NATIONAL SPORTS ACADEMY„VASIL LEVSKI“

DEPARTMENT „WATER SPORTS“

Petar Raychev Stoychev

Investigation of the specifics of the training load and the competitive activity in the preparation for long-distance swimming

AUTHOR’S ABSTRACT

of doctoral thesis for awarding

an educational and scientific PhD degree

Scientific supervisor: Assoc. prof. Stoyan Andonov, PhD

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The PhD thesis contains 199 standard pages and the text is supported by 48 tables and 32 figures. The bibliography includes 123 references: 78 in cyrillic alphabet, 42-in latin and 3 internet websites.

The numbering of the figures and tables in the author's abstract coincides with those of the PhD thesis.

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All documents concerning the defense of PhD dissertation are available in the Library, NSA "Vasil Levski".

Abbreviations used in the PhD dissertation

Absolute maximum oxygen uptake - VO2max (ml)

Absolute power, measured in watts - W

Aerobic Threshold– AT

Anaerobic Threshold – AnT

Complex functional testings - CFT

Critical Speed –CS

Control model - CM

Experimental model- EM

Heart Rate - HR

Lap (part) of 10-km swimming with serial number - lap 1; lap 2; etc.

Maximum Heart Rate - HR_{max}

Mesocycle -MSC

Microcycle -MIC

One-repetition maximum - 1RM

Petar Stoychev – P.S.

Relative maximum oxygen uptake -V_{O2max} *(ml/kg)*

Relative power measured in watts per kg weight - W/kg

Swimming speed at Aerobic Threshold level– V_{AT}

Swimming speed at Anaerobic Threshold level – V_{AnT}

Swimming speed at maximum oxygen consumption level -V_{VO2max}

Chapter one:Theory of competitive activity and training loads in long-distance swimming

I.1. Characteristics of competitive activity in swimming

The modern theory of sport (V. Rodichenko -1978; D.Harre D.-1982; V. Platonov - 1984; T.Bompa - 1999; D. Dasheva, L. Krastev-2002; E. Maglischo- 2003; V.Issurin -2016; Tsv. Zhelyazkov, D. Dasheva-2017, etc.) considers sports competitions as a relatively independent subsystem of the sports training system with its structure, content, conceptual apparatus, object and methods of research. A number of specialists (Godik M. - 1980; Ivaylov A.-1982; Zaporozhanov V.A, V.N. Platonov et al. 1985; Keller V.-1987; Dasheva, D., L. Krastev - 2002; Izov , N.- 2017, etc.) point out that the theory of sports competitions not only reflects the theoretical and practical experience related to the optimization of sports training, but competitions in modern sports are also a powerful tool for improving physical, mental and technical the tactical training of the athlete.The competition between the participants in the competition leads to the realization of the maximum opportunities of the athlete, achieving high sports results and setting records in measurable sports.

I.2. Emergence, development and modern varieties of competitive activity in long-distance swimming

The long-distance swimming received Olympic recognition in 2008, when the 10-km open water swim as a discipline was officially integrated in the programme of the Olympic Games.So far, however, these are disciplines with a long history, which have their origins in a number of applied activities and then as a competitive race.This group includes long-distance swimming longer than 1500 meters. Over time, sport competitions worldwide, which include 10,25,32 or over kilometers marathon swimming have become established.

Characteristic of this type of swimming disciplines is swimming with low intensity.The energy supply is aerobic with a minimal anaerobic component and as a result the lactate is in small quantities and the alkaline-acid balance of the body is relatively stable for a long time. The minute tidal volume increases mainly by increasing the depth of respiration, the pulse rate reaches 70-75% of the maximum pulse rate, and the lactate concentration does not exceed the individual for the aerobic threshold.

The systematization and analysis of the data related to thecompetitive activity in the 10-km long-distance swimming by means of retrospective analysis of information sources (references) gave us grounds to indicate three periods in its development: first stage- period to 2000;a period till its integration in the Olympic Games programme from 2000 to 2008; a modern period of development and popularization after 2008.

It was found that during the first stage the competitions are held sporadic, episodic and had the character of research organization and construction of competitive rules and requirements. We define it as a stage of "*appearance and experimentation*" of the discipline 10-km long-distance swimming in the FINA competition programmes. Regarding the development of the competitive activity during the next period, quantitative values of the changes of a number of indicators are integrated in Tables № 2.Their analyzes also form the specific features of the development of modern competitive activity in 10-km long-distance swimming.

During the second stage of development of the discipline 10-km long-distance swimming it is shown that in the short 8-year period until integration in the programme of the Olympics steadily increases both the number of competitors and the countries they represented. This positive increase was characterized by 29 competitors in 2000 from 20 countries in the first US World Cup to 52 competitors from 35 countries in the Olympic Qualification Tournaments in Spain in 2008. At the same time, the sports qualification of the participants, whose achievements are steadily approaching over time, is constantly improving.The improvement was accompanied by equalization of opportunities as the average achievements of the first 20 athletes in 2000 from 1 hour 58 minutes 52.86 seconds were improved to 1 hour 53 minutes 40.10 seconds in 2008. Undoubtedly, there are enough objective arguments to define this second period as a "*period of validation*" of the discipline 10-km long-distance swimming in the competition programmes of swimming competitions and among the sports community of swimming specialists in the world.

A positive catalyst for the subsequent development process after 2008 is undoubtedly its integration in the programme of the Olympic Games, which allows millions of people around the world to get acquainted with its specifics. In 10 years the number of participants reached 75 competitors from 47 countries in 2019 in the Republic of Korea. Comparisons with the first quantitative values of the same indicators form a qualitative leap of three times more competitors and two and a half

Table № 2

Dynamics of indicators characterizing the development of 10-km long-distance swimming for the period 2000-2008

Years	2000	2001	2002	2003	2004	2005	2006	2007	2008
Indicators	USA	Japan	Egypt	Spain	Dubai	Canada	Italy	Australia	Spain
Competitors	29	28	3	33	29	34	39	54	52
Successfully completed	28	24	3	30	25	31	34	43	48
Not completed	1	4	-	3	4	3	5	11	4
% completed	97	86	100	91	86	92	87	80	92
Participating countries	20	19	2	21	20	20	25	39	35
Best achievement	1:57:10.50	2:01:04.00	1:49:30.00	1:50:58.80	1:54:38.00	1:46:38.10	2:10:39.40	1:55:32.52	1:53:21.00
Worst achievement	3:05:22.56	2:24:20.00	1:49:35.00	2:03:20.10	2:05:03.40	2:05:51.80	2:39:57.00	2:14:48.74	2:10:22.50
Difference	1:08:12	0:23:16	0:0:05	0:12:62	0:8:67	0:19:13	0:29:18	0:19:16	0:17:01
X of the first 3	1:57:12.33	2:01:07.00	1:49:33.00	1:51:04.40	1:54:49.90	1:46:42.60	2:10:40.20	1:55:37.43	1:53:24.30
X of the first 10	1:57:16.56	2:01:35.00	-	1:51:11.50	1:55:06.70	1:47:15.30	2:10:44.10	1:55:50.57	1:53:37.40
X of the first 20	1:58:52.84	2:06:23.00	-	1:51:46.60	1:55:50.60	1:47:56.70	2:11:00.20	1:56:01.09	1:53:40.10

times more participating countries. This gives grounds to characterize this modern stage of development of the discipline as a period of *"intensive development"*.

There are a large number of objective arguments that lead to the summary that after a period of 20 years of presence the discipline has not only established itself sustainably in the system of swimming disciplines, but has formed a sustainable basis for its future development in the world.

I.3. Training loads in swimming

The problem of the loading in sports, as essential for the theory and methodology of sports training, has been the subject of scientific and applied research and publications for many decades. Some publications of a number of bulgarian (Tsv. Zhelyazkov - 1963; Il. Iliev et al. - 1982; Tsv. Zhelyazkov - 1998; V. Batchev, S. Neykov -2005; S. Neykov-2007,2012; Zhelyazkov, Dasheva - 2017; N. Izov - 2017; R. Yosifov - 2018, etc.) and foreign authors (Hollmann-1960; N.I. Volkov - 1970, N.I. Volkov, E.A. Shirkovets -1973, E.A. Shirkovets - 1975, Convertino-1991, Sawka et al - 2000, Maglischo-2003; Mairbaurl - 2013; Kraemer et al.- 2016) can be cited.For swimming as for any other sport, the characteristics of the different training loads are a major problem. It includes the determination of the state of a number of indicators, as the leading place is occupied by the volume of swimming work by load zones, the number of hours, trainings and periods of rest, recovery, etc.

