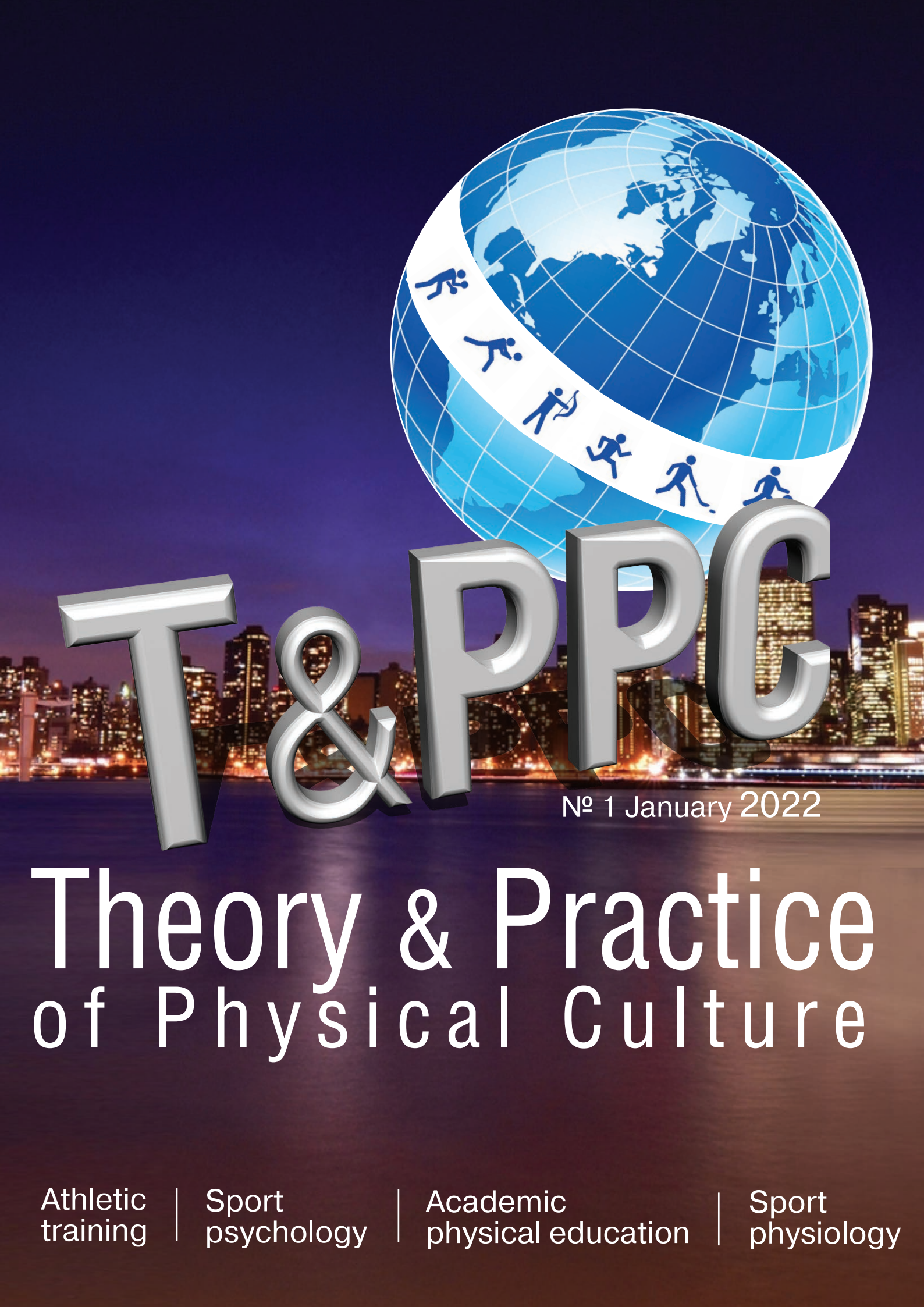

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Athletic training | Sport psychology | Academic physical education | Sport physiology

EDITORIAL

Key issues of the modern sports science for discussion

Olympism through the prism of modern social problems

Olympism has always been associated with sports, culture, education, respect for human values, fair play, and a sporty lifestyle. Olympic culture is based on the athlete's desire for harmonious development, beauty and respect for aesthetic principles. Olympism is understood as "a philosophy of life that exalts and unites the qualities of will, body and mind into a balanced whole...". According to the Olympic Charter, the goal of Olympism is the formation of sports at the service of the harmonious development of mankind, contributing to the creation of a peaceful society that cares about the preservation of human dignity.

However, the modern Olympic Games are experiencing unprecedented pressure from a number of social factors that create a crisis situation and threaten the integrity of the Olympic movement, changing the essential content of Olympic sports.

The crisis of the Olympic movement was especially pronounced in 2021, when at the XXXII Olympic Games in Tokyo, Russian athletes competed as a team of the Russian Olympic Committee, while raising the national flag and sounding the anthem of Russia in honor of the country's winning athletes was prohibited. Most recently, the United States announced a diplomatic boycott of the Olympic Games in Beijing, which was supported by Australia, Great Britain, Canada, and New Zealand. It is already becoming clear that the People's Republic of China (PRC) will not be able to get what it expected from the Olympic Games: a positive image of the country. In turn, the states that announced a diplomatic boycott of the 2022 Olympic Games in Beijing, according to the Chinese leadership, will "pay the price" for their erroneous actions. The use of the Olympic platform for political manipulation causes irreparable harm, first of all, to the Olympic Games themselves. The International Olympic Committee (IOC) adheres to political neutrality. Nevertheless, the growing political ambitions, as opposed to sports rivalry, act as a negative factor of public opinion in relation to Olympic sports. Unfortunately, the politicization of the Olympic Games leads to interference in the judging of competitions, as happened in Tokyo when Russian gymnasts lost a gold medal in the artistic

High-level competitions, such as the Olympic Games, attract a large flow of fans and tourists to the host country, which significantly affects social communication with the local population. This situation is accompanied by great discomfort, which is expressed in a change in the usual urban landscape: because of shopping malls and other tourist infrastructure, settlements turn into huge theme parks.

The construction of sports facilities for the Olympic holiday violates the ecology of cities, as some of them are built in protected areas. For example, during the construction of sports facilities for the organization of the

Olympic Games in Sochi, there was a threat to the site of the World Natural Heritage "Western Caucasus".

The holding of the Olympic Games should be ensured by taking measures of a high degree of security, which creates additional discomfort for the local population when they are recommended to leave their permanent places of residence for a while. This is also a significant factor characteristic of the present time, since society is in the conditions of possible terrorist attacks.

Thus, in the minds of the population of a country hosting large-scale sporting events, such as the Olympic Games, the question arises: "Does the country need the Olympic Games?".

At the same time, I would like to emphasize that the idea proclaimed by Pierre de Coubertin of the independence of Olympism from the politics and economics of the capitalist world turns out to be false both in its essence and in fact of world history. The capitalization and politicization of the Olympic Games is determined not so much by the personality of the IOC leaders as by their involvement in Western civilization as its immanent product and dependence on this social context. The scientific social forecast of the political and economic development of Olympism in the near future will continue to clearly fit into the mainstream of the transformation of modern society.

We invite scientists to publish articles that are aimed at finding new approaches in the development of the Olympic movement and large-scale sports events.

Editor-in-Chief, Honored Worker of Physical Culture of the Russian Federation, Ph.D., Professor L.I. Lubysheva

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Contents

Experiments in sports regulation

UDC 796:34

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Abstract

Objective of the study was to develop a theoretical basis for a regulatory experiment theory in application to the sports sector.

Methods and structure of the study. We used, for the purposes of the study, a set of standard analytical and generalization methods as a basic toolkit; comparative analysis of some legal and regulatory frameworks; formal legal theory and practice studies (to process the relevant regulatory and empirical input data); and a synthesizing method to design our own sports sector governmental regulatory framework concept. We analyzed the sports sector governmental regulatory framework of the following 30 nations: Australia, Austria, Argentina, Belarus, Brazil, Vietnam, Germany, Greece, Denmark, Iceland, Spain, Italy, Kazakhstan, Canada, China, Netherlands, Norway, UAE, Poland, Portugal, Russia, USA, Ukraine, Uruguay, Finland, France, Switzerland, Sweden, South Korea and Japan.

Results and conclusion. It is only natural for a sports sector nowadays to demonstrate high commitment for research, ambitious experiments and competitions – that needs to be facilitated by a modern legal and regulatory framework highly sensitive to the dynamically changing conditions, environments and interests of the key actors. This is the reason why the sports sector should be advanced with contributions from the relevant efficient regulatory experiment technologies – all the more that the regulatory experiment history is several centuries old. Such regulatory experiments and technologies in the sports sector may be quite extensive and versatile to encourage new experimental sports centers and facilities development projects; regulate the experimental sports equipment piloting initiatives; test benefits of experimental sports sector financing and taxation codes; offer and test experimental sports sector specialist training services; implement anti-crisis management models in some sports disciplines, etc.

Keywords: *sports, governmental regulatory framework in sports sector, regulatory experiment, regulatory provisions.*

Background. Modern governmental regulatory framework, as far as its efficiency, effectiveness and relevance is concerned within the modern management model (progress paradigm) [1; 2; 4] is always limited by its administrative resource and potential growth options – both in Russia and abroad. When such limitations are faced, it is fairly common and relevant to make resort to a regulatory experiment (considered on a more detailed basis in our prior studies with concern to its role, mission and ontology). Such experiments [3, p.510] in the legal domain on the whole and lawmaking field in particular (including the sports laws) are given a growing priority nowadays by many world economies.

Objective of the study was to develop a theoretical basis for a regulatory experiment theory in application to the sports sector.

Methods and structure of the study. We used, for the purposes of the study, a set of standard analytical and generalization methods as a basic toolkit; comparative analysis of some legal and regulatory frameworks; formal legal theory and practice studies (to process the relevant regulatory and empirical input data); and a synthesizing method to design our own sports sector governmental regulatory framework concept. We analyzed the sports sector governmental regulatory framework of the following 30 nations: Australia, Austria, Argentina, Bela-

rus, Brazil, Vietnam, Germany, Greece, Denmark, Iceland, Spain, Italy, Kazakhstan, Canada, China, Netherlands, Norway, UAE, Poland, Portugal, Russia, USA, Ukraine, Uruguay, Finland, France, Switzerland, Sweden, South Korea and Japan.

Results and discussion. Although regulatory experiments in the sports sector are still not common enough – apparently due to the sports sector specifics and limitation – there are still a few foreign sports sector regulatory experiences that deserve special attention and analysis – see an overview hereunder.

USA. The sports sector governmental regulatory framework includes Federal Act No. 93-107 of 14.09.1973 "Amendments to the Communications Act of 1934 on Some Professional Sports Club (PSC) Games Broadcasting Service" that states that the TV broadcasting contractual provisions prohibiting any other broadcasts from the match location should be considered null and void when all entrance tickets offered for sales for 120-plus hours before the match are sold out for 72-plus hours before the match. It should be mentioned that the prior governmental regulatory framework gave the professional sports teams the right to prohibit TV broadcasts of the sold-out matches [5, p.169].

The above Federal Act was effective for an experimental period of less than three years (till 31.12.1975) to give the lawmakers enough time to assess its actual benefits and drawbacks [6, p.37]. Federal Act No. 93-107 "Amendments to the Communications Act of 1934 on Some PSC Games Broadcasting Service" required that the relevant governmental agencies should analyze, on a permanent basis, actual pros and cons of the regulatory provisions thereof and report their findings on a yearly basis on or prior to April 15. Such reports were expected to provide detailed statistics and other relevant data, plus their regulatory system update recommendations for the professional football, basketball, baseball and ice hockey event broadcasting service to meet the lawful public interest. As reported by experts of the National Basketball Association, the above test period was too short to arrive at a well-grounded conclusion on the actual benefits of the Act for at least professional basketball [6, p. 37]. It should be mentioned that later on the effectiveness period of the Act was extended.

Germany (FRG). The national sports sector governmental regulatory framework at this juncture runs a regulatory experiment in the sports betting industry. The regulatory experiment provisions were set in the FRG Lands' Contract of 15.12.2011 (updated in 2019) "On Gambling in Germany". As provided by the "Experimental sports betting provisions" paragraph 10a, '(1) To attain the objectives set out in §1, including those regulating the black market control activity … §10 part 6 will be ineffective for the sports betting business till 30.06.2021. Should the State Contract be extended as provided by §35 part 2, this period will be extended till 30.06.2024. (2) Sports betting businesses in this period should be run only on a licensed basis (§§4a - 4e)'. Note that §10 part 6 of the Contract sets serious limitations for some gambling businesses/ classes and their management personnel. Thus §4a part 1 of the Contact clearly states that when §10 part 6 is ineffective for the sports betting business during the period specified by §10a, the gambling business may be run only on a licensed basis. As provided by §10 part 3, the above license makes its holder immune to the Internet sports betting business control limitations as provided by §4 part 4.

France. Of special interest in the valid national governmental regulatory framework is Decree No. 2018-460 of 08.06.2018 "On the Associations Development Foundation" Article 3. It vests the Foundation with the responsibility, inter alia, to channel national financial support for research projects and experiments of potential social benefits from the relevant social innovations. Listed among the eligible corporate beneficiaries thereof are the sports and physical education sector entities.

Conclusion. It is only natural for a sports sector nowadays to demonstrate a high commitment for research, ambitious experiments and competitions – that need to be facilitated by a modern legal and regulatory framework highly sensitive to the dynamically changing conditions, environments and interests of the key actors. This is the reason why the sports sector should be advanced with contributions from the relevant efficient regulatory experiment technologies – all the more that the regulatory experiment history is several centuries old. Such regulatory experiments and technologies in the sports sector may be quite extensive and versatile to encourage new experimental sports centers and facilities development projects; regulate the experimental sports equipment piloting initiatives; test benefits of experimental sports sector financing and taxation codes; offer and test experimental

sports sector specialist training services; implement anti-crisis management models in some sports disciplines, etc.

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Hydrodynamic characteristics of elite swimmers of different genders at final period of training for major competitions

UDC 797.21

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Abstract

Hydrodynamic characteristics of elite female and male swimmers were determined by the four variants of the perturbation method at the phase of decrease in training load before the 2016 Olympic Games in Rio de Janeiro and the 2017 World Championship in Budapest. Further, the ten best swimmers of both genders were selected by their maximal swimming velocity (v_{0max}) in all athletic strokes (80 subjects altogether). As a result of the proper processing of the data, statistical models of quantitative values of active drag force ($F_{r(ad}$), the dimensionless hydrodynamic coefficient ($C_{x(ad)}$) and total external mechanical power (P_{to}) were determined. In all four strokes, due to their essential superiority in P_{to}, men have higher levels of v0max than women. Naturally enough that at higher v_{0max} elite male athletes have greater $F_{r(ad)}$, too. Again, in terms of $C_{x(ad)}$, there was no statistical difference between women and men within each of the strokes. Consequently, regardless of their gender, elite swimmers may be stated to be equally successful in mastering proficient swimming techniques of all athletic strokes. Besides having an independent scientific significance, the statistical models of $F_{r(ad)}$, $C_{x(ad)}$ and P_{to} allow to increase considerably the quality of the individual analysis of these indicators on athletes of different performance levels. The key criterion for such analysis at the phase of decrease in training load is $C_{x(ad)}$, which determines the hydrodynamic efficiency of the individual swimming technique in any of athletic strokes in terms of quantity.

Keywords: *swimming velocity, active hydrodynamic resistance (active drag), mechanical power.*

Introduction. Specialists in the sphere of biomechanics of human and animal water locomotions widely use the small perturbation method for measuring the basic hydrodynamic characteristics of swimmers at their maximal swimming velocity [1, 2], both in its basic variant [3-5], and in its modifications [6-9]. In all those cases, the mathematical model of the method is constant, and the technological changes only refer to the construction of technical devices, creating the perturbation factor.

In its basic variant, the perturbation is induced by an additional hydrodynamic body of a certain resistance magnitude. For this purpose, French specialists developed an electromechanical device attached to the edge of the pool [6, 7]. While swimming a subject pulls the inflexible (non-elastic) cord out of the device, which creates constant and measurable additional resistance of certain magnitude within the range from 0 to 100 N. In the variant, elaborated by the Chinese specialists, the perturbation factor is induced by the mechanical block, sliding smoothly along the cord over the pool track, which can be regulated and which allows to register the magnitude of the created force [8]. For this purpose, the Australian specialists use the system of contact hydrodynamic leadership [9]. This system allows to produce the towing force, which can be regulated and measured in the real mode of time. Obviously, the authors of this technology use the negative value of the perturbation factor in the mathematical model of the method. The above-mentioned works represent the variants of the method in more detail.

The analysis of these researches' results has shown that individual quantitative values of the basic hydrodynamic parameters vary in all athletic strokes. They have multidirectional and regular oscillations depending on the content, amount and intensity of training exercises at different phases of the greater training cycle. Again, at the phase of decrease in training load,

these magnitudes tend to be optimal for each swimmer, and this is one of the main factors for successful performance at the competitions.

Objective. The research was aimed to elaborate the statistical models of the basic hydrodynamic characteristics of elite female and male swimmers at the phase of decrease in training load.

Methods. Individual values of active drag force $F_{r(ad)}$, the dimensionless hydrodynamic coefficient ($C_{x(ad)}$) and total external mechanical power (P_{to}) were determined by different variants of the small perturbation method. Regardless the variant used, these magnitudes were measured at the maximal swimming velocity (v_{0max}) at the distance of 30 m. The electronic system, used in the research, allowed to measure time within one-hundredths of a second.

The method name itself evidently implies that the accuracy of measurements depends essentially on the adequate magnitude (force) of the perturbation factor, which is determined individually in each testing. The objective quantitative criterion for the adequacy of this magnitude is the percent of the velocity change ($\%\Delta\upsilon_0$) while swimming under impact of the perturbation force in relation to the velocity of free swimming (decrease or increase of the velocity depending on the variant of the method). Due to the metrological modeling based on the mathematical model of the method, the optimal range of the magnitude was determined as $\%\Delta\upsilon_0$ = 4–6% (in this case the maximum experimental error doesn't exceed ±3%) [1, 2, 9].

Out of the great amount of experimental data at our disposal, at first we selected the results of individual hydrodynamic tests conducted on elite swimmers from different national teams, which were taken at the phase of decrease in training load before the 2016 Olympic Games in Rio de Janeiro and the 2017 World Championship in Budapest (all in all, 246 tests). These results only included the tests with the magnitude $\%\Delta\upsilon_0$ within the range 4–6%. To obtain maximally objective and accurate statistic models, at the second stage, out of 246 subjects 10 best female and male swimmers in each stroke were selected additionally (80 subjects altogether; each athlete is represented by the results of the only test). The only criterion for such selection of the best swimmers was the maximal swimming velocity value (v_{0max}) developed during testing. All the selected subjects belonged to the 25 best athletes of the current world ranking at the distances of 100 or 200 meters in the corresponding stroke.

Discussion. Table 1 represents statistical models (M±m) of the basic hydrodynamic characteristics of elite swimmers in different strokes obtained at the final period of training to the Olympic Games and the World Championship.

The analysis of the results has shown that, regardless of the subjects' gender, the athletic strokes can be ranked by the maximal swimming velocity in a determined order: freestyle, dolphin, backstroke and breaststroke (P<0,01-0,001) (Statistical difference in v_{0max} has not been revealed only between females' dolphin and backstroke). This order entirely correlates with the current World Record in swimming 50 meters by females and males. In all strokes, men have higher magnitudes of v_{0max} than women, which is the result of males' substantial superiority in developing total external mechanical power (P_{to}). Therefore, it is natural that at higher v_{0ma}x elite male swimmers have also greater active drag force $F_{r(ad)}$ in athletic strokes.

Table 1. *Statistical models (M±m) of the maximal swimming velocity (v0 $_{max}$, m·s^{-1}), active drag force (Fr$_{(ad)}$, N), the dimensionless hydrodynamic coefficient ($C_{x(ad)}$) and total external mechanical power (P_{to}, W) of elite female and male swimmers in athletic strokes*

Stroke	Magnitudes	Females	t; p	Males
front crawl	v_{0max}	1,800 ± 0,012	6,70; <0,001	2,037 ± 0,033
	$F_{r(ad)}$	66,40 ± 7,01	2,87; <0,05	104,37 ± 11,22
	$C_{x(ad)}$	0,262 ± 0,028		0,263 ± 0,034
	P_{to}	119,53 ± 12,76	3,46; <0,01	212,53 ± 23,68
dolphin	v_{0max}	1,657 ± 0,036	4,98; <0,001	1,857 ± 0,019
	$F_{r(ad)}$	76,25 ± 8,08	3,40; <0,01	113,63 ± 7,46
	$C_{x(ad)}$	0,355 ± 0,028		0,359 ± 0,029
	P_{to}	126,50 ± 14,99	3,99<0,001	211,07 ± 14,99
backstroke	v_{0max}	1,618 ± 0,025	4,20; <0,001	1,756 ± 0,021
	$F_{r(ad)}$	72,03 ± 5,43	3,48; <0,01	102,38 ± 6,83
	$C_{x(ad)}$	0,347 ± 0,024		0,361 ± 0,027
	P_{to}	116,55 ± 9,45	3,35; <0,01	177,25 ± 15,48
breaststroke	v_{0max}	1,401 ± 0,020	5,76; <0,001	1,571 ± 0,022
	$F_{r(ad)}$	73,05 ± 5,12	3,30; <0,01	108,57 ± 9,48
	$C_{x(ad)}$	0,472 ± 0,012		0,477 ± 0,045
	P_{to}	102,41 ± 8,34	3,81; <0,01	170,59 ± 15,83

Again, in each of the strokes, there is no statistical difference in the dimensionless hydrodynamic coefficient between female and male swimmers. According to the aforementioned researches [2, 10], it is the magnitude of $C_{x(ad)}$ that allows to conduct the *accurate hydrodynamic comparison* of different subjects between different strokes, excluding the influence of individual values of total body size and mass of athletes as well as their swimming velocity. That is why, specialists and coaches treat $C_{x(ad)}$, determined under natural swimming conditions, as an integral quantitative indicator of the swimmer's technical ability and level. Consequently, it is definite enough that, regardless of their gender, elite swimmers are equally successful in mastering the most recent and efficient swimming techniques in all athletic strokes.

