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STRUCTURE AND FEATURES OF THE MANIFESTATION OF DIFFERENT TYPES OF ENDURANCE IN WATER POLO PLAYERS AT THE STAGE OF ADVANCED SPECIALIZATION DURING THE PREPARATORY AND COMPETITIVE PERIODS

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ABOUT ARTICLE

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Abstract: The article examines the structure of endurance in water polo players at the stage of advanced specialization and identifies the specific features of the manifestation of its main types during the preparatory and competitive periods of the annual training cycle. The paper reveals the essential characteristics of general, special, aerobic, anaerobic, speed, and technical-tactical endurance, and analyzes their functions, interrelationships, and features of manifestation under training loads and competitive conditions.

Introduction. Modern water polo is recognized as a high-intensity team sport characterized by a pronounced intermittent pattern of activity and a complex combination of technical, tactical, physical, and physiological demands. The specific nature of competitive

performance in water polo is determined not only by the quality of technical execution and tactical decision-making, but also by the strict temporal structure of the game. Under the updated World Aquatics regulations, a match consists of four periods of 8 minutes of actual playing time, while the possession format has been modified in such a way that the first possession lasts 28 seconds and subsequent possessions last 18 seconds [15]. These regulatory changes have accelerated the pace of the game, increased the density of match episodes, and intensified the demands placed on the functional preparedness of players.

From a physiological perspective, water polo is distinguished by the repeated alternation of short, explosive actions and sustained efforts performed under conditions of incomplete recovery. During a match, players repeatedly execute sprints, accelerations, changes of direction, vertical jumps, wrestling actions, ball handling, and shooting, all while maintaining tactical awareness and technical precision. Such a pattern of work requires the simultaneous involvement of different energy supply mechanisms. According to contemporary reviews, competitive activity in water polo relies on a combination of aerobic and anaerobic energy contributions, which confirms that endurance in this sport should be understood as a multicomponent construct rather than as a single generalized quality [16,19]. In this regard, the traditional interpretation of endurance as merely the ability to sustain prolonged work appears insufficient for understanding the actual demands of water polo performance.

The multicomponent nature of endurance in water polo is also reflected in the diversity of its manifestations. In practical and theoretical terms, it is appropriate to distinguish general endurance, specific endurance, aerobic endurance, anaerobic endurance, speed endurance, and technical-tactical endurance. These forms of endurance are not isolated from one another; rather, they interact within the broader structure of sport-specific performance. General endurance provides a functional base for tolerating training loads, whereas specific endurance reflects the ability to maintain effectiveness in the specific motor and tactical conditions of the sport. Aerobic endurance contributes to recovery processes and overall work capacity, while anaerobic endurance supports the execution of repeated high-intensity efforts. Speed endurance and the ability to perform repeated sprints are especially important in a game environment characterized by frequent bursts of maximal or near-maximal intensity. Technical-tactical endurance, in turn, reflects the ability to preserve the quality of movement execution and decision-making under fatigue. Such differentiation is of particular importance when analyzing the role of endurance within the logic of long-term sports preparation.

A substantial contribution to the development of scientific and methodological ideas related to the training of water polo players in Uzbekistan has been made by the works of A. G.

Sadikov. His curriculum for children's and youth sports schools and specialized Olympic reserve institutions systematized the main sections of the long-term training process, including planning, organization, monitoring, and methodological support for players of different playing positions [1]. These provisions were further developed in the textbook by A. G. Sadikov, Kh. Yu. Matnazarov, and U. Kh. Rakhimboev, which addresses the theoretical and practical foundations of specialized training in water polo, including swimming technique, the organization of training sessions, and the preparation of specialists in this sport [8]. These works are of great value for the development of water polo methodology in Uzbekistan. However, despite their importance, the differentiated analysis of endurance types in water polo players during different periods of the annual training cycle remains insufficiently developed.

