in the athlete body. Authors who dealt with testing anthropometric-morphological characteristics of sailors, they found that the characteristics of different materials compared to a sailing class and position, or role, which behaves in a sailor crew. These differences are related to the body height and weight, and the amount of body fat mass. This problem is further complicated when one considers that the research conducted on different age categories of sailors who essentially have different characteristics of the entire anthropological space. Chronological age and training processes certainly change the character and ability of athletes, and that would be expected to tend to "model", of course, seniors with achievement in that category. Good and scientifically validated diagnostics and prognostics in space anthropometric-morphological characteristics of sailors all just supposed to be a path that forms the basis for the primary selection, training and specialization of sailors in all classes.

Comparing the values of anthropometric characteristics in a handful of authors conclude that the Croatian Lasers similar items sailors in this class in the world, with their numerical value of something bigger. The most recent data analysis of the morphological status of sailors in this class conducted on the 38 sailors Olympic levels indicate the range in height from 176 to 188, weight 80-84, while the average value of the sum of seven skinfold (measured using the same protocol as in the Croatian sample) is 54.6 millimeters.

So, Croatian Lasers have a similar height and weight with global pattern. The amount of the sum of skin folds with Croatian sailors on average higher by 19.8 mm, which is defined and a greater amount of fat mass of ballast ( $19.8 / 54.6 * 100$ ) 36.3%. At the same time, this is about proportionately smaller amount of muscle mass energy efficient. Comparing the sailors in the Laser radial and Laser in anthropometric-morphological area by Marinovic (2001) found that sailors Laser radial class belong to ectomesomorphic type while Lasers are characterized by endomesomorphy. We can conclude that the anthropometric and morphological space are badly treated and represented in scientific work in the field of sailing, and methodological approaches are different.

Therefore we are proposing that in future research of anthropometric-morphological space sailors used a set of 23 anthropometric variables were measured according to the protocol IBP (International Biological Program) as follows: leg length, total arm length, hand length, foot length, height, hand breadth, foot breadth, biacromial breadth, biiliocrystal breadth, biepcondilar femur, biepcondylar humerus, wrist breadth, chest girth, arm girth, forearm girth, thigh girth, calf girth, triceps skinfold, subscapular skin fold, axilar skin fold, calf skin fold, abdominal skin fold, weight and body mass index, body density, percent body fat (methodology and formulas to Katch FI, W McArdle (Hum Biol. 1973). the manifesto anthropometric area is suitable for regression procedures to identify the significance of individual variables and their contribution to the successful implementation of the sailors. for detection and definition of latent morphological space proposed standard factor analysis and taxonomic procedure.

#### *Motor skills*

Motor skills are defined as latent motor structures that are responsible for an infinite number of manifest motor reactions, which can be measured and described. This is a complex structure of quantitative and qualitative motor skills. Quantitative skills enable a high level of intensity and extensiveness of work and quality that allow the operation of high structural and biomechanical complexity. Quantitative skills include: power, speed, endurance and flexibility, while the qualitative include coordination, agility, balance and accuracy. Power is defined as the manifestation of the force produced by the muscle. It manifests itself in overcoming various resistances such as resistance substrate, a rival, a subject and others. Manifestations of power are: explosive, repetitive, static, absolute maximum and plyometric or elastic power. Explosive power is defined as the ability of the athlete to the maximum speed of their own body, an object or a partner in activities throwing and thrusting, jumps, kicks and sprint. Repetitive power - the ability of long-term work in the external load, not exceeding 80% of the maximum. Static power is the ability to generate maximum force in the attempt to move or ability prolonged contraction of muscles in static mode.

The absolute maximum power is the greatest power of movement that the athlete can produce in a dynamic mode. Plyometric power is a form of manifestation of power that allows the effective synchronization of eccentric and concentric portion of motor activity. Speed is defined as the ability to respond quickly, rapid execution of single-storey shops or more stereotyped movements per unit time. Exactly the same happens when measuring the speed of execution as single-storey shops or frequency of movement because the correlation between them is always above 0.95. Speed is the ability to overcome as many times in a short time. Manifestations of speed and also the ways in which we measure and is defined as: speed motor reaction speed of a single movement, movement frequency, cyclic and acyclic speed. Endurance is the ability to perform the training and competitive activities of adequate intensity in which a longer time. It is also the ability to delay the onset of fatigue, and metabolic products of tolerance primarily lactic acid determined by morphological, physiological, psychological, biochemical, biomechanical and motor characteristics. There are thus more definitions endurance of each of them is correct, but not complete. If, for pragmatic reasons, the need for the training of operational art, we want to define endurance, then we can do it only one way, defining it as a demanding force in which longer time for a given activity. It is clear that from the definition of results that endurance exclusively specific ability and that as such should always be treated. In order to successfully doing it is necessary to at least know precisely the size and percentage relationships explosive, repetitive and static strength specific to sailing and for each competition class. Flexibility is a feature that allows the execution of a large, maximum possible range of motion. The main factors that allow flexibility of the structural characteristics of muscles and ligaments are their resilience and structure and form of the joints where movement is performed. Coordination is the ability to manage the movements of the whole body or parts of the locomotors system. Psychomotor qualities, which we call coordination, the characteristics of extremely high complexity and it is difficult to simply define, just how difficult the measure. It is the ability to perform complicated movements with mean that the figurative point movement trajectories great complexity. In order to do this kind of movement could be exported, it is necessary to harmonize the movements in space and in time. These motor programs depend on the functioning of the CNS, practically at all levels what gives us the right to declare this characteristic act of thinking and motor opinions. In accordance with the objective pursued is often necessary to perform the movement as soon as possible in a given shape and speed of implementation and the complex structure of the movement depends on the final outcome, and its efficiency. The third aspect of this complex features about the ability to learn a complex action and exploit in the shortest possible time, then aspect of learning and adoption of complex motor tasks.

