

# The level of somatic health, sports specialization and qualification of an athlete as indicators of intermediate selection in the mixed martial arts

**Authors' Contribution:** Alexander Alexandrovich Gorelov<sup>1 ACD</sup>, Vladimir Mikhailovich Voronov<sup>2 ABC</sup>,  
Andrei Ivanovich Krylov<sup>3 CF</sup>, Viktor Leonidovich Kondakov<sup>2 CDE</sup>

**A** Study Design  
**B** Data Collection  
**C** Statistical Analysis  
**D** Data Interpretation  
**E** Manuscript Preparation  
**F** Literature Search  
**G** Funds Collection

<sup>1</sup> Saint Petersburg University of the Ministry of Internal Affairs of the Russian Federation, St. Petersburg, Russian Federation

<sup>2</sup> Belgorod State National Research University, Belgorod, Russian Federation

<sup>3</sup> National State University of Physical Education, Sport and Health, St. Petersburg, Russian Federation

## abstract

**Background:** This article presents the results of experimental research to identify high-priority types of martial arts whose representatives successfully implement their skills in mixed martial arts, as well as the results of the study of somatic health. Objective. To explore the mechanisms of the intermediate selection in sport of the highest achievements and to explore the possibility of using them in mixed martial arts.

**Material and methods:** We have attracted twelve fully qualified athletes of mixed martial arts for a study to identify criteria of talent prediction and intermediate selection in terms of somatic health. We have engaged eighteen leading Russian trainers with extensive practical experience in training athletes of combat sport and mixed martial arts as experts in this research.

**Results:** The results of our study show that having high potential of somatic health considerably exceeding the same indicator of ordinary man is a feature for being fully qualified mixed martial artists.

**Conclusions:** The results of ranking of the leading mixed martial artists and our long-term observations confirm representatives of sport and combat sambo and army hand-to-hand combat are the most promising in terms of success in competitive activity.

**Key words:** mixed martial arts, intermediate selection, somatic health, paired comparison, comparison of polar groups.

## article details

**Article statistics:** **Word count:** 3,721; **Tables:** 6; **Figures:** 0; **References:** 37

**Received:** August 2019; **Accepted:** August 2019; **Published:** December 2019

**Full-text PDF:** <http://www.balticsportscience.com>

**Copyright** © Gdansk University of Physical Education and Sport, Poland

**Indexation:** Celdes, Clarivate Analytics Emerging Sources Citation Index (ESCI), CNKI Scholar (China National Knowledge Infrastructure), CNPIEC, De Gruyter - IBR (International Bibliography of Reviews of Scholarly Literature in the Humanities and Social Sciences), De Gruyter - IBZ (International Bibliography of Periodical Literature in the Humanities and Social Sciences), DOAJ, EBSCO - Central & Eastern European Academic Source, EBSCO - SPORTDiscus, EBSCO Discovery Service, Google Scholar, Index Copernicus, J-Gate, Naviga (Softweco, Primo Central (ExLibris), ProQuest - Family Health, ProQuest - Health & Medical Complete, ProQuest - Illustrata: Health Sciences, ProQuest - Nursing & Allied Health Source, Summon (Serials Solutions/ProQuest, TDOne (TDNet), Ulrich's Periodicals Directory/ulrichsweb, WorldCat (OCLC)

**Funding:** This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

**Conflict of interests:** Authors have declared that no competing interest exists.

**Corresponding author:** Professor Viktor Leonidovich Kondakov, Doctor of Pedagogical Sciences (PhD), Belgorod State National Research University, 85 Pobedy Street, Belgorod, 308015 Russian Federation; e-mail: kondakov@bsu.edu.ru

**Open Access License:** This is an open access article distributed under the terms of the Creative Commons Attribution-Non-commercial 4.0 International (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits use, distribution, and reproduction in any medium, provided the original work is properly cited, the use is non-commercial and is otherwise in compliance with the license.

## INTRODUCTION

In the Russian Federation, MMA as a sport was officially recognized and included in the Russian register of sports in 2012. In such a short period of its existence, mixed martial arts have not accumulated yet scientific data whose analysis and synthesis would allow creating the science-based theory and methodology of mixed martial artists' training, including prediction of their success and selection.