In recent years, scientific interest in the assessment of water polo players' performance capacity has increased considerably. Contemporary studies focus on physiological swimming tests, athlete monitoring, repeated sprint ability, and the assessment of aerobic and anaerobic performance [16,17]. These areas of research have significantly expanded our understanding of the factors underlying success in water polo. In particular, repeated sprint ability has been identified as one of the central indicators of specific preparedness in elite water polo players, as it reflects the capacity to repeatedly perform short, intense actions without a marked decline in effectiveness [17]. This quality is especially relevant to the competitive period, during which match performance depends not only on the player's absolute functional capacity but also on the ability to sustain speed, coordination, and tactical efficiency under fatigue.

At the same time, the literature indicates that the structure and manifestation of endurance are not stable throughout the annual training cycle. During the preparatory period, the training process is primarily aimed at building the functional base of performance. At this stage, general and specific aerobic endurance, together with the anaerobic-glycolytic component, play a decisive role, as they support tolerance to substantial training volumes and create the prerequisites for subsequent sport-specific adaptation [18]. By contrast, in the competitive period, the priorities of training shift. The emphasis increasingly falls on speed endurance, repeated sprint ability, technical stability, and the preservation of effectiveness in game episodes under conditions of progressive fatigue [17,20]. Thus, the role of different types of endurance changes depending on the objectives and content of each training period.

Another important issue is the relationship between endurance, fatigue, and recovery. Modern studies of water polo performance show that increasing internal load during congested competitive schedules may impair perceived recovery, negatively affect functional status, and reduce the stability of sport-specific performance [19,20]. This means that endurance in water

polo should not be interpreted solely as the ability to continue working over time. It should also be considered in relation to the athlete's capacity to recover between bouts of high-intensity activity, between training sessions, and between matches. Therefore, the analysis of endurance in water polo must necessarily include the role of recovery processes and load management, especially in the competitive period.

Despite the growing body of literature on physiology, testing, monitoring, and recovery in water polo, the scientific and methodological literature still lacks a sufficiently clear understanding of the structure of endurance types within the framework of training periodization. Existing research often focuses on isolated functional indicators or separate aspects of sport-specific work capacity, whereas a pedagogically coherent differentiation of general, specific, aerobic, anaerobic, speed, and technical-tactical endurance during the preparatory and competitive periods remains underdeveloped [16–20]. As a result, endurance is often treated too broadly in coaching practice, without adequate consideration of the specific objectives of a given period of preparation.

This gap determines the relevance of the present study. There is a clear need for a theoretical interpretation of endurance in water polo players as a multicomponent quality whose structure changes according to the training period and the demands of competitive activity. Both theoretical and practical significance lie in identifying which types of endurance should be considered dominant during the preparatory period and which should receive priority during the competitive period, when the stability of game actions, technical accuracy, repeated high-speed efforts, and decision-making efficiency under fatigue become especially important [17,19,20].

The purpose of this study was to identify the structure and specific features of the manifestation of different types of endurance in water polo players at the stage of advanced specialization during the preparatory and competitive periods.

Methodology. The present study is theoretical and analytical in nature and is aimed at identifying the structure and specific features of the manifestation of different types of endurance in water polo players at the stage of advanced specialization during the preparatory and competitive periods. The methodological foundation of the study was based on contemporary concepts of sports training as a pedagogically managed process, the principles of sports training periodization theory, and scientific approaches to the study of sport-specific performance in team sports.

The main research materials consisted of scientific publications devoted to the problems of general and specific endurance, the physiological mechanisms of energy supply for muscular

activity, the specific features of training and competitive performance in water polo players, as well as the organization of training during different periods of the annual cycle. The analysis included studies examining aerobic, anaerobic, speed, and technical-tactical components of endurance within the structure of athletic performance.

The following methods were employed in the study: analysis and synthesis of scientific and methodological literature; comparative analysis; systematization and classification of endurance types; and theoretical interpretation of data presented in the works of domestic and international authors. The analysis of the literature made it possible to clarify the essential characteristics of different types of endurance, determine their place in the training system of water polo players, and identify differences in their manifestation during the preparatory and competitive periods.