Despite the substantial difference in the values of v_{0max} between various women's strokes, the quantitative values of $F_{r(ad)}$ and *Pto* are virtually the same, since there is no statistical difference between these magnitudes. In the male subjects, the observation is analogous. The biomechanical mechanism of this phenomenon can be clarified by the analysis of $C_{x(ad)}$, the values of which depend on the swimming stroke and are observed within the determined quantitative range (Both in the female and male subjects, statistical differences between the magnitudes of $C_{x(ad)}$ have not been revealed only between dolphin and backstroke, that was repeatedly observed previously [1, 2, 10]). Consequently, $C_{x(ad)}$ apparently depends on the individual features of the athlete's body (i.e., physical build), but to much greater extent, it depends on the inherent to every athletic stroke specific biomechanical system of motions, cinematic characteristics of which are strictly regulated by the competition rules.

Summary. The statistical models of the basic hydrodynamic characteristics of elite female and male swimmers are of principal importance for specialists and coaches, as they allow to increase essentially the quality of the individual quantitative analysis of these characteristics of swimmers of different performance levels. At the phase of decrease in training load (tapering phase), the key criterion for such analysis is the dimensionless hydrodynamic coefficient, which quantitatively determines hydrodynamic efficiency of the individual swimming techniques in any of athletic strokes.

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Features of sexual dimorphism in elite pentathletes

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Abstract

Objective of the study was to establish the degree of manifestation of sexual dimorphism in elite athletes specializing in modern pentathlon.

Methods and structure of the study. The study involved 18 elite athletes, both men and women, specializing in modern pentathlon and having the sports qualifications from MS to WCMS. In order to address the research issues, somatometric methods commonly used in sports morphology were applied. In addition, the method of bioimpedance analysis of body composition using the "Medass – ABC-01" device (Russia) was applied.

The degree of manifestation of sexual dimorphism was determined by five categories [5, 6]. The sex differences were deemed absent when the compared values approximated – ±1%; when these values differed within ±10%, the degree of manifestation was deemed low; within ±10-30% – average; within ±30-50% – high; above ±50% – very high. In addition to the generally accepted statistical indicators, the Mollison criterion (kM) was used to quantify the degree to which sexual **dimorphism manifested itself in the subjects.**

Conclusion. The study found that, according to the morphological characteristics, the degree of manifestation of sexual dimorphism in elite pentathletes was low to average. The body composition analysis revealed the high (SMM, IW and TBW, ACM), average (EW, fat mass) and low (percent SMM) degrees of manifestation of sexual dimorphism. In terms of almost all the studied indicators, the men were found to predominate over women, except for the fat mass.

Sexual dimorphism in assessing competitive performance in individual pentathlon events indicates that women are inferior to men in almost all the studied indicators, except for shooting. The most significant gender differences (kM) were found in mixed relay, 4,800 m running and swimming. The least significant differences were found in shooting.

To reduce the degree of manifestation of sexual dimorphism, attention should be paid to the sports selection of female athletes.

Keywords: *sexual dimorphism, elite athletes, modern pentathlon, competitive performance, morphological indicators, body component composition.*

Background. In modern sports training system, apart from the general provisions for men and women, we have two fundamental approaches concerning the orientation of women's training. In one of the cases, the authors emphasize that women's sports are characterized by their own unique features [1, 3, 12, 13]. In their opinion, specific requirements of individual sports generate differences in the adaptation processes in women. Therefore, individual biorhythmic characteristics of the reproductive system of a particular female athlete [1, 7, 8, 11-13] must be taken into account when organizing training activities.

Whereas, some authors [3, 10] are convinced that the training process should be planned regardless of the athlete's sex but based on the general patterns of sports training. Thus, T.S. Soboleva et al. [10] state that in most elite sports where women with an androgen hormonal profile are represented it is necessary to follow common approaches that are widely used in men's sports. This position is based on the fact that the elevated level of natural androgens (congenital hyperandrogenism) allows such female athletes to compete with men.

The authors [5, 12, 13] define dimorphism as the presence of two more or less different forms within the same species. There is another definition of dimorphism – the distinction between sexes at the genetic, anatomical, physiological, and psychological levels [2]. It is emphasized [3, 5, 6, 10, 11] that the possibility of female athletes to achieve high sports results is predermined by the convergence of the physiological and morphofunctional indicators in highly-qualified athletes of both sexes. For this purpose, according to T. Sokhi [11], it is necessary to strive for the adequacy of pedagogical effects of dimorphic differences in adaptive processes in the female body and psyche under the influence of training loads.

Several scientific works consider differences in the morphological and functional characteristics of women who are actively engaged in men's sports. The studies found a tendency towards leveling out of the dimorphic differences and suggested masculinization of women through sports activities [1, 6, 9, 10] and convergence in their competitive performance in a particular sport [4, 8-10, 12].

Objective of the study was to establish the degree of manifestation of sexual dimorphism in elite athletes specializing in modern pentathlon.

Methods and structure of the study. The study involved 18 elite athletes, both men and women, specializing in modern pentathlon and having the sports qualifications from MS to WCMS. In order to address the research issues, somatometric methods commonly used in sports morphology were applied. In addition, the method of bioimpedance analysis of body composition using the "Medass – ABC-01" device (Russia) was applied.

The degree of manifestation of sexual dimorphism was determined by five categories [5, 6]. The sex differences were deemed absent when the compared values approximated – ±1%; when these values differed within ±10%, the degree of manifestation was deemed low; within ±10-30% – average; within ±30-50% – high; above ±50% – very high. In addition to the generally accepted statistical indicators, the Mollison criterion (kM) [13] was used to quantify the degree to which sexual dimorphism manifested itself in the subjects. The latter was calculated by the formula:

$$kì = \frac{\overline{\tilde{O}_f} - \overline{\tilde{O}_m}}{S_m},$$

where $\bar{X}_f$ – arithmetic mean of the given feature in females; $\bar{X}_m$ – arithmetic mean of the given feature in males; S_m – quadratic deviation of a given feature in males. The higher the numerical values of the criterion, the higher the degree of manifestation of sexual dimorphism.

The competitive performance of the athletes of both sexes in various modern pentathlon events not influenced by external factors was also assessed.

Table 1. *Morphological indicators in highly-qualified athletes specializing in modern pentathlon*

Indicator	Men			Women			%	kM
	$\bar{X}$	S	V%	$\bar{X}$	S	V%		
Body length, cm	182.8	6.14	3.35	167.25	8.34	4.98	9.29	6.52
Body mass, kg	73.04	7.24	9.91	59.6	8.27	13.87	22.55	5.40
Body mass index, u.	21.86	1.55	7.09	21.25	1.23	5.78	2.87	1.41
Waist circumference, cm	76.4	3.97	5.19	67.25	3.40	5.05	13.61	7.95
Hip circumference, cm	95.4	4.21	4.41	92.5	5.25	5.67	3.13	1.89
Waist/hip ratio	0.79	0.86	5.12	0.72	0.02	3.95	9.72	0.41

Table 2. *Body component composition in elite athletes specializing in modern pentathlon*

Indicator	Men			Women			%	kM
	$\bar{X}$	S	V%	$\bar{X}$	S	V%		
Percent ACM, %	62.24	2.62	4.2	60.1	1.23	2.0	3.5	1.91
ACM, kg	38.66	4.12	10.6	28.0	2.63	9.3	38.0	10.19
SMM, kg	34.54	2.32	6.7	23.95	2.93	12.2	44.2	2.44
Percent SMM, %	55.76	1.48	2.6	51.3	1.26	2.4	8.6	10.43
Fat mass, %	14.96	1.85	12.3	21.15	4.33	20.4	-29.2	-5.51
Intracellular water, kg	27.62	2.58	9.3	19.8	1.73	8.7	39.4	11.71
Extracellular water, kg	17.76	1.29	7.2	14.35	1.78	12.4	23.7	6.73
Total body water, kg	45.4	3.84	8.4	34.17	3.46	10.1	32.9	9.82

Results and discussion. Given in Table 1 are the results of the comparative analysis of the morphological indicators in the athletes of both sexes specializing in modern pentathlon.

According to the morphological indicators, the degree of manifestation of sexual dimorphism was low to average. The indices of the athletes' body length (9.29%), hip circumference (3.13%), waist/hip ratio (9.72%) and body mass index (2.87%) had a low degree of manifestation of sexual dimorphism, while their body mass (22.55%) and waist circumference (13.61%) rates had an average degree of manifestation of sexual dimorphism.

The body composition analysis (Table 2) revealed a high degree of manifestation of sexual dimorphism in terms of the following indicators: skeletal muscle mass (SMM) (44.2%), intracellular water (IW) (39.4%), total body water (TBW) (32.9%), active cell mass (ACM) (38.0%).

The average degree of manifestation of sexual dimorphism was found in terms of the following indicators: extracellular water (23.7%), fat mass (29.2%), and the low degree – in the percent skeletal muscle mass (8.6%). The very high degree of manifestation of sexual dimorphism according to the Mollison criterion (kM) was detected in the following body composition indicators: intracellular water – 11.71; percent skeletal muscle mass – 10.43; active cell mass – 10.19. In general, the variability of the studied indicators was higher in the female pentathletes.

Given in Table 3 are the sexual dimorphism rates obtained during the assessment of the competitive performance of athletes in various modern pentathlon events.

The results obtained showed that the women lagged behind the men in almost all the studied indicators: swimming – 9.25%, **mixed relay** total time – 9.95%, and one of its events – 4,800 m running – 12.35%. The exception was the time of shooting in the mixed relay. The women were 5.49% ahead of the men (low degree). In our view, such difference in the values was ensured by a higher level of development of movement coordination, stress tolerance, economy and technical efficiency of the female athletes during shooting.

The analysis of the relative variability (coefficient of variation) rates obtained in both men and women during swimming and mixed relay revealed fairly stable results. The greatest variability in all the indicators was found among the women. However, the mixed relay events (shooting and 4,800 m running) showed wide ranges of variability. Thus, in the mixed relay, the athletes achieved identical results due to both the relatively even level of development of the main components of competitive performance and sharply disproportionate results demonstrated.

Conclusion. The study found that, according to the morphological characteristics, the degree of manifestation of sexual dimorphism in elite pentathletes was low to average. The body composition analysis revealed the high (SMM, IW and TBW, ACM), average (EW, fat mass) and low (percent SMM) degrees of manifestation of sexual dimorphism. In terms of almost all the studied indicators, the men were found to predominate over women, except for the fat mass.

Sexual dimorphism in assessing competitive performance in individual pentathlon events indicates that women are inferior to men in almost all the studied indicators, except for shooting. The most significant gender differences (kM) were found in mixed relay, 4,800 m running and swimming. The least significant differences were found in shooting.

To reduce the degree of manifestation of sexual dimorphism, attention should be paid to the sports selection of female athletes. Nowadays, as a rule, it is female athletes, who have been swimming in the past and have not performed well in this sport, who go in modern pentathlon. We also believe that more emphasis should be placed on fencing and running, as with the forthcoming change in the rules of modern pentathlon competitions this may trigger an increase in competitive performance.

Therefore, the dimorphic features in the structure and functions of the female body affect the

Table 3. *Competitive performance rates in highly-qualified athletes of both sexes specializing in modern pentathlon*

Indicator	Men			Women			%	kM
	$\bar{x}$	S	V%	$\bar{x}$	S	V%		
200 m swimming, s	2:06.11	4.81	3.49	2:18.53	4.77	3.14	9.25	2.66
4x800 m running, s	10:31.18	13.44	1.94	11:49.13	44.99	5.79	12.35	5.79
Shooting, s	56.27	15.36	25.1	53.34	16.82	28.79	5.49	-0.19
Mixed relay total time, s	11:27.44	5.93	0.79	12:42.46	33.49	4.01	9.95	10.91

competitive performance rates, which necessitates constant correction of the contents of training effects and their adequacy to the current state of the female athlete's body at the time of training. In doing so, and in keeping with the strategic objectives of training, it is necessary to take into account individual characteristics of female pentathletes and their leading motor abilities.

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New training goal based technical training model in long-term beginner futsal training system

UDC 796.015

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Abstract

Objective of the study was to test by experiment a new futsal technical training system with its goals in the long-term training process.

Methods and structure of the study. The new futsal technical training system testing experiment was run at Sergiev Posad Sports School in the Moscow Oblast in 2018 to 2021. We sampled for the three-year experiment the 7-9-year-old (n=36) futsal players. The futsal technical training system was customized in the training times, content and priorities as dictated by the long-term training mission and goals. The technical training was designed on a time- and cost-efficient basis by the training material being well systematized and staged to facilitate prudent sequencing of the individual technical progress. Every technical skill was mastered and excelled by special exercises so that to work out every technical element on a versatile basis, with reasonable repetitions of every motor action.

Results and conclusion. On the whole, the progress was the highest in the non-lead leg and both-legs ball control skills tests. An intergroup progress analysis found the poor progress in the both-legs test in the Control Group being probably due to the backlogs and inefficiencies in the non-lead leg ball control skills training service.

The new combined futsal technical training model complementary to the long-term training process was tested beneficial as it facilitates progress in the 'movement schooling' process with a special focus on the relevant technical fitness and competitive progress elements. The new futsal technical training model analyzed herein is designed on a reasonably customizable basis and, hence, may be recommended for application in the beginner futsal trainings and other team sports basics training systems.

Keywords: *futsal, junior footballers, long-term training, playing actions, technical fitness, training methods and tools.*

Background. The rapid competitive and physical/ technical progresses in modern futsal sport urge the sport community to give a special priority to the technical training elements at every stage of the long-term training system [2, 6], including new specific technical training models, methods and tools to facilitate training and competitive progresses in the beginner futsal groups [1, 3]. Competitive progress in the modern futsal is commonly known to largely depend on the individual technical fitness shaped up in the beginner training stages [5]. The technical progress, as provided by many authors [4], would depend in their turn on the movement coordination, accuracy, general and sport-specific physical qualities and theoretical/ practical learning ability. This progress in every element needs to be facilitated by modern efficient training models and tools reasonably combined and customized as required by the long-term training goals of the beginner futsal groups.

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Results and discussion. Technical fitness of the sample was tested for the lead/ non-lead leg ball control skills, to produce the technical fitness indices, with the tests run twice a year over the three-year testing experiment period: see Table 1 hereunder.

The technical fitness tests found progress in both groups, with the Experimental Group tested significantly better than the Control Group in six months in every non-lead leg ball control skills test ($p<0.05$), and a year later - in every lead leg ball control skills test ($p<0.01$). Later on the intergroup gap in the ball control skills tests had grown as demonstrated by the Student t-test figures of 8,485 and 8,929 for the lead and non-lead leg, respectively. For the three-year experiment period, the lead leg / non-lead leg tests showed progress of 44.7% and 55.5% in the Control Group versus 74.5% and 98.5% in the Experimental Group, respectively.

Furthermore, the technical fitness indices were found to grow with time, with the Experimental Group in six months tested significantly better than the Control Group ($p<0.05$), with the test gap growing thereafter to reach $p<0.01$ in the post-experimental tests. On the absolute and relative progress test scales, the Control Group technical fitness indices grew by 8.6% and 19%, respectively – versus 24.9% and 25% in the Experimental Group. The individual technical fitness index variation range in the pre-experimental tests was 55-96% in the Control Group versus 57-90% in the Experimental Group. The post-experimental tests showed the technical fitness indices varying in the range of 66-94% and 90-112% in the Control and Experimental Group, respectively: see Figure 1 hereunder.

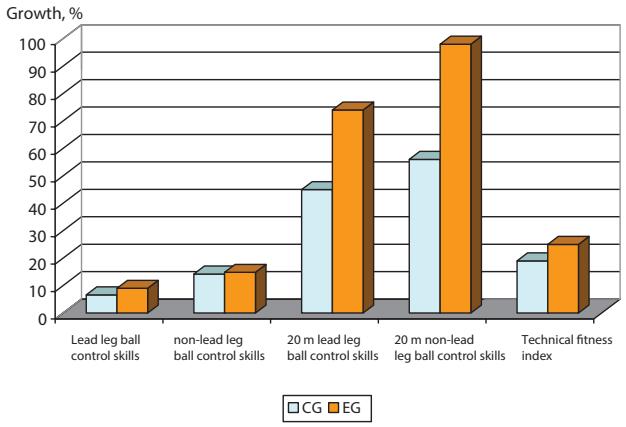

Figure 1. *Group progresses in the ball control skills tests and technical fitness indices*

The technical fitness tests showed significant progress of the Experimental Group versus Control Group in the lead leg ball control skills ($p<0.01$), non-

Table 1. *Junior futsal sample ball control skills / technical fitness test data, M±m*

Test	Test No.	Control Group	Experimental Group	t	p
20m lead leg BCS test, s	1	21,6 ± 0,8	22,1 ± 0,9	0,415	>0,05
	2	19,3 ± 0,9	17,8 ± 0,6	1,387	>0,05
	3	16,4 ± 0,6	13,8 ± 0,5	3,329	<0,01
	4	14,8 ± 0,4	11,4 ± 0,6	4,715	<0,001
	5	14,2 ± 0,4	10,3 ± 0,4	6,894	<0,001
	6	13,7 ± 0,3	10,1 ± 0,3	8,485	<0,001
20m ball control skills non-lead leg test, s	1	30,4 ± 1,5	30,6 ± 1,4	0,097	>0,05
	2	25,7 ± 1,2	21,5 ± 1,1	2,580	<0,05
	3	19,8 ± 1,2	14,4 ± 1,0	3,457	<0,01
	4	19,0 ± 0,6	12,4 ± 0,4	9,153	<0,001
	5	18,0 ± 0,7	11,2 ± 0,4	8,434	<0,001
	6	17,2±0,7	10,4 ±0,3	8,929	<0,001
Technical fitness index	1	71,1± 2,1	72,2 ±2,5	0,337	>0,05
	2	75,1± 2,3	82,8 ±2,8	2,125	<0,05
	3	82,8 ±3,4	95,8 ±2,4	3,124	<0,01
	4	77,9 ±3,2	91,9 ±2,2	3,605	<0,001
	5	78,9 ±3,1	92,0 ±2,5	3,289	<0,01
	6	79,7 ±3,0	97,1 ±2,6	4,358	<0,001

lead leg ball control skills ($p<0.001$) and both legs ($p<0.05$) tests; with the intergroup gap maximized in the post-experimental tests ($p<0.01$). Thus the post experimental tests found progress in the lead-leg and non-lead leg ball control skills and both-legs tests of 18.6%, 7.4% and 11.0% in the Control Group versus 26.4%; 15.3% and 27.7%, in the Experimental Group, respectively. On the whole, the progress was the highest in the non-lead leg and both-legs ball control skills tests. An intergroup progress analysis found the poor progress in the both-legs test in the Control Group being probably due to the backlogs and inefficiencies in the non-lead leg ball control skills training service.

Conclusion. The new combined futsal technical training model complementary to the long-term training process was tested beneficial as it facilitates progress in the 'movement schooling' process with a special focus on the relevant technical fitness and competitive progress elements. The new futsal technical training model analyzed herein is designed on a reasonably customizable basis and, hence, may be recommended for application in the beginner futsal trainings and other team sports basics training systems.

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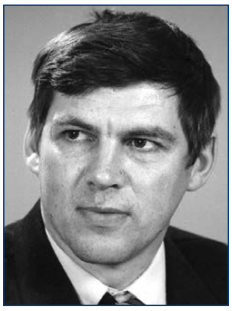
Individualization of judo styles based on 2019 world championship data

UDC 796.015



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Abstract

Objective of the study was to analyze the weight-class-specific differences in the judo styles and techniques, with the 2019 World Judo Championship in Tokyo taken for the case study.

Methods and structure of the study. The study was intended to analyze the technical and tactical toolkits of the 2019 World Judo Championship leaders by the weight classes with the actual specializations and favored techniques, to find the holds typical for different individual fight styles; i.e. prioritize the holds by the weight classes if possible. We respected in our analysis the Y.A. Shulika classification of the basic fight control styles.

Results and conclusion. Our analysis showed that the individual judo training systems need to be customized to the individual anthropometric characteristics due to the simple fact that the response time i.e. muscle extensions/ flexions tend to grow with the growing anthropometric characteristics, including the limb length/ size; associated with the lower movement frequency, slower metabolism, etc. One more training system individualization factor is the specific physicality, gifts and physical qualities with a special role played by strength, speed-pace, coordination and other natural abilities. Generally the technical toolkits in the modern judo tend to fast contract with the weight growth. The individual technical versatility is still important for a competitive progress although the sport leaders were found to heavily score in the top-ranking events by at most two favorite holds in every weight class. Thus we found that the 2019 World Judo Champions scored 48%, 72% and 88% of their total points by one, two or three favorite ("crown") holds, respectively. Our analysis of the 2019 World Judo Championship (men) video replays found domination of strength and strength endurance among the physical qualities critical for success. These physical qualities were found the key for the 14 top holds in 155 actions scored by the refs – versus 43 coordination-dominated actions and 81 speed-pace dominated ones.

Keywords: *judo, training, techniques, tactics.*

Background. Presently training systems in modern martial arts give a growing priority to individualized technical and tactical skills training models since the traditional institutional and practical training approaches are often weight-class-unspecific and, hence, fail to effectively customize the training service for the individual progress needs and priorities. One of the key aspects for consideration in the training system is the individual anthropometric characteristics (morphological type) [1-3] with its high heritability and, hence, influence on the training system that needs a special sensitivity to this factor. It should be mentioned that the morphological typing attempts for judo were made more than 30 years ago, and no surprise that their findings need to be updated as required by at least the modern rules of competitions in judo. Note that subject to analysis in this study is only the technical aspect of the training system individualization process – net of the organizational, psychological and a few other aspects.