N. Izov (2017) analyzed the used criteria to divide zones from different schools and concluded that in addition to the type of energy supply of work, training areas are characterized by physiological changes, which aimed at the methodology for achieving them. There are 9 zones of training loads in swimming: 1. Basic endurance 1; 2. Basic endurance 2; 3. Anaerobic exchangethreshold; 4. High-intensity endurance; 5. Lactate tolerance; 6. Lactate productivity; 7. Speed; 8. Special durability; 9. Recovery. From the load system from the 70s of the XX century (Neumann, Pfeifer, 1982), which had a very positive impact on Bulgarian swimming, in 2009, "Basic Endurance I" (GAI) was divided into " Basic endurance I - extensive "and" Basic endurance I - intensive ". In a similar way, "Basic Endurance II" (GAI) was divided into "Basic Endurance II - Economization" and "Basic Endurance II - Developing".

I.4. Working hypothesis

We assumed that the study of the problem based on the systematization of data from leading competitions, training programs of highly qualified athletes at 10 km long-distance swimming as well as our many years' experience and performances will allow not only its clarification, but also the development of models that will improve the management of sports training.

Chapter two: Aim, tasks, methods and organization of research

II.1. Aim and tasks of the research (PhD dissertation)

The aim of the study is to improve the competitive performance and management of the training process in highly qualified athletes - men and women in 10-km long-distance swimming through up-to-date characteristics of the competitive activity, development, implementation and comparative analyzes of models for training loads in this discipline.

Research tasks:

1. Analysis based on data from information sources (references), current theoretical and applied knowledge about competition and training loads in sports, swimming and 10-km long-distance swimming.

2. Systematization and characterization of the impact of leading components of the competitive activity in the 10-km long-distance swimming for highly qualified male and female athletes (competitors).

3. Building a science-based model for tactically optimal competitive performance in 10-km long-distance swimming in highly qualified male and female competitors.

4. Development of an objective approach for control of the competitive performance in the 10-km long-distance swimming of highly qualified male and female athletes and analysis of its effectiveness in the long-term realization of a world-class elite athlete.

5. Development, implementation and comparative analysis of the content of two models for training loads in the 10-km long-distance swimming for highly qualified male athletes in a one-year training cycle.

6. Optimization of the management of the training process in the 10-km long-distance swimming for highly qualified male athletes by determining the effectiveness of the two models of training loads

II.2. Object, subject areas and subjects

The object of study is the competitive activity and training loads in the one-year training cycle in the 10-km long-distance swimming for highly qualified male and female athletes.

The subject areas of research are: sports achievements in 10-km swimming; models of competitive performance; the control of the sports achievements of highly qualified male and female athletes in the 10-km long-distance swimming; the long-term realization of a one world's elite athlete; the content and the comparative analyzes by zones of two models for training loads during the one-year training cycle in the 10-km long-distance swimmings for highly qualified male competitors; the effectiveness of the models

Subjects. In the long-term realized researches, some systematized and analyzed sports achievements and competitive performances of the whole world elite of male and female athletes-participants in the 10-km long-distance swimming, were registered. Quantitative information is shown in Table № 5. We used training plans and data from information sources in order to achieve a systematization, characteristics and analysis of applied training loads.

Table № 5

Highly qualified athletes - men and women in 10-km swimming included in the sports achievements study

Quantitative Values / Methods and analyzes	**Athletes (competitors)**	**Events**	**Number of indicators**	**Research units**
Development of long-distance swimming - 10 km	Men - 963	19	6	109782
Competitive activity analyzes	Men -175 Women -114	7	8	16184
Competitive activity models	Men -30	3	8	720
Control of sports achievements	Men - 175 Women -114	7	7	14161

As a priority action some original own annual training plans were systematized and studied, developed and implemented in the preparation of highly qualified male and female athletes for 10-km swimming. Six male athletes training at the SV05 Würzburg-Germany Swimming Club, established in 1905, were selected and included in these studies. During the research period the club was a gathering center of the German Swimming Federation for long-distance swimmers training.

II.3. Research methods

Methods of information research: *literature research, document analysis, internet surveys and interviews, optical methods* - analyzes of video recordings made by FINA were performed during the research. On this basis, according to the organization of the competitions, the distance of 10 kilometers was divided into 4 or 6 laps (parts) with a serial number - lap 1; lap 2; etc. The lengths of each lap when the distance is divided in 4 parts were 2500 m each, and when the distance is divided in 6 laps: lap 1 -1700 m .; lap 2-1600 m; lap 3-1700 m .; lap 4 -1700 m; lap 5-1600 m; lap 6 -1700 m.

Modeling and models of competitive realization and training loads. The training loads applied by us were distributed according to the type of energy supply in three operating modes - aerobic, mixed and anaerobic. Their specific differentiation was done in five zones: Zone1. Aerobic provision; Zone 2. Aerobic-anaerobic provision; Zone 3. Anaerobic-aerobic provision; Zone 4. Anaerobic-glycolytic provision; Zone 5. Anaerobic-lactate provision. The recovery work was characterized separately as "Compensatory", and the training loads outside the aquatic environment - as "Dryland preparation ". Other activities (travel, illness, etc.) were also separated.

Pedagogical experiments: *An ascertaining pedagogical experiment* was realized in two training and competition years from 01.09.2010 to 01.09.2012. The first year covering the period from 01.09.2010 to 01.09.2011 was conditionally defined as a Control one. We were characterized the period from 01.09.2011 to 01.09.2012 (the second year) as an Experimental year. The two training loads' models we have developed and applied: Model 1 - Control model (CM) and Model-2 – Experimental model (EM) were compared in terms of their quantitative and content characteristics. For the effectiveness of the models, some comparative analyzes in terms of informative indicators of: sports pedagogical control tests, functional tests, sports results were made; *Individual author's experiments* were related to systematization and analysis of the long-term training and competition activities of one athlete-P.S. from the world elite - men in the 10-km long-distance swimming; *Control tests and testings:* crawl -400 m, crawl -4X400 m in 60 seconds, swimming - 1600 m were applied. The achievements of these tests, measured in seconds were registered by two specialists, using electronic chronometers of the "Omega" company. A step test was also used for veloergometer's load to failure, as well as complex functional testings' indicators (CFT), respectively.

Mathematical and statistical methods: Variation analysis, correlation analysis; Studen's t-test, Martin's method, Persetile method, Software products - SPSS 25 and Excel.

Theoretical analysis and synthesis

II.4. ***Organization of the research***. Four research stages covering the period 2014-2020 can be indicated in the research process.

Chapter three: Results and analyzes

III.1. Characteristics of the competitive activity in long-distance swimming

III.1.1. Variability of sports achievements in 10-km competitive swimming for men and women (male and female athletes)

The 10-km long-distance competitive swimming is performed in open water, not in swimming pools, which does not allow full standardization of the conditions of competitive activity. Undoubtedly, this fact shows that it is not strictly scientifically possible to absolutize and integrate mechanically quantitative values with regard to sports achievements. Individual analyzes for each competition and subsequent principle comparative analyzes with variability of final generalizing conclusions turn out to be really possible.

III.1.1.A. Variability of sports achievements - Setubal 2012

Integrated data for male competitors (Table №8) give grounds to point out that the best achievement reached in this competition is a function of dynamically changing in each subsequent part results.The slowest first part is followed by an improvement in the performance in each subsequent one, in order to reach the final 6th part, which is almost seven minutes faster than the first swimming. The established progressive dynamics of the achievements is typical for the best competitors and it is not observed for the competitors who ranked last. The dynamics shown in them was heterochronous in nature, as after the first to the third part of the distance the achievements improve, then a decrease in the achievement by almost 30 seconds was observed and until the end a visible desire to improve could be seen, but it had low values-from 5 to 8 seconds. In a generalized analysis of the pronounced tactical realization of the average achievements of the whole group of athletes, a positive, but in a very small - one-minute range of improvement of the sports result from the second to the final part of the 10 km distance was established.

Table № 8

Achievements (in minutes) of the competitors - men, 10 km - Setubal 2012

Изследване	n	X_{min}	X_{max}	R	$\overline{X}$	S	V	As	Ex
Lap 1	53	21,53	25,5	3,97	22,21	0,61	2,75	4,009*	18,906*
Lap 2	53	17,38	20,47	3,09	17,86	0,64	3,58	2,236*	5,25*
Lap 3	53	17,17	19,57	2,4	17,71	0,70	3,97	1,442*	0,633
Lap 4	53	16,38	20,29	3,91	17,15	1,07	6,26	1,319*	0,524
Lap 5	53	16,11	20,24	4,13	17,02	1,14	6,71	1,207*	0,27
Lap 6	53	14,59	20,21	5,62	16,51	1,36	8,23	1,29*	0,938

The analyzes of the quantitative values of the coefficients of variation, which vary from 2.75 to 8.23, are a proof for the very homogeneous in terms of possibilities competitors who took part in this swimming. Namely, the registered achievements are a function of serious competition and have a real prognostic value in building a model for optimal competitive performance. An argument for the reasoning is the quantitative values of the range of results, which is in the range of 2.4 to 5.6 minutes, respectively in the third and sixth parts of the race distance.