The progress of modern sport and strong intensification of competition at the world sport stage caused the relevance of sport selection problems. A comprehensive practice of sport selection has appeared in sports-developed countries. This fact indicates that sport selection is a necessary link in the system of training world class athletes. Theoretical and methodological foundations of sport selection problems are covered in detail by experts [1-6].

Since the beginning of the 21st century, a trend towards universalization of the existing types of wrestling and appearance of new ones began to show in the sports world. Mixed Martial Arts is a relatively young sport in Russia. Unlike the Olympic kinds of wrestling, they use a powerful arsenal of shock (boxing, taekwondo, karate, etc.), throwing (freestyle and Greco-Roman wrestling, judo, sambo) and painful (judo, sambo, jiu-jitsu, etc.) methods and actions. Boundaries of age and level of sports training limit admission to competitive fight in mixed martial arts. The rules of a competitive bout permitting the use of punches, kicks, throws, stalling and painful methods determine these restrictions.

During a match, a mixed style fighter has to withstand high physical loads and endure exorbitant pain and neuro-emotional stress. High extremity of MMA declares the specific requirements for the selection of candidates. In our country, only people of age 16 and older having extensive experience in combat sport can be selected. If a fighter wants to participate in competitions, he must be of age 18 and have a qualification in another sport of candidate master or higher. Therefore, in the process of intermediate selecting a trainer needs to know what kinds of wrestling are a priority in order to achieve success in the competitive activity in mixed martial arts [7-13]. Another important aspect of this selection is an athlete's somatic health to confirm the possibility to withstand high physical loads and endure exorbitant pain.

These positions served as prerequisites for research which attempts to prove experimentally the hypothetical views on the criteria that can serve as indicators for the selection of mixed martial arts fighters and can show the athlete's readiness to high results in major competitions. Therefore, the purpose this research was to study the mechanisms of intermediate selection in world class sport and explore the possibility of using them in mixed martial arts.

## MATERIAL AND METHODS

A ranking has been made to identify the most promising types of martial arts whose representatives could realize themselves in mixed martial arts in the best way. Eighteen leading Russian trainers with extensive practical experience in training athletes of combat sport and mixed martial arts have been engaged as experts in this research. Twelve fully qualified athletes of mixed martial arts have been recruited to identify criteria of talent prediction and intermediate selection in terms of somatic health.

To achieve these objectives, the following methods have been used: collection, theoretical analysis and generalization of scientific sources and literature, the method of paired comparisons [12], a comparison of polar groups [7], research methods of somatic health [1], methods of mathematical statistics [7].

## RESULTS

Table 1 shows characteristics of leading Russian trainers attracted to conduct the ranking of the leading mixed martial artists of Russian Federation.

As shown in Table 1, all experts have quite high experience in coaching in combat sports. Coaching experience in hand combat and sambo have been referred to mixed martial arts because their rules are the same.

Table 1. Characteristics of leading Russian trainers attracted to rank the leading mixed martial artists of Russian Federation

No.	Experts	Sport specialization	The general experience of coaching in combat sports	Experience in MMA	Region of Russia
1	B-v Kh.	sambo	17	7	Makhachkala
2	V-ov V.	sambo	22	12	Sary Oskol
3	G-ov S.	sambo	19	12	Moscow
4	D-ev I.	freestyle wrestling	17	5	Grozny
5	Z-niy D.	greco-roman wrestling	19	5	Kaliningrad
6	Z-in K.	judo	20	5	Belgorod
7	Z-ky G.	sambo	21	8	Krasnoyarsk
8	I-ev M.	freestyle wrestling	18	7	Vladikavkaz
9	K-ov A.	sambo	16	10	St. Petersburg
10	K-ev S.	judo	17	5	Sevastopol
11	M-ov A.	sambo	23	14	Sary Oskol
12	P-ov S.	dogfight	17	12	Norilsk
13	P-ov A.	dogfight	15	11	Tobolsk
14	C-yan A.	thai boxing	17	5	Belgorod
15	S-ko U.	karate	19	5	Abakan
16	T-ov V.	sambo	21	12	Abakan
17	Kh-v D.	dogfight	19	10	Kislovodsk
18	Ch-ev A.	dogfight	20	11	Nizhny Novgorod

The results of experts' evaluation of various kinds of combat sports which are the most preferred for selection in MMA are shown in Table 2. As can be seen from Table 2, coaching community preferred sambo, fighting, sport sambo and kickboxing. This fact indicates these kinds of sport are a priority during an intermediate selection.

