

Individualization of training qualified rock climbers on the basis of model characteristics of general and special physical fitness

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Abstract: Rock climbing as a new Olympic discipline requires the improvement of the training process of athletes, who represent our country in the international arena. Speed climbing in 2024 has a separate set of awards. It sets new challenges for this discipline development. Speed climbing differs from other rock climbing disciplines: short competition time (5-7 seconds); a large contribution of physical qualities to effectiveness (about 40%); repetitive competitive distance gives an opportunity to set records. **Materials.** The article considers the criteria and scales for assessing general and special physical fitness of climbers who specialize in speed climbing. We formed pedagogical conditions. They help to use an individualized approach to the training process: the scheme of pedagogical control use, the principles of pedagogical objectives determination and load distribution, the program of training during the macro cycle, complexes of exercises and the cards of an individual lesson. We substantiated the process of physical training organization in qualified rock climbers during a macro cycle. The results of the experiment are demonstrated connected with model characteristics use among athletes, who are masters of sports and candidate masters of sports. **Research methods.** Scientific and methodical sources analysis and synthesis, pedagogical experiment, mathematical-statistical research results handling. **Results.** Substantiated pedagogical conditions for educational-training process organization using model characteristics of general and special physical fitness of qualified rock climbers, who specialize in speed climbing, in the experimental group provided valid time of climbing change at a competitive distance ($P < 0,01$). The experimental groups trained according to individual programs of physical training, based on not developed physical qualities improvement. The control groups trained according to the traditional program of physical training. **Conclusion.** Model characteristics of general and special physical fitness of the qualified rock climbers, who specialize in speed climbing, showed the effectiveness in the training process organization in national teams.

Keywords: rock climbing, physical training, pedagogical conditions, model characteristics.

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Introduction

In the Olympic program rock climbing has its own place since 2020. During the Olympic Games in 2024 in Paris there will be 4 sets of medals in two disciplines: double-event (obstacle climbing and bouldering) and speed climbing. The distinctive features of speed climbing are the following:

- short time period of competition distance overcoming. The time of distance overcoming in speed climbing during the international competitions in men was $6,00 \pm 0,23$ seconds;
- integrated competitive distance. In speed

climbing the route doesn't change and it gives an opportunity to register the records of the world. Each athlete has an opportunity to form a unique technical-tactical set of the repetitive movements;

- great contribution of physical qualities into the effectiveness of competitive activity. Literature analysis and a survey among the specialists in climbing showed, that physical fitness contribution into the result was 44% [5].

Present state of the scientific and methodical support in sports climbing doesn't have sufficient substantiation and very often the process of

athletes training is based on a personal opinion of the coaching staff. The existing evaluation scales presented in the Federal standard of sports training in “rock climbing” kind of sport don’t correspond with the demands of training qualified climbers. Model characteristics are one of the instruments of physical training process improvement in athletes of any qualification [2, 3]. Highly-qualified athletes need clear instrument of own physical state evaluation during the whole macro cycle of training, as such kind of process is continuous and successive [4]. It is important to form model characteristics of physical fitness of athletes (master of sports (MS) and candidate master of sports (CMS)) [1].

The aim of the research is substantiation of physical training structure among qualified climbers on the basis of model characteristics.

In order to achieve the aims we realized the following objectives:

1. To form the complex of pedagogical conditions for physical training individualization in

qualified rock climbers.

2. To substantiate the effectiveness of model characteristics use in a yearly macro cycle in athletes, who have MS and CMS categories.

Materials and methods

In order to estimate physical fitness of the qualified rock climbers, who have master of sports and candidate master of sports categories, we used earlier created scales of general and special physical fitness evaluation, presented by table 1 and 2 [6]. Test includes 9 tests, however, there is an opportunity to use the program of express-estimation. It helps to define current physical state of an athlete without great energy and time expenditures. Tests consider the questions of fitness according to the separate physical qualities: speed power of legs and pectoral arch, coordination and flexibility. Tests take into account both total mark and the points in the separate tests.

Table 1
Model characteristics of general and special physical fitness in the qualified rock climbers (MS), who specialize in speed climbing