Another aspect is the ability to carry out non-stereotypical actions or movements. This is a form of motor creativity in which a completely new act of great complexity solves a motor problem. A final aspect is the one that talks about the ability to choose the best coordinated response with a defined purpose, the most practical and thus the most effective coordination as a top act of the motor, but also the wider thinking and reflection. Due to the great complexity of these features and more different forms through which the estimate, it is necessary to perform conclusions not based on one, but on the basis of multiple tests. Accuracy is the ability that allows the activities of the shooting or targeting guess some static or moveable target at a distance. Such types of precision do not appear in sailing but also precision in execution sailors manifested through correctly and quickly implemented actions as more like coordination, dexterity and agility. The equilibrium or balance is the ability to keep the body in equilibrium position in a way that moves the body parts, then active muscle activity, prevents the force of gravity on the creation arm forces. There are three basic types of balance: labile, stable and indifferent. Labile represent all views with lower reliance. Security equilibrium position is defined by the polygon support, and the position of general central brunt (OCT = point at which the hypothetical concentrated total weight lifters), and the median relative to the ground support. Angle security equilibrium position closes the medians descended from OCT perpendicular to the surface and the line connecting the OCT with the end point on the surface of the support in that direction. In standing with both feet straddle we have therefore four corners of safety, and thus the four possibilities of establishing a movement or disturbance of balance (forward, backward, left and right). Any balance will be disrupted at a time when the medians come out of the polygon support, so it is in many sports maneuvering corners security extremely important. Stable are all vain, therefore the upper supports, and is defined as a balance in which the OCT is below the pivot points. Indifferent balance represents such a position in which the OCT trainees in the same point where the axis of rotation. Principles of upsetting the balance, and thus the establishment of the movement, and to establish a balance, when she was disturbed, in all forms of balance is reduced to maneuver angles security, and use the force of gravity and the force of muscle in order to maintain or disrupting the balance. Sailboat and sailor in it represent a common system in which sailors move constantly changing center of gravity system which automatically changes the relationship metacenter (center thrust) and the center of gravity system-boat sailor what complicates this problem. Equilibrium conditions in the water are very much essential for the successful performance of all tasks in sailing. Properly taking the position of sailors in the system-boat sailor controls the balance system and thus determines the efficiency of navigation, of course, in the changing conditions of the race competition.

All listed psychomotor skills at the same time and in a certain percentage participate in all actions of sailors. The proportion of these skills sailors are given the assessment of ten experts, all with a degree in kinesiology or maritime university, specialized in working with sailors and with years of experience. The results of this assessment resulted in a ranking or hierarchical arrangement of psychomotor qualities of sailors as well as the percentage of influence of each of them, and represent expert opinion of those ten experts of sailing. The results (Table 1) are essential for sailors and coaches represent the basic information for the construction of the training was to situational or additional training of sailors.

Table 1. Ranking of psychomotor qualities of sailors on the basis of an expert's view of ten independent experts. Snaga = Power/Strength, Brzina = Speed, Izdržljivost = Endurance, Fleksibilnost = Flexibility, Koordinacija = Coordination, Preciznost = Precision, Ravnoteža = Balance (In Croatian).

	Snaga	Brzina	Izdržljivost	Fleksibilnost	Koordinacija	Preciznost	Ravnoteža	Sum
	2	5	1	6	3	7	4	28
	2	5	1	6	3	7	4	28
	2	6	1	5	3	7	4	28
	2	6	1	5	3	7	4	28
	2	5	1	6	3	7	4	28
	2	5	1	6	3	7	4	28
	2	5	1	6	3	7	4	28
	2	6	1	5	3	7	4	28
	2	5	1	6	3	7	4	28
	2	5	1	6	3	7	4	28
Sum	20	53	10	57	30	70	40	280
Rang	2	5	1	6	3	7	4	

Based on the ranking of psychomotor skills of sailors by ten independent experts, psychomotor skills are classified as shown in Table 2.

Authors Boysen-Møller et al. (2015) in the work Physical requirements in Olympic sailing describe the latest developments in the Olympic sailing due to the types of sailing analyze existing knowledge about the physical demands of the modern Olympic sailing. Final recommendations for future research given in the field of planning and any research in the field of complete psychomotor sailors In conclusion, the authors say that in accordance with the changes of the Olympic sailing has a lot more dynamics which includes several shorter races with a lot of maneuvers. Number of sailors is defined for each class. The obtained data are the basis for planning and programming of training process sailors in Olympic classes. Number of sailors on a trapeze increased. The literature suggests that prior to today's sailors in the Olympic class sets high requirements for impeccable mental and physical preparation. Trapeze artist must have an extremely high power extensor knee and also high capacity muscular endurance followed by aerobic capacity of medium to high value, appropriate anaerobic capacity, high agility and excellent balance. The physical demands placed before the sailors and their impact on the aerobic and anaerobic metabolism in intensity and extensity can be compared with the ones in cycling, running and cross-country skiing.

Table 2. Ranges of psychomotor skills of sailors in the Olympic class. Rangiranje = Ranking, Izdržljivost = Endurance, Snaga = Power/Strength, Koordinacija = Coordination, Ravnoteža = Balance, Brzina = Speed, Fleksibilnost = Flexibility, Preciznost = Precision (In Croatian).