To confirm these data, we subjected 12 mixed style artists of high qualification to the ranking according by the method of paired comparisons. Table 3 shows data characterizing the age, sports specialization and qualifications, as single combat training duration in general and MMA in particular, as well as the highest sporting achievements of athletes recruited to the research.

Table 2. Summary matrix of peer reviews of the forms of martial arts whose representatives are more suitable for selection in mixed martial arts

No.	Forms of martial arts	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Σ	Rank
1	combat sambo		14	17	17	15	17	17	16	17	17	17	15	9	17	205	I
2	judo	3		17	17	14	17	17	14	15	14	17	5	2	17	169	III
3	boxing	0	0		0	0	10	16	0	1	0	7	0	0	2	36	XII-XIII
4	box savate	0	0	17		3	14	16	6	9	8	12	4	2	9	100	VIII
5	kickboxing	2	3	17	14		17	17	8	15	15	16	9	3	15	151	V
6	freestyle wrestling	0	0	7	3	0		16	0	0	0	8	0	0	2	36	XII-XIII
7	greco-roman wrestling	0	0	1	1	0	1		0	0	0	0	0	0	0	3	XIV
8	thai boxing	1	3	17	8	9	17	17		16	13	14	5	1	14	138	VI
9	karate	0	2	16	8	2	17	17	1		2	12	2	0	9	88	IX
10	kung fu	0	3	17	9	2	17	17	4	15		15	2	0	14	115	VII
11	taekwondo	0	0	8	5	1	9	17	3	5	2		0	0	8	61	XI
12	sambo	2	12	17	13	8	17	17	12	15	15	17		4	17	166	IV
13	dogfight	8	15	17	15	14	17	17	16	17	17	17	13		17	200	II
14	jiu-jitsu	0	0	15	8	2	15	17	3	8	3	9	0	0		80	X

Table 3. Characteristics of the test continent

Name (initials)	Age (years)	Sport specialization and expertise before joining MMA	Age of getting involved in combat sports	Years of experience in MMA	Sport qualification in MMA	The highest sporting achievement
SKU	28	sambo hms	9	19	MSIC	1st place in World Cup MMA
MVI	25	sambo ms	11	14	MSIC	European Champion in MMA SBI
NVA	25	sambo msic	7	5	MS	European Champion in sambo
SDA	32	sambo, judo ms	7	12	MS	European Champion in sambo
GDA	26	boxing ms	6	2	MS	Champion in MMA SBI
GAM	24	sambo ms	17	7	MS	Champion of Russia in sambo
KSV	19	sambo cms	10	3	MS	the winner of the championship of Russia MMA
IDYU	18	sambo cms	7	3	MS	Vice-winner of Central Russia in sambo
MNV	18	army dogfight ms	4	3	CMS	Member of the military close combat World Championship
TAA	27	army dogfight cms	15	8	CMS	ASB Champion League
TVA	21	army dogfight cms	9	1.4	CMS	Champion of "Dragon" Event in China
SVO	18	sambo 1st class	7	2	CMS	Member of the European Championship MMA SBI

Table 4. Ranking places of the leading mixed martial artists in accordance with assessment of expert community of Russia

No.	Experts No.																		Σ	Rank
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
SCYU	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	18	I
MVI	2	2	3	2	2	3	2	2	2	3	3	2	2	3	2	2	2	3	42	II
NVA	4	3	2	3	4	2	3	4	3	2	2	3	4	2	3	3	3	2	52	III
SDA	3	4	4	4	3	4	4	3	4	4	4	4	3	4	4	4	4	4	68	IV
GDA	5	5	6	5	6	5	5	5	6	5	5	6	5	6	5	5	6	5	96	V
GAM	7	7	5	6	7	7	6	6	5	7	6	5	6	5	6	6	5	6	103	VI
KSV	6	6	7	7	5	8	8	7	8	6	7	7	7	8	8	7	7	7	126	VII
IDYU	8	9	8	8	8	6	9	8	7	9	8	9	8	7	9	8	8	8	145	VIII
MNV	9	8	9	9	9	9	7	9	9	8	9	8	9	9	7	9	9	9	155	IX
TAA	10	11	11	10	10	11	10	11	10	10	11	10	10	10	11	10	11	10	187	X
TVA	11	10	11	11	11	10	11	10	11	11	10	11	11	11	10	11	10	11	192	XI
SVO	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	216	XII

