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SYNCHRONIZED SWIMMING – THEORETICAL CONCEPT OF THE CRITICAL TRAINING ZONE

INTRODUCTION

The complex experiment served us for the determination of the relationship between interdisciplinary and laboratory established integrated physiological parameters and their quantitative equivalents measured on the terrain when we have“…content of individual practice…”(12). We upgrade our theoretical concept how is influenced by the practically oriented research findings in 6 Bulgarian dissertation for doctoral degree and the summaries for the development of international teams of Canadian and French researchers. Scientifically analyzed are the contributions in the dissertations of the Bulgarian scientists – only 5 person works in the field, like: D-r. Georgi Dimitrov, PhD in Medicine, Prof. D-r.Il. Iliev, PhD in medicine, Prof. B. Serafimova, (3, 7, 16). For “critical work” particularly in the swimming sport only Prof. Biserka Serafimova defines "critical effort under load of elite swimmers " in her dissertation (16, 17, 19) and Prof. Petia Kutintcheva bold the importance of the “algorithmic programs or planing skills” (9). “…In normal gait we using planar registration and analysis on the hip and knee joints gives satisfactory results, while values obtained for the ankle joint are with significant error…“(4).

We joined to the scientific principles generally accepted in the writings of sports experts in technical skills (12, 14) and others on the nature of the plateau (steady-stade) and methods for VO2max determination: Vaytsehovski, L. (1), Astrand, P.O. (20), E. A. Shirkovets (19), Forbes, MS (24), Famos, JP (22), Bernal (21), H. Morehouse L. et al., Milner, A. (26) et al, Pineau, C. (28), Margaria, I. (25), Зациорски, В.(6), Желязков, Ц., Д. Дашева (5). Our physiologists with top rating served us for scientific justification of opportunities to create an equivalent field, starting from the integrated physiological parameters: Flandrois, M. R. (23), Morehouse, L. (26), and Nadean, M (27). In support of that argument is made our biophysical analysis for the specificity of the processes in the cardiovascular system, explaining adaptation processes in “**critical speed** of blood flow”. The name is scientifically approved - “critical” because the upcoming changes in the traffic of blood circulation, transform its form from “linear to turbulent” (16).

Based on these scientifically validated facts, we built our **work hypothesis** on the assumption that the definition of the “parallel equivalents” and the determination of the “critical zone” during the effort in synchronized swimming will improve the management of the functional preparation for top level competitors.

Aim of the research is to determine the value for the parameters characterizing the specific function on the effort and the training border in the “critical area” for the sport synchronized swimming.

The **paper studies** the biophysical, physiological and field performance in the “critical area” of the training effort for synchronized swimming, witch are their parallel equivalents.

The **subject** of the study is to define the “critical area” concept of the training effort in synchronized swimming. By combining border between two scientific fields will be possible through the biophysical theory of sports training, to measure the integral physiological parameter “maximal aerobic capacity (VO2max)”.

The structural analysis in this publication is based on the theoretical concepts and findings research of Bulgarian and foreign experts whose scientific interests are close to our working hypothesis. We start with systematic information defining the existence of "critical speed" of the blood through biophysical perspective. It should summarize the definitions characterizing the integrated physiological parameters established in the laboratory experimentation. We present research conclusions from the sports and pedagogical practice for “effectively treated areas” of the load. At the end of the analysis we define the “critical area” of the synchro-training effort. Through biophysical and terrain equivalents we prove its “high speed performance” for the sports practice of top level swimmers. Occurrence of a “critical speed blood flow” is based on the change in the nature of blood flow. It goes from “linear to turbulent” proven by the speed of Reynold (see Chart 1).

An interdisciplinary approach for the analysis was carried out by interpretation of:

- biophysical indicators - including Reynold (Rn), V and linear turbulent V, the circulation of blood flow, critical velocity of blood (short thick vertical lines):
- physiological indicators - values of the deployment of VO2max., primary length, initial, critical and maximum power load;
- terrain equivalents - achievement (length of effort) in minutes and seconds, overcoming distance in meters, and the maximum initial velocity of the movement in km / h, a critical speed in m / s.