	RANGIRANJE
1	IZRŽLJIVOST
2	SNAGA
3	KOORDINACIJA
4	RAVNOTEŽA
5	BRZINA
6	FLEKSIBILNOST
7	PRECIZNOST

Based on analysis of the study authors is obvious that they need additional studies in order to increase existing knowledge of the requirements in Olympic sailing. Progress technologies such as GPS, telemetry and portable measurement devices provide high-quality physiological measurements, detailed study of navigation, so in that sense it may make additional steps of introducing science into sailing. In relation to psychomotor sailors it should be testing of power in all its manifestations, agility, precision and balance, aerobic and anaerobic requirements and capacities, abilities as a whole, especially in terms of maximum energy stress sailors in all sailing classes. Increasing physical demands that are placed before sailing Olympic class in itself includes the aspect of fatigue as well as the development of strategies for optimal return from consecutive races in one day and between days of competition going on, as well as between the races in the season. Finally, the overall increase physical demands of Olympic sailing, a change towards more dynamic action in sailing also introduces a more important aspect of fatigue, which in turn requires the development of strategies for optimal return from consecutive races on one day, between one generation ago, but a race within the season. Knowledge of optimal muscle return derived from other sports with similar.

#### *Energetics*

Functional capabilities include the ability range and stability control transport system, that is, the ability to release adequate amounts of energy in the cells of the body to retain the homeostatic conditions and the operation of the specific functions of certain parts. The basic structure of training functional abilities form of aerobic and anaerobic stimuli character, and every branch of sport it is possible to describe some energy mechanisms, and they are: anaerobic, phosphagenic, glycolytic and aerobic. In their paper, the authors Castagna and Brisswalter (2007) analyzed the impact of exercise endurance and skill level in relation to the duration

of the exercise and the consumption of energy in laser sailing. Measured as 23 of the subject are divided into two groups according to their abilities: 13 high (HS) and 10 low (LS). Each subject performed the test sailing in the wind for 30 minutes, with changing direction every 2 minutes. Heart rate (HR) and respiratory gas exchange parameters were analyzed during the course of the test, and measured the concentration of lactate in the blood [label] at rest and immediately after the exercise with three repetitions at intervals of 4 min. The intervals selected for analysis. 6-10 minutes (T10), 16-20 minutes (T20) and 26-30 min (T30). Unlike previous studies, the authors found a significant progressive aerobic energy metabolism. Duration of sailing in the HS group (T10 = 45%; T20 = 61%; T30 = 68% VO<sub>2</sub>max; P < 0.05), while consumption remained stable. Significantly lower results were achieved in the LS group (T10 = 45%; T20 = 52%; T30 = 51% VO<sub>2</sub>max, p < 0.05). The study shows that aerobic power is more important in the LS than in HS patients in the 30-minute race. The results suggest that the data are important factors set performance sailors in the Laser. The authors recommend further research to confirm and explain these differences. When one thinks and speaks in terms of transformation processes of primary and specific anthropological characteristics, state of training, sports form, modeling development condition, then you are actually in the field of teaching methodology of sports training. Methodology of sports training is the scientific discipline that studies the legality of the methodological organization of training work, modeling and evaluation of training and recovery measures. In fact it is a choice, dosage, organization and implementation, the training stimulus and the training of operators. Training operators (exercises) are a stimulant that in terms of response products appropriate quantitative and qualitative changes of the athletes. Methodical procedure in top sport, the process of implementation of selected operators of training, coordinated with appropriate, operationally defined aims. Because of exceptional complexity of sailing as a sport, it is very difficult to define the anthropological dimension that should be monitored and diagnosed, the determination and the training status and the determination of the sports form as and modeling developmental state thus much more difficult.

#### *The primary and specific anthropological characteristics*

##### *Primary*

Morphological characteristics sailors define the structure and the structure of these athletes and have a direct connection with all biomechanical outputs that significantly influence the success in the sport and are specific just for the sport. Motor skills are in turn those features that are related to the efficiency of the neuromuscular system, which is responsible for the intensity, duration and control of movement. They provide a powerful, fast, long-lasting, precise and coordinated performance of different motor tasks.

Functional skills are associated with the efficiency of the anaerobic energy mechanisms and effectiveness system to transport oxygen responsible for aerobic fitness sailors. Cognitive abilities are capable of receiving, processing, retention and use of motor information which assures make fast and accurate decisions during the training or competition activities sailors. Conative dimensions determine personality structure and responsibility for all forms of behavior and activity level during training and competition sailors.

#### *Specific anthropological characteristics of sailors determined*

specific fitness levels, specific skills and knowledge, technical preparedness, specific tactical preparedness and specific theoretical knowledge. The specific and situational fitness levels are manifested in the specific structure of the movement of sailors in this class, the structure of the situation that sailor solves, precisely in its class, resulting in technical and tactical preparedness sailors. Technical, tactical and theoretical preparedness also means requires a high level and integrated operation of technical and tactical skills of sailors to ensure successful resolution of situational problems during training and competition. Training functional abilities in a methodical and methodological sense, in sports including sailing can be treated and develop situational or extra training. Most often or almost always serve to develop specific endurance sailors and certainly the most useful ways of working with the sailors. Specific functional capabilities best sailors will be controlled and developed in a way that separately develop their components, such as anaerobic and aerobic capacity sailors (partial methods or partial training) combining this work with the work of the situational conditions when at the same time working on both sub capacity (situational training ). This is the only correct approach in developing energetic potential of sailors and the development of energetic components of sailors.