The values' changes of the other two indicators - "asymmetry" and "excess" vary in limit intervals that do not characterize normal configuration distributions of sports achievements. In this regard, the weakest achievements were expertly eliminated and the values of the same indicators were recalculated. Their values changed, for example, for Lap 1- "asymmetry" from 4,009 to 0,686 and "excess" from 18,906 to 5,939, which determined the possibilities for correct comparative analyzes and development of normative tables for evaluation of the results by the percentile method in 10-km long-distance swimming of elite male athletes. The abovementioned analyzes are supplemented by the data analyzes listed in Table № 9 to 12, which contain objective scientific evidence for the mathematical and statistical reliability of the observed differences between the achievements registered in different parts of the 10 km race distance.

The quantitative values of the confidence probability P (t) and the Cohen coefficient prove that the passage of the first part of the distance is actually slower than each subsequent distance component.

Table № 9

Reliability of the differences in achievements between the first and the rest of the race distance for swimmers - men, 10 km -Setubal 2012

n	Lap 1		Lap 2		Lap 2				
	$\bar{X}_1$	$\bar{X}_1$	$\bar{X}_1$	S_2	d	d%	Cohen d	t	P (t)
53	22,28	17,86	17,86	0,93	-4,30	-19,28	6,141	45,96	100,00

n	Lap 1		Lap 3		Lap 3				
	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_2$	S_2	d	d%	Cohen d	t	P (t)
53	22,28	17,71	17,71	0,85	-4,48	-20,13	6,812	50,98	100,00

n	Lap 1		Lap 4		Прираст на резултатите				
	$\bar{X}_1$	S_1	$\bar{X}_2$	S_2	d	d%	Cohen d	t	P (t)
53	22,21	0,61	17,15	1,07	-5,06	-22,80	5,272	38,38	100,00

n	Lap 1		Lap 5		Прираст на резултатите				
	$\bar{X}_1$	S_1	$\bar{X}_2$	S_2	d	d%	Cohen d	t	P (t)
53	22,21	0,61	17,02	1,14	-5,19	-23,38	5,338	38,86	100,00

n	Lap 1		Lap 6		Прираст на резултатите				
	$\bar{X}_1$	S_1	$\bar{X}_2$	S_2	d	d%	Cohen d	t	P (t)
53	22,21	0,61	16,51	1,36	-5,70	-25,66	5,036	36,67	100,00

The established facts are logically expected and are determined by reasons related to the start of the competition, where the swimming speed starts from zero and also the competitors are in a dense group and can not be positioned in their first 400-500 m in a way allowing to express their real speed capabilities.

The foregoing analysis related to the competitive performance of the elite male swimmers is expanded with analyzes of the competitive performance of the women who participated in this 10-km long-distance swimming competition.The quantitative values of sports achievements are systematized in Table № 13

Table № 13

Achievements (in minutes) of female athletes,10 km - Setubal 2012

Изследване	n	X_{min}	X_{max}	R	$\overline{X}$	S	V	As	Ex
Lap 1	39	20,59	24,24	3,65	21,13	0,53	2,49	5,684*	34,599*
Lap 2	39	16,40	20,57	4,17	16,70	0,77	4,63	3,95*	17,168*
Lap 3	39	16,51	21,06	4,55	17,06	0,85	4,97	3,397*	13,506*
Lap 4	39	16,19	21,45	5,26	17,00	1,09	6,38	2,489*	6,926*
Lap 5	39	16,37	21,31	4,94	17,37	1,13	6,54	1,564*	2,496*
Lap 6	39	15,56	21,33	5,77	17,41	1,42	8,16	0,975*	0,195

A fact established by us is the observed great homogeneity (as well as in the case of male athletes) of the sports and technical level of the participants. The coefficient of variation varies from 2.49 to 8.16, and the range of achievements is from 3.65 minutes for the first part of the distance to 5.77 minutes for the last. Further, we add the characteristics of the quantitative values of the indicators - "asymmetry" and "excess" related to the type of distribution of the obtained data. It cannot be reasonably concluded that the achievements registered in full and as partial for each part of the distance have a normal character of distribution. As already stated, additional calculations allowed an adequate evaluation system to be developed, as well as some models of competitive performance in 10-km swimming - women.

We also expand the foregoing analyzes with analyzes of the competitive performance during the London 2012 Olympic Games. The analyzes of the sports achievements give grounds to point out that the competition is the highest possible as well as the achievements in each of the six components of the whole distance are very close to each other - from 18.18 minutes to 19.09 minutes, ie in only one minute intervals throughout the competition. The values of the coefficients of variation, which are from 1.06 to 4.84, complement the provability of the analyzed. The registered achievements show the absence of outstanding leaders until the final sixth lap, and the outstanding equal opportunities of the participants in the second Olympic competition set the highest requirements for the process of their sports training. The comparative analyzes with the competitive performance in the 10-km long-distance swimming of the pre-Olympic qualification - Setubal 2012 outline the logically explainable great homogeneity of the finalists participating in the Olympic Games compared to the contenders, who are divided in the last parts of the distance into better and weaker athletes.For the implementation of rational tactics in 10-km swimming, the established trends give grounds for forecasting of the same in accordance not only with the current own capabilities but primarily with the class of participants in each competition.

III.1.2. Models of competitive activity in 10- km long-distance swimming for men and women

The models for crossing the racing distance of the first 10 classified (ranked) athletes in the 10-km long-distance swimming discipline at the London 2012 Olympic Games are systematized in Table № 25. The registered achievements for the whole competition distance of 10000 m are formed as partial achievements of swimming in 6 sections - two with lengths of 1600 m and four with lengths of 1700 meters. These headings lead to the following form of the model: $E(v) = b_o + b_{1v} + b_{2v} + b_{3v} + b_{4v} + b_{5v} + b_{6v}$.

The content of the model includes the speed for passing individual parts of the distance.Considerably significant is the biomechanical expediency of the movements, which in swimming as a cyclic sport was associated with optimal economization and consumption of the available bioenergy potential through the theoretically most effective uniform distance.

The analyzes of the results of the first 10 ranked athletes in the 10-km long-distance swimming discipline at the London 2012 Olympic Games (Table № 25) give grounds to point out that the competitors applied several tactical models for swimming across the distance. The variant 2-6-3-4-5-1 was predominantly applied, ie. variant of: fast start, non-uniform crossing of the middle distance, acceleration of the finish, as its relative share was 50%. There was no second tactical option in general, but in the remaining 40% of cases the first part of the 10 km distance was swum the fastest and the final meters were swum by 6 competitors with their maximum average speed. The model of the London Olympics champion O. M. from Tunisia is $E/(1.516\ ) = 1700/(1.560) + 1600/(1.396) + 1700/(1.529) + 1700/(1.525) + 1600/(1.502) + 1700/(1.593)$.

The comparative analysis of the models gives grounds to point out that the first and last parts and meters were being swum across fastest of all competitors (with two exceptions). The explosive start and the rapidly increasing final speed are a prerequisite for successful ranking. This fact outlines the leading trend of swimming with the maximum possible effort, from the start to the crossing of the finish line. Indeed, the exceptional competition in the world, the equal opportunities and the long duration of the competitive activity form the requirement for such realization. In addition the psychological advantages of leadership positions are added, undoubtedly the high level of training, which gives confidence that it is possible to implement such a tactical option.

The uniform crossing of the racing distance turns out to be only a theoretical priority feature, which does not characterize the swimming of the distance of 10,000 meters, which is emphasized by the average speed of non-uniform motion. No case of uniform crossing of the competition distance was found for all participants in the Olympic finals.

New arguments for quantitative protection and explanation of the separate models for speed distribution when swimming across a 10-km racing distance are found in the analysis of the formed correlations between the achievements registered when crossing the whole and each of the 6 or 4 parts of it.