It should be noted that the fact that 11 people out of 12 came in mixed martial arts of sambo, judo and an army dogfighting can speak about certain aspects of the intermediate selection in mixed martial arts exactly of these sports.

The authors own long-term observations also indicate the representatives of combat sambo and army dogfighting are the most promising ones in terms of achieving success in the competitive activities. A multiple MMA world champion Fedor Emelianenko who came in MMA from combat sambo can be a shining example.

A further aspect of our research was to investigate the functional area of fully qualified MMA artists. The features of modern sport preparation are large volumes of mobility, high intensity and tension of training and competitive loads often being on the edge of human physiological possibilities. Therefore, health diagnosis is a mandatory and integral part of the selection in a particular sport.

In order to assess the level of athletes' somatic health, the method of G.L. Apanasenko and U.S. Chistyakova [8] was used based on a point scale assessment of morphofunctional indicators such as the Kettle index, the life index, the Robinson index, the heart rate recovery time after 20 sit-ups in 30 seconds, the power index. The results of this study are presented in Tables 5 and 6 illustrating that somatic health far exceeds the same indexes of an ordinary man, both in the entire study sample, as well as in conventionally divided groups. Thus the calculation of the living index showed that indicators of respiratory function are very high in all groups ( $\bar{x}_1 - 71.0 \pm 0.7$ ;  $\bar{x}_2 - 70.0 \pm 0.4$ ;  $\bar{x}_3 - 70.0 \pm 0.7$ ) and have no significant difference between them ( $p > 0.05$ ). A similar pattern is typical of the mean body mass index values ( $p > 0.05$ ).

Table 5. Somatic health characteristics of mixed martial athletes of Alexander Nevsky Club

No.	More successful			$\bar{x}_1 \pm m_1 / G1$	Successful						$\bar{x}_2 \pm m_2 / G2$	Less successful			$\bar{x}_3 \pm m_3 / G3$	$\bar{x} \pm m / G$ for the entire sample
	SKU	MVI	NVA		SDA	GDA	GAM	KSV	IDYU	MNV		TAA	TVA	SVO		
Body mass index (conv. units).	34.8	31.9	32.7	33.1 ±1.0/1.7	32.1	33.4	29.9	34.1	31.9	33.4	32.5 ±0.5/1.7	29.9	33.6	34.3	32.6 ±1.5/2.6	32.7 ±0.4/1.5
Mark	2	2	2	2±0	2	2	2	2	2	2	2±0	2	2	2	2±0	2±0
Life Index (conv. units).	72	71	70	71.0 ±0.7/1.2	71	69	70	70	68	72	70.0 ±0.4/1.6	69	71	70	70.0 ±0.7/1.2	70.30.4 ±/1.2
Mark	3	3	3	3±0	3	3	3	3	3	3	3±0	3	3	3	3±0	3±0
Power index (conv. units).	89	84	87	86.7 ±1.7/3.0	85	83	85	82	81	83	83.2 ±0.6/1.6	82	81	84	82.3 ±1.0/1.8	84.1 ±0.7/2.5
Mark	3	3	3	3±0	3	3	3	3	3	3	3±0	3	3	3	3±0	3±0
Heart rate recovery time after 20 squats in 20 sec	44	47	50	47.0 ±2.1/3.6	47	49	51	53	49	54	50.5 ±1.1/2.8	46	49	54	49.7 ±1.7/4.7	54.9 ±/3.1
Mark	7	7	7	7±0	7	7	7	7	7	7	7±0	7	7	7	7±0	7±0
Robinson index (conv. units).	48	47	49	48.0 ±0.7/1.2	49	50	47	49	47	50	48.7 ±0.5/1.2	50	47	51	49.3 ±1.0/1.8	48.7 ±0.3/1.2
Mark	2	2	2	2±0	2	2	2	2	2	2	2±0	2	2	2	2±0	2±0
Overall health assessment (conv. units).	17	17	17	17.0 ±0.0/0	17	17	17	17	17	17	17.0 ±0.0/0	17	17	17	17.0 ±0.0/0	17.0 ±0.0/0