#### *Anaerobic capacity*

*defines the total amount and availability of stored muscle hydrolytic compounds (energy- rich substances), which is directly used as an energy source for muscle contraction (ATP and ADP resynthesis reaction with anaerobic glycolytic process).* This capacity sailor was short, but used as an energy source several times. For example, when the sailor should suddenly pull the sheet, to contract to a significantly higher number of muscle cells than in the conditions of daily life, and will be used for such work a certain amount of energy from their anaerobic capacity. Activities suitable for the development of anaerobic capacity sailors, depending on the purpose of focus and purpose of the work on their development, they are suitable for anaerobic energy depots and those that are suitable for improving the tolerance to biochemical changes that occur during the anaerobic energy reactions.

Aerobic capacity is defined as capability and efficiency of the system for the transport and utilization of oxygen in the biochemical processes of energy production oxygenation. The simple and understandable definition of aerobic work is that it is the work in which the amount of inhaled air, but from him oxygen during labor sufficient to supply all the tissues that acute work without having not produced a long oxygen is being paid upon completion of the work. Maximal aerobic power was defined as the maximum amount of oxygen that can be supplied to the muscle cells in the manufacture and use of energy for fulfilling muscular work. For the development of aerobic capacity sailors use exercises of different character such as cyclic Extracurricular activities and their combinations (walking, running, swimming, rollerblading, etc.), Contemporary Extracurricular cyclical activities and their combinations (bicycle ergometer, rowing ergometer, conveyors, steppers, etc.) and programs of modern aerobics. (Matveev, (1999), Bompá Tudor O (2000), Lozovina, V., Lozovina, M. (2012).

#### *Balance training and sports form sailors*

The term sport of preparation involves the optimum condition and functioning of sailors, optimal health and the highest level of physiological and functional (fitness) capability, maximum technical and tactical efficiency, adequate mental stability, high motivation and optimal structure of morphological characteristics. The optimum condition implies permissive state and functioning of the athletes within the set limits determines the level of preparation of specific work potential athletes and its potential and actual ability to achieve high competitive results. Sports preparation appears as a product of the various sports training programs that take into account all the pedagogical and didactic principles. Programs may vary only in the principle equidistance (different paths to the same destination) as the programs and in the work of different trainers of trainers.

Sports form the highest state of training of sailors, which allows achieving the best competitive results in the most important and biggest events (programmable, usually for a one-year cycle, the Olympic cycle and perennial). A sailor who is in the sports form is completely healthy, expresses the need for training, show all his skills and turn them into the best result, quickly adapts to training and competition requirements. Indicators of sports form manifested itself in the biochemical state of the body (the concentration of lactate and urea in the blood and the state of glycogen and catecholamines...), physiological state of the organism (Freq. Heart spiroergometric indices, body temperature, pressure ...) and motor condition athletes ( the results of tests of motor skills). Development phases in sports that form sailors in one macro cycle are entering the phase of athletic shape, phase stabilization and maintenance of the top sporting form and stage a temporary decline in the sports form.

*Planning and programming*

Planning of training represents complex control actions of the aims and tasks of the training process, cycle times to achieve them (periodization) and the necessary technical, material and human resources. For each training plan, it is important that it is based on quantitative (measurable) size, so it will only be possible to objectively determine its parameters and evaluate effects. Diagnosed initial state, programmed final state, certain transitive state as the point of measurement and control in time, all aligned with the calendar of events, sets of data that guarantees full control of the sports form. Periodization of training is the process of determining the cycle sports training or simply sharing a larger cycle less. It is defined as the timing of training in which the expected and desired programs of non-objective and measurable changes outlined in the transitive and final state of sailors. *Programming* training is a management action laying down the procedures that contain information about resources, workloads and work methods of training, recovery and competition. This is actually a choice, dosage and schedule of training of operators to be applied in different cycles for sports training and necessarily must meet the conditions of training sailors as well as the conditions under which prepares sailors carried out. For effective planning and programming training are essential two prerequisites: the amount of scientific and technical knowledge of the sport as sailing and vocational training of trainers and other professional staff involved in working with athletes. Planning and programming is usually carried out for a period of one year, two years, four years or a period of one Olympic cycle, sometimes two Olympic cycles. Sports career in a biolympic cycle is managed with long-term, and the Olympic and two-year cycle of the medium-term planning and programming of sports training, and in the short term plan and program, annual and semi-annual macro cycle. For the periods and phases applied current, and the microstructure of training (micro cycle, training day and individual training) operational planning and programming of sports training. Modeling of the plan and training programs carried out in four phases: The first model year cycle, Second period and modeling stage, 3rd modeling micro cycle, 4th modeling of training days and individual training.

*Long-term planning and programming* refers to the total time sports career sailors. A multi-year cycle (according to Matvejev, 1999) consists of three basic stages with substages. And those are:

1<sup>st</sup> stage - basic preparation (preliminary preparation, beginning sports specialization)

2<sup>nd</sup> stage - maximum realization of an athlete's individual abilities (actualization preparation or profound sports specialization, implementation, record individual achievements)

3<sup>rd</sup> stage - extended sports career (maintenance level sporting achievements, sporting preparation)

4<sup>th</sup> stage - medium-term planning and programming in the work of the sailors cover the Olympic cycle.

In the first two years conducted an extended preparatory cycles and training seeks to raise the basic functional and motor preparation, to improve and to automatism bring new and cost-effective technical and tactical skills. In the third year dominates training structure dominated by competition system as it is foreseen in the Olympic year. In this period of testing the model of training that has been folded for competition in the Olympic year. In the fourth year realized tested model with any corrections, which ensures the highest level of sporting achievements in the Olympic competition.