The performed analysis is also confirmed when discussing the quantitative values of the correlation coefficients systematized in Table № 28. The listed coefficients reveal that they clearly outline the heterochronous nature of the lead and the leading positions in the individual parts of 10-km distance as well as the final ranking. The leading positions during the first and second laps allow positive forecasts for successful final positions, but the displacements and temporary rankings in the middle of the race distance - 3rd, 4th parts, do not affect and do not really guarantee prizes. At maximum performances in the fifth and sixth laps, the guarantees for a place in the top six are objectively formed. From a tactical point of view, the formed dependencies guarantee a successful competitive performance with a good start and place in the top group during the first lap, a distance presence without striving for a lead in the middle and 6-7 km of the distance and a mandatory maximum performance in the final kilometers.Based on the separate and above-mentioned correlations, it became possible to develop models for forecasting or control of sports achievements in 10-km long-distance swimming for men and women.The models are the kind of polynomial set out above in the text, namely$У = b_o + bt_1 + bt_2 + bt_3 + bt_4 + bt_5 + bt_6$ and based on the results of the competitions in Setubal and London have the following specific content:

Table № 25

10 000 m Tactical swimming speed models-men Olympic Games - London (August 12, 2012)

Ranking (position)	**Athlete**	**Country**	**Parts of the distance/Length (m)**	**1 1700 m**	**2 1600 m**	**3 1700 m**	**4 1700 m**	**5 1600 m**	**6 1700 m**
1.	O. Mellouli	Tunisia	Speed (m/s)	1.560	1.396	1.529	1.525	1.502	1.593
	Average speed (m/s) 1.516		Model	2	6	3	4	5	1
2.	T. Lurz	Germany	Speed (m/s)	1.557	1.396	1.527	1.526	1.500	1.592
	Average speed (m/s) 1.516		Model	2	6	3	4	5	1
3.	R. Weinberger	Canada	Speed (m/s)	1.561	1.397	1.523	1.527	1.495	1.592
	Average speed (m/s) 1.515		Model	2	6	4	3	5	1
4.	S.Gianniotis	Greece	Speed (m/s)	1.557	1.397	1.523	1.527	1.494	1.495
	Average speed (m/s) 1.512		Model	1	6	3	2	5	4
5.	D.Fogg	Great Britain	Speed (m/s)	1.560	1.395	1.526	1.480	1.484	1.491
	Average speed (m/s) 1.508		Model	1	6	2	5	4	3
6.	S. Bolshakov	Russia	Speed (m/s)	1.542	1.401	1.525	1.525	1.485	1.561
	Average speed (m/s) 1.507		Model	2	6	3	4	5	1
7.	V. Dyatchin	Russia	Speed (m/s)	1.544	1.393	1.542	1.525	1.483	1.559
	Average speed (m/s) 1.506		Model	2	6	3	4	5	1
8.	A. Waschburger	Germany	Speed (m/s)	1.560	1.398	1.526	1.526	1.483	1.551
	Average speed (m/s) 1.506		Model	1	6	3	4	5	2
9.	P. Stoychev	Bulgaria	Speed (m/s)	1.554	1.396	1.526	1.526	1.468	1.558
	Average speed (m/s) 1.505		Model	2	6	4	3	5	1
10.	A. Meyer	USA	Speed (m/s)	1.560	1.397	1.521	1.523	1.469	1.559
	Average speed (m/s) 1.505		Model	1	6	4	3	5	2

Men - У = $b_o + 0.67t_1 + 0.87t_2 + 0.58t_3 + 0.64t_4 + 0.96t_5 + 92t_6$;

Women - У = $b_o + 0.78t_1 + 0.88t_2 + 0.88t_3 + 0.96t_4 + 0.90t_5 + 0.86t_6$;

Table № 28

Correlation coefficients between achievements in different parts of the race distance for swimmers - men, 10 km - London - 2012.

Correlation analysis

London 2012 man

	lap 1	*lap 2*	*lap 3*	*lap 4*	*lap 5*	*lap 6*	*total*
lap 1	**1**						
lap 2	**0,977**	**1**					
lap 3	**0,014**	**-0,038**	**1**				
lap 4	**0,007**	**-0,046**	**0,991**	**1**			
lap 5	**0,874**	**0,836**	**0,356**	**0,358**	**1**		
lap 6	**0,706**	**0,603**	**0,443**	**0,458**	**0,881**	**1**	
total	**0,885**	**0,826**	**0,328**	**0,333**	**0,965**	**0,934**	**1**

The two models have specific and clearly separated quantitative differences and compatible structural units, among which is the established leading trend for the priority influence of the final components of the polynomial on the higher values of the function. From an application's perspective, this clearly forms the priority of tactical options for swimming across a 10 km distance with the best performance in the final 2 km.

In swimming at 10 km distance real and most effective for both sexes is the model with a high initial, but not much above average speed, subsequent reduction, ie. swimming at a distance speed and finally increasing the possible maximum in the last two parts of the distance.When the achievements are consist of four parts, the polynomials are contradictory in content and their separate content does not clearly reveal the priority influence on the final achievement of the partial values. So the larger the number of partial components, the higher the prognostic values of the developed models.

III.1.3. Control of sports achievements in 10-km long-distance swimming for men and women

A number of normative tables have been developed for the implementation of operational, current and stage control of the sports achievements in 10-km swimming for men and women. They are related to specific sports competitions in order to observe as far as possible standardity and comparability in assessments according to the specific requirements of the sporting event.

Normative tables - men - Barcelona - 2013

Assessment	Limits
very high	**under 117.51**
high	**From 117.52 to 117.57**
above average	**From 117.58 to 118.53**
average	**From 118.54 to 121.14**
below average	**From 121.15 to 121.29**
low	**From 121.30 to 123.38**
very low	**above 123.38**

Normative tables - women - Barcelona - 2013

Assessment	Limits
very high	**under118,2**
High	**From 118,21 to 118,24**
above average	**From 118,25 to 118,30**
Average	**From 118,31 to 122,08**
below average	**From 122,09 to 125,15**
Low	**From 125,16 to 135,04**
very low	**above 135,05**

The developed tables are methodological examples for control of the realized sports achievements in 10-km long-distance swimming. They can be applied to any competition, but since it is not possible to create standard conditions for swimming in open waters, it is scientifically expedient to develop specific evaluation normative tables.

III.1.4. Applied efficiency of the models and the control process in the long-term performances of one athlete from the world elite

The retrospective analysis of the data reveals that in his many years of performances the athlete from the world elite named P. S. has officially made a specialization in 10-km long-distance swimming in 2000. He made his first participation in the World Cup - USA, where he succeeded to reach his first high achievement with the ranking in 2nd place. After that he continued his sports training activity and competitive performances for 12 years as a priority in this discipline - until 2012 inclusive.

The analysis of the data shows that despite a number of specific circumstances, P. S. took part in 46 competitions, ie. in 71% percent of 10-km races in the world.Of all the starts he did not finish only one-in 2010 in Hong Kong. Some facts explaining the qualitative merits of the analyzed competitive performance in the discipline 10 kilometers are added to these quantitative characteristics. These include:

- two successful participations in the Olympics with prestigious rankings respectively on the 6th place at the Beijing 2008 Olympics and on the 9th place at London 2012 Olympics;

The comparisons between the winner from swimming across the distance - Oussama Mellouli, Petar Stoychev, who ranked 9th as well as Mazen Metwaly who ranked at 24th place and the average achievements in each of the six parts of the race distance are presented graphically in Fig. № 3.

The comparative analyzes reveal that decisive for the final ranking are the achievements in the fifth and sixth parts of the distance, where the athletes in the best physical form and realized the most effective tactical plan outline their advantage over the others.

After an equal crossing of the first four parts, the final accelerations in the last two begin, which form the final ranking. In a comparative analysis of the model of swimming realized by P.S., Bulgaria, the same form of distribution of efforts is established, ie. the swimming speed is non-uniform realized in the same scheme - high-speed start, significant reduction and non-uniform swimming of the middle distance parts and maximum acceleration in the final meters. The specific model is ***E/(1.505) = 1700/ (1.554) + 1600/(1.396) + 1700/(1.526) + 1700/(1.526) + 1600/(1.468) + 1700/(1.558).***

The analysis of P.S.'s competitive performance shows that he always had a better result than the average level of the competitors from the start to the final meters. The small difference with O.M.'s achievement is an argument for an equivalent class and is a function of random factors.

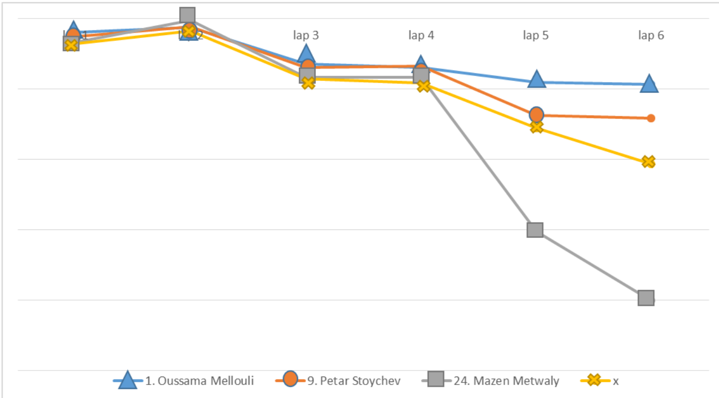

Figure № 3 - Comparisons between swimming across the distance from different competitors participating in the 10-km long-distance swimming - London 2012 Olympics

In accordance P.S.'s ranking, with an achievement of 1.50.46.2 (110.46), for example, is objectively evaluated as high with a verbal rating of "Excellent - 5.50".