We can evaluate the heart rate recovery rapidity as very high based on mean values of the heart rate recovery time after 20 squats in 20 sec (exercise intensity is one squat in 1 sec). We can suppose this index is not a key one in the process of sportsman's talent prediction to MMA training for there is no reliable difference between more ( $\bar{x}_1 - 47.0 \pm 2.1$ ) or less ( $\bar{x}_3 - 49.7 \pm 1.7$ ) successful athletes.

The Robinson index calculation showed the aerobic capacity (energy potential) of all investigated athletes also exceeds the average parameters of an ordinary man ( $49.3 \pm 1.0$ ), and the polar groups are not significantly different ( $p > 0.05$ ).

The power index calculation shows the relative strength is within  $84.1 \pm 0.7$  conv. units for the entire sample, thus greatly exceeding the same parameter of an ordinary man. Despite the fact this index in the more successful sportsmen's group is 4.4 conv. units higher ( $\bar{x}_1 - 86.7 \pm 1.7$ ;  $\bar{x}_2 - 82.3 \pm 1.0$ ) than in the group of less successful ones, the t test Student difference is not significant.

Table 6. The difference in authenticity of somatic health indexes of MMA athletes in groups of various success

Studied parameters	More successful	Successful	Less successful	P among $\bar{x}_1$ and $\bar{x}_2$	P among $\bar{x}_1$ and $\bar{x}_3$	P among $\bar{x}_2$ and $\bar{x}_3$
	$\bar{x}_1 \pm m_1 / G1$	$\bar{x}_2 \pm m_2 / G2$	$\bar{x}_3 \pm m_3 / G3$			
Body mass index (conv. units).	33.1 ±1.0/1.7	32.5 ±0.5/1.7	32.6 ±1.5/2.6	-	-	-
Life index (conv. units).	71.0 ±0.7/1.2	70.0 ±0.4/1.6	70.0 ±0.7/1.2	-	-	-
Power index (conv. units).	86.7 ±1.7/3.0	83.2 ±0.6/1.6	82.3 ±1.0/1.8	-	-	-
Heart rate recovery time after 20 squats in 30 sec	47.0 ±2.1/3.6	50.5 ±1.1/2.8	49.7 ±1.7/4.7	-	-	-
Robinson index (conv. units).	48.0 ±0.7/1.2	48.7 ±0.5/1.2	49.3 ±1.0/1.8	-	-	-

## DISCUSSION

In Russia, mixed martial arts had been officially recognized in 2012. In such a short period of its existence, this sport has not accumulated yet scientific data on prediction and selection. Each coach usually uses its own experience gained as a result of coaching in other combat sports. That, in turn, gives rise to contradictions in the definition of priorities at various stages of selection. Thus, experts of army dogfight select representatives of this sport only. Coaches qualified in sambo and judo prefer these same sports. A similar situation occurs with other combat sport: kickboxing, Thai boxing, karate, kung-fu, and others. There are also considerable disagreements in the selection criteria. Some experts believe the main criteria are health and functional fitness, others - the development of physical qualities and motor skills, and still others - athletes' technical and tactical preparation. Apart from anything else, there are contradictions in the indicators used to evaluate the above parameters [10].

Undoubtedly, for the mixed martial arts characterized by submaximal physical loads and extreme painful sensations, the problems associated with athletes' health are of utmost importance. Most researchers of this scientific field consider health not as condition, but as a process of preservation and development of physiological properties, mental and social potentials, for there are considerable changes of individual health parameters during sports training [14]. The obvious signs of the voltage of adaptation mechanisms accompany intensification of the training process. At the same time, occurring adaptive changes can be a factor of improving special efficiency and the initial phase of adaptive mechanisms failure [7-9,13,15-18]. The results of biomedical research in various laboratories around the world show modern sport training and competition loads are above any heavy physical labor [14]. They can give rise to human body complex adaptive adjustment, which can cause even irreversible consequences [18]. Modern mixed martial arts pessimalness is due to the appearance of new technical elements, accompanied with a high risk to the health and lives of athletes. The presence of the above extreme factors is associated with maximum mobilization of functional reserves and compensatory-adaptive mechanisms. Accumulation of these negative effects can lead to the breakdown of compensatory-adaptive mechanisms with subsequent development of acute or chronic "deviations" in health. This, in turn, can cause injures to various joints and intervertebral discs and pathologies in cardiovascular, respiratory and central nervous activities.