*The annual cycle of training* of sailors is planned and programmed in one or more of training macro cycle, each of which consists of preparation, competition and transition period. As for the planning and programming period and phase of note is that they are a necessary part of the training process as they enable purposeful management of the cumulative effects of training. Periods are integral parts of the macro cycle, but in its structure containing multiple phases. In the preparation period carried out development programs of a sailing character enable achieving sports form. It consists of a stage of multilateral preparation stage of basic training, specific stages of preparation and PRE-stage. The transitional period includes an active vacation a few weeks at the end of the season. While this is theoretically a period of several weeks in practice is usually ten days, with active recreational vacation sailors. *Micro cycle* is the basic, the unit, the structure of sports training process through which we manage the process of preparation. Each micro cycle programmed is a relatively closed whole that is repeated with greater or lesser adjustments depending on the periodization of previously achieved results enabling successful management of the effects of extended training. According to the criterion of size and arrangement of training and competition loads may vary, ordinal (ordinary) micro cycle, shock and relaxation micro cycle.

Each one has features which are different. Each micro cycle contains stimulating and relaxation phase. Practice day part of the micro cycle, having one or more individual training. Individual training is basic: training units which generate immediate effects, which are by the way immeasurable immediately after training. This is because training is a series of distinct, separated, the operation by which the terms of the cumulative effect and a delayed transformation we can expect his score improvements that can be accurately measured as a percentage of progress against previous state, if the training well programmed and executed, or the percentage of stagnation or even regression in case of bad programming. The organization and implementation of training is more complex when one day performs two or more training. Then the individual training divided into basic and additional. All training in its inner structure is composed of four parts, the introduction, the preliminary, main and final part. (Lozovina and Lozovina, 2012, Bompá, 2000).

## An example of planning and programming in sailing

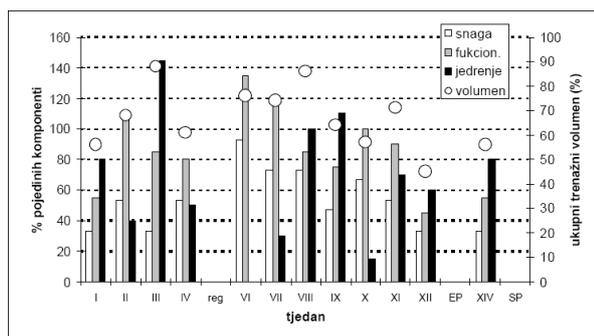


Figure 1. Periodization in a four-month period for sailing in the Finn (Sekulić, 2003).

The most important competition of the season was the European Championship and World Cup, one of which is undoubtedly significant was SP. Potentially, the form could be timed in three ways: plan top sports form for the European Championship, followed by a decline that inevitably affects the SP. Plan top sports form for the World Cup and also "sacrifice" EP, achieve a solid, if not the highest, the form of the EP, and then to maintain SP. In this case, not a single event affects not complete top form, but none are in advance "sacrificed". In order to avoid any confusion, at major competitions in sailing, the peak form can not be maintained at the maximum level for a period longer than seven days, due to the characteristics of the competition. At the European Championship and World Cup, a competition lasts for six days and each day will be sailed on average 2 regattas. Thus, it appears that after such efforts inevitably follows a drop of form, which is all the more pronounced the higher the level of form that had been achieved before the competition. Why?

For reasons of a supercompensational nature. To achieve the necessary increase in the forms before the event substantially reduce the volume of the work, so a few weeks before the competition reduced working volume. However, what to do after the competition in which you entered complete supercompensation? In order for the coach's work to be successful and therefore the preparation of sailors to work, the coach must be able to manipulate the sport form. The prerequisite for this is that to know in detail the dynamics and intensity of the individual phases of recovery athletes to know that the best time for the next training. The best time for going training is at the time of the summit of a supercompensational wave. Super Compensation is a condition where there is an increase of energy reserves of the body to a higher level. If you have time to reboot the volume of work, the accumulation of training effects and supercompensation, then everything is fine. In this example, it was not possible. Between EP and SP was barely 10 days. The coach and sailor competitor decided to do partial supercompensation EP, light restitution and "capture" the SP now again in stage partial supercompensation.

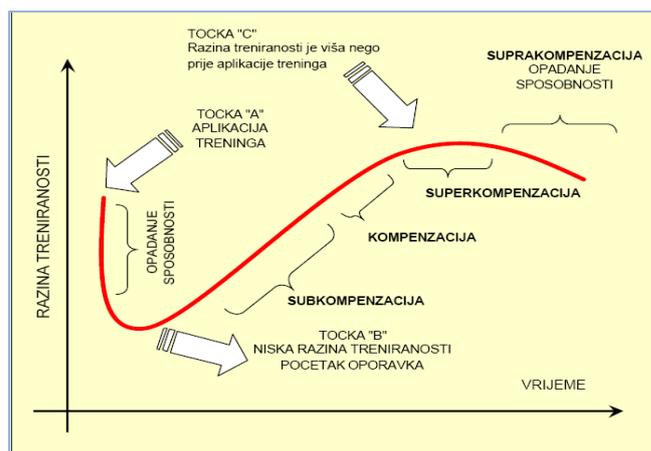


Figure 2. Dynamic of training effects (Sekulić, 2003).