Comparative analysis was used to identify the specific features of endurance manifestation depending on the objectives of a particular training stage. Special attention was paid to distinguishing between general, specific, aerobic, anaerobic, speed, and technical-tactical endurance, as well as to determining their leading role during different periods of sports preparation. Based on the systematization of scientific data, an attempt was made to present endurance in water polo players not as an isolated physical quality, but as a multicomponent functional and pedagogical structure that changes depending on the nature of training and competitive loads.

The logic of the study included several consecutive stages. At the first stage, scientific sources on endurance in water polo and related team sports were selected and reviewed. At the second stage, existing approaches to the classification of endurance types and the definition of their content within the training process were analyzed. At the third stage, the specific features of the manifestation of different types of endurance in the preparatory and competitive periods were compared. At the final stage, generalized conclusions were formulated reflecting the pedagogical significance of a differentiated approach to the development of endurance in water polo players at the stage of advanced specialization.

The applied set of theoretical methods made it possible to reveal the structure of endurance in water polo players, identify its main components, and substantiate the need for their purposeful consideration depending on the training period.

Results and Discussion. The analysis of scientific and methodological literature made it possible to establish that endurance in water polo cannot be regarded as a homogeneous physical quality. The specificity of competitive activity in water polo is determined by the intermittent nature of the game, the combination of swimming and non-swimming actions,

frequent changes in intensity, and incomplete recovery between game episodes. Consequently, the structure of endurance in water polo players is multicomponent in nature and includes general, specific, aerobic, anaerobic, speed, and technical-tactical components.

The analysis also demonstrated that, during the preparatory period, general and specific aerobic endurance, as well as the anaerobic-glycolytic component, play a leading role. It is during this period that the functional basis for the athletes' subsequent sport-specific performance is established. Studies devoted to the preseason training of water polo players indicate that the use of interval methods in combination with strength training contributes to improvements in swimming and sport-specific performance indicators.

The literature review further showed that, during the competitive period, speed endurance, repeated sprint ability, and technical-tactical endurance become priorities. For a water polo player, it is fundamentally important not only to possess a sufficient level of general work capacity but also to maintain the effectiveness of game actions under progressively increasing fatigue. Studies on repeated sprint ability in elite water polo players confirm that this component is closely related to the overall structure of sport-specific performance and serves as one of the key criteria of specific preparedness during the competitive period.

A significant result of the analysis was the identification of differences in the manifestation of endurance within competitive activity itself. It has been shown that, over the course of a match, athletes may demonstrate a decline in repeated sprint performance and in specific swimming test results, whereas more highly qualified players exhibit a smaller degree of performance deterioration.

Another important finding of the analysis was the clarification of the role of recovery and load management during the competitive period. Contemporary evidence indicates that, under a congested competition schedule, an increase in training and competitive load may impair athletes' perceived recovery, whereas rational load reduction promotes recovery and improves performance in specific tests [18; 19].

Thus, the results of the analysis allow us to conclude that the structure of endurance in water polo players at the stage of advanced specialization changes depending on the training period. In the preparatory period, the dominant types of endurance are those that provide the functional basis and support tolerance to substantial training loads, whereas in the competitive period, speed, game-specific, and technical-tactical endurance come to the forefront, ensuring the maintenance of competitive effectiveness under fatigue.

The findings obtained in the course of this theoretical and analytical study confirm that endurance in water polo players at the stage of advanced specialization should not be regarded

as a single physical quality, but rather as a complex multicomponent system including, at a minimum, aerobic, anaerobic, speed, and sport-specific game-related components [15; 18].

The results of the analysis help explain why general and specific aerobic endurance, as well as the anaerobic-glycolytic component, play a leading role during the preparatory period. These components provide the functional basis for subsequent specialization, increase tolerance to training loads, and ensure the possibility of repeatedly performing substantial volumes of sport-specific work in the water.