According to some researchers [12, 19], the incidence of athletes' injuries is increasing from year to year, so their health diagnostic is needed to output the athletes on the maximum parameters of training loads and record-competitive results. Famous scientists V.I. Balandin [2, 4], V.N. Platonov [1] and L.P. Sergienko [3] think the basis of intermediate selection consists of identifying athlete's abilities to reach the highest achievements in sport and endurance of heavy training loads. According to them, the coach should constantly analyze the dynamics of athletes' functional fitness. The organism's ability of effective recovery should be in his sight line. V.N. Platonov [1] believes the athlete's transition on the stage of "maximizing the individual capabilities" needs work to identify its ability to achieve world class results, study the body capacity to carry out exactly an intense training program and effectively adapt to the applied loads.

The share of perfectly healthy athletes in Russian national teams tends to reduce. According to G.A. Makarova [20], a great harm to athlete's health is applied

by boosted backbreaking training loads, haste to achieve maximum results, insufficiently trained athletes participating in important competitions, when the applied physical and neuro-psychological loads exceed the body's functionality. Frequent weight loss, use of pharmacological drugs, and violation of the sport mode also harms health of athletes. Deteriorating of health is accompanied by a reduction of athletes' adaptation and mobilization capabilities, and with this, reliability of their competitive activities decreases.

Dissatisfaction with the state of this problem and the constant need to take into account the level of health has contributed to numerous studies [2, 4, 9, 13, 15-17, 21-23] to determine criteria to athletes' health. A special place among them belongs to the research of Ukrainian famous scientist GL Apanasenko [7], who developed objective criteria for the level of somatic health, basing on long-term experimental studies.

Summarizing the experts' opinions, it can be stated that many sport selection specialists [3, 24-27] put emphasis on model features of high-level sportsmen and prefer parameters of stability and genetic conditions [28-30].

Currently, there are opinions about selection priority of biomechanical, morphological physiological, psycho-physiological and other traits [31-34] ensuring sport success.

Modern MMA experts have not reached consensus on the means and methods for assessing the prospects of athletes. According to James et al. [35], athletes' aerobic and anaerobic parameters play a key role in the competitive activity success in mixed martial arts. At the same time, Kostikiadis et al. [36] believe a short-term high-intensity weight training is the most important one. Osipov et al. [26] consider an increase in functional readiness through cross fit workout as a major factor of success. It should be noted some experts [37] attribute athletes' coordination capacity to the number of the most important factors in the success of competitive activity.

The value of selection as an important factor of sport achievements growth in all phases of training is widely recognized. The selection system and orientation is a complex social mechanism not only working on the sport, but also closely linked with other spheres of activity. The search for new forms of sport selection and identification of the most informative tests are the most important goals coaches and scientists set themselves.

## CONCLUSIONS

The results of ranking of the leading mixed martial artists, as well as our own long-term observations, show that representatives of sport and combat sambo, and army dogfight are the most promising ones in terms of achieving success in competitive activities. It is a regularity that fully qualified mixed martial artists have a high potential of somatic health. In fact, all the parameters under study serving as the basis for calculating an overall assessment of physical health were significantly higher than the normal human parameters, and pointed 17 conventional units (the highest level). They can be definite criteria of the selection of MMA and an indicator of the athlete's readiness for competitions.