Objective of the study was to analyze the weight-class-specific differences in the judo styles and techniques, with the 2019 World Judo Championship in Tokyo taken for the case study.

Methods and structure of the study. The study was intended to analyze the technical and tactical toolkits of the 2019 World Judo Championship leaders by the weight classes with the actual specializa-

Table 1. *Basic fight control styles*

Planned				Reactive/ situational			
Straightforward		Combinational		Active		Passive	
Positional	High-pace	Threats	Footwork	Pressure	Provoke	Open	Hold-back
Power Speed-power	Power Speed-power	High-pace Spurts	Moves Grapples	Dog fight Pacing	Moves Grapples	Dog fight Outpace	Dog fight Outpace

tions and favored techniques, to find the holds typical for different individual fight styles; i.e. prioritize the holds by the weight classes if possible. We respected in our analysis the Y.A. Shulika [7] classification of the basic fight control styles: see Table 1.

Kozina L. [8] offered the following fight control classifier prioritizing the key physical qualities: (1) power style dominated by strength and strength endurance (F×t); (2) durable high-pace style dominated by speed and speed endurance (V×t); and (3) mixed style with a special role of the movement coordination skills largely dictated by the nervous system type.

Results and discussion. We analyzed the performances and successes of the 2019 WJC leaders (men) in 147 bouts: see Table 2.

We analyzed 167 holds in total. Note that a judo bout lasts till two holds are scored by some of the competitors. Subject to our analysis were the fight videos available on YouTube for the 60kg, 66kg, 73kg, 81kg, 90kg and 100kg weight classes: see Table 3.

The technical toolkit listed above in Table 3 was further broken down by the weight classes: see the top-four 60kg competitors' data: Table 4.

Table 5 gives a detailed breakdown of the technical toolkit given in Table 3 by the weight classes, with the top four competitors in each. It gives shares of the same techniques for six-seven bouts of every leader. For example, when a competitor used hold #2 in six bouts out of 12, the hold share was estimated at 6/12 = 0.5.

As demonstrated by Table 5, the shares of one, two and three favorite individual holds were estimated at 48%, 24% and 16% of the total toolkit. Therefore, favorite holds of every leader were found to account for 80% of their total scores – albeit the actual distributions of the techniques by the bouts were found quite irregular: see Table 6.

Furthermore, every technique claims a variety of physical qualities normally dominated by one or two key ones, with the dominance easily detectable by the sports experts having good competitive and/ or coaching experiences. Table 7 hereunder gives an account of the techniques classified by the key physical qualities.

Table 2. *2019 WJ Champions: formal results*

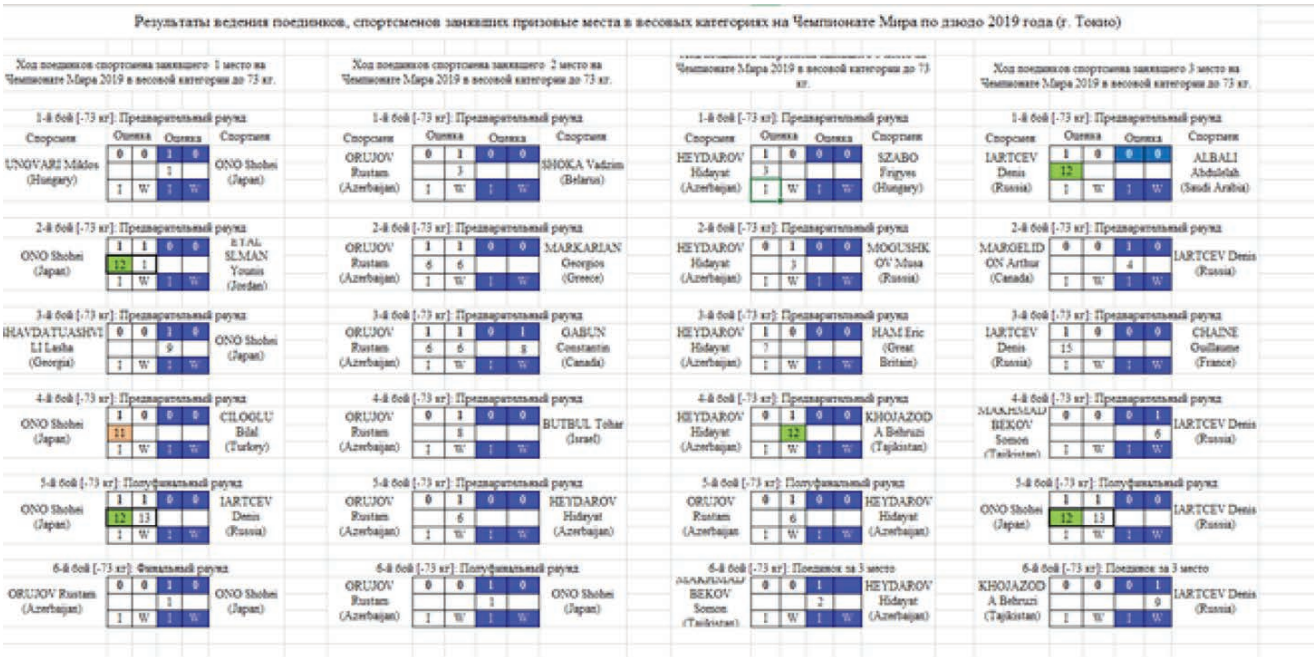
Результаты ведения поединков, спортсменов занявших призовые места в весовых категориях на Чемпионате Мира по дзюдо 2019 года (г. Токио)

Table 3. *2019 World Judo Championship: technical statistics by the weight classes*

	Holds	60kg		66kg		73kg		81kg		90kg		100kg		Total	
	Score	Ippon	Wazari	Ippon	Wazari	Ippon	Wazari	Ippon	Wazari	Ippon	Wazari	Ippon	Wazari	Ippon	Wazari
1	Foot sweep	5	2	4	1	2	1	1	2			1	1	13	7
2	Inner hook	2		4	4		1		1	2	2	1	0	9	8
3	Twist	4	4		1	1	2	1	2	2	3		1	8	13
4	Side two-leg hook		1			1					1			1	2
5	Back throw from two knees		3	1	0	1		2	2	9	2	7	6	20	13
6	Front hook	2	1			2	4	1	1	2	1			7	7
7	Shoulder wheel		1		2		1							0	4
8	Scoop throw	1	1		4		1		1			3	1	4	8
9	Rear hook				1	1	1	6	5		1	2	1	9	9
10	Choke	2			0					1				3	0
11	Submission				1	1								1	1
12	Holds		1		0	2	2	1	3		1	1	2	4	9
13	Foot-in-the stomach throw				1		1		1					0	3
14	Hip throw				1			2	1					2	2
	Total	16	14	9	16	11	14	14	19	16	11	15	12	81	86

Table 4. *2019 World Judo Championship: top four in the 60kg weight class*

м-60	Name	Bout 1		Bout 2		Bout 3		Bout 4		Bout 5		Bout 6		Bout 7	
Place		Ippon	Wazari	Ippon	Wazari	Ippon	Wazari	Ippon	Wazari	Ippon	Wazari	Ippon	Wazari	Ippon	Wazari
1	CHKHVIMIANI, Lukhumi (GEO)	3	6		5		3	3			5		3	6	3
2	LUTFILLAEV, Sharafuddin (UZB)	2	1	1	4	1		2		1		1			
3	NAGAYAMA, Ryuju (JPN)	1			1		7	3	5			12	8		
3	SMETOV, Yeldos (KAZ)	10	3	10		6				3		8			

As demonstrated by Table 7, strength and strength endurance are the key physical qualities for success followed by speed-pace and coordination skills. Therefore, we would recommend giving a special priority in the training system to the following techniques depending on the weight class: Table 8.

Conclusion. Our analysis showed that the individual judo training systems need to be customized to the individual anthropometric characteristics due to the simple fact that the response time i.e. muscle extensions/ flexions tend to grow with the growing anthropometric characteristics, including the limb length/ size; associated with the lower movement frequency, slower metabolism, etc. One more training system individualization factor is the specific physicality, gifts and physical qualities with a special role played by strength, speed-pace, coordination and other natural abilities. Generally the technical toolkits in the modern judo tend to fast contract with the weight growth. The individual technical versatility is still important for a competitive progress although the sport leaders were found to heavily score in the top-ranking events by at most two favorite holds in every weight class. Thus we found that the 2019 WJ Champions scored 48%, 72% and 88% of their total points by one, two or three favorite ("crown") holds,

Table 5. *Priority techniques of the top-four competitors in every weight class*

м-60	Name / Holds (shares)	1	2	3	4	5	6
1	CHKHVIMIANI, Lukhumi (GEO)	0,55	0,22	0,22			
2	LUTFILLAEV, Sharafuddin (UZB)	0,62	0,25	0,12			
3	NAGAYAMA, Ryuju (JPN)	0,28	0,14	0,14	0,14	0,14	0,14
3	SMETOV, Yeldos (KAZ)	0,33	0,33	0,17	0,17		
м-66							
1	MARUYAMA Joshiro(JPN)	0,71	0,14	0,14			
2	KIM, Limhwan (KOR)	0,85	0,14				
3	VIERU, Denis (MDA)	0,6	0,2	0,2			
3	ABE, Hifumi (JPN)	0,33	0,33	0,14	0,14		
м-73							
1	ONO, Shohei (JPN)	0,37	0,25	0,125	0,125	0,125	
2	ORUJOV, Rustam (AZE)	0,66	0,16	0,16			
3	HEYDAROV, Hidayat (AZE)	0,33	0,16	0,16	0,16	0,16	
3	IARTCEV, Denis (RUS)	0,2	0,2	0,2	0,2	0,2	
м-81							
1	MUKI Sagi (Israel)	0,62	0,25	0,125			
2	CASSE Matthias (Belgium)	0,42	0,28	0,14	0,14		
3	MAISURADZE Luka (Georgia)	0,44	0,22	0,11	0,11	0,11	
3	VALOIS-FORTIER A(Canada)	0,33	0,22	0,22	0,11	0,11	
м-90							
1	VAN T END Noel (Netherlands)	0,42	0,28	0,14	0,14		
2	MUKAI Shoichiro (Japan)	0,66	0,33				
3	MAJDOV, Nemanja (Serbia)	0,42	0,28	0,14	0,14		
3	CLERGET Axel (France)	0,33	0,33	0,16	0,16		
м-100							
1	FONSECA, Jorge (POR)	0,75	0,125	0,125			
2	ILYASOV, Niyaz (RUS)	0,5	0,33	0,16			
3	WOLF, Aaron (JPN)	0,33	0,33	0,16	0,16		
3	KORREL, Michael (NED)	0,42	0,28	0,28			
	Average for all weight classes	0,48	0,24	0,16	0,15	0,08	

Table 6. *Key technical toolkit: all weight classes*

Holds	Bout statistics						
	1	2	3	4	5	6	7
Foot sweep	4	6	3	0	2	4	1
Inner hook	4	2	3	5	0	3	3
Twist	5	2	2	4	1	4	0
Side two-leg hook	0	2	0	0	0	1	0
Back throw from two knees	4	8	6	4	7	3	0
Front hook	1	2	4	2	2	0	3
Shoulder wheel	1	1	2	0	0	0	0
Scoop throw	3	1	3	2	0	3	0
Rear hook	2	4	3	2	3	4	0
Choke	1	1	1	0	0	0	0
Submission	0	0	0	2	0	0	0
Holds	6	2	1	1	2	1	0
Foot-in-the stomach throw	0	0	1	1	1	0	0
Hip throw	0	1	1	1	0	2	0

respectively. Our analysis of the 2019 World Judo Championship (men) video replays found domination of strength and strength endurance among the physical qualities critical for success. These physical qualities were found the key for the 14 top holds in 155 actions scored by the refs – versus 43 coordination-dominated actions and 81 speed-pace dominated ones.

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Table 7. *Dominant physical qualities claimed by the key 14 priority holds of the 2019 WJ Champions*

Hold	Strength	Strength endurance	Speed/ pace	Coordination skills		Strength	Strength endurance	Speed/ pace	Coordination skills
1	1		1			20	20		
2				1					17
3		1		1				21	21
4			1				3		
5	1		1			33	33		
6	1					14			
7	1	1				4		4	
8	1	1				12		12	
9			1				18		
10		1						3	
11	1			1		2			2
12	1	1				13		13	
13			1	1			3		3
14	1		1			4	4		
						102	81	53	43

Table 8. *Training service individualization algorithm, with the priority holds versus physical qualities*

	Hold/ pin	Special physical qualities	60	66	73	81	90	100
6	Front hook	Strength						
7	Shoulder wheel	Strength + strength endurance						
8	Scoop throw	Strength + strength endurance						
12	Hold	Strength+ strength endurance						
10	Choke	Strength endurance						
1	Foot sweep	Strength + speed						
5	Back throw from two knees	Strength + speed						
4	Side two-leg hook	Strength/ pace						
9	Rear hook	Strength/ pace						
14	Hip throw	Strength/ pace						
2	Inner hook	Coordination						
3	Twist	Coordination + strength endurance						
11	Submission	Coordination + strength						
13	Foot-in-the stomach throw	Coordination + speed						

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Centenary of academic sports biomechanics discipline

UDC 796(094)

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Abstract

Objective of the study. Biomechanics in the meaning formulated by the movement theorists N.A. Bernstein, G.A. Kogan, V.K. Balsevich, L.V. Chkhaidze, V.M. Zatsiorsky and D.D. Donskoy is designed to study the mechanisms, missions and values of a healthy motor activity with its disease prevention aspects – to lay an analytical basis for progress in sports and healthy lifestyles. The sports biomechanics discipline coming to its birth centenary should undoubtedly be protected for its great service and benefits for humanity, and this is the core idea of our article.

Results and conclusion. As things now stand, it is very likely that Biomechanics PhD dissertations will not be defended anymore since 2021 – that may be interpreted as indicative of the interest in the discipline being lost by the Russian research community. It is necessary to understand the true reasons for the collapse of the academic biomechanics discipline on the verge of its birth centenary, otherwise our sports research may be stalled due to the need for a human movement theory to facilitate competitive progress in many sports disciplines, particularly the most difficult ones – including e.g. figure skating, artistic and rhythmic gymnastics with their unprecedentedly beautiful and complex elements and movement culture on the whole. This movement culture is akin to ballet in terms of the movement expression and artistic merits – that have always been of special interest for the Russian biomechanics researchers working in collaboration with the leading choreographers and athletes in the above-mentioned and other projects by the Research Institute of Physical Education.

The article analyzes the progress history of academic biomechanics discipline on the eve of its birth centenary to acknowledge, among other things, a special contribution of the Peter Lesgaft University faculty in this discipline delivered and advanced mostly by the University graduates including those who excelled in biomechanics in some other academic establishments and defended dissertations in biology or pedagogy. It could be beneficial at this juncture to empower the Biological Dissertation Councils with a responsibility to assess dissertations in sports biomechanics viewed as the human movement science or kinesiology as provided by Vadim Balsevich and commonly accepted by the relevant foreign science.

Keywords: *sports biomechanics, achievements of new biomechanical pedagogics.*

Background. The subject to analysis herein emerged when the Russian Academy of Sciences came up with its draft Regulation No. 118 dated 24.02.21 on consolidation of the scientific specialties subject to scientific degrees. If this Regulation comes into effect, it is very likely that the academic biomechanics discipline will disappear with the relevant postgraduate training and research system and the Dissertation Council responsible for the biomechanics specialist training and qualifications for the national physical education and sports sector. Modern academic sports biomechanics in our country (similar to kinesiology as it is called abroad) is geared to analyze individual physical movement systems in physical education and sports. If the academic sports biomechanics disappears one day, what science may take over this integral research domain? In the purely biological filed, the neuromuscular aspects of the movement system may be advanced by biologists much like Peter Lesgaft did in medicine; although the second

domain of the research system – that covers responses to external forces – may unlikely be advanced and delivered by biologists at universities due to the shortage of specific knowledge, sporting experiences and special backgrounds – that are now rather extensive in the physical education specialist training system.

Objective of the study. Biomechanics in the meaning formulated by the movement theorists N.A. Bernstein [2-7], G.A. Kogan [11], V.K. Balsevich [1], L.V. Chkhaidze [12], V.M. Zatsiorsky and D.D. Donskoy [9] is designed to study the mechanisms, missions and values of a healthy motor activity with its disease prevention aspects – to lay an analytical basis for progress in sports and healthy lifestyles. The sports biomechanics discipline coming to its birth centenary should undoubtedly be protected for its great service and benefits for humanity, and this is the core idea of our article.

Results and discussion. Biomechanics foundation history. The first practical problems for the newly originated biomechanics came up in the movement registration light system tests and analyses by N.A. Bernstein and T.S. Popova [5]. A cyclographic technique was advanced A.K. Gastev, leader of the labor organization science who argued that a movement research should be designed to analyze serial snapshots and profile the movement mechanics by a cyclographic toolkit for further analysis. The cyclography was then called a "time magnifying glass" [7]. By 1926 N.A. Bernstein summarized his prior study reports in the fundamental work "General Biomechanics" [4]. This is the prime reason for us to consider the 1920s a startup period for the Russian academic biomechanics that was expected to facilitate the social, artistic, athletic, educational and labor progresses in its capacity of a new research discipline.

Origins of biomechanics. It was in 1905 that P.F. Lesgaft published "Fundamentals of Theoretical Anatomy" with the associating "Bodily Movements Theory" curriculum for his students – that later on made its fast way to the national physical education universities and other sectors. This may be the reason why P.F. Lesgaft was considered an inventor of the notion of biomechanics since then. His ideas were advanced in the 1920-30s by his students at the Department of Anatomy in Leningrad including A.A. Krasuskaya and E.A. Kotikova, and many followers leaded by I.M. Koryakovsky, D.A. Semyonov, E.G. Kotelnikova et al. who contributed much to movement biomechanics and supported it by the relevant analytical systems for many sports disciplines. These productive efforts resulted in the first textbook "Biomechanics of physical exercises" (1939) of the E.A. Kotikova's edition [8] with basics of physical practicing didactics for gymnastics, athletics and some other sports disciplines. The physical education experts shared in this book with the physical education community their knowledge of the movement biomechanics, breath controls, body balancing techniques, muscle group operation mechanisms, etc.

Biomechanics persecution period in the USSR. It was in 1947 that N.A. Bernstein's monograph "On Movement System" was published [7] and immediately awarded by an innovation prize. However, it is traditional for any innovation to face opposition, and the life biomechanics was no exclusion as well as cybernetics in our country. Supporters of the N.A. Bernstein's multilevel movement design theory were called "mechanists" at that time and fiercely opposed by a scientific group leaded by I.P. Pavlov's school of physiology. It was not unusual for the public scientific debates in1949 to 1956 that even some supporters of the great scientist had to betray the "mechanists' theory" for fears of repressions, whilst the great experimenter had to quietly resign from many research offices and biomechanics laboratories all the more that most of them were closed under pressure, and his colleagues and followers developed an instinctive fear of the very word "biomechanics". The persecution faded not sooner than by the late 1958 when the national physical education universities were again allowed offering elective biomechanics curricula, although N.A. Bernstein was first seen at a physiology conference only in 1966.

Biomechanics renaissance period. The lifestyles in the country were slowly changing at the time when a man's flight into space was underway with contributions from biomechanics experts including, among others, L.V. Chkhaidze [12], a Bernstein's follower; the research community was proudly celebrating the first breakthroughs in robotics and labor automation [9, 13]; and the nation on the whole was proud of the great competitive accomplishments in global sports. These successes would have been impossible without progress in biomechanics – that was recognized and resumed in the physical education and sports specialist training curricula and research at this time. However, the biomechanics persecution period had stalled its contribution into the global progress of the discipline. The GDR researchers published a sports biomechan-

ics monograph; R. Alexander in the USA published "Biomechanics"; Italy and Finland also launched their biomechanics research initiatives. In the Soviet republics, Professor L.V. Chkhaidze resumed biomechanics research activity in Georgia [12], associate Professor the E.G. Kotelnikova [10] in Leningrad resumed her biomechanics consulting service at the SCOLIPE Physiology Department headed by Professor N.V. Zimkin – after E.K. Zhukov, renowned movement physiologist, moved to the Institute of Evolutionary Physiology. E.G. Kotelnikova at that time combined her consulting service at the Institute with lecturing biomechanics at the Vaganova Choreographic School – following the footsteps of G.A. Kogan [11] and N.A. Bernstein who lectured at musical schools in 1930s [7].

First Biomechanics Department in the academic education system of the USSR.

The biomechanics recovery process was marked in 1961 by the first Symposium on Biomechanics hosted by the P.F. Lesgaft Institute on the initiative of its Research Vice-Rector D.A. Semenov, where the ways to establish the first biomechanics department in the USSR were discussed. However, the Biomechanics Department at the Peter Lesgaft Institute was established not sooner than in 1963; followed by the similar departments at Moscow Institute of Physical Education in 1965, and then in Tbilisi, Minsk, Lvov, Kiev and other research centers. In a decade, the academic biomechanics made progress from a prohibited to obligatory – and rather popular – discipline, with the biomechanics specialists being in high demand all over the country.

In 1968, a Biomechanics Department with the cutting-edge laboratory equipment was established at Omsk Institute of Physical Education by Biology Doctor and Pedagogical Science PhD V.K. Balsevich, the globally renowned specialist in age biomechanics who offered a new kinesiological approach for elite sports based on his own concept of physical resource [1]. V.K. Balsevich severed the human movement research science from the general biomechanics to establish kinesiology as an independent discipline, thereby taking a global lead in this process. The Biomechanics Laboratory at the SCOLIPE was particularly strong and successful under leadership of Professor V.M. Zatsiorsky [9].