- in all other competitions the rankings of P.S. were as follows: 1-3 place - 9 rankings; 4-6 place - 8 rankings; 7-20 place - 22 rankings. When integrating these results, we come to the conclusion that in 39 starts, ie. in 85% of the participations P.S. was among the top 20 athletes in in the world for the discipline 10-km long-distance swimming.

This forms an objective basis for the summary that the developed and applied models, control tables and analyzed in the following parts of the dissertation training loads and management of the training process were not only effective but also in line with world achievements in theory and methodology of sports training.

III.2. Integral characteristics of the structure and content of two models of training loads in the preparation of athletes for 10-km long-distance swimming

From the various models of annual training plans developed in our many years of training, we present two models applied in our strategy of preparation for participation in the 2012 Summer Olympic Games - London. The first of the models conditionally defined as a *control model* (CM) was applied during the training and competition 2010/2011, and the second *experimental model* (EM) was applied during the training and competition 2011/2012.

Both models have a classic structure consisting of three major periods - preparatory, competition and transitional. In time, they have the same time macro framework. *Preparatory period* – November to the end of March next year, *competition period* - April to the end of August and *transitional period* - September and October. The CM adopted a single-peak planning curve aimed at the best performance during the World Championships, and the EM - a two-peak planning curve, associated first with the maximum performance at the start of the Pre-Olympic qualification and then at the 2012 London Olympic Games, Great Britain.In the presented macroframe as a methodological principle it was systematically adopted to include microcycles with five two-time training sessions and episodic-seven. 4 workouts (trainings) with the largest possible volume of loads and one-way aerobic orientation are systematically applied in their content.

A summary of the training loads in the CM applied in 2010/2011 are the data listed in Table № 36 and the integrated quantitative values of the training loads in the EM applied in 2011/2012 are placed in Table № 37.

The comparative analyzes give a small quantitative priority related to a larger number of training hours - 60, the volume of kilometers swum - 89, the number of training sessions - 16, the number of training sessions - 6 of the loads realized in EM. Another significant difference is the larger number of competitions, starts and main competitions and starts in 2012. The objective reason is the pre-Olympic qualification, Olympic Games, Open European Championship and World Championship in 2012, while in the CM the most significant for 2011 competitions are the European Championship and the World Championship.

In the two models developed and applied by us, the following ratio of training loads in the annual cycle is built: 8-10% with compensatory aerobic orientation; 75-80% with building aerobic orientation; 10-12% with mixed aerobic-anaerobic character; 1-2% anaerobic-glycolytic-lactate orientation. In these reference frameworks, the energy supply capabilities are improved in the annual training cycle. The two models of the annual training plans applied by us are characterized by specific volumes (length) by working zones in km and undulation of the load intensity.

Table № 36

Quantitative characteristics of training loads
in CM of the annual cycle in the training and competition 2010/2011

	Training hours	**Volume (km)**	**Training days**	**Number of training**	**% load limits**	**Competitions**	**Starts**	**Basic**	
								Comp.	**Start**
Men	1200	2831	300	518	12	8	12	2	2

Table № 37

Quantitative characteristics of training loads
in EM of the annual cycle in the training and competition 2011/2012

	Training hours	**Volume (km)**	**Training days**	**Number of training**	**% load limits**	**Competitions**	**Starts**	**Basic**	
								Comp.	**Start**
Men	1260	2920	316	524	12	10	14	4	4

III.3. Comparative analyzes of the content of the applied two models of training loads

III.3.1. Comparative analyzes of the models for the preparatory period

The first group of analyzes includes the characteristics of the methods of training loads applied during the preparatory period. In agreement with the specialized references as well as our experience, it can be concluded that the initial wide application of the continuous uniform method leads to various repeated and interval training loads - for example 4-minute anaerobic series with accumulated training time 2.5 - 3 minutes to series with over 30 minutes of training and 40 minutes of total time.

The following analyzes are focused on the applied training tools. It is necessary to specify that during the realization of the training loads during the preparatory period we applied the same training tools to the 10-km long-distance swimming athletes. The differences between CM and EM consist in their internal structure, ratios of applied loads and target orientation.

-a long-term (continuous) swimming with a duration of 40-60 minutes, as the pulse rate and swimming speed are at the level of Aerobic Threshold *(AT);*

- a long-term (continuous) swimming with variable speed increase, first option - pulse rate is 100-130 beats per minute and swimming speed - V_{AT} do not exceed the level of Aerobic Threshold (AT); The swimming series applied by us have the following content: from 2000 to 5000 m of V_{AT} at pulse 90 - 110; 1000 m of V_{AT} at pulse 90-100 + 1000 m at pulse 100 - 130 (total 3000 m); 1500 m of V_{AT} at pulse 90 - 100 + 1500 m at pulse 100-130 (total 3000 m); 2000 m at V_{AT} at pulse 90 - 100 + 2000 m at pulse 100 - 130 (total 4000 m);

- a long-term (continuous) swimming with variable speed increase, second option - pulse rate and swimming speed - V_{AnT} exceed the level of Aerobic Threshold (AT), but do not exceed the level of Anaerobic Threshold (AnT). The swimming series have the following content: 3000 m at V_{AT} + 1000 m at V_{AnT} (total 4000 m); 4000 m at V_{AT} + 1000 m at V_{AnT} (total 5000 m); 5000 m at V_{AT} + 1000 m at V_{AnT} (total 6000 m); 5000 m at V_{AT} + 2000 m at V_{AnT} (total 7000 m); 3000 m at V_{AT} + 1000 m at V_{AnT} +3000 m at V_{AT} + 1000 m at V_{AnT}. The application of these training loads leads to long-term involvement of slow muscle fibers and the development of aerobic endurance.

- a periodic"fartlek" style crawl swimming, which includes various options with "speed game" aimed at developing aerobic abilities. Sections that help to stimulate the respiratory processes and increase the pulse to 150 alternate in the area of AnT and sections to remove the lactate and delay fatigue with low to moderate intensity at the level of AT. The following variants were applied:

1000 m (100 m at V_{AnT} + 100 m at V_{AT}); 1000 m (200 m at V_{AnT} + 200 m at V_{AT}); 2000m (200 m at V_{AnT} +200 m at V_{AT}); 2000 m (200 m at V_{AnT} +200 m at V_{AT} +100 m at 90-100% V_{VO2max} + 200 m); 2000 m (200 m at V_{AT} +200 m at V_{AnT} +100 m at 90-100% V_{VO2max} + 200 m at V_{AT} +100 m at 90-100% V_{VO2max} + 200 m at V_{AT}); 3000 m (200 m at V_{AnT} + 200 m at V_{AT}); 3000 m (100 m atV_{AnT} +200 m at V_{AT}); 3000 m (100 m at V_{AnT} + 300 m at V_{AT}); 3000 m (100 m at V_{AnT} + 400 m at V_{AT}); 3000 m (100 m at V_{AnT} +200 m at V_{AT} +100 m at V_{AnT} + 200 m at V_{AT}));

The analyzes give grounds to clearly characterize the indulatory nature of the applied loads both in the mesocycles from 2010/2011 and in the following ones from 2011/2012. The comparative analyzes between the content and the direction of the two models lead to the generalizations that in CM and EM the loads were aimed at stabilizing the basic endurance and development of V_{AT} and V_{VO2max}.The differences between the models are related to the nature of the intensity and length of the training and rest intervals, as the speed corresponding to the AT is the lowest speed that leads to an effective improvement of aerobic endurance. Another significant difference relates to the quantitative differences and the percentages of the training loads applied in the different zones.

The specific differences for the training loads applied in Zones 1/2 in the three mesocycles of *the preparatory period* for each weekly microcycle are presented in Fig. № 4; № 5;

First mesocycle with a duration of 9 weeks (01.11 - 01.01); Second mesocycle with a duration of 7 weeks (01.01 - 20.02); Third mesocycle lasting 6 weeks (20.02 - 01.04).

It is obvious that in CM during the first mesocycle (Fig. № 4) not only larger loads were applied, but they also had a different peak distribution in their undolatory dynamics.A distribution with two maxima that are realized during the second and eighth microcycle of this mesocycle was applied. In EM, another dynamic of a single-peak gradual increase from the first to the fourth microcycle, a subsequent plateau to the seventh microcycle and a gradual decrease to the end of the first mesocycle was applied. Namely, the two models have a significant internal structural difference.