Our analysis makes the first attempt to justify the possibility of creating an “interdisciplinary bridge”. It allows defining the physical, quantifiable equivalents of the known integrated physiological parameters for diagnosis of functional status and determine the grade of the composition. This particular line of analysis, in harmony with our scientific intetrests to define the leading concepts in the “critical area” during the effort in synchronized swimming:

- ✓ Our individual practical and theoretical contributions to the preparation of top level synchro swimmers is probating the fieldwork methodology enabling the individual “critical speed”. In this paper we attempt to summarize and adapt theoretical contribution of other scientific studies to improve the management system in synchronized swimming. The analysis of the results of laboratory and field experiments offer a methodology allowing these important training zone for synchronized swimming, trekking:
- ✓ laboratory measurements in the field;
- ✓ intergral translation of physiological parameters in quantifiable field values;
- ✓ adaptation of the indicators in the dry environment to aquatic area.

Our desire is to define the “critical zone” of the effort for top level synchro swimmers through the establishment of the parallels between “biophysical and the field equivalents” for **speed and power**. Proving their high efficiency for the sports practice by defining the specificity of their manifestation. Clarified is the direct relation between the technical and functional parameters of the management in the preparation of top synchro swimmers because the”…exercise is particularly useful for kids...”(10). In synchronnized swimming "the balance sustainability is multidimensional and the statistical evaluation shows that 42% are right-handed, 16% are relatively symmetrical and 43% are left-leaning." (11, 18) because "…the preparatory elastic potential ... ... creates… elastic deformation ..."(15). For the first time we put into practice "functional and technical levels of training" aimed at improvement of the the preparation in synchronized swimming.

Enriching our theoretical and methodological expertise from the sports and scientific exchanges abroad we made an analysis of the trends in the free routine competition on the last Olympic Games (China'08). We are enable to recognize that synchronized swimming achievement are results from one single technical or functional training. International FINA rules obliged by its basic criteria for evaluation - "High and controlled execution" these two types of training to be addressed in a coherent whole. The term "high" is provided by functional Preparation, and the term "controlled" is provided by technical and educational synchro training. In our coaching practice with the national team, we managed technical mastery through a subjective review of the pedagogical expert assessment made by a panel of independent judges in regular video. In the thesis, we first analyzed and proved advantages of adopting quadrant assessment of the effectiveness of specialized techniques. The introduction of technical levels of training for the first time puts the management of technical mastery of scientific foundaments. The term "control performance" account individual anthropometric priorites of the swimmer. Through regression models was established objective basis for predicting sports results in all three disciplines. Despite the successes achieved through the management of functional training by heart rate into account that the term "High" was driven solely by the subjective perception of the individual swimmer. FINA Rules defines the category of "very good score" within 8 to 8.9 points at certain level of performance. Scientific arguments for improving the management of functional training on the theoretical analysis, we find the need to improve the management of the training process by introducing in the practice-functional and technical levels of training. We have seen also that in our coaching practice we worked on the traditional scheme of separate management of the two preparations. We practiced traditionally adopted in the synchronized swimming expert assessment method and individual adaptation to altitude performance. In this paper we are guided by the desire to minimize subjective factors in managing the training process, working with future national teams of Bulgaria. Theoretical summary of definitions and research findings in sport science is based on one hand on the established parallel to the pulse rate and its critical power (WMA = Wcr) load in laboratory experiments, but on the other hand established parallel to the maximum

aerobic capacity and corresponding its critical speed (VMA = Vcr) in terrain experiments. Consensus found in the thesis works of many of our medical experts. On the other hand, we joined the scientific principles displayed in the works of conventional sports experts, the nature of the plateau (stady-stad) and indirect methods for determining aerobic capacity and bring it into quantifiable values in terrain conditions (see Chart 2).

The opinions of physiologists have served to us for scientific justification of opportunities to create a terrain test, proceeding from the integral physiological parameters. Summarized expert opinions direct us to the implementation laboratory and the field tests of indirect measures of maximum aerobic capacity in synchronized swimming.

By looking argumentation by physiological laboratory parameters and the possibility of objectifying altitude of performance by identifying the range of capacities in critical area of the effort and the relationship with the verbal categories of the compositions in the rules of FINA. Establishing a link between the terrain quantifiable variables and laboratory parameters will permit to offer accessible and easily applicable instruments control permitting theoretical modeling and prognosis of functional levels of preparation and objective controlling of height by the critical power. Therefore, we can define the basic concepts of the critical area of strength as follows:

The critical speed (Vcr) or maximum rate of aerobic capacity (VMA) are equivalent. The critical power of the terrain load Wcr or the maximum aerobic power of the capacity (WMA), in which the integral indicator of maximum aerobic capacity (VO2max) reaches about 100% deployment due to the occurrence of the the critical speed of blood in the cardiovascular system. The critical speeds (VMA = Vcr) can be used in the practice for individual modeling of the critical power. Through her, according to type of equipment can be controlled the load by guaranteeing the critical zone effort during the training process, in synchro swimming.