## REFERENCES

- [1] Platonov VN. The system of sportsmen's preparation in the Olympic sport. The general theory and its practical applications. Academic Press; 2004.
- [2] Balandin VI. Psihologo-pedagogicheskie osnovy prognozirovaniya v sporte [Psychological and pedagogical bases of sport's prediction]. Sankt Peterburg; 2000. Russian.
- [3] Sergienko LP. Sportivny otbor: teoriya i praktika: monographia [The sport's selection: theory and practice: monograph]. Moskva; 2013. Russian.
- [4] Balandin VI, Chebrakov UV, Shmagin VV. Efficiency's research of sportsmen selection's methods for education at schools of Olympic reserve. Sankt Peterburg, 2000.
- [5] Bakulev SE. Povyshenie effektivnosti prognozirovaniya uspeshnosti sportsmenov-edinobortsev s uchetom geneticheskikh osnov rodovoy, mezhhvidovoy i vnutrividovoy orientatsii. [Improvement of prediction's efficiency of successfulness of martial artists with genetics' bases accounting of generic, interspecific and intraspecific orientation]. Sankt Peterburg; 2009. Russian.
- [6] Bakulev SE. Genealogical foundations of successfulness of martial artists' competitive activity. Sankt Peterburg; 2006.
- [7] Apanasenko GL. Individual health: in search of essence and measurement criteria. Environment and health. 2015;3:8-11.
- [8] Apanasenko GL, Chistyakova US. Zdorov'e sportsmena: kriterii otsenki i prognozirovaniya. [Sportsman's health: evaluation and prediction criteria]. Moskva; 2006. Russian.
- [9] Bulich EG. Human health. Kiev; 2003.
- [10] Voronov VM, Gorelov AA. Smeshannie edinoborstva: prognozirovanie I otbor: monographia. [Mixed martial arts: prediction and selection: monograph]. Stariy Oskol; 2018. Russian.
- [11] The International Olympic Committee (IOC) Consensus Statement on periodic health evaluation of elite athletes. Br J Sports Med. 2009;43:631-643. <https://doi.org/10.1136/bjsm.2009.064394>
- [12] Geselevich VA. Health and professional pathology of elite athletes. Academic Press; 1997.
- [13] Gornst NA, Lychagina SN. Somatotip i funktsional'nie pokazateli adaptatsii serdechno-sosudistoy sistemi v unosheskom vozraste. [Somatotype and functional indicators of adaptation of cardiovascular system at youthful age], Astrakhan'; 2008. Russian.
- [14] Podrigalo L, Volodchenko A, Rovnaya O, Podavalenko O, Grynova T. The prediction of success in kickboxing based on the analysis of morfo-functional, physiological, biomechanical and psychophysiological indicators. Physical education of students. 2018;22(1):51-56. <https://doi.org/10.15561/20755279.2018.0108>
- [15] Landa BX. Metodika kompleksnoy otsenki fizicheskogo razvitiya i fizicheskoy podgotovlennosti: uchebnoe posobie. Moskva; 2011.
- [16] Panyukov MV, Parastaev SA, Plotnikov VP, Buyankin VM, Fedotkin AU. Otsenka psikhoemotsional'nogo urovnya i zdorovya sportsmenov-professionalov, studentov-sportsmenov i studentov-nesportsmenov. [Psychological level and health assessment of professional sportsmen, students-sportsmen, students-no sportsmen]. Moskva, 2009. Russian.
- [17] Shamardin AA, Solopov IN. Funktsional'nie aspekty trenirovki sportsmenov. [Functional aspects of athletes training]. Volgograd; 2013. Russian.
- [18] Hollmann W, Hettinger T. Sportmedizin Arbeit und Trainingsgrundiagen. Stuttgart, NY; 1980.
- [19] Bauer VG. Condition and preparation of sports reserve of national Russian teams. Academic Press; 1997.
- [20] Makarova GA. Faktori riska v sovremennom sporte [Risk factors in modern sport]. Moskva; 2004. Russian.
- [21] Nikolaev DV. Sostav tela i bioimpedantsiy analiz v sporte [Body composition and bioimpedance analyses at sport], Moskva, 2012. Russian.
- [22] Bony-Westphal A, Danielzik S, Dörhöfer RP, Later W, Wiese S, Müller MJ. Phase angle from bioelectrical impedance analysis: population reference values by age, sex, and body mass index. J Parenter Enteral Nutr. 2006;30(4):309-316. <https://doi.org/10.1177/0148607106030004309>
- [23] Martinsen OG, Grimnes S. Bioimpedance and bioelectricity basics. Academic Press; 2011.
- [24] Borges P H, Cumming S, Ronque ERV, et al. Relationship between tactical performance, somatic maturity and functional capabilities in young soccer players. J Hum Kinet. 2018;64(1):160-169. <https://doi.org/10.1515/hukin-2017-0190>
- [25] Mocrusov E. Modern initial selection of 7-8-year-old girls for table tennis. In: Grigore V, Stanescu M, Paunescu M, eds. ICPEKS 2017 - 7th International Congress on Physical Education, Sport and Kinetotherapy. 2018;36:232-239. <https://doi.org/10.15405/epsbs.2018.03.31>
- [26] Osipov AY, Kudryavtsev MD, Iermakov SS, Jagiello W. Increase in level of special physical fitness of the athletes specialising in different combat sports (judo, sambo, combat sambo) through of CrossFit training. Arch Budo. 2018;14:107-115.
- [27] Andersen JL, Schjerling P, Saltin B. Muscle, Genes and Athletic Performance. Scientific American. 2000; 283: 48-55. <https://doi.org/10.1038/scientificamerican0900-48>
- [28] Ben-Zaken S, Meckel Y, Nemet D, Rabinovich M, Kassem E, Eliakim A. Frequency of the MSTN Lys(K)-153Arg(R) polymorphism among track & field athletes and swimmers. Growth Hormone & IGF Research. 2015;25(4):196-200. <https://doi.org/10.1016/j.ghir.2015.04.001>
- [29] Fedotovskaya O, Eider J, Cieszczyk P, et al. Association of muscle-specific creatine kinase (CKM) gene polymorphism with combat athlete status in Polish and Russian cohorts. Arch Budo. 2013;9(4):233-237.