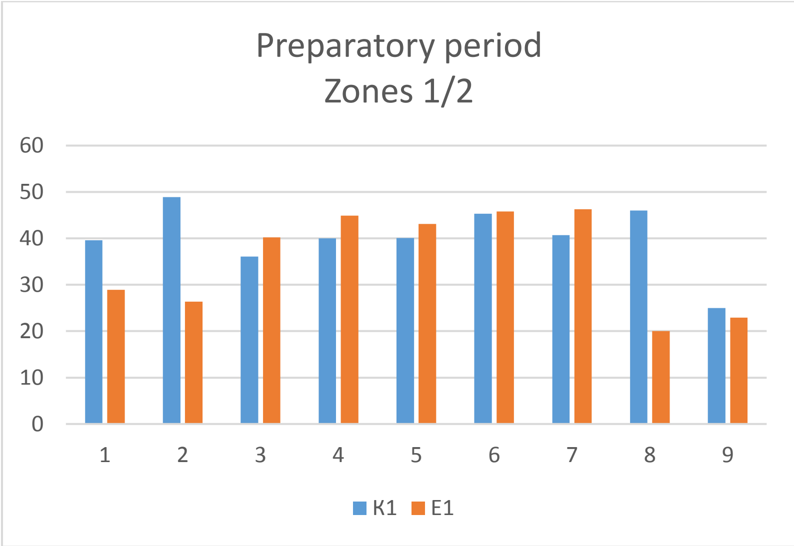

Fig.№ 4 - Comparative distribution of training loads in Zones 1/2 during the 1st mesocycle of the preparatory period in CM and EM

Substantiated structural differences between CM and EM are also found in the comparative analyzes of the content of the third mesocycle from the preparatory period (Fig. № 5).The two-peak curve of CM is clearly emphasized by the first maximum in the third microcycle and the second in the sixth. For EM, the first peak is during the second microcycle, and the highest second peak is realized during the fifth microcycle. The higher total summary value of the loads in these areas for CM is also visible.

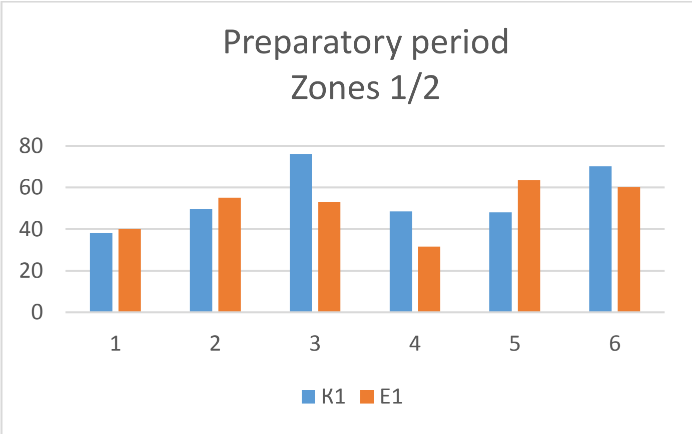

Fig.№ 5 - Comparative distribution of training loads in Zones 1/2 during the 3rd mesocycle of the preparatory period in CM and EM

The differences in terms of the structure of the applied training loads in the Compensation Zone in the two models are summarized and presented by microcycles, respectively for the three mesocycles of the preparation period in Fig. № 6, № 7.

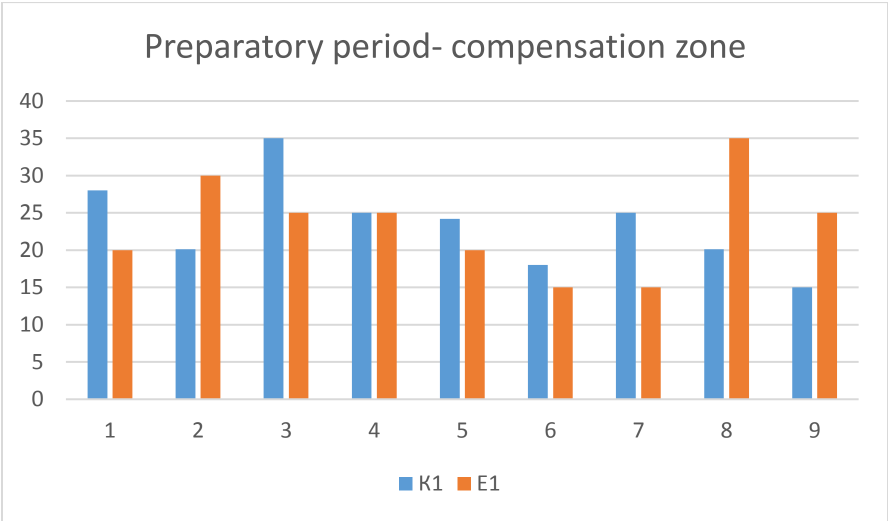

Fig.№ 6 - Comparative distribution of the training loads in the Compensation Zone during the 1st mesocycle of the preparatory period in CM and EM

The comparative analyzes for the first mesocycle of the preparatory period (Fig. № 6) reveal that in CM the loads in this zone have a three-peak structure, significantly decreasing at the end of the mesocycle. The maxima are in the 1st, 3rd and 7th microcycles, and in EM they are two and are realized in the 2nd and 8th of the microcycles.

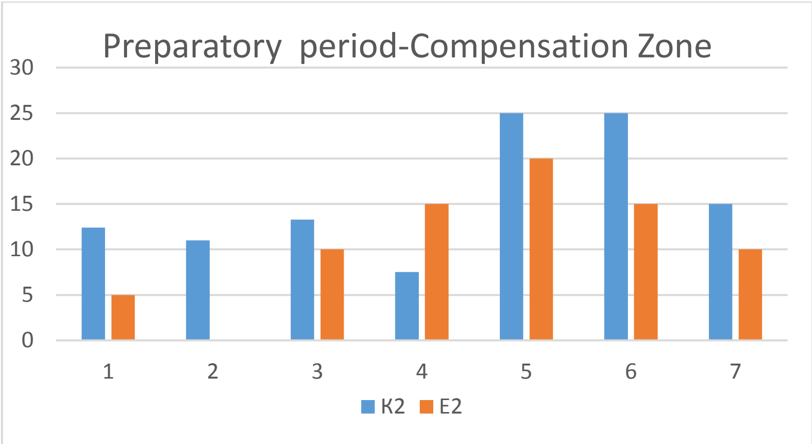

Fig.№ 7- Comparative distribution of the training loads in the Compensation Zone during the 2nd mesocycle of the preparatory period in CM and EM

During *the second mesocycle* of the preparatory period (Fig. № 7) in CM a large amount of loads in the compensation zone, structured in a two-peak curve which reaches its equal maxima in the fifth and sixth microcycles were applied.

In a comparative aspect, another approach has been applied in EM. There are significantly less training loads in this area, and they are also structured differently as a single-peak curve with a maximum during the fifth microcycle.

Analyzes regarding the direction of the *applied training loads* in both - CM and EM during the preparatory period of sports training give grounds to point out that in general they are one-way and can be classified predominantly as aerobic loads grouped in Zone 1 LIT (low-intensity training), also called LSD (long slow swimming). The zone is characterized by a stable lactate concentration below 2 mmol / l and localization below VT1.

The loads that cause a metabolism corresponding to the lactate concentration range from 2 mmol/l to 4 mmol/l between VT1 and VT2 defined as Zone 2 (THR threshold training) are in second place. The applied loads in the presented two zones occupy the largest, dominant share during the preparatory period as they are leading for the construction of basic aerobic endurance. High-intensity training (HIT) with lactate higher than 4 mmol/l and VT2 were not used.

Some examples of the quantitative values and respectively the differences of the percentage distributions of the loads' volumes during *the three mesocycles of the preparatory period* are systematized and graphically presented in Fig. № 14, 15.The analysis of percentage distributions of the loads volumes during *the third microcycle of the second mesocycle* from the preparatory period graphically summarized in Fig. 14 and 15. 1st and 2nd zones are 54%, and for EM - 60%, in the third zone CM - 19%, and EM - 21%, in the 4th and 5th zone - CM 2%, and EM - 2%, for CM in the compensation zone - 13% and for EM - 10%, in CM 10% are allocated for dryland loads, and for EM they are - 5%.

Comparative analyzes reveal that the quantitative differences during the third microcycle of the third mesocycle from the preparatory period are as follows: for CM the percentage of loads in the 1st and 2nd zone is 72%, and for EM - 39%, in the third zone CM - 22%, and EM -20%, in the 4th and 5th zones - CM 2%, and EM - 3%, for CM at the compensation zone -1%, and for EM -20%, for CM 1% are allocated for dryland loads, and for EM they are -5%.