As things now stand, it is very likely that Biomechanics PhD dissertations will not be defended anymore since 2021 – that may be interpreted as indicative of the interest in the discipline being lost by the Russian research community. It is necessary to understand the true reasons for the collapse of the academic biomechanics discipline on the verge of its birth centenary, otherwise our sports research may be stalled due to the need for a human movement theory to facilitate competitive progresses in many sports disciplines, particularly the most difficult ones – including e.g. figure skating, artistic and rhythmic gymnastics with their unprecedentedly beautiful and complex elements and movement culture on the whole. This movement culture is akin to ballet in terms of the movement expression and artistic merits – that have always been of special interest for the Russian biomechanics researchers working in collaboration with the leading choreographers and athletes in the above-mentioned and other projects by the Research Institute of Physical Education.

Conclusion. The article analyzes the progress history of academic biomechanics discipline on the eve of its birth centenary to acknowledge, among other things, a special contribution of the Peter Lesgaft University faculty in this discipline delivered and advanced mostly by the University graduates including those who excelled in biomechanics in some other academic establishments and defended dissertations in biology or pedagogy. It could be beneficial at this juncture to empower the Biological Dissertation Councils with a responsibility to assess dissertations in sports biomechanics viewed as the human movement science or kinesiology as provided by Vadim Balsevich and commonly accepted by the relevant foreign science.

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Canoeing training systems in russia and belarus: comparative analysis

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Abstract

Objective of the study was to make a comparative analysis of the canoeing elite training systems in Russia versus Belarus in view of the great competitive accomplishments of the Belarus canoeing elite in the top-ranking events for the last five years.

Methods and structure of the study. We have analyzed, for the purposes of the study, the following: more than 50 foreign and national study reports; individual Russian canoeing elite training system for three years (2014-2016) versus that of the Belarus canoeing elite training system accessible in the reference literature.

Results and conclusion. The comparative analysis found a few differences in the national canoeing elite training system which contributions to the actual competitive progress cannot be fairly rated in fact (with the analysis being further complicated by the data being not always reported on a yearly basis).

Regardless of the training system designs as such, it is still difficult to analyze the contributions of the Russian/ Belarusian canoeing elite training system differences in the competitive progresses. We believe, however, that the following training system design provisions deserve special attention: the Belarusian canoeing elite shows an expressed wavelike workout management pattern with the training system individualization service that is very important. Our analysis of the relevant reported foreign and domestic canoeing elite experiences for the last few years showed that some other training and competitive progress factors with their contributions need to be respected by the national canoeing elite training systems.

Keywords: *Belarus canoeing elite, annual training system, training process, individualized training system, comparative analysis.*

Background. One of the most serious drawbacks of the national elite training system in the endurance-intensive cyclic disciplines, as we believe, is that the national sports community tests to neglect serious comparative analysis of the national versus foreign training system design and management experiences [1, 11], otherwise the training system would be timely and efficiently updated/ customized in every element for success.

Objective of the study was to make a comparative analysis of the canoeing elite training systems in Russia versus Belarus in view of the great competitive accomplishments of the Belarus canoeing elite in the top-ranking events for the last five years.

Methods and structure of the study. We have analyzed, for the purposes of the study, the following: more than 50 foreign and national study reports; individual Russian canoeing elite training system for three years (2014-2016) versus that of the Belarus canoeing elite training system accessible in the reference literature [4, 5, 9].

Results and discussion. The comparative analysis found a few differences in the national canoeing elite training system which contributions to the actual competitive progress cannot be fairly rated in fact (with the analysis being further complicated by the data being not always reported on a yearly basis). The analysis found that in 2014 and 2016 the unsuccessful

athlete's workouts were higher in the intensity zones 4 and 5; and in 2015 and 2016 the unsuccessful athlete's total workouts were higher. Furthermore, the comparative analysis of the annual totals of the Russian and Belarus samples (see Table 1) found differences in the workout intensity zoning approaches, with the Belarusian experts prioritizing lactate variations and training times (a really important index) as recommended by the V.S. Farfel [8] classification system adopted by N.I. Volkov [3].

Note that the Russian experts tend to rate the blood lactate versus the competitive speed ratio [2, 6] which is known to vary in a wide range due to a number of external factors of influence that may not always be fairly accounted and analyzed.

The comparative analysis of the Russian/ Belarus canoeing elite trainings and standard physical conditioning complexes found the following differences. The Russian canoeing elite showed much wider variations of the key training system test criteria – unlike the Belarusian canoeing elite. We should note above all that the Russian canoeing elite was tested with the lower total distances, lower Zone 1/ 2 rowing and lower training machine workouts; plus somewhat lower general physical conditioning workouts. On the other hand, the Russian canoeing elite was tested with the higher Zone 3 totals and higher unspecific trainings (jogging, skiing, swimming), as well as the training machine ™ and weightlifting workouts, with a special focus on flexibility trainings.

Regardless of the training system design as such, it is still difficult to analyze the contributions of the above differences in the competitive progresses. We believe, however, that the following training system design provisions deserve special attention: the Belarusian canoeing elite shows an expressed wavelike workout management pattern, with a rest break in January unusual for the Russian canoeing elite; significant growth of the aerobic trainings in June (in the competitive period); and, most important, prudent training system individualization in every workout element, with a special sensitivity to the relevant competitive progress contributors.

It should be also mentioned that the Belarusian canoeing elite training system offer individual progress scenario for every athlete [5, 7, 10]; whilst the Russian canoeing elite tend to benchmark provisionally "successful" and "unsuccessful" individual progress in the annual training system with the progress rating criteria. It may be also assumed that the correlation analysis of the individual competitive accomplishments for the last 6-7 years versus the training system elements with a regression analysis (as is the case for the Belarusian canoeing elite) is less efficient than the modern ROC analysis (based on a comprehensive test data set of course) that help highlight the key progress factors with their sensitivities and specific contributions. However, the training system individualization provisions (standard for the Belarusian canoeing elite) may be recommended for application by the Russian canoeing elite.

As for the other training system parameters that need to be addressed by the Russian canoeing elite training system (as demonstrated by our analysis of the foreign and domestic study reports), we would recommend the individual training system and progress

Table 1. *Canoeing elite annual training systems in Russia and Belarus*

Belarus: Intensity zones and training tools	km/ hours	Russia: Intensity zones and training tools	km/ hours
Zone 1: lactate< 2 mmol/l, 10+min, km	1869-2173	Zone 1: lactate < 2 mmol/l, 60% maximal speed, km	1699-1962
Zone 2: lactate 2-4 mmol/l, 2-10min, km	1682-1808	Zone 2: lactate 2-4 mmol/l, 70-80% maximal speed, km	1068-1464
Zone 3: lactate 4-8 mmol/l, 40s-2min, km	438-494	Zone 3: lactate 4-8 mmol/l, 80-85% maximal speed, km	471-623
Zone 4: lactate >8 mmol/l, 15-40s, km	202-230	Zone 4: lactate >8 mmol/l, 90-100% maximal speed, km	97-280
Alactate zone: 15-minus s, km	66-82	Alactate zone, maximal speed, km	50-97
Total distance, km	4258-4786	Total distance, km	3667-4098
Jogging, h	95-109	Jogging, skiing, swimming, h	130-140
Training machine workouts (dansprint ergometer), h	100-116	Training machine workouts, h	35-79
Cycled weightlifting workouts, h	91-107	Cycled weightlifting workouts, h	142-153
Standard body conditioning workouts without apparatuses	74-86	Flexibility exercises, h	111-116
Total general physical training, h	377-419	Total general physical training, h	352-390

plans giving a special priority to the strength training; stress tolerance trainings in varied conditions; subjective/ objective workout intensity tests in the trainings; a range of strength training practices on water, taping procedures and some others.

Conclusion. Regardless of the training system designs as such, it is still difficult to analyze the contributions of the Russian/ Belarusian canoeing elite training system differences in the competitive progress. We believe, however, that the following training system design provisions deserve special attention: the Belarusian canoeing elite shows an expressed wavelike workout management pattern with the training system individualization service that is very important. Our analysis of the relevant reported foreign and domestic canoeing elite experiences for the last few years showed that some other training and competitive progress factors with their contributions need to be respected by the national canoeing elite training systems.

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Kinematic/ dynamic indicators of breaststroke technique of junior swimmers

UDC 797.2

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Abstract

Objective of the study was to test benefits of the new swimming technique excellence training model for the 10-11-year-old breaststroke groups facilitated by integrated structuring of special technical indicators of physical fitness.

Methods and structure of the study. In the new swimming technique excellence training model testing experiment, we combined and analyzed benefits of the integrated structuring of special technical indicators of physical fitness to facilitate progress of the sample. We sampled for the tests the 10.5 ± 0.4 year-old swimmers (n=42, 24 boys and 18 girls) and split them up into Reference (RG, 10 boys and 8 girls) and Experimental (EG, 14 boys and 10 girls) Groups. The integrated training model was geared to offer the most efficient combinations of training methods, tools and aspects for fast competitive progress facilitated by the integrated structuring of special technical indicators of physical fitness. The elementary technical progress was harmonized with the physical qualities building elements to prudently sequence the training stages for success. The progress tests enabled us to develop a set of the age-group progress benchmarks and test benefits of the integrated structuring of special technical indicators of physical fitness tests for efficiency of the breaststroke excellence model.

Experimental assumptions and effects were verified by the strength, physical fitness and swimming technique rating tests in practical trainings.

Results and conclusion. The new swimming technique excellence training model for the 10-11-year-old breaststroke groups facilitated by the integrated structuring of special technical indicators of physical fitness was found beneficial for competitive progress and in many other aspects including metabolic plastic transformations due to synchronization of endogenous processes.

Keywords: *ijunior swimmer, swimming technique, physical fitness indices.*

Background. Modern swimming theory and practice with concern to the swimmer training issues give fairly comprehensive accounts of the swimming style specific training methods [1]; although the sport community still needs more detailed analysis of the style-unspecific (convergence) training models for junior groups, sets of the progress/ fitness benchmarks ('model characteristics'); and combinations of the training models and tools most beneficial for the beginner trainings and early specialization stage [4]. As things now stand, the relevant study data and practical recommendations for physical progress depending on the vocational swimming styles are rather fragmented in fact with little if any consideration for the synergy/ mutual influences of the style-specific trainings and competitive progress depending on the training combinations and components [7]. It should be mentioned, however, that the same progress in physical fitness elements with consolidation of the technical skills in trainings may be differently efficient in practice [8]. These are the reasons for the sport community to prefer integrated/ synergized sports training models that secure the technical and other special progresses on a synchronized/ harmonized basis.

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Experimental assumptions and effects were verified by the strength, physical fitness and swimming technique rating tests in practical trainings. Stroke power was rated by a 10s top-intensity leash-swimming dynamometry with zero speed [5] to obtain a force kinematic impulse using the following formula: I=F×t, where I is the force kinematic impulse; F is the stroke power; and t is the stroke time. We also computed a stroke power ratio as the total stroking impulse (legs + arms) to the free swimming/ coordinated stroke power [2]. Significance of the pre- versus post-experimental test data differences was rated by the Student's t-test using the formula:

$t = x_1 - x_2 / \sqrt{m_1^2 + m_2^2}$. The above stroke test rates were used to rate the swimming technique efficiency.

Results and discussion. The synchronized stroke power progress in the coordinated swimming tests and elementary stroke power test rates helped excel the swimming techniques and dynamics in the training. Trainings at the early specialization stage gave a special priority to the swimming style energy-efficiency achieved by the optimizing the special strength, general and high-speed endurance of every swimmer, i.e. the ability to maintain the stroke power on the distance. Tables 1 and 2 hereunder give the pre- versus post-experimental test data of the sample in the special strength, general and special endurance tests and in the test exercise.

The above tests and analyses were proved efficient for the swimming technique excellence model in application to the 10-11-year-old swimmers' trainings, particularly for the progress benchmarking and promising prospects' selection missions [3, 9]. The integrated trainings of special strength, general and spe-

Table 1. *Pre- versus post-experimental breaststroke swimming technique dynamic test data: female swimmers*

Test rates	EG			RG		
	Pre-exp.	Post-exp.	t	Pre-exp.	Post-exp.	t
Force kinematic impulse, kgs	4,99±0,4	6,61±0,3	1,4	3,89±0,4	6,00±0,4	1,5
Coordinated swim stroke power, kg	6,45±0,8	8,26±0,5	2,7	6,90±0,4	8,43±0,6	0,8
Stroke power ratio	0,68±0,04	0,75±0,03	3,7	0,66±0,03	0,73±0,05	4,2
Leg stroke power, kg	5,78±0,2	6,95±0,3	0,6	4,62±0,3	6,19±0,4	0,5
Arm stroke power, kg	4,45±0,4	5,96±0,5	1,7	4,44±0,4	5,51±0,5	2,1
Test exercise, s	107,2±0,9	90,5±0,8		108,4±1,5	93,2±1,3	

Table 2. *Pre- versus post-experimental breaststroke swimming technique dynamic test data: male swimmers*

Test rates	EG			RG		
	Pre-exp.	Post-exp.	t	Pre-exp.	Post-exp.	t
Force kinematic impulse, kgs	4,97±0,4	6,65±0,3	1,8	4,89±0,2	6,04±0,2	1,9
Coordinated swim stroke power, kg	8,45±0,6	9,26±0,5	1,3	8,90±0,5	8,93±0,5	1,5
Stroke power ratio	0,68±0,04	0,77±0,03	2,5	0,66±0,03	0,73±0,05	3,7
Leg stroke power, kg	6,92±0,4	7,95±0,3	2,3	6,60±0,3	7,19±0,4	1,4
Arm stroke power, kg	6,23±0,2	6,96±0,5	1,4	5,94±0,4	6,51±0,5	2,6
Test exercise, s	96,4±1,4	80,6±1,7		95,7±1,2	92,7±1,6	

cial endurance to make the swimmers able to maintain the stroke power on the distance, with a special priority to the swimming style efficiency were found beneficial, provided the special physical fitness is developed in every aspect.

It should be emphasized that training overstress in the adolescent age, when they exceed the training standards and progress benchmarks in the vocational swimming style, may be associated with high multiple health risks. At the same time, it was found that a range of aerobic capacity building trainings of this age group facilitate progress both in the speed endurance in the test exercise and swimming technique efficiency. Benefits of such trainings are further increased by the balanced progress in the technical and physical fitness and, hence, competitive accomplishments. The new swimming technique excellence model was found beneficial as verified by the EG progress in qualifying for Class II – versus the RG that could qualify only for Class III.

Conclusion. The new swimming technique excellence training model for the 10-11-year-old breaststroke groups facilitated by the integrated structuring of special technical indicators of physical fitness was found beneficial for competitive progress and in many other aspects including metabolic plastic transformations due to synchronization of endogenous processes.

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Weightlifting elite's power snatch technique

UDC 796.012

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Abstract

Objective of the study was to analyze and improve the power snatch techniques applied by the modern elite weightlifters.

Methods and structure of the study. Special studies at Moscow State Academy of Physical Culture in 2010-2020 showed that the modern elite weightlifter's power snatch technique excellence research and the relevant individual progress recommendations need to be based on analyses of the individual weightlifting technique micro-structuring studies – that require modern expertise and technologies. Since 2006 our research team has analyzed sports techniques using a high-speed video capturing toolkit, analysis of the reference literature, mathematical modeling tools, digital filters and modern software packages Matlab, Tema, MaxTraq, etc. The study was designed to: (1) Analyze the relevant theoretical and practical literature; (2) Make high-speed video captures (by a single of few cameras including the synchronized ones) to analyze some 100-plus snatches in the elite weightlifting trainings and top-ranking competitions including the World and European championships; (3) Select the most informative execution elements and indices; (4) Analyze the power snatch technique biomechanics; (5) Describe the best power snatch technique of the elite weightlifters; and (6) Come up with practical power snatch technique improvement recommendations.

Results and conclusion. Our power snatch technique phasing analysis showed benefits of the following execution sequence for the weightlifting elite: toes-standing in the acceleration phase with a powerful push on the weight. We would also recommend a focused training of the aerial phase in the power snatch technique with a special attention to the arms straightening in the elbow and shoulder joints.

Keywords: *power snatch biomechanics, mathematical modeling.*

Background. As things now stand in the weightlifting sport, specialist training programs for the coaches, athletes and researchers are governed by the studies dated back to the 1970-80s and largely irrelevant and outdated. Efforts to advance the specialist training service show a growing demand for modern expertise and technologies. Since 2006 our research team has analyzed different sports techniques using a high-speed video capturing toolkit, analyses of the reference literature, mathematical modeling tools, digital filters and modern software packages Matlab, Tema, MaxTraq, etc.

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Results and discussion. We made an analysis of the snatch phases and microstructure with a special priority to the key technical elements with the relevant execution indices (approach; beginning with an emphasis on tips; dip-under; final acceleration startup phase with top speed of the barbell butt; and computed the snatch spacing, timing (spatial-temporal indices), kinematics and dynamics.

It is traditional for the weightlifting research community to apply the notion of movement phase structure. We made herein a detailed power snatch technique phasing analysis with a national elite weightlifter I sampled for the study. His 170kg weight power snatch technique was video captured by a single lateral camera at 250 fps to analyze the following movement phase structure.

Phase I: approach moves, with the athlete handling the weight till the takeoff moment.

Phase II: pre-acceleration moves from the takeoff moment to the full extension of the knee joints taking 0.444 s. The pre-acceleration phase includes microphase 1 from the full extension of the knee joint to the knee joint flexion startup taking 0.024s on average.

Phase III: shock absorption moves from the knee joints flexion startup to knee joints flexion taking 0.15 s; with microphase 2 (transition from shock absorption to final acceleration i.e. from the flexion startup to the knee joints extension startup taking 0.008s). Catch is the moment at the shock absorption end and final acceleration startup when the horizontal speed of the barbell butt equals zero (see Figure 3) taking 0.094s in the case.

Phase IV: final acceleration from the knee joints extension start to finish taking 0.15s; with microphase 3 that (a transition from final acceleration to squat 1 i.e. from the extension finish to the knee joints flexion startup) taking 0.012s.

Phase V: squat 1 from the knee joints flexion start to the second heel takeoff moment, with the front foot mov, taking 0.06s.

Phase VI: aerial move from the second heel takeoff/ front foot move to the first heel contact with the ground (front foot move stoppage) taking 0.13s.

Phase VII: squat 2 from the first heel contact with the ground (front foot move stoppage) to the weight fixed in the squat, taking 0.30s.

Figure 1-3 shows the power snatch technique pacing, timing, kinematics and dynamics [1], with the points marking the above phases and acceleration moments as follows: point 1 is the takeoff moment; point 2 is the shock absorption startup; point 3 is the final acceleration startup; point 4 is squat 1 startup; point 5 is the aerial phase startup; point 6 is the squat 2 startup; and point 7 is the weight stop moment. Points O1 and O3 mark the acceleration startup and finish; and point O2 is the maximal horizontal speed of the barbell butt.

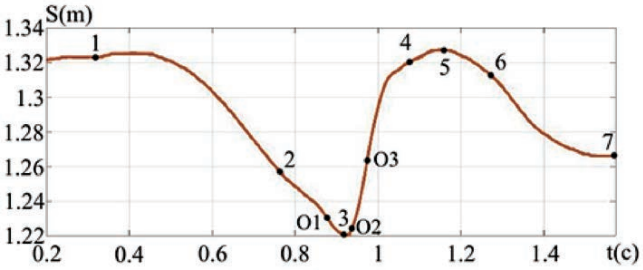

Figure 1. *Horizontal speed of the barbell butt*

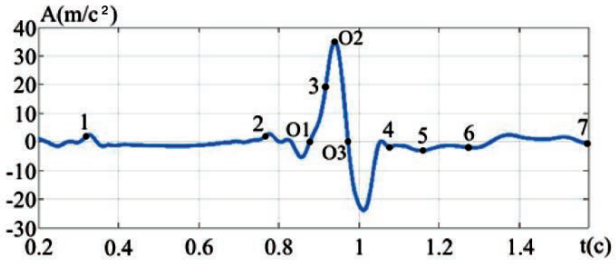

Figure 2. *Horizontal acceleration the barbell butt*

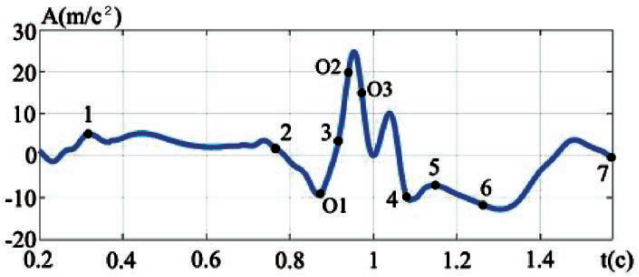

Figure 3. *Vertical acceleration the barbell butt*

Let's now consider the power snatch technique elements still underexplored, as we believe, by the theoretical and practical study reports. Note that the knee joints height in the heel takeoff phase is higher than when this element is executed with a full-foot contact. In the toes-standing technique the knee joints angle is

1. Acceleration startup point

2. Maximal horizontal speed of the barbell butt in the acceleration sequence

3. Acceleration finishing point

Figure 4. *Snapshots of the acceleration sequence*

lower than in the full-foot contact technique. Minimal vertical acceleration of the barbell butt was 9.2 m/ s2 in shock absorption phase – indicative of the eased athlete's action on the barbell and, hence, faster knee and ankle joint flexion, with the shock absorption stage taking 0.15s. The athlete's executes acceleration (final acceleration) on the toes with a high amplitude and power and vertical acceleration coming to 24.8 m/s2, and with the ankle joint used to lever forces. Note that the toe-standing acceleration phase requires the foot extensors being strongly trained.