- [30] Gabbasov RT, Arkhipova AA, Borisova AV, et al. The HIF1A Gene Pro582Ser Polymorphism in Russian Strength Athletes. *J Strength Cond Res.* 2013;27(8): 2055-2058. <https://doi.org/10.1519/JSC.0b013e31827f06ae>
- [31] Malina RM, Rogol AD, Cumming SP, Silva M, Figueiredo AJ. Biological maturation of youth athletes: Assessment and implications. *Br J Sport Med.* 2015;49(13):852-859. <https://doi.org/10.1136/bjsports-2015-094623>
- [32] Rocznio R, Zajac A, Maszczyk A, et al. Determining the sport level of the players in ice hockey using multivariate analysis. *Biol Sport.* 2016 Mar;33(1):43-48.
- [33] Wilk R, Fidos-Czuba O, Rutkowski L, Kozlowski K, Wisniewski P, Maszczyk A, Stanula A, Rocznio R. Predicting competitive swimming performance. *Centr Eur J Sport Sci Med* 2015;9(1):105-112.
- [34] Sandercock GRH, Ogunleye AA, Parry DA, Cohen DD, Taylor MJD, Voss C. Athletic performance and birth month: Is the relative age effect more than just selection bias? *Int J Sport Med.* 2014;35(12):1017-1023. <https://doi.org/10.1055/s-0034-1368725>
- [35] James LP, Haff GG, Kelly VG, Beckman EM. Physiological determinants of mixed martial arts performance and method of competition out-come. *Int J Sport Sci Coach.* 2018;13(6):978-984. <https://doi.org/10.1177/1747954118780303>
- [36] Kostikiadis IN, Methenitis S, Tsoukos A, Veligeas P, Terzis G, Bogdanis GC. The effect of short-term sport-specific strength and conditioning training on physical fitness of well-trained mixed martial arts athletes. *J Sport Sci Med.* 2018;17(3):348-358.
- [37] James LP, Beckman EM, Kelly VG, Haff GG. The neuro-muscular qualities of higher- and lower-level mixed-martial-arts competitors. *Int J Sport Physiol Perform.* 2017;12(5):612-620. <https://doi.org/10.1123/ijsp.2016-0373>

Cite this article as:

Gorelov AA, Voronov VM, Krylov AI, Kondakov VL.  
The level of somatic health, sports specialization and qualification of an athlete as indicators of intermediate selection in the mixed martial arts  
*Balt J Health Phys Act.* 2019;11(4):18-27  
doi: 10.29359/BJHPA.11.4.03