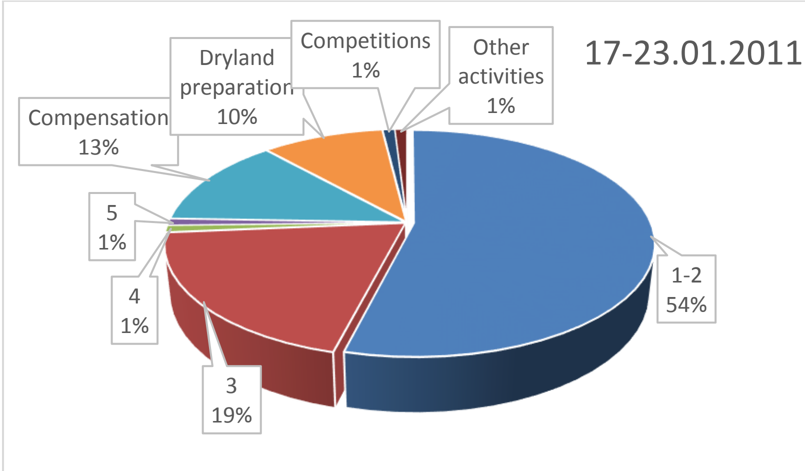

Fig.№ 14 - Percentage distributions of load volumes during the third microcycle of the second mesocycle of the preparatory period - ***CM***

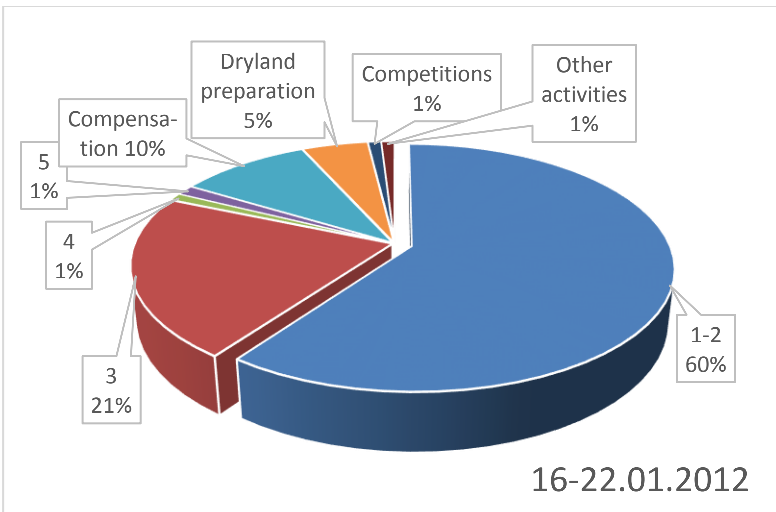

Fig.№ 15 - Percentage distributions of load volumes during the third microcycle of the second mesocycle of the preparatory period - ***EM***

The extrapolation of the comparative analyzes of the EM and CM content of each of the microcycles of the three mesocycles during *the preparatory period* gives grounds for the summary that there are significant content differences between the two models of training loads developed and applied by us. The absolutization of each of the models is debatable and according to the training objectives they can be useful in different training strategies. We present and analyze part of our specific sports and pedagogical experience. Arguments for the effectiveness of the two models are systematized through comparative analyzes in two of the following parts of our dissertation.

III.3.3. Comparative analyzes of the two models in the period of main competitions

The analyzes of the models content show that the main method of training is the method of interval training, which emphasizes the exceptional specificity of the models in terms of the training tools used. It was also found a striving for uniform quantitative distribution of the loads with different content orientation throughout the studied period.

Regarding the training tools, it can be pointed out that in both models we have applied series with a gradual increase in intensity as well as compensatory swimming after the onset of acidosis to preserve energy and motor abilities.

We use the following varieties: 10 x 200 m / 20 sec. (5 x 200 for V_{AT} + 5 x 200 for V_{AnT}); 4 x 500 m (V_{AT}) / 60 sec. + 4 x 500 m (V_{AnT}) / 60 sec;

10x400m / 30sec. (5 x400 V_{AT} +4 x 400 V_{AnT} +1 x 400 at 90-95% V_{VO2max});

8x500m (2x500 V_{AT} / 60sec. + 2x500 V_{AnT} / 60sec. + 2x500 at 90-95% V_{VO2max} / 90 sec. + 2x500 V_{AT} / 60sec.); 2x800m (V_{AT}) 90 sec. + 2x500 m V_{AnT} / 60 sec. + 2x200m 90-95% V_{VO2max} / 90 sec.); 5 x (400 m V_{AT} / 60 sec. + 200 m. V_{AnT} / 60 sec. +100 m at 90-100 V_{VO2max} / 90 sec); 5 min active rest.

When applying the series of sections type 8 x 500 m; 5x 400 m and 2 x1000 m the rest intervals vary depending on the tasks of the specific training. There is no approach for free return to the start and recovery of the pulse up to 120 beats / minute. With training effects aimed at developing speed endurance in the series 5 x 400 m, the rest intervals are reduced to 60 seconds in order to obtain a decrease in heart rate to 140 beats / min.

The comparative analyzes of the training plans' models show that they contain in their structure developing, stabilizing, competitive and recovery microcycles, as the arrangement is in accordance with the sports calendar.

The variant 1 developing + 1 competitive + 1 stabilizing +1 competitive + 1 recovery + 1 developing + 1 stabilizing is applied in CM.

The structure of the mesocycle in EM is 1 developing + 2 stabilizing + 1 competitive + 1 recovery + 1 competitive + 1 recovery.

Two constructive trainings with one selective orientation are realized in the developing microcycles, in the stabilizing in the two consecutive trainings loads with different direction are applied, in any event creating variability and specialized diversity. Such a combination of undulatory in size and direction training loads allow for the realization of effective modeling of the training process in the competition period. It should be emphasized that this is a stopper for the most responsible competitions of the year and for EM this is the start of the Olympic Games, which outlines high-intensity loads.

It can be concluded that the applied models of training plans are characterized by specificity, high intensity, emphasis on the application of interval type of training and selective direction of training loads in individual microcycles.

The comparative analyzes of the presented in Figs. № 27 and № 28 percent load distributions during the 1st microcycle in CM and EM reveal that quantitative differences have been formed with respect to the loads applied in the third zone, which is 8% for CM and 12% for EM, as well as they are 14% for CM and 9% for EM in zone 4 and 5, respectively.

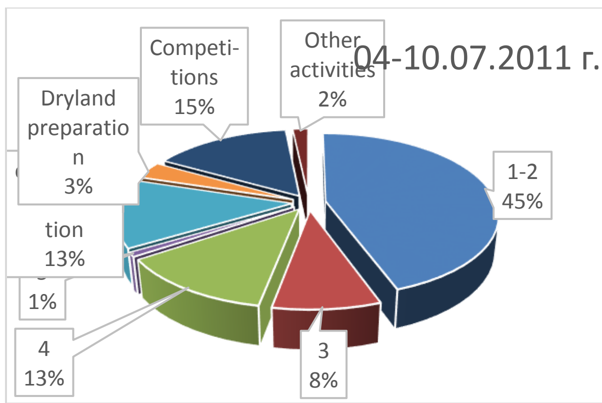

*Fig. № 27- **CM** - 2011 ; main competitions, first microcycle;*

Distribution of training loads by zones

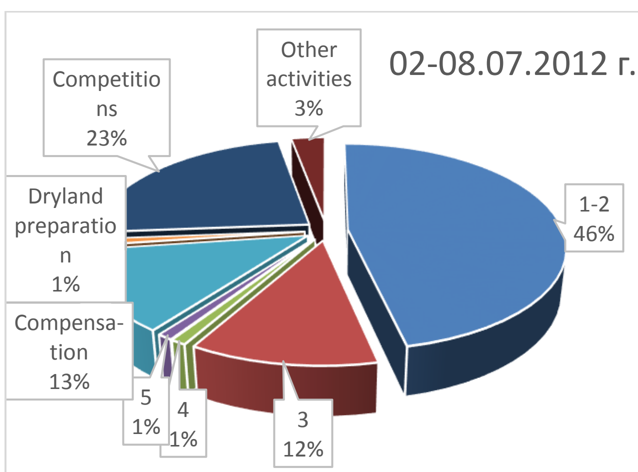

*Fig. № 28- **EM** - 2012 ; main competitions, first microcycle;*

Distribution of training loads by zones

III.4. Comparative analyzes of the effect of the applied two models of training loads

III.4.1. Comparative analyzes of changes in indicators from control tests

The registered changes of the achievements in the two control tests 4x400 m and 1600 m (indicators for assessment of specific endurance) are combined and presented in fig. № 31. Positive changes in the achievements in both applied models, which are quantitatively larger in EM, are clearly distinguished.

The explanation of this fact is also associated on the one hand with the lower starting level noted in EM and on the other hand may be due to its better efficiency.