Figure 4 analyzes the weight acceleration element. In the shock absorption and final acceleration the athlete pulls the barbell to the groin level (Fig. 1). This is the point where the weight acceleration starts with the legs extended in the knee joints, ankle joint and hip joints, and the back straightened. The ankle joint would develop maximal vertical (t= 0.95, a= 24.8 m/s2, Fig. 3) and horizontal (t=0.94, a= 36.5 m/s2, Fig. 2) forces acting on the weight (Fig. 4, snapshot 2) [2]. The athlete-weight system energy would grow, with the athlete's body moved backwards to shift the weight forward to a degree and develop an extra force acting upward, with the vertical component of this force pushing the weight up.

The strength variation and energy rating method are described in study [3]. Strength of the weight contact with the hips was estimated at 390 kg, with the extra energy in the acceleration phase making 15% of the total athlete-weight system energy.

Aerial phase: One of the key goals of the power snatch technique is to extend the arms in the shoulder and elbow joints in coordination with the knee and hip joints flexion. It should be noted that the aerial phase time depends on the vertical speed of the weight – that was estimated at 0.13s in this case. When the athlete fails to fully extend the arms at the end of the aerial phase, he would try an extra push or lose the attempt.

Conclusion. Our power snatch technique phasing analysis showed benefits of the following execution sequence for the weightlifting elite: toes-standing in the acceleration phase with a powerful push on the weight. We would also recommend a focused training of the aerial phase in the power snatch technique with a special attention to the arms straightening in the elbow and shoulder joints.

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Biomechanical parameters of running technique of sprint athletes-finalists of world championship

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Abstract

Objective of the study: to compare the spatio-temporal, kinematic and angular characteristics of the distance running technique of the strongest 100 and 200 m sprinters in the world.

Methodology of the study. The study analyzed the data of the spatio-temporal, kinematic and angular characteristics of distance running presented in the IAAF biomechanical report of the men's 100m and 200m finals of the 2017 World Athletics Championships.

Results of the study. In the middle of a straight line in a 100 m run, the average speed is 11,60±0,06 m/s, in a 200 m run – 10,31±0,09 m/s. The difference in speed is achieved due to the step rate (4,80±0,08 stride/s and 4,27±0,05 stride/s, respectively, p≤0,05), because the stride length at both distances is identical and is equal on average to 2,42 m (Table 1). A high step rate per 100 m is achieved due to the shorter time of the contact time (0,093±0,002 s and 0,103±0,002 s, p≤0,05) and flight time (0,116 ±0,002 s and 0,132±0,003 s, p≤0,05). When placing the leg on a support, reliably significant differences (p≤0,05) are observed in the angle of inclination of the body, the angle between the thigh of the swinging leg and the vertical line. When removing the leg from the support, a reliably significant difference (p≤0,05) is observed in the angle of inclination of the body and the angle between the lower leg of the supporting leg and the horizontal line.

Keywords: *sprint running, sprint running technique, 100 m and 200 m running, spatio-temporal and kinematic characteristics of running, biomechanical parameters of sprint running.*

Introduction. Effective technique is one of the key components in achieving a high competitive result in sprint running. The study and comparison of its parameters among the strongest sprinters in the world makes it possible to identify the relations of individual links of technique, to form model characteristics. The data obtained in the work can be used in the preparation of runners at various distances of sprint running, in the selection and development of training means, exercises, which are close in spatio-temporal characteristics to the competition form.

Objective of the study: to compare the spatio-temporal, kinematic and angular characteristics of the distance running technique of the strongest 100 and 200 m sprinters in the world.

Study methods and organization. In our study, we used data from the biomechanical report of the IAAF (International Association of Athletics Federation) of the men's 100 m and 200 m finals at the 2017 World Athletics Championships in London [3,4]. The report presents the results of a video analysis carried out for the 100 m run in the range from 47 m to 55 m, for the 200 m run at the 150 m mark. A comparison of the spatio-temporal and angular characteristics of the running technique of the men's 100 m and 200 m finalists was made. Statistical data processing was carried out using the Statgraphics Centurion software, the validity of differences was determined by Student's t-test for independent samples.

Study results and their discussion. The main characteristics that determine the speed of movement along the distance are the length and step rate. The higher the length and step rate, the higher the running speed. The average values of the length of the running stride in the 100 m and 200 m sprints are identical – 2,42 m. The minimum values for 100 m are

2,26 m, for 200 m – 2,29 m, the maximum values are 2,70 m and 2,60 m, respectively. It should be noted that since in the 100 m run the measurements were carried out on the interval from 47 to 55 m, when there is still some increase in the running speed, i.e. starting, it can be assumed, there are even greater maximum stride length values. The step rate at 100 m is significantly higher than at 200 m, 4,80±0,08 s and 4,27±0,05 s, respectively, p≤0,05. The time of the supported and unsupported periods of the running stride cycle in running is statistically less by 100m than by 200 m, p≤0,05, but in unsupported step this difference is more significant. The range of values of the supported period for 100 m lies within 0,08–0,09 s, for 200 m – 0,09–0,10 s; unsupported period for 100 m – 0,11–0,12 s, for 200 m – 0,13–0,15 s. The stride length-to-height ratio of a runner at both distances is approximately the same and has an average value of 1,31–1,33.

At the beginning of the contact period, the horizontal distance between the ground contact point at touchdown and the CM (centre of mass) does not have statistically significant differences (p>0,05) and is within 0,28–0,48 m. At the end of the contact period, the average horizontal distance between the ground contact point at toe-off and the CM is significantly greater by 100 m (0,62±0,01 m) than by 200 m (0,56±0,01 m), p≤0,05.

The study analyzed the angular characteristics of runners at the moment of placing the leg on the support and removing it from it (Figure 1): the angle of inclination of the trunk relative to the horizontal line (α), the angle of flexion of the knee joint (β), the angle between the vertical line and the hip of the swing-up leg (ζ), the angle between the swing-up and support legs (η), the angle of inclination of the lower leg/calf of the support leg relative to the horizontal line (θ), the angle of the ankle joint of the support leg (l).

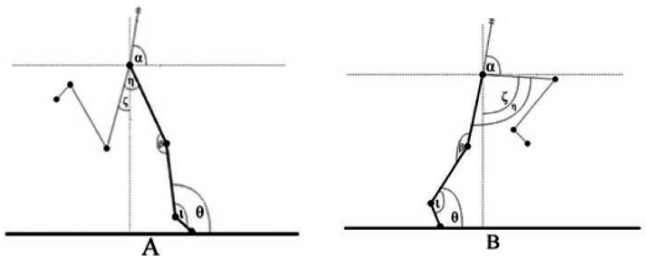

Figure 1. *Body schematic angles at touchdown (A) and toe-off (B)*

In the practice of training sprinters, many coaches pay attention primarily to the height of the hip raise (angle ζ) and extension of the support leg at the knee joint (angle β) at the moment of take-off, usually giving the setting for maximum flexion of the swing-up leg hip and extension of the support leg. The study of these values among the world's leading sprinters shows that the average value of the angle ζ for the 100 m run is 67,6±2,3°, and for the 200 m run is 60,6±2,8° (p> 0,05). The angle of flexion of the knee joint (β), despite the similarity of the mean values at both distances, has a significant scatter of values. At the moment of placing the foot, its minimum value for the 100 m sprint is 143° for the sprinter who took the eighth place and 144° is the second, maximum 168°, for 200 m the minimum and maximum values are 149° and 175°, respectively. When pushing off in a 100 m run, the range of values is from 138° to 160°, in 200 m from 141° to 170°. It is important that in addition to the large scatter of values in this indicator among the studied groups, some sprinters have a difference of more than 20° when comparing the angles in the left and right legs, which shows the existing asymmetry of motor actions even among the top-class sprinters.

Another, no less important characteristic of running, is the position of the foot when it is placed on

Table 1. Spatio-temporal characteristics in running at the 100 m and 200 m distances among the world-class sprinters

		Result	Time reaction (s)	Step rate (stride/s)	Step length (m)	Velocity (m/s)	Step length/ heigth	Contact time (s)	Flight time (s)	Distance from the ground contact to the body CM (m)	
										Touch-down	toe-off
100m (n=8)	$\bar{x} \pm S_{\bar{x}}$	10,04± 0,04	0,155± 0,111	4,80± 0,08	2,42± 0,05	11,60± 0,06	1,33± 0,01	0,093± 0,002	0,116± 0,002	0,38± 0,01	0,62± 0,01
	σ	0,12	0,033	0,22	0,14	0,16	0,03	0,004	0,007	0,04	0,04
200m (n=8)	$\bar{x} \pm S_{\bar{x}}$	20,31± 0,08	0,156± 0,003	4,27± 0,05	2,42± 0,03	10,31± 0,09	1,31± 0,02	0,103± 0,002	0,132± 0,003	0,41± 0,02	0,56± 0,01
	σ	0,23	0,009	0,15	0,09	0,25	0,06	0,006	0,008	0,04	0,03
p			>0,05	≤0,05	>0,05	≤0,05	>0,05	≤0,05	≤0,05	>0,05	≤0,05

Table 2. *Angular characteristics in 100 m and 200 m distances running for world-class sprinters*

			Touchdown (°)						Toe-off (°)					
		Result	α	β	ζ	η	θ	(l)	α	β	ζ	η	θ	(l)
100m (n=8)	$\bar{x} \pm S_{\bar{x}}$	10,04± 0,04	75,1± 1,0	156,2± 2,1	17,1± 2,8	9,7± 3,7	97,9± 1,1	115,9± 1,1	80,4± 1,2	153,8± 1,4	67,6± 2,3	93,1± 2,4	38,4± 0,6	138,5± 1,1
	σ	0,12	3,0	6,1	7,1	10,6	3,0	3,1	3,3	4,1	6,6	6,9	1,6	3,0
200m (n=8)	$\bar{x} \pm S_{\bar{x}}$	20,31± 0,08	81,5± 1,2	159,1± 1,6	6,6± 2,9	17,1± 3,1	99,9± 0,9	114,9± 1,6	84,3± 0,5	157,8± 1,6	60,6± 2,8	86,1± 2,8	43,1± 0,6	131,4± 3,5
	σ	0,23	3,5	4,7	8,1	8,6	2,6	4,5	1,5	4,5	7,8	7,8	1,7	9,9
p			≤0,05	>0,05	≤0,05	>0,05	>0,05	>0,05	≤0,05	>0,05	>0,05	>0,05	≤0,05	>0,05

the support. The angle of the ankle joint (θ) at the moment of touching the running track at both distances is on average 114–115° (p>0,05), i.e. the heel is slightly above the surface of the track. The lower leg is placed almost vertically, the angle θ slightly exceeds 90°, the average values are 97-99° (p>0,05). At the same time, the angle of inclination of the trunk (α) for the 200 m run is significantly higher both when the legs are set (81,5±1,2°) and when pushing off (84,3±0,5°).

It is generally accepted that the strongest sprinters are distinguished by the ability to quickly "bring their legs together", which is characterized by the location of the swing-up hip next to or even in front of the support leg at the time of its placing. It means that the angle η should be near zero. However, according to biomechanical data, both the gold and silver medalists of the 100 m race has their swing-up leg behind the support leg at an angle of 24–28°. Usain Bolt, the bronze medalist, world record holder for 100 m and 200 m, his support left leg has a swing-up leg at 21° behind, and when placing the right leg - the left is in front by 4°. For the rest of the participants in the finals, the values are in the range from 0 to 11°, while only in one case the swing-up leg is in front of the support leg, by 7°. In the 100 m sprint, all sprinters have the swing-up leg in front of the vertical line, the average angle ζ 17,1±2,8°. The same is observed among the runners who took from the first to the fourth places in the 200 m race (angle ζ from 7° to 19°). The calculation of the correlation coefficients did not reveal a reliably significant relation (p>0,05) between the investigated angular and space-time characteristics.

Conclusion. Comparison of the spatial-temporal and angular characteristics of the world's leading 100 m sprinters (47–55 m segment) and 200 m (150 m segment) sprints showed that reliably significant differences were observed in the running speed (11,60±0,06 m/s and 10,31±0,09 m/s), cadence (4,80 ± 0,08 stride/s and 4,27±0,05 stride/s), contact (0,093±0,002 s and 0,103±0,002 s) and flight (0,116±0,002 s and 0,132±0,003 s) periods of the running strides, the horizontal distance between the ground contact point at toe-off and the CM (0,62 ±0,01 m and 0,56±0,01 m), p≤0,05. When comparing the angular characteristics, reliably significant differences (p≤0,05) are observed in the angle of inclination of the trunk (α), in both studied phases, the angle of inclination of the lower leg when removing the leg from the support (θ).

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Effects of single normobaric hypoxic exposure on physiological indicators of swimmers

UDC 796.03

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Abstract

Objective of the study was to assess the effects of artificial normobaric hypoxia on the biochemical and physiological indicators of swimmers working in the aerobic power zone.

Methods and structure of the study. The study was carried out at the Research Institute of Sports and Sports Medicine of Russian State University of Physical Education, Sports, Youth and Tourism. Sampled for the study were apparently healthy short- and middle-distance swimmers, who were split into the Experimental (EG) and Control (CG) Groups, 10 people each.

The athletes were asked to perform a step load test on the Monark Ergomedic 894E Peak Bike vertical cycle ergometer (Sweden). Their aerobic performance was evaluated in terms of volume, intensity and time of work using the hardware and software complex Ergomax (Russia) and specialized software (Patent No. 83004). The spirometric studies were conducted using the Cortex METALYZER 3B-R2 gas analyzer (Germany). The following gas exchange indicators were recorded: lung ventilation (LV), exhaled O_2 and CO_2 levels; O_2 consumption (VO_2). HR was measured using Polar T34 pulsometer (Finland). The blood lactate concentration (HLa, mmol/l) was measured by the electrochemical method using the NOVA Biomedical Lactate Plus (USA) analyzer. The capillary blood samples were taken in a quiescent state before the test and at the 3rd, 5th, 7th, and 10th minutes after the test. The pulse oximetry method (stationary – NONIN 8600, USA; carpal- MD300W, China) was used to record blood oxygenation (SO_2). HR and blood oxygenation during the hypoxic tests were recorded in three stages: at rest – before the hypoxic exposure, for 1 min; during the 30-min exposure to the 9% O_2 gas mixture; after the hypoxic exposure (recovery period) – under normal breathing conditions, for 3 minutes. Blood oxygenation and HR were recorded during the hypoxic test with a step of 10 seconds: before the hypoxic stimulus – at rest, for 1 minute; during the 30-min exposure to the 9% O_2 gas mixture; after the hypoxic exposure (recovery period) – under normal breathing conditions, for 3 minutes.

Results and conclusion. The findings showed an ambiguous reaction of the biochemical and physiological characteristics of the swimmers' body to the single hypoxic exposure when working in the aerobic mode. The efficiency of hypoxic exposure on the body and individual hypoxic tolerance rate, when coupled with load hypoxia, is largely determined by the rate of recovery of all the body functional systems involved. The single hypoxic exposure in the aerobic mode does not inhibit the adaptation mechanisms, and this variant of exposure may help improve physical working capacity at the specified power.

Keywords: *hypoxia, swimmers, working capacity, aerobic performance.*

Background. Today there is a large body of scientific literature on the effects of hypoxia on health, in particular physical and mental capacity, of both athletes and non-sporting people [1, 4, 5]. However, this remains a pressing problem until present [2, 3]. Sports activities cover a wide range of issues related, first of all, to the enormous workload imposed on athletes in the training and competitive periods, high demand for sports results demonstrated, correct and effective recovery of trainees and maintenance of their health [8, 9]. Moreover, particular attention should be paid to careful examination of the internal metabolic shifts that always occur under physical loads. Oxygen deficiency is among

the serious problems that an athlete constantly encounters [2, 4, 5]. Hypoxia inevitably goes with a state of ever-increasing functional activity. Besides, these hypoxic states differ in intensity and are associated with the discrepancy of the energy demand of the body and the possibility of resynthesis of energy resources of cells by means of oxygen consumption. However, hypoxic states are a powerful factor in the adaptation processes of the body and contribute to the formation and reinforcement of training effects. The specific effects of oxygen deficiency in operation in different power zones can be altered under the influence of other variants of hypoxic stimulation [6, 7]. In fact, the effects that arise from the combination of cross adaptation processes and different variants of hypoxic stimulation potentiate metabolism and have a significant impact on adaptation to the existing and permanent hypoxic stimulus [2, 4, 5]. The selection of the most effective hypoxic loads in different combinations to stimulate and expand compensatory abilities and mechanisms will help realize methodological training options in elite sports.

Objective of the study was to assess the effects of artificial normobaric hypoxia on the biochemical and physiological indicators of swimmers working in the aerobic power zone.

Methods and structure of the study. The study was carried out at the Research Institute of Sports and Sports Medicine of Russian State University of Physical Education, Sports, Youth and Tourism. Sampled for the study were apparently healthy short- and middle-distance swimmers, who were split into the Experimental (EG) and Control (CG) Groups, 10 people each. At the time of the study, the subjects were examined and admitted to the experiment by a physician. They all gave their written informed consent to participate. The study was carried out in compliance with the principles of humanity and ethical standards of Helsinki Declaration, 2000, and European Community Directive 86/609).

The athletes were asked to perform a step load test on the Monark Ergomedic 894E Peak Bike vertical cycle ergometer (Sweden). Their aerobic performance was evaluated in terms of volume, intensity and time of work using the hardware and software complex Ergomax (Russia) and specialized software (Patent No. 83004). The spirometric studies were conducted using the Cortex METALYZER 3B-R2 gas analyzer (Germany). The following gas exchange indicators were recorded: lung ventilation (LV), exhaled O_2 and CO_2 levels; O_2 consumption (VO_2). HR was measured using Polar T34 pulsometer (Finland). The blood lactate concentration (HLa, mmol/l) was measured by the electrochemical method using the NOVA Biomedical Lactate Plus (USA) analyzer. The capillary blood samples were taken in a quiescent state before the test and at the 3rd, 5th, 7th, and 10th minutes after the test. The pulse oximetry method (stationary – **NONIN** 8600, USA; carpal- MD300W, China) was used to record **blood oxygenation** (SO_2). HR and blood oxygenation during the hypoxic tests were recorded in three stages: at rest – before the hypoxic exposure, for 1 min; during the 30-min exposure to the 9% O_2 gas mixture; after the hypoxic exposure (recovery period) – under normal breathing conditions, for 3 minutes. Blood oxygenation and HR were recorded during the hypoxic test with a step of 10 seconds: before the **hypoxic stimulus** – at rest, for 1 minute; during the 30-min exposure to the 9% O2 gas mixture; after the **hypoxic exposure** (recovery period) – under normal breathing conditions, for 3 minutes.

Results of the study. The experiment showed that in EG t_{work} in the aerobic power zone was 12 min 11 sec on average with a variation of 11%, the relative $VO_{2\ max}$ reached 52 ml/min/kg with a variation of ±10%, and the anaerobic exchange threshold was 74% of MOC. The effects of normobaric hypoxia were determined by combining the force of the applied hypoxic stimulus (F_iO_2) and the duration of the hypoxic exposure. The dynamics of changes in HR and SO_2 during

Table 1. *Blood oxygenation and HR during single hypoxic exposure, before aerobic work on cycle ergometer ($\bar{X} \pm \sigma$, n=5)*

Indicator	Unit of measurement	Single hypoxic exposure using the hypoxicator, before anaerobic load		
		Initial state	Hypoxic test	Recovery
Time	min	1	30	3
HR	bpm	76±4.23	84±6.02	76±5.60
SO_2	%	97±1.53	85±5.74	91±3.52

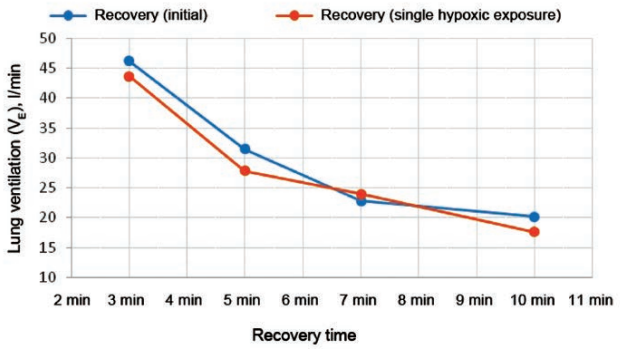

Fig. 1. *Dynamics of changes in V_E (l/min) depending on time of recovery after aerobic load with single hypoxic exposure*

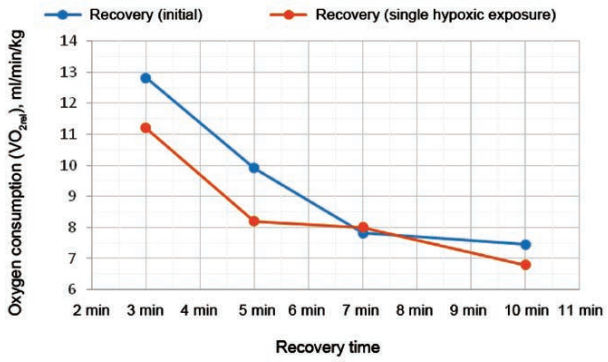

Fig. 2. *Dynamics of changes in VO_2 (l/min/kg) depending on time of recovery after aerobic load with single hypoxic exposure*

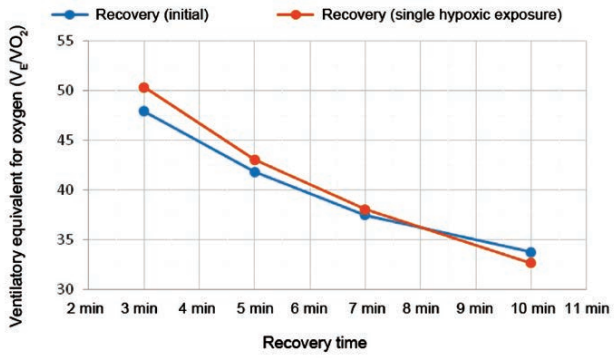

Fig. 3. *Dynamics of changes in V_E/VO_2 depending on time of recovery after aerobic load with single hypoxic exposure*

the single 30-min hypoxic exposure indicated a trend towards higher HR and lower blood oxygenation in EG (see Table).