Judging by the result obtained in the intention and managing, they won bronze at the European Championships and silver at the World Cup. (Sekulic 2003)

#### Field Hockey

Sailing is meant the movement by taking advantage of the sails of wind energy. A boat is sailing in exposed apparent wind generated by composing the actual direction and speed of the boat. The apparent wind when it blows from the front is stronger and came under small angle of true wind, the more the boat faster. As a consequence to the fast cruisers acting apparent wind much stronger than the right, so they therefore sail faster than the wind speed in which they are located. Flow around the core, the center creates aerodynamic force perpendicular to sail a sailboat that pushes in that direction. If this is not the preferred course sailing boats, this force pushes the boat forward (push) and pushing it sideways (drift and tilt). When it is useful only urge. Drifting sailboats opposes fin, and the tilting stability.

*Speed of a boat* depends on the shape of its hull, sail and wind. Sports sailing is sailing for recreation in the narrow sense (cruises), and regatta sailing. Cruising regularly in closed boats equipped with an auxiliary motor and suitable equipment. Races are held in turn in a certain class sailboats. In competitive sailing is common competition: Offshore race - the race field connects distant places on the coast and very far away. In these races appear sailboats built and equipped for sailing in all weathers. Time spent in the regatta compensated according to the classes in which the boats classified.

*Races in the field - sailing in a triangle* - with three buoys located in the triangle mark the trail and the race field. Total field a competitive boat with crew must pass several times. The longest side of the race field sets always in the wind as to reach the target in the direction of the wind shows the quality of yachts and crew on it. The longest side in the wind leads to expansion of the fleet sailing.

Often are used the so-called Olympic circles with eight marks on the perimeter. Then in the instructions for the regatta must be accurately described all variants racing stripes. If a significant change in the wind direction after the start of the race, the race committee may change the windward page by moving the original windward mark or to set up additional windward mark to ensure sharply sailing upwind.

*Races in the field - sailing in a stick - racing area marked with two buoys through which extends the direction of the race field. Racing area boat with crew passes one or more times. Racing stripes in this case may exist and bypass any code, for example lighthouse, island and alike. Then, the instructions for maintaining the race are accompanied by a maritime map. The duration of the race is limited to cases where there is not enough wind. The minimum average wind speed in order to maintain the race at all is usually two nodes. If the first boat has finished the race in a given time, the regatta is valid for all boats. Sometimes navigation and regattas limits during the race, but scored only boats that the interim targets and aim to reach the set deadline (or date).*

Table 4. Basic technical data of Olympic classes

Basic characteristics	Finn	470	49er	49erFX	RSX	Laser	Laser	Nacra 17
Crew number	1	2	2	2	1	1	1	2
Spinnaker	NO	YES	YES	YES	NO	NO	NO	YES
Men/Women	M	M/W	M	W	M/W	M	W	MIX
Sail number	1	2	2	2	1	1	1	2
One seat/two	1	2	2	2	0	1	1	2
Hull weight	107kg	120 kg	70kg	130kg	15,5kg	59kg	59kg	142kg
Overall length	4,5m	4,70m	4,995m	4,99m	2,86m	4,23m	4,23m	5,25m
Width	1,5m	1,7m	2,9m	2,9	0,93m	1,37m	1,37m	2,59m
Sail surface	10,2m <sup>2</sup>	13,04m <sup>2</sup>	21,2m <sup>2</sup>	19,6m <sup>2</sup>	9,5m <sup>2</sup> M	7,06m <sup>2</sup>	5,76m <sup>2</sup>	18,45m <sup>2</sup>
Spinnaker	0	12,16m <sup>2</sup>	38m <sup>2</sup>	25,1m <sup>2</sup>	0	0	0	18,5 <sup>2</sup>

#### Sailing techniques

In accordance with the direction of the wind and the race field sailboat can be maneuvered from zero to 3600. For those possibilities there are techniques and methods that are managed sailboat. A boat will be stopped if the geared head to wind and sails to 00. Zone 00- +/- 450 (left-right) is called a "dull" zone or a zone that is not sailing. When space in the direction of the wind overcomes the zigzag movement it is done by changing the actions tacking, accepting and declining. When sailing in the direction of 450 to the left or right of the wind direction competition is fierce in the wind, as is sailing 450-900 sail upwind and sailing under 900 in relation to the direction of the wind sail with the wind at your side. The angular value of 1350 in relation to the direction of the wind sail with the wind in the middle of the feed and then a boat is the fastest. The angular values 1350-1800 sail with the wind astern. There are four basic technical actions by which a sailor learns the racing area:

*Tacking* (with the wind in the right side (starboard tack) or with the wind in the left side (port tack)), sailing sharply with the wind it is at an angle of 450 to the direction of the true wind. In order to be moving in the rates of exchange in the opposite

Such rules can avoid waiting for the boats that gave up sailing. Primary competition consists of a series of races, usually five or seven races. At the Olympics are regularly held seven races, and not less than five. At the same time every day to keep one race. The race with the weakest results are discarded and charged, and the rest are scored. Ordering and placements determined by the sum of points from all races. The scoring system may be the place (the order of arrival in the goal that is at the same time the number of points). After this scoring system better are those crews that after completion of the competition all the regattas have the least number of points. It can be applied the principle that the crew that first arrived on the goal is assigned the highest number of points. Then the winner of the crew is the one with the highest sum of points in all the races. In the same number of points the right to a better order and placement has crew that won more and better places (the sum of the first and third place is better than two second places).