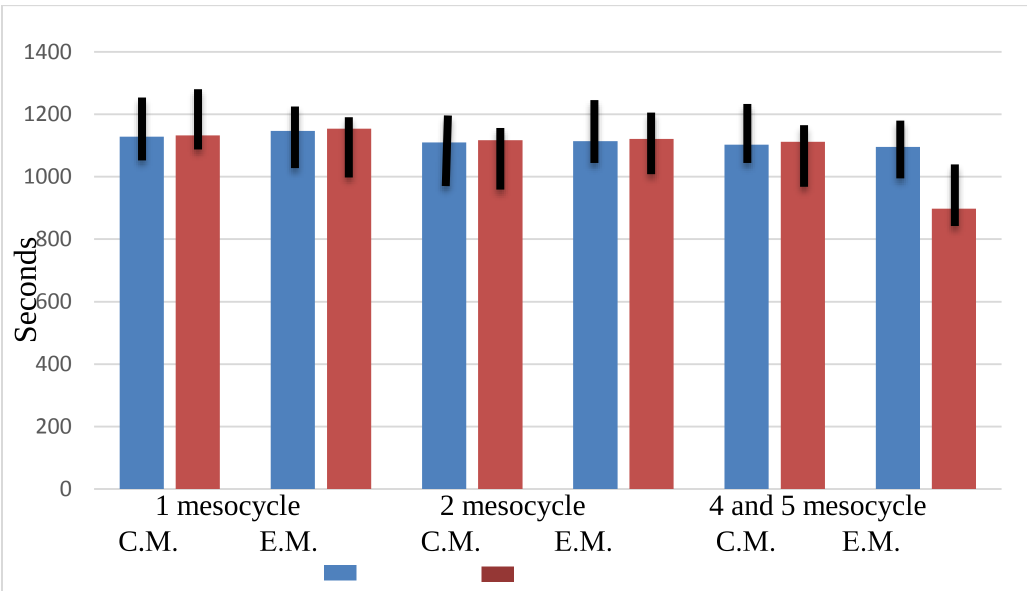

Fig. №31 - Changes in the achievements in the control tests
4x400 m and 1600 m for CM and EM

Scientific evidence of this statement can be established only after the analysis of the reliability of the observed differences.

The combined in Table. № 46 values of Student's T-test and Cohen's test from the first control test do not give grounds to characterize the established differences between the results as reliable. In the second control test, the values of P (t) for 400 m -5 8.14; for 4x400 m - 63.02; for 1600 m - 47.68. In the third test, the values of P (t) for 400 m-91.90; for 4x400 m - 89.02; for 1600 m -64.08.

Table № 46

Reliability of the registered differences of the achievements in the control tests between CM and EM-first test

Indicator	n	C.M.		E.M.		Increase in results				
		X_1	S_1	X_2	S_2	d	d%	Cohen d	t	P (t)
4x400	5	1128,10	44,52	1146,74	35,95	18,64	1,65	0,704	1,57	80,92
Indicator	n	C.M.		E.M.		Increase in results				
		X_1	S_1	X_2	S_2	d	d%	Cohen d	t	P (t)
1600	5	1132,52	42,55	1153,64	38,57	21,12	1,86	0,859	1,92	87,28

Namely, the formed dependences do not give grounds to claim that the application of one or the other model in a comparative aspect has led to reliable and scientifically proven better changes in test performance. So, it can be concluded that there is an equal efficiency of both applied models.

III.4.2. Comparative analyzes of the sports achievements dynamics

Partial and comparative analyzes of the data show that in both models there is a divergent dynamics of achievement, which is not convincingly confirmed by statistical evidence by the values of Student's T-test as well as the Cohen's test. In the first test P (t) is 98.23, in the second P (t) - 92.28, in the third P (t) 32.56. The findings give grounds to determine the equal influence of the two models on the changes in sports achievements, without outlining a clear priority of efficiency.

The experimental model was applied in the period 01.09.2011. -31.08.2012 and during it 10 international competitions in 10-km long-distance swimming were also held. P. S. has taken part in 4 of them, successfully completed 4 including Pre-Olympic qualification and a successful start of the Olympic Games.

For comparative efficiency of the two models the following five criteria were applied: ranking, sports achievement; difference from the winner; difference from the first 3; difference from the first 10 competitors. In this direction of comparisons, it should also be noted that the lack of standardization in the conduct of open water competitions at 10 km always contains a great deal of uncertainty, which reduces their scientific significance, but does not completely reject it. Another starting point on the effectiveness of the two load models applied shows that there was a significant margin for optimization in their macro framework regarding the strategy for participation in the 2012 London Olympics. In both models the highest level of sports form is reached in the middle of July, ie. in the second part of the *early competitions stage*. The arguments for such a conclusion are related to the fact that in this time period the best rankings and sports achievements are registered at a distance of 10 km. They are for the CM on 18.06.2011 in Portugal 2nd place and achievement 1: 40: 31.40, and for EM - 10.06.2012 again in Portugal - 3rd place and achievement 1: 45: 34.10 respectively.

In CM one month later - on 16.07.2011 he participates in a competition where the ranking is 27th place and the achievement is 1: 55: 39.50. So, there are objective arguments that the peak of sports form has been passed and there is a qualitative decrease. At the same time, a month later, at the time of the Olympic Games next year, there was also an international start where P.S. does not take part in. This methodological omission does not allow to make applied effective conclusions whether this decline in sports form has been overcome and on the basis of what factors this has happened or not realized.

The successful participation of P.S. in the Olympic Games - 2012 can be considered as a proof that a positive expert analysis has been made. This has also led to the development and implementation of a new EM on loads, which can essentially be considered assuccessful and more efficient than the CM implemented in 2011, but arguments remain for discussion that the EM could have been even more - successful.

Conclusions and recommendations

Conclusions

1. Based on the retrospective analysis of specialized references made for the first time, three stages in the development of the 10-km discipline are outlined for the 1980-2019 period: the first stage- until 2000 of "appearance and experimentation", the second from 2000 to 2008 - " stage of validation " and from 2008 to 2019 –"intensive development" stage

2. It was found that the world's elite highly qualified male and female athletes implement applied and effective tactical models for swimming across the distance of 10 km. They were characterized by a dynamic start and swimming with maximum effort during the initial part of the distance and then the average distance speed varies in each subsequent part to reach a new maximum in the final 1700 meters.

3. The uniform swimming across the distance of 10 km by highly qualified male and female athletes turns out to be only a theoretical priority feature, which does not characterize the long-distance swimming. It was performed emphatically by using a non-uniform average speed.

4. A partial quantitative approach for control of sports achievements in the 10-km discipline for highly qualified male and female athletes has been developed, using evaluation tables. It forms an objective basis for effective management of the competitive process and is confirmed in the successful multi-year competitive performances of P.S. as one of the representatives of the world elite in this discipline.

5. In order to optimize the management of the training process in the 10-km long-distance swimming of for highly qualified male athletes, two original models of training loads in the structure and content of the annual training cycle have been developed and experimentally tested.

6. It has been experimentally established through the changes of indicators from informative control tests and sports achievements analyzes, the positive influence of both applied models for training load management. This gives grounds to determine their equality on sports achievements, without outlining a clear priority for efficiency in elite 10-km long-distance swimmers.

Recommendations

1. Highly qualified 10-km swimmers can apply in their competition activities the characterized tactical models for optimal swimming of the individual parts of the distance.

2. It is appropriate for training loads during the preparatory period for elite athletes at 10 km long-distance swimming to apply long-distance swimming with pulse rate and swimming speed at the level of Aerobic Threshold (AT), as well as with variable speed increase and continuous swimming between Aerobic Threshold (AT) and Anaerobic Threshold (AnT) levels for the development of aerobic endurance.

3. In the training of highly qualified swimmers at 10 km distance, it is advisable to widely apply in the entire annual cycle of"fartlek" swimming including sections to stimulate respiratory processes and increase heart rate to 150 beats per minute in the area of AnT and sections to remove lactate and delaying low- to moderate-intensity fatigue at a level up to AT.

4. We recommend swimming specialists to apply in their professional activity the developed and experimentally tested models of annual training programs. Their effectiveness have been proven and they are an applied positive example for improving sports performance in 10-km long-distance swimming.

Scientific contributions

* Retrospectively, three time periods in the development of competitive 10-km swimming from its appearance to the current 2020 were characterized and differentiated.

* Applied effective tactical models for swimming across the distance of 10 km in the world elite highly qualified male and female athletes were characterized.

* Original in structure and content models for training loads in 10-km long-distance swimming for highly qualified male athletes in the annual training cycle were developed, quantitatively characterized and experimentally implemented.

Publications related to the dissertation topic:

1. **Stoychev, P.** (2019). Comparative analysis of the competitive activity of elite male swimmers in 10-km long-distance swimming, Sport and Science issues 5-6, 2019, ed. Zona Art Print EOOD, (pp. 101-119), Sofia, ISSN 1310-3393;

2. **Stoychev, P.** (2020) "Models for training loads during the preparatory period for elite athletes in 10 km long-distance swimming." Sports and Science issue 1-2; 2020, S., ISSN 1310-3393;