The dynamics of changes in HR and SO_2 under 30-min hypoxic exposure (±Δ) before and after the single hypoxic exposure amounted to +10.5 and -10.3, respectively.

The measurement of the blood oxygenation levels and HR showed that the single normobaric hypoxic exposure leads to a decrease in SO_2 and an increase in HR due to a certain degree of tension in the cardiorespiratory system and a decrease in oxygen transport in the body. As oxygen delivery decreases, the share of anaerobic glycolitic processes in energy supply increases, as evidenced by the growth of excess non-metabolic carbon dioxide ($ExcCO_2$).

It is shown that during the single hypoxic exposure, the average t_{work} on the cycle ergometer increased slightly, by only 1.8%, while HR and the relative W_{work} at all test stages decreased significantly. The anaerobic exchange threshold dropped by 7.5%, and VO_2 decreased.

The analysis of the dynamics of changes in the blood lactate concentrations showed that it decreased at all test stages and significantly reduced at the 7th and 10th minutes in the recovery period, which may be due to greater substrate and oxidative phosphorylation activation and intensification of aerobic synthesis of adenosine triphosphoric acid.

Figures 1-3 illustrate the dependence of lung ventilation, O_2 consumption and ventilatory equivalent for O_2 on the time of recovery after the aerobic testing with and without hypoxic exposure.

It is shown that these physiological indicators decreased significantly during the recovery period at the 5th, 7th, and 10th minutes of the recovery period. The lung ventilation and oxygen consumption rates under hypoxic exposure reached a constant level at the 5th-7th minutes, which was especially significant under the influence of the single hypoxic exposure, while the ventilatory component – at the 10th minute.

Therefore, the analysis of the obtained parameters shows that single normobaric hypoxic exposure may contribute to the improvement of tolerance to hypoxia when working in the aerobic and anaerobic-aerobic power zones.

Conclusion. The findings showed an ambiguous reaction of the biochemical and physiological characteristics of the swimmers' body to the single hypoxic exposure when working in the aerobic mode. The efficiency of hypoxic exposure on the body and individual hypoxic tolerance rate, when coupled with load hypoxia, is largely determined by the rate of recovery of all the body functional systems involved. The single hypoxic exposure in the aerobic mode does not inhibit the adaptation mechanisms, and this variant of exposure may help improve physical working capacity at the specified power.

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Low carb - high carb diet plan to increase special endurance of elite climbers

UDC 796.01:612

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Abstract

Objective of the study was to develop and evaluate the effectiveness of the low carbohydrate -high carbohydrate diet plan for climbers to be used in the precompetitive period.

Methods and structure of the study. Sampled for the study were 12 elite climbers (CMS and MS of Russia; Russian, European and World champions). The Harvard step test was used to determine the level of development of the subjects' overall endurance (cardiovascular system functionality). A specific test method was used to evaluate the local muscle endurance in the forearm: standard-grip hang with both hands with 70% of maximum weight for 8 seconds with 5-sec rest intervals. The total execution time was recorded.

The level of development of strength (special) endurance was assessed by the number of grips and finger holds made. The athletes were to climb a moderate-difficulty route as long as possible without rest. The number of grips and finger holds was calculated. This test was performed on an artificial climbing wall.

After initial testing, the climbers were offered a low carb-high carb diet plan.

Results and conclusion. The authors have developed and adapted a 7-day low carb-high carb diet plan for elite climbers. The tests conducted upon its introduction into the climber training process proved to be effective in increasing special and local endurance in the precompetitive period. This diet plan can be recommended to increase the glycogen levels in the climbers in the precompetitive period.

Keywords: *competitive climbing, low carb-high carb diet, precompetitive period, strength endurance, local muscle endurance in forearm.*

Background. Each sport climbing discipline – speed climbing, bouldering, lead climbing – requires special endurance being developed to the given kind of activity. In addition to strength endurance, athletes must have a highly developed speed-strength abilities. From a biochemical perspective, climbers train mainly in the ATP-CP and anaerobic lactic (glycolytic) energy system. ATP resynthesis is an anaerobic process, which uses glycogen as a substrate [1, 2]. Competitive activities take place in the submaximal power zones [3]. The depletion of glycogen stores in the muscles is a generally recognized factor that limits strength endurance [4]. In order to increase these stores, we developed and adapted a carbohydrate unloading-loading diet plan for elite athletes from sports that require a well-developed special endurance associated with anaerobic glycolysis (apart from climbing, they include cross-country skiing, long-distance swimming, triathlon, etc.) [5, 6, 8].

Objective of the study was to develop and evaluate the effectiveness of the low carb-high carb diet plan for climbers to be used in the precompetitive period.

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After initial testing, the climbers were offered a low carb-high carb diet plan.

Results and discussion. For climbers performing speed-strength work in the anaerobic mode the percentage of proteins, fat and carbohydrates in the energy supply should equal 17-18%, 30% and 52-53% [6], respectively.

In lead climbing, it is strength endurance that plays a key role. Therefore, athletes are recommended the following diet: proteins – 14-15%, fat – 25%, carbohydrates – 60-61% of total calorie intake.

Climbers' routine food typically has the ratio of proteins, fat, and carbohydrates as follows: 15%, 25%, and 60%, respectively, which is 2.25 g of proteins, 1.66 g of fat, and 9.0 g of carbohydrates per kg of body weight. The caloric value of the diet is 60 kcal per kg of body weight.

We have developed and adapted the most suitable low carb-high carb diet plan for climbers to keep to during trainings by the method of Sherman et al. This diet plan does not exclude carbohydrates, but prefers complex carbohydrates that are rich in fibers. This improves the digestion of large amounts of proteins.

Climbers usually have four meals a day: breakfast - 40% of proteins, fat and carbohydrates of total calorie intake, lunch - 30%, snack - 5%, dinner - 25%.

Low carb-high carb diet plan. It includes an 8-day diet to be kept to before the start of competitions.

Stage 1 – low carbohydrate diet. 3-7 days before the control event (competition), the amount of proteins and carbohydrates was equaled to 3 g, fat – 1.1 g per kg of body weight. The main food products at this stage were egg whites, curdled dairy products, fish and seafood, meat and meat products, whole-grain bread, vegetables, low-sugar fruits.

Stage 2 – high carbohydrate diet. Carbohydrates were introduced 1-3 days before the competition. Their quantity was gradually increased and the day before the competition reached 9.5 g per kg of body weight, while proteins were decreased to 0.9 g, and fat was 1.3 g per kg of body weight. By the final day of the diet plan, the volume of training loads was decreased, based on the subjective feelings of each athlete.

Stage 3. On the control event day (the day of the intended start), the amount of carbohydrates was 10.5 g per kg of body weight, proteins – 2.25 g, fat – 1 g.

6 days before the control test, the athletes performed an aerobic load with the oxygen cost of 70% oxygen of MOC for 90 min. 5-4 days before the control test, the duration of loading was reduced to 40 min, while its intensity did not decrease. 3-2 days before the control test, with the constant load intensity, the training session lasted 20 min. The athletes had a rest day 24 hours before the control test.

The effectiveness of the developed low carb-high carb diet plan was determined by the extent to which the local, special and overall endurance rates had changed.

The results of the Harvard step test did not show any significant changes in the cardiovascular system functionality throughout the experiment rates. In each test, the cardiovascular system functionality was rated as «good» and «excellent».

The dynamics of endurance rates was positive but did not increase significantly and amounted to 0.3%, i.e. less than 1%.

Since the introduction of the low carb-high carb diet plan in sports training of climbers, the average special endurance level has increased. The maximum growth rate was 23%, the minimum – 11%. The baseline rates increased by an average of 17%. A week after the introduction of the diet plan, the special endurance rates dropped by 5%. However, this level exceeded the baseline by 12%.

The control test showed a positive trend in the local muscle endurance in the forearm. The results of two intermediate tests of local endurance indicated that the average execution time was 104.1 and 114.7 sec, respectively. Therefore, after the introduction of the developed diet plan, the control test results improved on average by 10% (see Figure 1).

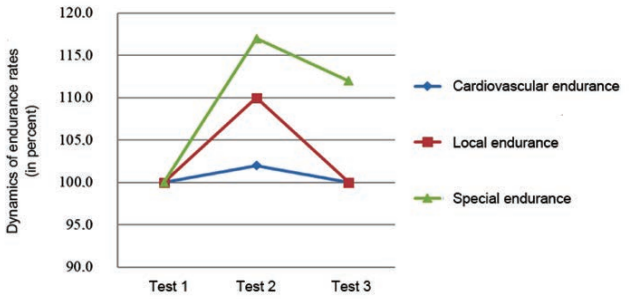

Figure 1. *Dynamics of endurance rates*

On the 15th day of the experiment, the average test rate was 104 sec, which indicates that the local endurance was reduced to the initial level.

The experiment found that the use of the developed and adapted low carb-high carb diet plan in the sports training of highly-qualified climbers contributes to the increase of their strength endurance – by 17% and local muscle endurance in the forearm – by 10%.

Conclusion. The authors have developed and adapted a 7-day low carb-high carb diet plan for elite climbers. The tests conducted upon its introduction into the climber training process proved to be effective in increasing special and local endurance in the precompetitive period. This diet plan can be recommended to increase the glycogen levels in the climbers in the precompetitive period.

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Mental well-being of sporting women

UDC 796.01:159.9

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Abstract

Objective of the study was to test benefits of habitual physical training and sporting lifestyles for the 25-42 year-old women's mental health and wellness.

Methods and structure of the study. We randomly sampled for the study the 25-42-year-old (32.7 years on average, SD =.51) women (n=78) residing in Yekaterinburg with representative variations in ages, education levels and socio-economic situations. The sample was tested in February through April 2019. We split the sample into an unsporting Reference Group (RG, n= 38) and habitually sporting/ physical education and sports-devoted Experimental Group (EG, n= 48). Mental well-being of the sample was tested by the D. Shevelenkova and T.P. Fesenko mental well-being test and the D.A. Leontiev and E.I. Rasskazova Life Mission and Priorities Survey.

Results and conclusion. The test and survey data analyzed herein give us good grounds to believe that physical progress is associated with mental well-being progress – in agreement with the prior study findings.

The sporting versus unsporting women's group mental well-being / mental health test differences showed the habitual physical training and sports being mostly beneficial for the following: individual self-control and self-management mechanisms; stress tolerance; independence; and self-esteem. On the whole, the study demonstrated benefits of habitual physical training and sporting lifestyles for the 25-42 year-old women's mental health and well-being.

Keywords: *mental well-being, physical education, mental health, emotional status, physical activity.*

Background. Individual health may be interpreted as the balanced mix of physical, social and mental health elements forming a basis for a personality progress in every vocational field [2]. mental well-being in this context may be defined as the emotionally and psychologically balanced status indispensable for a joyful lifestyle [2] full of happiness and contentment [2], with positive experiences, life values, meanings and priorities [4], good moods, positive emotions and life satisfaction on the whole [5]. G. Lordan et al. have demonstrated that sporting lifestyles tend to improve mental health / mental well-being [6]. F. Penedo and J. Dan [7], K. Kiz [5] and Z. Gidami et al. [3] found some benefits of habitual physical activity for mental health; with these studies urging the research community to further explore correlations between habitual physical training and sports lifestyles and mental well-being / mental health [1].

Objective of the study was to test benefits of habitual physical training and sporting lifestyles for the 25-42-year-old women's mental health and wellness.

Methods and structure of the study. We randomly sampled for the study the 25-42-year-old (32.7 years on average, SD =.51) women (n=78) residing in Yekaterinburg with representative variations in ages, education levels and socio-economic situations. The sample was tested in February through April 2019. We split the sample into an unsporting Reference Group (RG, n= 38) and habitually sporting/ physical education and sports-devoted Experimental Group (EG, n=

48). Mental well-being of the sample was tested by the D. Shevelenkova and T.P. Fesenko mental well-being test and the D.A. Leontiev and E.I. Rasskazova Life Mission and Priorities Survey.

Results and discussion. The mental health / mental well-being tests and surveys rated the sporting EG higher than the RG on the following scales:

- Close and precious relations with relatives and friends (significant difference verified by the Mann-Whitney ratio of 0.0001 at $p<0.001$);
- Higher commitment to the personal principles/ values even when they run counter to the common social standards (significant difference verified by the Mann-Whitney ratio of 0.0001 at $p<0.001$);
- Higher stress coping and solution-finding skills in everyday problematic situations (significant difference verified by the Mann-Whitney ratio of 0.0001 at $p<0.001$);
- Higher assurance in own gifts, skills and lifelong progress (significant difference verified by the Mann-Whitney ratio of 1.5 at $p<0.001$);
- More purposeful behavior, with the goals better set and articulated (significant difference verified by the Mann-Whitney ratio of 2.0 at $p<0.001$);
- More determined in the situational responses, with a strong belief in the high chances to find something personally relevant and valuable for their personality progress agendas (significant difference verified by the Mann-Whitney ratio of 0.0001 at $p<0.001$);
- More prepared to cope with their life problems even when a success is not guaranteed (significant difference verified by the Mann-Whitney ratio of 0.01 at $p<0.002$);
- More prepared to acquire and appreciate new experiences, go beyond the standard situational life tracks and sacrifice comfort and security as the life-impoverish aspects (significant difference verified by the Mann-Whitney ratio of 0.01 at $p<0.002$); and
- Higher stamina, with reasonable optimism as an injury-prevention and stress coping mechanism (significant difference verified by the Mann-Whitney ratio of 0.001 at $p<0.001$): see Table hereunder.

The intergroup difference was the lowest on the self-acceptance scale (with the Mann-Whitney ratio of 18.0 at $p<0.15$). This may mean that the unsporting women tend to stall in viewing themselves as having virtually no physical and mental health related progress motivations. In the averaged terms, the sporting EG was tested significantly higher than the RG (with the integrated Mann-Whitney ratio of 0.0001 at $p<0.001$). The test and survey data analyzed herein give us good grounds to believe that physical progress is associated with mental well-being progress – in agreement with the prior study findings by D. Edwards [1], G. Faulkner [2], Z. Gifami [3] and F. Pinedo [7].

Conclusion. The sporting versus unsporting women's group mental well-being / mental health test differences showed the habitual physical training and sports being mostly beneficial for the following: individual self-control and self-management mechanisms; stress tolerance; independence; and self-esteem. On the whole, the study demonstrated benefits of habitual physical training and sporting lifestyles for the 25-42-year-old women's mental health and well-being.

Table 1. *Mental health / mental well-being test and survey data of the sporting and unsporting groups*

Mental health tests	Mann-Whitney ratio	Significance rate, p	Average	
			EG	RG
Relations	0,0001**	0,0001	15,50	5,50
Autonomy	0,0001**	0,0001	15,50	5,50
Life situation management	0,0001**	0,0001	15,50	5,50
Personality growth	1,5 **	0,0001	15,50	5,50
Life missions	2,0 **	0,0001	15,50	5,50
Self-acceptance	18,0 *	0,015	13,70	7,30
Mental well-being	0,0001**	0,0001	15,50	5,50
Commitment	0,0001**	0,0001	15,50	5,50
Control	0,01**	0,002	14,85	6,15
Risk management	6,5 **	0,0001	15,50	5,50
Stamina	0,0001**	0,0001	15,50	5,50

*Note: *p<0.05; ** p<0.01*

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Perfectionism and stress coping strategies in elite basketball

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Abstract

Objective of the study was to test and analyze the dominant aspects of perfectionism in a university elite basketball sample and their correlations with the key stress coping strategies.

Methods and structure of the study. We sampled for the study the Ural Federal University basketball team leaders (n=11) aged 25 years on average. The sample was tested for the adaptive perfectionism / maladaptive perfectionism using the FMPS (Frost, Marten, Lahart & Rosenblate, 1990) multidimensional perfectionism test scale. The stress coping strategies were profiled by the Coping strategies (Coping Strategies in Sports) test (ACSQ-1; Kim 1999; Kim & Duda, 1997). The test data were processed by a regression analysis in the standard mathematical statistics toolkit.

Results and conclusion. The study found a direct correlation of maladaptive perfectionism with the Social Support Seeking stress coping strategy and an inverse correlation of the Doubts in Action with the Emotions Control stress coping strategy.

Our tests and analysis of dominant aspects of perfectionism in the elite basketball sample and their correlations with the key stress coping strategies found dominance of adaptive perfectionism and constructive stress coping strategy. We also found that the higher are the doubts in own actions the lower is the individual emotional control in the stress coping strategies. The findings may be recommended for attention of sports psychologists, coaches and instructors.

Keywords: *perfectionism, coping strategies, elite basketball players.*

Background. Modern sports are increasingly competitive, with the individual perfectionism and ambitions considered among the strongest success motivators. No wonder that the sports research community shows a growing interest in perfectionism in sports and its influences on the stress coping strategies [2, 3]. Perfectionism may be interpreted as the individual strive for perfection with the associating high demands and expectations as to own self and others [1, 6]. Such inflated standards, however, can be detrimental to behavior and progress in many aspects due to, among other things, the growing competitive pressure and mental stressors – countered to a degree by the positive aspects of athletic perfectionism dominated by the success motivations [2]. This contradiction deserves a special study – that in our case was designed to test and analyze the dominant aspects of perfectionism in a university elite basketball sample and their correlations with the key individual stress coping strategies. We respected in our study the common foreign approaches that basically classify perfectionism into adaptive and maladaptive (adaptive perfectionism, maladaptive perfectionism) classes [4, 5].

Objective of the study was to test and analyze the dominant aspects of perfectionism in a university elite basketball sample and their correlations with the key stress coping strategies.

Methods and structure of the study. We sampled for the study the Ural Federal University basketball team leaders (n=11) aged 25 years on average. The sample was tested for the adaptive perfectionism / maladaptive perfectionism using the FMPS (Frost, Marten, Lahart & Rosenblate, 1990) multidimensional perfectionism test scale. The stress coping strategies

Table 1. *University basketball elite's adaptive perfectionism / maladaptive perfectionism test data on a 5-point scale*

Maladaptive perfectionism		Adaptive perfectionism		
Doubts in Action	Maladaptive perfectionism	Personal Agenda	Self-management	Adaptive perfectionism
2,25	2,55	3,57	3,50	3,53
3,00	2,05	3,29	3,33	3,31
4,25	2,97	2,71	4,33	3,52
2,50	2,25	3,29	4,50	3,89
2,50	2,85	3,86	5,00	4,43
3,00	2,28	2,86	4,67	3,76
3,75	2,89	2,57	4,00	3,29
3,00	2,37	3,40	4,83	4,12
2,25	2,35	3,14	3,66	3,40
2,00	2,10	2,85	4,00	3,43
3,50	3,12	4,14	4,66	4,40

were profiled by the Coping strategies (Coping Strategies in Sports) test (ACSQ-1; Kim 1999; Kim & Duda, 1997). The test data were processed by a regression analysis in the standard mathematical statistics toolkit.

Results and discussion. The adaptive perfectionism / maladaptive perfectionism test data on a 5-point scale are given in Table 1 hereunder. Maladaptive perfectionism was tested moderate on average in the elite basketball sample, with the highest points on the Doubts in Action scale (M = 2.9). The adaptive perfectionism test rates were significantly higher than the maladaptive perfectionism, with the Self-management (M= 4.25) rated higher than the Focus on Personal Agenda (M=3.24). Note that the tests found the individual adaptive perfectionism / maladaptive perfectionism varying in a wide range, with some athletes rated low by one or two perfectionism aspect tests (see Table 1). Generally our test data were found to agree with the relevant foreign study reports [5].

Then we run the stress coping strategy tests followed by a regression analysis to find influences of the perfectionism test rates (as independent variables) on the individual stress coping strategies (dependent variables). The analysis scored the highest the Cognitive Adjustment stress coping strategy (M=3.98) when the athlete tends to analyze the problems and situation to find the best solution for success. On the whole the sample was found to prefer the Emotions Control stress coping strategy (M= 3.21), with the least popular stress coping strategies including the Social Support Seeking (M= 2.18) and Problem Avoiding (M=1.76) ones.

Furthermore, the study found a direct correlation of maladaptive perfectionism with the Social Support Seeking stress coping strategy ($r=0.686$, $p\leq0.01$); and an inverse correlation of the Doubts in Action with the Emotions Control stress coping strategy ($r=-0.639$, $p\leq0.05$). It should be mentioned that we found no significant correlations between the adaptive perfectionism and stress coping strategies – that may be due to the too limited sample, knowing the fact that T. Yancheva et al. found the adaptive perfectionism being correlated with the Emotions Control and Cognitive Adjustment stress coping strategies [5].

Conclusion. Our findings of the dominant aspects of perfectionism in the elite basketball sample and their correlations with the key stress coping strategies found dominance of adaptive perfectionism and constructive stress coping strategy. We also found that the higher are the doubts in own actions the lower is the individual emotional control in the stress coping strategies. The findings may be recommended for attention of sports psychologists, coaches and instructors.

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Endurance training nordic walking model for university students: tests and benefit analysis

UDC

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Abstract

Objective of the study was to offer and test benefits of an endurance training Nordic walking model in application to university students.

Methods and structure of the study. We sampled for the new endurance training Nordic walking model testing study (run at Ural Federal University in 2018 to 2021) the Ural Federal University students (n=54, 27 boys and 27 girls) from the non-physical education departments, with the endurance training Nordic walking model tested as complementary to the regular physical education service. Practical Nordic walking trainings included combinations of different practices (standard Nordic walking in a few versions; dorsal muscle group training and physical conditioning practices with sticks; postural control practices etc.). Endurance was tested by the 3km Nordic walking tests (six tests for three years run on a pre- versus post-year basis).

Results and conclusion. The three-year endurance training Nordic walking model in application to university students was tested beneficial as verified by the significant gender group progress in the 3km Nordic walking tests. The gender gap in the progress tests demonstrates the need for the Nordic walking model to be prudently customized and individualized for the students\ actual progress needs, health and challenges.