Table 3. Olympic classes

Finn	470	49er	49erFX	RS:X	Laser	Laser Radial	Nacra 17
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direction from where the wind blows must be sailed in zigzag courses, each time at an angle of 450 in the direction of the wind. Turning the boat's bow so that it passes through the wind called tack. Technical action looks like this: abs sitting to windward rudder pushes the opposite of itself, then the boat changes direction passing head to wind, when the sails start shaking out releasing the sheets and moves to the other side accepting the other sheets and the appropriate tuned sails continues to drive sharply with the wind . Tacking is practiced until the automation of technical elements in all maritime conditions. Maneuver definitely should not take more than a couple of seconds. If a boat rides tougher upwind (400), its speed will be lower than normal, and greater enthusiasm and the progress toward the goal slowly. If the boat sails less sharply upwind (500), its speed will be only slightly higher than normal, enthusiasm slightly smaller, but will therefore increase the time and she will therefore advance rate will be lower.

*Circling* - technique or maneuver circulation sailor will apply when sailing with the wind astern must still fall off, and when sailing with the wind astern wind changes direction and begins to blow on the side where there is a boom.

Before circling maneuver necessary to assure the possibility of the same. Before the maneuver sail defects downwind while vane to show the direction of the bow. Then perform the following actions: the rudder moves in the opposite direction from those of the boom. Collected sheets to sail, at a time when the boom, making us to go to your head move to the other flank boat's rudder is pushed slightly in the opposite direction, then returned the pass and discounts sheets sails. Accepting - the action or technique with which the boat to veer off course with the wind astern to the course to head to wind. A boat will tend acceptance if you turn to windward when they leave the helm. The tendency of acceptance will be reduced if the crew moved to the stern. When the balance with sailboats of sail and jib, make sure to sail and jib are equally tensioned and at the same time begin to discharge along the front hem along the whole length. Declining - boat is in the debris when moving from the course sharply with the wind to the course with the wind astern. A boat has a tendency to fall off sharply when sailing with the wind changing course to leeward and when you leave the tiller. If the jib is stretched over the core, a boat will tend to fall off. When sailing with the wind astern, the core pushes the bow to more diving, but the crew has to move more toward the stern and his weight leveled. Statistical analysis of sailing racing exchange rates shows that 550 of his boat sailing time spend sailing upwind, about 200 with the wind in half and feed 250 downwind. A large percentage of sailing upwind is clear when one bears in mind that exchange rates upwind occupy half circle pinwheel. Sailing close hauled wind in part, means time to the wind, this is the reason for the greatest interest of sailors to overcome precisely these courses. Downwind sailing is the most left to the wind and waves. In these conditions the sailing without swaying symmetry is an important force in the sail (jib is set to achieve symmetry in the opposite direction from the wind, if there raises the spinnaker or at least a large flock). This increases the overall speed boat. In this type of sailing the problem is the wave that comes with feed or from the side. Another way of overcoming is "mowing" downwind. A boat on the course in half the feed cores alternately moves to the left and right track. Speed of sailing is much higher, and sailing is peaceful. Kolin, CICAR, Lakos, Mitrovic, (1979).

#### *Tactic sailing*

Tactic sailing consists of successfully and to perfection of scientific techniques, knowledge of the racing rules and maritime conditions prevailing in a competitive field. The peculiarity of sailing reflected and defined rules. Sailing regatta opponents are facing each other are removed from the track and each other to seek and interfere with each other whenever they get the opportunity. Since the start is very important for the race, the starting field comes much earlier, studied the circumstances (wind, currents and waves) and repeated the tests the maneuver start. A good start was made when a boat went as fast as possible, free and uncovered

by other boats. Route selection is one of the key tactical factors in all forms of competition. It is especially important in the race in the triangle. As in this case after the start follows a long sailing windward, the success of overcoming these stocks usually decides in the final standings. This side of the triangle can be overcome in two long years or shorter with each turn means loss of speed or time. On the part of the route with a favorable or stern wind usually sail directly to the mark with the exception of when the obvious opportunities outside of that part of the route. Route selection can dictate and the current is strong and fast and the track is cut vertically. Likewise, the choice of route may be affected, and certainly expected change in the wind (mistral in the sun). For navigation regatta is necessary to analyze in detail the course, know the winds, currents, tidal stream and all other details of the successful navigation. Sailing on the line or the rod usually is free and without wind coverage at the start or during the race to create a dense group of sailing. These groups should be avoided because the field is turbulent, disturbed and reduced wind. The second part of the tactic lies in the fact that the other boats are not allowed to get in better opportunities direction where to get the speed of the height in the wind. Sailing a boat in the wind of the attack defends it by always holding opponents behind and leewarding repetitive maneuvers. If, however, the opponent comes closer to the turbulent water and wind or the "cone of coverage" front boat, the front of boat always defends itself if it is attacked by multiple boats. A boat sailing upwind attack does exactly the opposite of what works leading boat. Dictating the action is likely to benefit from the poorer and slower maneuver first boat. The classic form of "attack" is a lot of consecutive tacks. The meeting sailing upwind common is where the rule of the right reins in principle decided by the outcome of the meeting. A boat from the port tack in such event can occur before an offensive by tacking to leeward bow (without interfering with the way a sailboat with priority right of way), thereby establishing a safe leeward position, and thus lagging behind the boat with the priority times. If this maneuver sailboat with port tack can not do, is obliged to pass astern of the other boat. A boat with starboard tack can tack to windward and ahead of another boat is bringing in so unpromising position. Against tack to leeward of the other boat can not do anything but herself to fly so as not to fall behind. The crosswind tactic is the same as the wind. The crosswind sailing boats are most inferior and have a similar speed. In the crosswinds decide only faster and better maneuvers. From covering the boat's persecutor, the front if the boat defends the avoidance cone covering the rear boat. This cone is the longest in the extension of symmetry boat. In defense of acceptance leading boat seeks fall behind the bow attacker preventing a sudden maneuver falling and sudden breakthrough in the lee. At buoy, leading an external position it is necessary to replace the internal, even at the cost of losing the order by passing astern of one or more boats. The breakthrough ahead to windward,