During the competitive period, however, the logic of preparation changes naturally. At this stage, a high level of general functional fitness alone is no longer sufficient; decisive importance is attached to the ability to repeatedly perform short, intense actions without a pronounced decline in speed, accuracy, or the effectiveness of game-related decisions. Studies of repeated sprint ability in elite water polo players have shown that this component is closely associated with both aerobic and anaerobic performance and therefore serves as an integrative indicator of sport-specific competitive endurance.

From a pedagogical perspective, this means that the periodization of endurance development in water polo should not be based on the principle of uniformly improving all of its manifestations throughout the year. A more rational approach is a differentiated one, in which the preparatory period is dominated by means aimed at developing the functional base, whereas the competitive period emphasizes means that support sport-specific game-related manifestations of performance.

Particular attention should be paid to the issue of performance stability over the course of a match. Studies of competitive activity show that, as fatigue develops, players may exhibit a decline in repeated sprint performance and in certain manifestations of specific motor activity, while more highly qualified athletes generally demonstrate a smaller degree of such decline.

The aspect of recovery is no less important. Contemporary evidence related to the competitive period indicates that an increase in internal load is accompanied by poorer recovery indicators, whereas appropriate management of training volume and intensity contributes to improvements in functional status and athletic performance [18; 19].

The discussion of the results makes it possible to conclude that the structure of endurance in water polo players at the stage of advanced specialization does indeed change depending on the training period. In the preparatory period, the dominant components are those that provide the functional basis of performance, whereas in the competitive period, the dominant manifestations are those directly related to game activity, repeated high-speed actions, technical stability, and the effectiveness of decision-making under fatigue.

At the same time, the present study has certain limitations. This work is theoretical and analytical in nature and does not include an original pedagogical experiment; therefore, the identified provisions currently reflect a generalization of contemporary scientific evidence rather than the results of the authors' own empirical comparison of groups of water polo players. In addition, the existing literature demonstrates considerable heterogeneity in terms of testing procedures, evaluation criteria, and the characteristics of the athlete samples studied, which makes direct comparison between individual studies difficult. This limitation has also been explicitly noted in the systematic review of physiological tests in water polo.

Overall, the discussion confirms that the structure of endurance in water polo players at the stage of advanced specialization varies according to the training period. For this reason, the pedagogical management of endurance development in water polo should be based on the principles of differentiation, periodization, and the mandatory consideration of the specific features of competitive activity.

Conclusion. The conducted theoretical and analytical review leads to the conclusion that endurance in water polo players at the stage of advanced specialization represents a multicomponent structure comprising general, specific, aerobic, anaerobic, speed, and technical-tactical components. This conclusion is consistent with contemporary reviews on the testing and evaluation of water polo players' performance, which emphasize the need for an integrated approach to the analysis of athletes' preparedness.

It was established that, during the preparatory period, priority is given to those types of endurance that form the functional basis of athletic performance, primarily general and specific aerobic endurance, as well as the anaerobic-glycolytic component. During the competitive period, the role of speed, game-specific, and technical-tactical endurance increases, as these components ensure the repeated execution of intense actions, technical stability, and the preservation of the effectiveness of game episodes under fatigue. This conclusion represents a synthesis of contemporary literature on the specificity of testing, repeated sprint ability, and the structure of sport-specific performance in water polo players.

The practical significance of the study lies in the fact that its findings may be used in planning the training process of water polo players, selecting means for the development of different types of endurance, and designing a system of pedagogical monitoring during the preparatory and competitive periods. Given the updated dynamics of modern water polo, including the current game regulations with 28- and 18-second possession phases, a differentiated approach to endurance development acquires even greater importance for maintaining effectiveness during matches. At the same time, the results of the present study

should be regarded as a theoretical basis for further experimental research. A promising direction for future work is the development and testing of a pedagogical methodology for the differentiated development of endurance types in water polo players at the stage of advanced specialization, followed by an experimental verification of its effectiveness.

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