Keywords: *Nordic walking, endurance, physical activity, cyclic training.*

Background. Nordic walking is getting increasingly popular the world over since it offers, as compared to the standard walking practices, coordination-intensive physical activity [1] beneficial for many key physical qualities for many age groups including university students. Benefits of any sports practices are known to maximize when they are specific enough i.e. focused on the key physical qualities and skills need to be trained. Modern Nordic walking is commonly ranked with the cyclic sports that facilitate progress in general and special endurance, whilst endurance in its turn is critical for success in everyday living, professional service including sports as it improves working capacity on the whole [3, 4, 5].

Endurance is commonly trained by cyclic exercises taking fairly long time, with Nordic walking ranked high among them. However, actual benefits of the Nordic walking models for different age groups still need to be further explored. The accessible Russian and foreign study reports on the subject are basically centered on the health and physical conditioning benefits of different Nordic walking practices for senior groups [2, 6, 7]; whilst modern Nordic walking models applicable in the endurance training service for university students still deserve special studies.

Objective of the study was to offer and test benefits of an endurance training Nordic walking model in application to university students.

Methods and structure of the study. We sampled for the new endurance training Nordic walking model testing study (run at Ural Federal University in 2018 to 2021) the Ural Federal University students (n=54, 27 boys and 27 girls) from the non-physical education departments, with the endurance training Nordic walking model tested as complementary to the regular physical education service. Practical Nordic walking trainings included combinations of different practices (standard Nordic walking in a few versions;

Table 1. *Endurance rating 3km Nordic walking test data (min): boys group*

Indices	Pre-year 1	Post-year 1	Pre-year 2	Post-year 2	Pre-year 3	Post-year 3
$\bar{x}$	24,4	23,8	23,2	22,7	21,9	21,1
σ	1,7	1,6	1,6	1,4	1,4	1,2
mx	0,3	0,3	0,3	0,3	0,3	0,2
V	6,9	6,8	6,7	6,3	6,3	5,6

Table 2. *Endurance rating 3km Nordic walking test data (min): girls group*

Indices	Pre-year 1	Post-year 1	Pre-year 2	Post-year 2	Pre-year 3	Post-year 3
$\bar{x}$	26,4	25,8	24,9	24,3	23,8	23,0
σ	2,1	1,8	1,8	1,6	1,5	1,3
mx	0,4	0,3	0,3	0,3	0,3	0,2
V	7,8	6,9	7,2	6,6	6,1	5,7

dorsal muscle group training and physical conditioning practices with sticks; postural control practices etc.). Endurance was tested by the 3km Nordic walking tests (six tests for three years run on a pre- versus post-year basis).

Results and discussion. Tables 1 and 2 hereunder give accounts of the students' progress in the endurance rating 3km Nordic walking tests. Note that the Student t-test found the 1-year group progress insignificant (t=1.3 and t=1.2 for the boys and girls groups respectively). Later on till the end of the study the yearly progress was tested significant ($p < 0.001$).

The significant progres demonstrated by both gender groups in the endurance training Nordic walking model testing study may be interpreted as indicative of the model benefits for the endurance training (Fig. 1). Note that the boys' group progresses were significantly higher than the girls' group ones (with t ranging from 3.9 to 5.8).

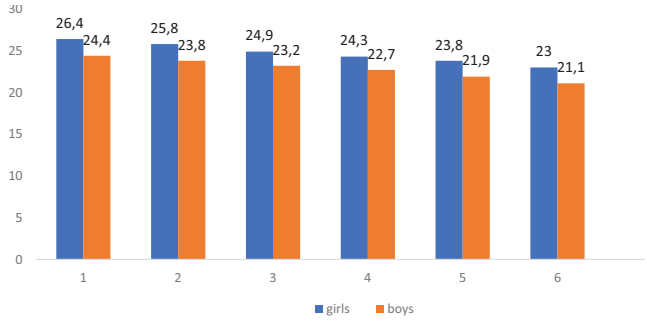

Figure 1. *Gender group progress in the endurance rating 3km Nordic walking test, min*

Conclusion. The three-year endurance training Nordic walking model in application to university students was tested beneficial as verified by the significant gender group progress in the 3km Nordic walking tests. The gender gap in the progress tests demonstrates the need for the Nordic walking model to be prudently customized and individualized for the students\ actual progress needs, health and challenges.

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Gym fitness equipment to build motor abilities in man

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Abstract

Objective of the study was to develop and excel gym fitness equipment for physical progress and rehabilitation needs.

Methods and structure of the study. The gym fitness equipment development process was organized to (1) design and test fundamentally new gym fitness equipment; and (2) excel the existing fitness equipment.

Results and conclusion. The gym fitness/ rehabilitation equipment of our design analyzed herein was designed to build and improve strength, speed-strength and movement coordination qualities on an individualized basis, with some trainers applicable for specific rehabilitation purposes. The hand grip, for instance, may be used for the post-injury rehabilitation of the relevant hand muscles, ligaments and tendons; the gymnastic bench may be used to recover and excel the walking movement coordination; and the gymnastic ladder to correct a range of postural and spinal disorders/ dysfunctions. We have also developed an ankle joint muscle rehabilitation and training machine. Every piece of the gym equipment of our design can be easily produced using the standard industrial equipment and readily accessible materials.

Keywords: *physical development, gym fitness equipment, motor abilities, ankle joint trainer, gymnastic bench, tennis trainer, gymnastic ladder.*

Background. Nowadays physical progress needs are largely facilitated by modern technologies geared to fully mobilize the inherent biological resource using modern gym fitness equipment for application in the physical education and training systems for physical progress, rehabilitation, health and motor skills excellence purposes [1, 2, 7]. The gym fitness equipment design process claims great creative resource since the modern fitness industry is well supplied with training machines to facilitate selective training of every key muscle group.

Objective of the study was to develop and excel gym fitness equipment for physical progress and rehabilitation needs.

Methods and structure of the study. The gym fitness equipment development process was organized to (1) design and test fundamentally new gym fitness equipment; and (2) excel the existing fitness equipment.

Results and discussion. We give herein overviews of the following new gym fitness equipment: hand grip, gymnastic bench; tennis trainer, gymnastic ladder, and ankle joint trainer for the joint flexibility, rehabilitation and training purposes. Every piece of the above fitness equipment is designed for focused training of specific physical qualities (strength, speed-strength, coordination, etc.) and, in some cases, for physical therapeutic/ rehabilitation service.

Hand grip [3]. The device may be described as a set of rings with attached springs, with the larger ring fixed on the thumb, whilst four sequential springs on

the other rings fixed on distal phalanges of the other fingers. Diameter of the rings is customized to the sizes of the fingers. The springs create a workload on the finger extensor muscles and go back to the prime position when the fingers are flexed. The hand grip design is simple enough and effective for training the hand muscles and joints, easy in operation and for industrial production. The hand grip may be beneficial for the post-injury and post-surgery rehabilitation purposes as it may be customized to train specific hand/ forearm extensor muscles, ligaments and tendons. It may be also recommended for rehabilitation of impaired cerebral circulation with dysfunctions of peripheral nerves in the upper limbs, for training paretic and weakened muscles so as to restore fine differentiated movements in the affected limbs.

Gymnastic bench [4]. Gymnastic bench may be helpful for safe movement coordination training in the seat-up and seat-down positions, in contrast to a traditional static gymnastic bench that may not be customized and, hence, not always beneficial enough. This was the reason for us to offer a new gymnastic bench design more efficient for the movement coordination training missions. The new gymnastic bench elements are equipped with steel rods and beam with bearings so that the beam swings horizontally when the bearings roll inside the U-shaped grooves in the legs to the limiters of the beam rotation angle. For the training process efficiency in the seat-down position, the beam is movable horizontally due to its steel rods sliding and rotating in the leg grooves. The trainee's movements are facilitated by the beam easily rocking in the grooves on the bearings, with the beam rotation angle adjustable by the limiters.

Movement coordination is trained using the gymnastic bench as follows. The gymnastic bench may be fixed in the seat-up or seat-down position depending on the difficulty level required for training. The seat-down position is considered more difficult and effective. The varied trainee's pressure on the seat is responded by the beam rocking horizontally, whilst the trainee strives to maintain equilibrium and thereby trains the movement coordination. The beam rotation angle may be customized to the individual fitness or training goal by adjusting the rotation angle limiters. The new gymnastic bench may be easily produced using a standard set of industrial machinery and accessible materials.

Tennis trainer [5]. Tennis trainer is the standard gym equipment for training table tennis attacks to a designated zone on the table. Our goal in the tennis trainer design was to facilitate the zone attack skills training process by separating one part of the table from the other, with the target section being quarter-size of the standard and movable. This movable target section will be fixed in whatever zone to train the specific attack skill. The tennis trainer facilitates trainings of the attack accuracy, response speed and versatility; and was tested to fast improve the individual tennis trainer techniques and tactics, with special benefits for the training process effectiveness on the whole.

Gymnastic ladder [6]. Gymnastic ladder is the gym fitness/ medical equipment formally ranked with the muscle training and spine dysfunction/ disorder correction systems applicable to gym trainings, physical therapy and other physical education and sports missions. Our goal was to redesign a standard gymnastic ladder to facilitate trainings of specific muscle groups and correct spinal dysfunctions/ disorders. The new gymnastic ladder design offers movable crossbars that slide in the vertical grooves and may be stopped in the required position by lockers in the vertical uprights. Positions of the horizontal crossbars may be adjusted as required for the training efficiency. Training service will be prudently customized to train the key muscles and correct spinal disorders with a special sensitivity to the individual anthropometrics. The trainee will start in suspended position on the gymnastic ladder with the back to the gymnastic ladder and the arms fixed on the upper crossbar. The upper crossbars will be adjusted to the individual spinal profile and/ or as required by the spinal malfunction correction protocol. The training service will prudently combine the static and dynamic exercises as required by the spinal function rehabilitation and postural disorder correction purposes. The new gymnastic ladder may be easily made of wood and steel bars.

Conclusion. The gym fitness/ rehabilitation equipment of our design analyzed herein was designed to build and improve strength, speed-strength and movement coordination qualities on an individualized basis, with some trainers applicable for specific rehabilitation purposes. The hand grip, for instance, may be used for the post-injury rehabilitation of the relevant hand muscles, ligaments and tendons; the gymnastic bench may be used to

recover and excel the walking movement coordination; and the gymnastic ladder to correct a range of postural and spinal disorders/ dysfunctions. We have also developed an ankle joint muscle rehabilitation and training machine. Every piece of the gym equipment of our design can be easily produced using the standard industrial equipment and readily accessible materials.

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Determinants of level of declared physical activity of belarusian students

UDC 613.72

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Abstract

Background. The current state of the knowledge of determinants of the level of physical activity is still insufficient. Predominance of diagnostic research over explanatory one and focusing only on relations between physical activity and unmodified demographical determinants are among the most important limitations characterizing most research conducted.

Objective of the research was to determine the level of declared physical activity undertaken by students of Belarusian universities and to learn about its determinants.

Methods and structure of the study. The survey covered 739 people studying at universities in Brest, Minsk and Grodno (Belarus). The age of the respondents ranged from 17 to 46 years. The mean age was 18.6 ± 3.3 years. In the studied group, women constituted a greater percentage (75.8% of all respondents). The research was carried out using the diagnostic survey method using the long version of the International Physical Activity Questionnaire - IPAQ, with its own modification. For the purposes of this study, questions about the self-assessment of the level of physical activity and the budget of free time were added to the IPAQ record.

Results and conclusions. It was found that nearly 60% of the surveyed youth show a high level of physical activity. The determinants included in the statistical analysis (gender, self-assessment of the level of physical fitness and the amount of free time) were statistically significant. Men turned out to be more active than women. A greater proportion of respondents with a BMI indicating overweight were more active than those with a normal BMI or those who were underweight. High self-esteem and declaration of not having free time by the surveyed youth are associated with a higher level of physical activity. The higher the physical fitness self-assessment, the higher the respondents' physical activity.

Keywords: *students, physical activity, IPAQ, Belarus.*

Introduction. It is difficult to clearly define its optimal level of physical activity (PA) - it is determined by many factors, including age, sex, physical fitness, health, life situation or the goal we want to achieve [4, 6].

According to the recommendations of the World Health Organization, we should strive to increase the level of physical activity of the population, treating it as one of the strategic health problems [7, 9]. Close connection between physical activity and health make it a desirable individual and social value, necessary in health promotion [5].

Objective of the study was to determine the level of declared physical activity undertaken by students of Belarusian universities and to learn about its determinants. The analysis took into account such variables as gender, the value of the Body Mass Index (BMI) and the self-esteem of the level of physical activity, fitness, and the declared amount of free time.

Methods and structure of the study. The survey covered 739 people studying at universities in Brest, Minsk and Grodno (Belarus). The age of the respondents ranged from 17 to 46 years. The mean age was 18.6 ± 3.3 years. In the studied group, women constituted a greater percentage (75.8% of all respondents). The research was carried out using the diagnostic survey method using the long version of the International Physical Activity Questionnaire - IPAQ [9], with its own modification. For the purposes of this study, questions about the self-assessment of the level of physical activity and the budget of free time were added to

Table 1. *Characteristics of the studied group*

Determinant	Category	In total	
		No	%
Sex	Woman	560	75,8
	Man	179	24,2
Place of the research	Minsk	263	35,6
	Grodno	465	62,9
	Brest	11	1,5
Field of study	Humanities	581	78,6
	Medical	11	1,5
	Technical	58	7,8
	Sports	89	12,0
Self-esteem of the level of physical activity	Low	92	12,4
	Medium	553	74,8
	High	94	12,7
Declared amount of free time	Sufficient amount	342	46,3
	Insufficient amount	299	40,5
	Lack of free time	98	13,3

n – number , % – percentage

the IPAQ record. The detailed data characterizing the studied group are presented in tab. 1.

Due to the recorded minimum numbers of extreme categories of the Body Mass Index (BMI), three values were adopted: underweight, normal value and overweight. Of the total respondents, 72.7% had a BMI in the normal value, underweight was found in 19.0% of the respondents and overweight in 8.3% of the respondents.

The collected data were statistically analyzed in the Statistica 10.0 PL programme. The distribution of the analyzed data differed from the normal distribution (the distributions of the variables were analyzed with the Shapiro-Wilk test). The Mann-Whitney U test was used to investigate differences in the value of the MET-min / week index due to gender. Kruskal-Wallis test was used for more than two predictors. In all analyzed cases, the level of significance was $p < 0.05$.

Results and discussion. The data presented in Fig. 1 shows that more than half of the respondents meet the IPAQ criteria [9] for the high level. Unfortunately, almost every tenth student is not physically active enough.

Taking into account sex, a statistically significant differentiation was found in the level of PA. A greater percentage of the studied men compared to women was highly active (Fig. 2).

The BMI value did not statistically differentiate the level of students' PA. Among the overweight respondents, nearly 64% met the criteria for the high level, and almost 28% of the respondents from this group had a moderate level. A similar percentage distribution was also observed among the respondents with BMI indicating the correct value. In the case of underweight students, the percentage of highly active students was slightly lower - it amounted to 47.5%. Respondents with a high self-assessment of the level of physical fitness presented a higher level of PA compared to people assessing themselves as moderately and poorly physically fit (Fig. 3).

Over the recent years, the observed global trends in the level of physical activity [5] do not indicate its improvement. It should be noted, however, that women perform worse than men [3, 8]. According to WHO data, Belarusian men were 1.5 times more active than the surveyed women. The own research also showed a higher level of PA among male students than among female students. The results of surveys conducted among students in Russia and Kazakhstan [1] prove a low level of PA. In eastern countries, the percentage of people systematically undertaking physical activity amounted to only 11% [2].

Conclusions. The surveyed Belarusian youths show a satisfactory level of physical activity - a significant percentage (57.5% of all respondents) met the criteria for a high level of physical activity. The determinants included in the statistical analysis (gender,

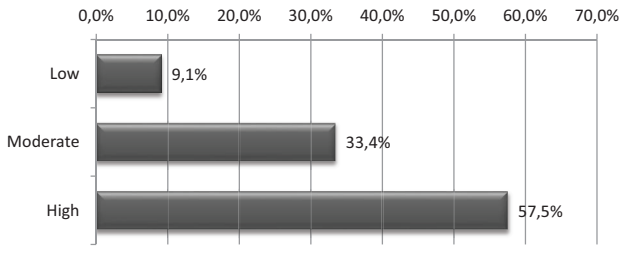
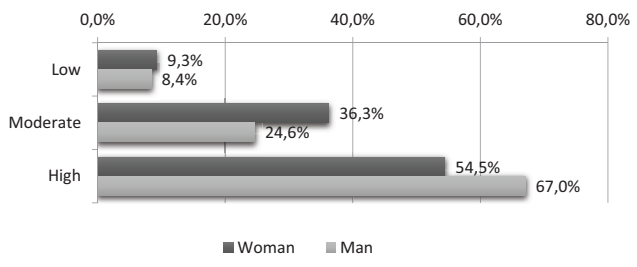
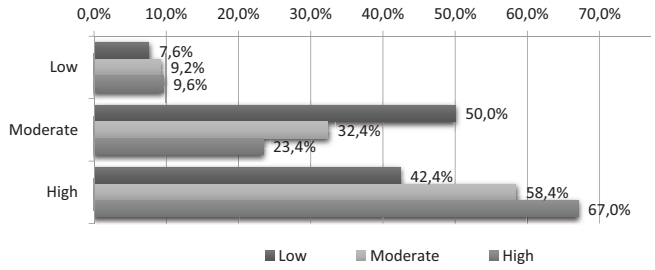


Figure 1. *The level of physical activity of the respondents*



The Mann-Whitney U test value: Z=2,71; p=0,0067*

Figure 2. *The level of the respondents' physical activity taking gender into account*



The Kruskal-Wallis test value: H=8,87; p=0,0118*; 1-3**

* - significant differentiation at p<0,05;

** - variables between which there is statistically significant differentiation in the post hoc Kruskal-Wallis test

Figure 3. *The level of physical activity of the respondents taking into account the self-assessment of the level of physical fitness*

self-assessment of the level of physical fitness and the amount of free time) were statistically significant. Men turned out to be more active than women. A greater proportion of respondents with a BMI indicating overweight were more active than those with a normal BMI or those who were underweight. High self-esteem and declaration of not having free time by the surveyed youth are associated with a higher level of PA. The higher the physical fitness self-assessment, the higher the respondents' physical activity.

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Transformation of liberal ideology mirrored by modern olympics: scientific analysis

UDC 796.01

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Abstract

Objective of the study was to provide scientific evidence for and forecast further progress of the Olympics in the context of modern Western economic, political and sociological research conventions, particularly fixed in the UNESCO materials and encyclopedic documents.

Results and conclusion. We found the transformations of the Olympic movement and International Olympic Committee service in the late XIX to XX century replicating in every minor detail regresses of the liberal governance and its social scientific support service in Western countries as verified by the following:

– The idea of the Olympic movement independence from the politics and economy of the capitalist world – proclaimed by Pierre de Coubertin – has turned out erroneous in its essence as demonstrated by the global history since then;

– The ongoing Olympic Games capitalization and politicization process may unlikely be explained by the personal agendas of Juan Antonio Samaranch, Thomas Bach and other International Olympic Committee leaders, rather by the Olympics being effectively subdued by the Western civilization as its immanent product totally dependent on its social contexts;

– Theoretically grounded social forecast of the political and economic progress of Olympic Games in the near future – already formatted by the New Code of Ethics – implies that the Olympic movement will be kept within the liberal ideology transformation track of the Western capitalist society;

– It should be emphasized that in practical reality the Olympics has regressed into one of the key social institutions and pillars of the Western world and, hence, need to be theoretically analyzed within this frame clean of mythology, idealistic philosophy and other ideological manipulations with common public opinions.

Keywords: *liberal ideology, transformation, economic science, political experts, sociology, Olympic movement, International Olympic Committee, social context.*

Background. Since the middle to late XX century, Olympic sports have been increasingly subject to analysis by social scientists including philosophers, cultural and political analysts, sociologists, lawyers, economists and, last but not least, historians whose role is to answer with documentary accuracy who, where, when and how has contributed to the Olympic movement chronicles [1, 6]. It should be mentioned that the research community has been widely contrary in its views and conclusions that have varied from expressly negative to unrestrainedly apologetic [2, 4, 8, 9]. This controversy of views on the same subject has been naturally associated with multiple and differently approached classifications, systems and typologies in the attempts to understand and systematize the Olympic movement and Olympic Games history via the relevant research provisions, topics and contents [3, 4, 7].

Most of the leading national and foreign experts in the issues have been much the same in the sense that they tend to major in specific applied discipline(s) being normally little if ever familiar with the general progress laws addressed by the economic, political and sociological sciences. Moreover, these experts are more often than not alien to the mainstream Western research community in these fields 10 and, hence, their studies of Olympics are normally alien to the sci-

entific conventions common for the Western nations including those fixed in the UNESCO materials and encyclopedic documents [4]. Therefore, their research analyses virtually never go beyond limitations of the traditional fact sampling templates and, hence, fail to track dependencies of the International Olympic Committee policies and practices from variations of the social contexts [3, 6].

Objective of the study was to provide scientific evidence for and forecast further progress of the Olympics in the context of modern Western economic, political and sociological research conventions, particularly fixed in the UNESCO materials and encyclopedic documents.

Results and discussion. Progress of the Olympics and the International Olympic Committee services appears to strictly replicate, with some natural inertial lag, progress of the Western social system in every period. Thus, the Olympic movement had made fast regress from the liberal declarations of equal opportunities for the harmonious personality development within unrestrained physical and creative progress domains facilitated by fair competitions (in the late XIX to early XX century) to the International Olympic Committee mandated 1936 Olympics in the Nazi Germany – with the further growing support from the International Olympic Committee to many authoritarian, racist and puppet regimen. These International Olympic Committee policies were expanded and advanced after the World War II and peaked in the 28 African countries boycotting the 1976 Olympics in Montreal (Canada) to put the International Olympic Committee on the verge of bankruptcy.