away from the opponents will only succeed at a higher speed with the wind in half and feed it to the stage of the journey is not too long. The breakthrough in the lee manages only to a greater distance. Round the mark is very important tactical maneuver which often loses place. Too sharp a turn always means slowing down and loss. Therefore, the mark goes around in the mild arc especially when the code reaches under favorable wind, but after the tour continues course sharply with the wind. On the label comes with a starboard tack boat because the left has to miss all those with the right. In case of failure of the arc before the tour marks the passage next to the label can mean profit. It is common to provoke opponents with whom there is no possibility of overlap in the fight before accepting the mark. It should cover it with a stern wind and come to overlap. Defense before marking consists in feigned maneuver struggle by accepting and putting opponents with the wind, and thus in coverage. Nevertheless handling sails, especially spinnakers should be seamless because the mark (buoy) fundamentally changing course. In order for the race area in the competition worked optimally it is necessary to long-term learning and training sailors to bring the situation to the technical elements of the sailing defeat to perfection in all possible conditions of competition. This implies as his knowledge of technical and other characteristics of the vessel with which it competes. Thus, the characteristics of the hull with the keel, the characteristics of the steering system (torque ship), rig, main and auxiliary engine if the boat has, navigators, nautical charts, radio broadcasting system, main and auxiliary safety equipment on board. In the case of the navigation race, preparing for the regatta begins studying the area of navigation. To obtain a general picture of the navigation area sailors will serve maps and manuals after which they will approach an exhaustive study of certain parts of the track on the basis of which they will select the best navigational route. Selection of the best sailing route will depend on: hydrometeorological conditions and weather forecasting primary, hydrographic and navigation features, distance reference points in the regatta, boat equipment, or coastal navigation devices, recommendations that give guides to navigation, traffic density, etc. Here are all necessary elements for carrying out such an event, and for its success in the end. However, the success of sailors competing in regattas in the field

except that depends on the degree of adoption of technical elements, since in those races show a large number of boats, it is important to know the sailing tactics. The choice of tactics will depend on the possible conditions in a given pathway. This implies knowledge of meteorology and thus the micro-meteorological conditions and the likely potential on the race field. Equally, sailors must know the tides and currents of the tides on the race area and types of tides that can be a one-day, half-day and mixed type. Given the additional action of ocean currents and waves, a sailor must know calculate courses and in navigation under ecstasy. These are all elements with which the sailor has to be informed before the start of the race. When the race starts he will choose the kind of tactics that he will at some point be most useful for the purpose that it would be a better place. However, since the most common meteorological conditions are not permanent, sailor will change that occurs, react by adapting, which means changing the current tactics. As the regatta sailor "fighting" with other sailors, then he will change tactics if necessary, to ensure themselves a better position, and also at the end and better placement. Anyway, whatever tactics sailor chooses, it will be right if he brought him victory.

## Conclusion

In the analysis of the relative lack of no scientific literature cited research on the Olympic class sailors that their content linked to the work presented features and capabilities of sailors in the Olympic classes. Anthropometric and morphological space, psychomotor skills, energetic status and technical and tactical knowledge and skills of sailors in Olympic classes are not scientifically thorough, and at least sufficient, processed. Considering these shortcomings in the context of the theory and methodology of sports training, in this paper, is relevant date information to all who are engaged in sailing and scientists are encouraged to be directed towards scientific approaches that will lead to work with in practice usable results. This refers to the experimental studies on representative samples of sailors, well-thought-out and realized, with a possibility of generalization. Results obtained in the transparent scientific works or works on insufficient samples are not usable for serious planning and programming of work with sailors in the Olympic classes.

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## ANTROPOMETRIJSKA-MORFOLOŠKA, PSIHOMOTORNA, ENERGIJSKA I TEHNIČKO-TAKTIČKA SVOJSTVA JEDRILIČARA U OLIMPIJSKIM KLASAMA

### Sažetak

Sportskom jedrenju u olimpijskim klasama, u ovom radu, pristupilo se analizirajući neka dosadašnja znanstvena istraživanja antropoloških karakteristika jedriličara u tim klasama. Pozornost je posvećena antropometrijsko- morfološkom prostoru, prostoru psihomotoričkih sposobnosti, energetičkoj komponenti, izraženoj kroz aerobni i anaerobni rad jedriličara kao i tehničko-taktičkim značajkama jedriličara u olimpijskim klasama, područjima koja su najčešće istraživana i prezentirana u domaćoj i svjetskoj znanstvenoj literaturi. Analizirana područja ne bi imala svrhu kada ih se ne bi stavilo u kontekst teorije sportskog treninga jedriličara pa smo u radu prezentirali teorijske osnove stanja treniranosti i forme jedriličara kao i planiranja i programiranja treninga u sportskom jedrenju. Sagledavajući manjkavosti i nedostatnost znanstvenih radova u obrađivanim područjima antropološkog statusa jedriličara u olimpijskim klasama u radu smo iznijeli relevantne informacije svima koji se jedrenjem bave, a znanstvenicima je upućena poruka i usmjeravaju se ka znanstvenim pristupima koji će rezultirati radovima sa za praksu upotrebljivim rezultatima.

**Ključne riječi:** jedrenje, olimpijske klase, antropološki status, teorija treninga.

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