From our made theoretical analysis, we cane make the following conclusions:

☐ Using the concept of **critical speed** (Vcr) or maximum rate of aerobic capacity (VMA) and critical power (Wcr) or maximum aerobic power of the capacity (WMA) in synchronized swimming coaching practice, creates the conditions for scientific guarantee of effective individual intensity of the overhead of management of the training process.

☐ In the **critical zone** of the effort in the bloodstream cardiovascular system is characterized by the critical speed is the internal adaptation (Vcr Reynolds). The external adaptation is critical speed of movement (VMA). Both speeds parallel equivalents in the critical zone of effort in synchronized swimming;

☐ The **critical power** and critical speed coincides with the time of virtually full development of the aerobic capacity and be parallel equivalents in the critical area of the effort in the synchronized swimming;

☐ The **critical speed and power** permit modeling of the individual load and improve the management of the training exercise in synchronized swimming;

☐ Each coach can **creatively interpret and apply** the percentages of the critical speed and power loading the management of top level synchro athletes.

Chart 1. *Illustration of the circulation of blood, according to the law of Poiseuille-Hagen. Variations of the in the flow linearly movement depending on the pressure exercised. Critical flow rate - Section A, Segment AB appearance of turbulent motion, critical velocity; Segment BC-momentum changes in the chemical composition of the blood-V continuous line in the flexible container.*

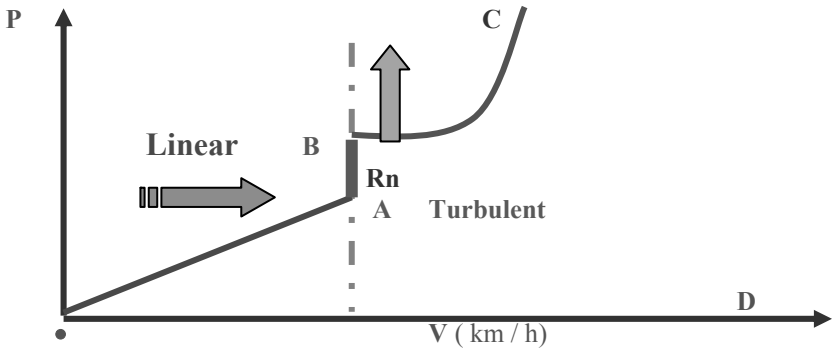
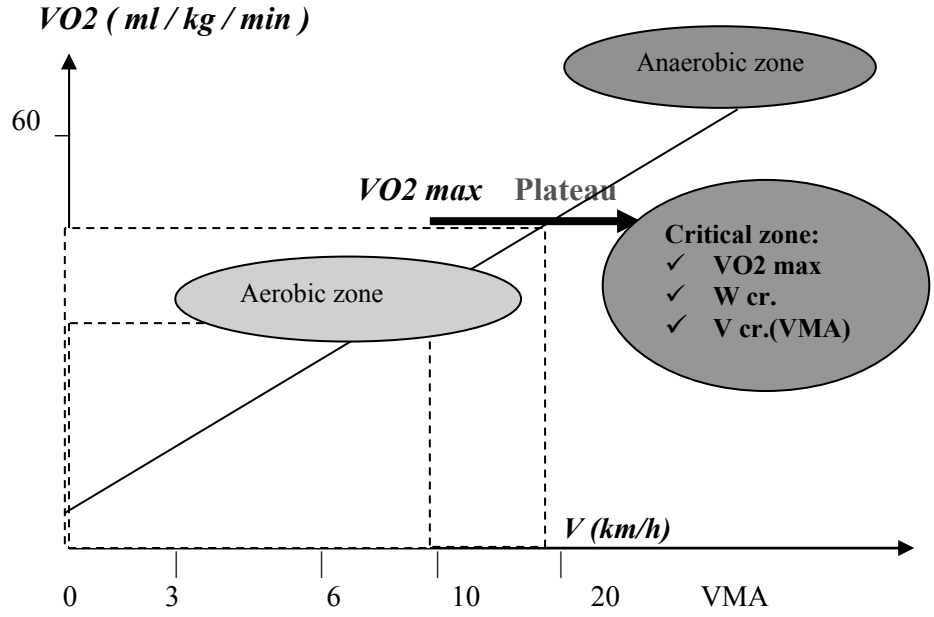


Chart 2. *Illustration of a critical area cycle effort (the timetable referred B.Serafimova, 1971 and Zh.Kazorla, 1996).*



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