Later on the International Olympic Committee polices have been still geared to establish a global oligopoly by cracking down on the Nordic Games in Scandinavia, subduing the international women's sports movement – and lately the Youth Games – and thereby to betray its own mission, foundation principles, liabilities and the historical Olympic traditions. These polices have always been designed to reinforce the International Olympic Committee financial and political power as verified, among other things, by the key valid International Olympic Committee documents (20x20 Program, New Code of Ethics, etc.) and actual policies and practices of its 14 commissions – with only three of them provisionally free of special financial and political agendas. Note that these policies and practices have always been disguised by idle rhetoric with assurances of the Olympic movement being kept politically neutral.

Of special interest is the ongoing regress of the popular liberal ideas in the political science that have always contributed to the West- European socio-scientific discourse in the XIX-XX centuries by standing the grounds of individualistic morality and ideology. Since the late XIX century, the Western political science has worked hard to develop and establish the conception of "legal positivism" – that may be defined as a logical rationale for the bureaucratic public administration system. A few versions of this conception are driven by a liberal abstract analysis based on the idea that the law is rather an expressed will of a state power than a product of a socially accepted regulatory basis.

In the post-WWII period, the abstract analysis was gradually abandoned to give way to a "professional political science" with its empirical behavioral conceptions of the driving forces and mechanisms behind the "formally systemic management" and operations of political institutions. This was the period when the political analysts fully rejected the liberal individualistic political modeling toolkit. Since the late XX century, the West conventionally approved leadership (still effective nowadays) of the "post-behavioral political science" and "rational choice theory", with the both geared to establish in every target country, under the slogan of "struggle for democracy", controlled institutional provisions for the desired political agenda with the expected practical benefits. As provided by Bjorn Witrock (Sweden), Peter Wagner (USA) and some other Western experts in the political science history, it is traditional of this science nowadays to persistently reject moral reasoning and "management wisdom and modesty".

The International Olympic Committee operations in this context are fairly typical in terms of the "passive" soft power acting on the politics, economies and ideologies of the national governments, particularly in the pre-Olympic and Olympic cycles, plus within the so-called "Olympic legacy". We would emphasize in this context the rapidly growing immorality of the International Olympic Committee policies and practices that are effectively and openly designed to build up the above-mentioned global oligopoly.

It should be mentioned that the sociological science has been no less decisive and consistent in rejecting the liberal ideology. The popular concepts of "classical sociology" of the XIX century, for instance, were condemned in the early XX century for their roots in liberalism. As a result, an empirical sociology was established with major contributions from the Chicago and Columbia based sociological schools in the

USA, the John Dewey's philosophy of pragmatism and the George Herbert Mead's social theory. Unsurprisingly, since the 1940s the Bureau of Applied Social Research at Columbia University have switched over to the governmental contracts for the large-scale "administrative research projects" to give way to the system-functionality concept by Talcott Parsons that took the lead in the mid-XX century. In the 1960s it was complemented by the "mid-level sociology" Robert Merton, one more "Colombian", who also prioritized qualitative and quantitative analyses of the existing social organisms viewed as interdependent systems.

This total generalization of the social ordering and consistency ideas, however, was rejected in the 1970s to give room for even more specific alternative theories of "communicative interaction", "structure formation in action", "social movements", "logics of practical activity", etc. The sociology since then has been dominated by the Jurgen Habermas (Germany) and Anthony Giddens (England) concepts geared to create a philosophically and linguistically specific "strong scientific agenda" to rejects once and forever the "social reality inventing" practices.

We feel that that this kind of extremely modernized sociology is destined to explore the modern Olympic movement and services of its governing agency rather as a concrete social reality in the context of the ongoing transformations in the Western world than a sacred symbol and cradle of unshakable Olympic values and ideals.

Conclusion. We found the transformations of the Olympic movement and International Olympic Committee service in the late XIX to XX century replicating in every minor detail regresses of the liberal governance and its social scientific support service in Western countries as verified by the following:

– The idea of the Olympic movement independence from the politics and economy of the capitalist world – proclaimed by Pierre de Coubertin – has turned out erroneous in its essence as demonstrated by the global history since then;

– The ongoing Olympic Games capitalization and politicization process may unlikely be explained by the personal agendas of Juan Antonio Samaranch, Thomas Bach and other International Olympic Committee leaders, rather by the Olympics being effectively subdued by the Western civilization as its immanent product totally dependent on its social contexts;

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– It should be emphasized that in practical reality the Olympics has regressed into one of the key social institutions and pillars of the Western world 11, 12 and, hence, need to be theoretically analyzed within this frame clean of mythology, idealistic philosophy and other ideological manipulations with common public opinions.

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World student games as cultural resource and student community mobilizing factor

UDC 796.01

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Abstract

Objective of the study was to survey the students' motivations for the cultural resource mobilizing and contributions to the 2023 FISU World Student Games.

Methods and structure of the study. We run, for the purposes of the study, a digital questionnaire survey (on CAVI platform, with the survey data mathematically processed by D.V. Shkurin using Vortex software tools) of a representative student sample (n=333); and analyzed contents of the personal accounts in the VKontakte social network (n=368) of students from 18 universities in the Sverdlovsk Oblast in December 2020 through January 2021. The survey and content analysis were designed to profile the values and priorities, personal and social problems, physical education and sports commitments, and attitudes to the 2023 FISU World Student Games, potential contributions and perceived regional and federal benefits of the event.

Results and conclusion. One of the key conditions and factors for success of the upcoming major event is the commitment of the student community for preparations and hosting services, its interest and activity. The gender-specific survey data showed that women are apparently more interested in the international cooperation sensitive projects; men in the physical education and sports service infrastructure progress; with both of the gender groups equally interested in the youth physical education and sports encouragement initiatives. As for the negative and pessimistic opinions on physical education and sports on the whole and the 2023 World Student Games in particular, their origins need to be explored by special qualitative surveys. The 2023 World Student Games are expected to provide a great impetus for the sporting community and the national Sporting Life Norm project, and in general for the student cultural resource mobilizing initiatives in the homeland.

Keywords: *World Student Games, student community, cultural potential, self-actualization, resource, physical education, sports, gender.*

Background. The 2023 FISU World Student Games offer an immense multidimensional resource and solutions for multiple physical education and sports projects and missions since their core objective is national health as a fundamental social value. The traditional university projects including the professional education, research, social and managerial ones, are geared to shape up the students' world overviews and healthy lifestyle with the relevant healthy values and priorities. Social benefits of major sports events generally depend on how well the student communities are prepared for active contributions to the events.

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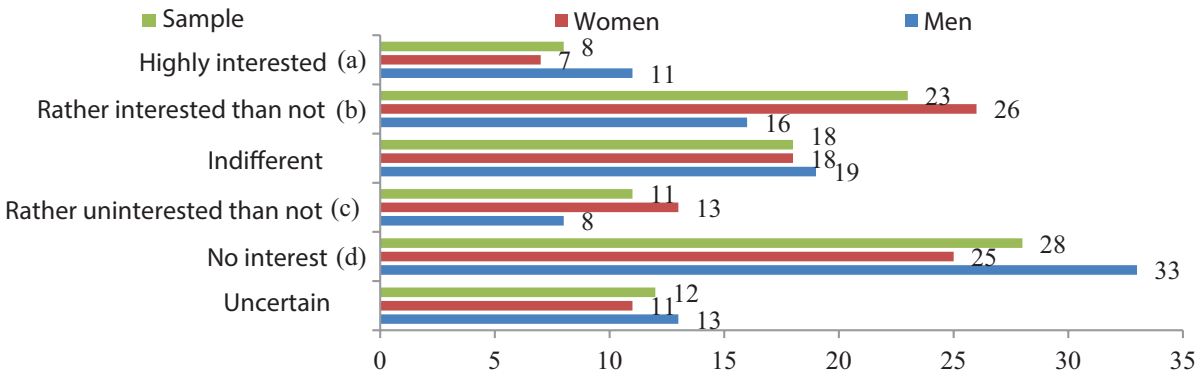

Figure 1. *Gender groups' attitudes to the upcoming 2023 FISU World Student Games: 2020 survey*
Note: Interest ratio (K): men: -0,366; women -0,231; total sample: -0,277. K= (2a+b-c-2d)/100

Results and discussion. The social survey of the mid-Urals student communities made it possible to portray their socio-cultural resource. The survey generally found the students' agendas being dominated by the happiness-related factors critical for the lifestyles, priorities, values and life strategies on the whole. Health and physical fitness needs were unsurprisingly ranked among the top-five key values (by 63% of the sample) with self-reliance, independence and freedom (66%); and loyal friends; love and family (64% each).

As far as the personal problems are concerned, most of the sample was found to rely on themselves (90% of responses), families (60%) and friends (43%). The sample estimated the problem-solving role of the relevant educational and government institutions and industries (including instructors, teachers, university managers, business leaders, youth organizations, etc.) as negligible – it accounted for 10% of responses in total, including 2.1% contribution of the federal and regional governments and 1.8% of trade unions.

The social portrait generated by the survey and content analysis gives an insight to the potential motivations and cultural resource mobilizing options of the student community. Thus the test of leisure-time activity found that the healthy lifestyle related values are associated with the physical education and sports practices and contributions to the sports events mostly by supporting activity (mentioned by 10% in the 2020 survey).

It should be emphasized that the pandemic-related self-isolation period has radically changed the leisure-time activity, with the active physical education and sports practices ranked number 9 in the class activity list (versus 37% and 39% in 2020 and 2016, respectively) – down from the multiannual rank 4 - after music, trekking tours and hobbies. In 2020, the students reported a higher engagement in the Internet surfing, social media news, reading fiction, and online friendly communication.

Nevertheless, 34% of the sample reported giving now more time to the indoor/ outdoor physical education and sports practices than before the pandemic; whilst 39% reported no changes in this domain; with the finding indicative of the physical education and sports being ranked mostly among the instrumental values. The terminal component, however, was rated at 17% of the sample prepared for active contributions to the physical education and sports / healthy lifestyle advocacy (versus the social account content statistics that showed this share even higher at 20%; compared to only 12% in 2016). Note that the account content

Table 1. *Attitudes to the physical education and sports and major events including University Games: social account content statistics, group %*

Response options	Men	Women	Sample
Interested in the major international and Russian sports events	33	34	33
Physical education and sports devotee	32	19	27
Physical education and sports interest limited by only supporter activity	26	24	25
Interest in student sports	17	24	20
Professional athlete	14	21	17
Interested in the top-ranking events like University Games	8	18	12
Average	1,30	1,42	1,35

Table 1. *Attitudes to the physical education and sports and major events including University Games: social account content statistics, group %*

Response options	Men	Women	Sample
Great impetus for the federal and regional sports and physical education and sports infrastructure development projects	35	26	29
Great boost for the image of Russia and its role in the global sports movement	21	30	27
Good impetus for the national professional and amateur/ health sports	27	24	25
Facilitates the international cooperation	8	19	16
Provides special physical education and sports motivations for many people	14	14	14
Heavily promotes sports and athletic successes	6	10	8
Russian team success will add to the people's patriotism	4	8	7
No interest in the event and physical education and sports on the whole	34	30	31
Physical education and sports sector needs everyday growing support rather than haste prior to major international sports events	18	21	20
Doubt that the event hosting costs will be paid back	14	14	14
Average	1,83	1,98	1,93

statistics also found a gender gap in attitudes to the physical education and sports and University Games, as verified by analysis of the texts and audio/ video uploads in the feed: see Table 1.

The gender groups were found equally interested in sports competitions, although the men more often posted updates on the healthy lifestyle and popular sports, whilst the women showed more interest in the student sports and personal sports accomplishments plus Russian University Games. Of special interest for the study were the students' attitudes to the upcoming 2023 FISU World Student Games: see Figure 1.

Dominance of the negative interest values are indicative of the mostly indifferent attitudes to this mega-event, with the men's group more polarized i.e. showing the higher shares of the highly interested and uninterested than the women. The passively supporting plus uncertain shares were found virtually gender-equal at around 33% of the groups. They may be still expected to join the active supporter community at the 2023 World Student Games provided their cultural resource is duly mobilized for the relevant missions. This mobilization may be facilitated by special student engagement programs, PR/ promotion campaigns with special contributions scoring systems: see Table 2.

Conclusion. One of the key conditions and factors for success of the upcoming major event is the commitment of the student community for preparations and hosting services, its interest and activity. The gender-specific survey data showed that women are apparently more interested in the international cooperation sensitive projects; men in the physical education and sports service infrastructure progress; with both of the gender groups equally interested in the youth physical education and sports encouragement initiatives. As for the negative and pessimistic opinions on physical education and sports on the whole and the 2023 World Student Games in particular, their origins need to be explored by special qualitative surveys. The 2023 World Student Games are expected to provide a great impetus for the sporting community and the national Sporting Life Norm project, and in general for the student cultural resource mobilizing initiatives in the homeland.

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Image of 2023 fisu world student games in digital student sociocultural space

UDC 796.:658

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Abstract

Objective of the study was to survey and analyze attitudes to the upcoming 2023 World Student Games image in the host mid-Urals university student communities using a social networking activity analysis and questionnaire survey on a specialty-specific basis.

Methods and structure of the study. We run for the purposes of the study a digital questionnaire survey (on CAVI platform, with the survey data mathematically processed by D.V. Shkurin using Vortex software tools) of a representative student sample (n=333); and a social networking activity analysis of the VKontakte accounts (n=368) of the students from 18 universities in the Sverdlovsk Oblast [3, p. 66], in December 2020 through January 2021. The survey and social networking activity analysis were designed to profile attitudes to the 2023 FISU World Student Games, its perceived role for the federal and regional progress, and the physical education and sports devotions in the sample.

Results and Conclusion. The study found a significant proportion of the sample demonstrating positive attitudes to the 2023 World Student Games – apparently as a result of the event promotion/ imaging initiatives. Further advocacy is recommended along these lines, including empowerment of the activists and special encouragements for the still passive/ uncertain student groups. Target efforts to shape up a positive image of the event using modern social and communication technologies will help improve the 2023 World Student Games organizing, management and hosting services, with special benefits for the student social networking activity. Of special interest in this context may be the PR campaigns, communication technologies and promotions (including the social networking ones) geared to engage the still passive/ hesitant students, with the potential communication toolkits including the linguistic means to encourage healthy considerations/ reflections, motivations and rationale for contributions to the mega-event – and facilitate the transition from the “Me and event” to "My event” mindsets. Such campaigning and promotions should be reasonably customized to the socio-cultural environments and specialties in the host student communities.

Keywords: *2023 World Student Games, image, digital sociocultural space, student communities.*

Background. The 2023 FISU World Student Games hosted by the Sverdlovsk Oblast and Urals Federal County is commonly considered a great catalyst for the physical education and sport sector progress in at least the host area [2, 4]. The event hosting expectations and experiences are known to trigger a shift in the young people’s perceptions of the event from the purely sporting to multisided socio-cultural ones. For the host university community, the event offers "important contributions to the international image and authority of the university" [1, p. 9]. The 2023 World Student Games format is particularly appreciated in this context since it was complemented by a large-scale cultural program geared to boost the social activity in connection with the mega-event.

Objective of the study was to survey and analyze attitudes to the upcoming 2023 World Student Games image in the host mid-Urals university student communities using a social networking activity analysis and questionnaire survey on a specialty-specific basis.

Methods and structure of the study. We run for the purposes of the study a digital questionnaire sur-

vey (on CAVI platform, with the survey data mathematically processed by D.V. Shkurin using Vortex software tools) of a representative student sample (n=333); and a social networking activity analysis of the VKontakte accounts (n=368) of the students from 18 universities in the Sverdlovsk Oblast [3, p. 66], in December 2020 through January 2021. The survey and social networking activity analysis were designed to profile attitudes to the 2023 FISU World Student Games, its perceived role for the federal and regional progress, and the physical education and sports devotions in the sample.

Results and discussion. Our analysis of the offline/ online survey data and their correlations including behavioral models of the traditional/ digital student communities made it possible to profile many social networking activity aspects within the scope of the study [3, pp. 65-66]. Virtual communication implies the personal social identity being constructed so as to mimic to a degree the offline 'real' socializing patterns and succeed in the online community as allowed by a variety of personality factors and social provisions.

An online community, with its socializing needs formed on rather significant than formal basis, tends to demonstrate the choices dictated by the reference group and individual intelligence, vocabulary, etc. An objective socio-cultural environment will be interpreted in the case as dictated by the commonly accepted ideas spontaneously formed in the digital communication flow. Public (primary) channels basically play an informative and image shaping roles; whilst the secondary (personal) channels tend to shape up and interpret contents as required by the group mindsets, preferences and interests. Image/ perceptions of any social phenomenon, including a mega-event will be constructed by the group on a multisided basis.

In the context of the transition from rational to emotional aspects, and from the pure information to the

Table 1. *Attitudes to the upcoming 2023 World Student Games in the specialty groups: 2020 questionnaire survey data, group %*

Group	Interest reported	Specialty				Sample
		Humanities	Natural sciences, mathematics	Engineering/ technology	Socio-, economic	
a	Highly interested	3	9	12	8	8
b	Rather interested than not	25	14	21	31	23
	Indifferent	22	15	17	18	18
	Uncertain	8	23	9	9	12
c	Rather disinterested than not	14	14	8	12	11
d	No interest	29	25	33	23	28
	Interest ratio (K)*	-0,411	-0,308	-0,285	-0,116	-0,277

*Note: *K= (2a+b-c-2d)/100*

Table 2. *Social networking activity content analysis: attitudes to the major sports events like 2023 World Student Games and physical education and sports, group %*

Attitude	Specialty				Sample
	Humanities	Socio-, economic	Natural sciences, mathematics	Engineering/ technology	
Interest in the major international and Russian sports events	37	36	44	20	34
Interest in student sports	14	26	21	24	21
Interest in the top-ranking events like World Student Games	15	8	11	17	12
Physical education and sports devotee	22	33	28	20	26
Physical education and sports interest limited by only supporter activity	30	27	11	17	25
Professional athlete	14	16	33	20	17
Average	1,31	1,47	1,28	1,17	1,36

predispositions-driven interpretations, image may be defined as the socio-communicative technology of special influence on the public opinion shaping process. However, this opinion shaping flow is rather spontaneous in fact, with an image established in the social opinions as a result of a mix of ideas, conceptions, impressions etc. – largely driven by emotions with associations, symbols, etc.

Therefore, a spontaneously formed image may also be viewed as the emotional construct not necessarily compliant with the objective reality due to the specific limitations of the modern online communication toolkit. This process is known to develop a default spiral that means that some group members are disproportionally authoritative knowing that their opinions are supported by the group majority, whilst their opponents tend to keep silent. Such distorted communication process is known to spiral and effectively inflate some topics or opinions and marginalize the others in the group communication system, thereby forming images of every social phenomenon. These logics hold true for the attitudes to the 2023 World Student Games.

The questionnaire survey found a gap between the objective and subjective images of the 2023 WSG in the mid-Urals student sample. Thus an interest-rating survey found the following three relatively independent groups (Table 1): interested (positively active); indifferent; and disinterested (negatively active) in the mega-event.

Note that a negative interest ratio is indicative of the dominant passive/ negative attitudes to the upcoming event – that may be explained to a degree, as we believe, by the perceived "no personal gain" and “little relevance” beliefs – partially due to its time falling beyond the academic timeframe. It should be mentioned that the specialty groups were somewhat different in their attitudes, with the socio-economic (a + b =39%) and engineering (33%) groups showing much more interest than their peers from the humanities (28%) and natural science (23%) groups.

The social networking activity content analysis found a higher interest in the major sports events like 2023 World Student Games and physical education and sports related information (see Table 2) than the questionnaire survey; with 34% of the analyzed accounts, however, found irrelevant.

The specialty group social networking activity data were found to correlate with the questionnaire survey data, with the ‘interested’ subgroup also making around 33% of the sample. As far as benefits of the event for the region are concerned, the sample prioritized the federal and regional physical education and sports infrastructure development benefits (29% of the sample, with the intergroup differences tested meaningless); plus benefits for the national image and role in the global sports movement (27% of the sample, with 15% and 35% support in the natural science and socio-economic groups, respectively); and impetus for the national professional and amateur sports (25% of the sample).

Furthermore, 20% of the sample reported the need for the physical education and sport sector to be supported everyday rather than rushed prior to major international sports events (with the lowest share of 14% in the humanities group); and one of seven respondents doubted that the event hosting costs are paid back (with the highest share of 18% in the engineering group). The groups showed the lowest support of the idea that the Russian team success will boost the people’s patriotism: only 7% of the sample (with 3% and 9% shares in the natural science and engineering groups, respectively).

The 2023 World Student Games related information was found to circulate in the social networking activity with the news reposts (above 50% of the sample), with one of four willing to join the fan community, and one of six to volunteer. One of six was found critical of the event, mostly among the indifferent or negative subgroups; with some having doubts in the payback of the investments and seeing more beneficial alternative projects for the finance (scholarships, classrooms/ dormitories rehab projects, procurements of necessary laboratory equipment, etc.).

Conclusion. The study found a significant proportion of the sample demonstrating positive attitudes to the 2023 World Student Games – apparently as a result of the event promotion/ imaging initiatives. Further advocacy is recommended along these lines, including empowerment of the activists and special encouragements for the still passive/ uncertain student groups. Target efforts to shape up a positive image of the event using modern social and communication technologies will help improve the 2023 World Student Games organizing, management and hosting services, with special benefits for the student social networking activity. Of special interest in this context may be the PR campaigns, communication technologies and promotions (including the social networking ones) geared to engage the still passive/ hesitant students, with the potential communication toolkits including the linguistic means to encourage healthy considera-

tions/ reflections, motivations and rationale for contributions to the mega-event – and facilitate the transition from the “Me and event” to "My event” mindsets. Such campaigning and promotions should be reasonably customized to the socio-cultural environments and specialties in the host student communities.

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