№	Test		Level of development, points						
			1	2	3	4	5	6	7
1	High jump, cm*	OPF	61<	61 – 65	66 – 67	68 – 73	74 – 75	76 – 80	>80
2	Broad jump, cm	PF	< 236	237 – 250	251 – 264	265 – 279	280 – 293	294 – 307	> 308
3	Forward lean, cm*	PF	<3	3 – 8	9 – 11	12 – 18	19 – 21	22 – 27	>27
4	Kopylov test	PF	< 4	5 - 6	7 - 8	9 - 10	11 - 12	13 - 14	>14
5	Tapping-test 30 sec., quantity	PF	<187	187 – 235	236 – 260	261 – 310	311 – 334	335 – 383	>383
6	Lafaye test for 2 hands, cm*	PF	<83	83 - 105	106 – 116	117 – 140	141 - 152	153 - 175	>175
7	Margaria-Kalamen test, W	PF	<1228	1229 - 1363	1364 - 1498	1499- 1634	1635- 1769	1770- 1904	>1905
8	Leg lifting 10 sec., quantity	PF	< 21	22 - 24	25 - 27	28 - 30	31 - 33	34 - 36	> 37
9	Compulsory technical program (speed climbing), sec.*	PF	>6,58	6,57 – 6,35	6,34 – 6,12	6,11 – 5,88	5,87 – 5,65	5,64 – 5,42	<5.42

Notes. 1 point (very low) = $\bar{x} < 2\sigma$, 2 points (low) = $\bar{x} - 1\sigma$ till $\bar{x} - 2\sigma$, 3 points (below the average) = $\bar{x} - 0,5\sigma$ till $\bar{x} - 1\sigma$, 4 points (average) = $\bar{x} \pm 0,5\sigma$, 5 points (above the average) = from $\bar{x} + 0,5\sigma$ till $\bar{x} + 1\sigma$, 6 points (high) = from $\bar{x} + 1\sigma$ till $\bar{x} + 2\sigma$, 7 points (very high) = $\bar{x} > 2\sigma$;

* – tests, included into the methodology of express-evaluation for intermediate and current control

The base for the selected block of tests is formed with the help of approved results of the International research works [7, 8, 9]. The block also includes generally adopted methodologies of testing and the tests of the Federal standard

of sports training in “rock climbing”. Taking into consideration the results of this testing a coach has an opportunity to define the leading and not developed physical qualities.

Table 2

Model characteristics of general and special physical fitness of the qualified climbers (CMS), who specialize in speed climbing

№	Test	PF	Level of development, points						
			1	2	3	4	5	6	7
1	High jump, cm*	PF	<54	54 – 57	58 – 60	61 – 65	66 – 68	69 – 72	>72
2	Broad jump, cm	PF	<207	208-226	227-245	246-264	265-282	283-301	>302
3	Forward lean, cm*	PF	<2	2 – 7	8 – 9	10 – 16	17 – 19	20 – 25	>25
4	Kopylov test	PF	<170	170 – 206	207 – 224	225 – 263	264 – 281	282 – 318	>318
5	Tapping-test 30 sec., quantity	PF	<5	6-7	8-9	10-12	13-14	15-16	>17
6	Lafaye test for 2 hands, cm*	PF	<84	84 - 101	102 - 110	111 - 129	130 - 138	139 - 156	>156
7	Margaria-Kalamen test, W.	PF	<1034	1035-1188	1189-1342	1343-1497	1498-1651	1652-1805	>1806
8	Leg lifting 10 sec., quantity	PF	<12	13-16	17-20	21-25	26-29	30-34	>35
9	Compulsory technical program (speed climbing), sec.*	PF	>9,00	8,99 – 8,4	8,39 – 7,78	7,79 – 7,19	7,18 – 6,59	6,58 – 5,99	<5,58

Notes. 1 point (very low) = $\bar{x} < 2\sigma$, 2 points (low) = $\bar{x} - 1\sigma$ till $\bar{x} - 2\sigma$, 3 points (below the average) = $\bar{x} - 0,5\sigma$ till $\bar{x} - 1\sigma$, 4 points (average) = $\bar{x} \pm 0,5\sigma$, 5 points (above the average) = from $\bar{x} + 0,5\sigma$ till $\bar{x} + 1\sigma$, 6 points (high) = from $\bar{x} + 1\sigma$ till $\bar{x} + 2\sigma$, 7 points (very high) = $\bar{x} > 2\sigma$;

* – tests, included into the methodology of express-evaluation for intermediate and current control

Model characteristics formed the base for the athletes' individual profiles determination. Taking them into account we defined the program of their training according to the scheme (picture). According to the results of the intake test a coach received the information concerning the state of an athlete's general and special physical fitness after the transition period. As an intake test we offer 9 tests. The results of them should be compared to the created by us model characteristics. Thus, we reveal an individual profile of each athlete.

After the individual profiles of an athlete formation the coach has two variants. If the separate physical qualities development is at a model level or higher, it is necessary to create the program in order to support this level. There is also the variant of

own indices comparison with the model for a higher level.

At the beginning of the competitive period we realize express-evaluation for tactical decisions formation concerning the future competitions, taking into account the leading and not developed physical qualities of an athlete.

The coaching staff selects the strongest athletes for the main starts in a season.

Using the principle of individualization at the stage of higher sportsmanship we created table 3. It helps to distribute the volume of the load in terms of not developed and the leading physical qualities improvement. This program was experimental one and was used in further experiment.

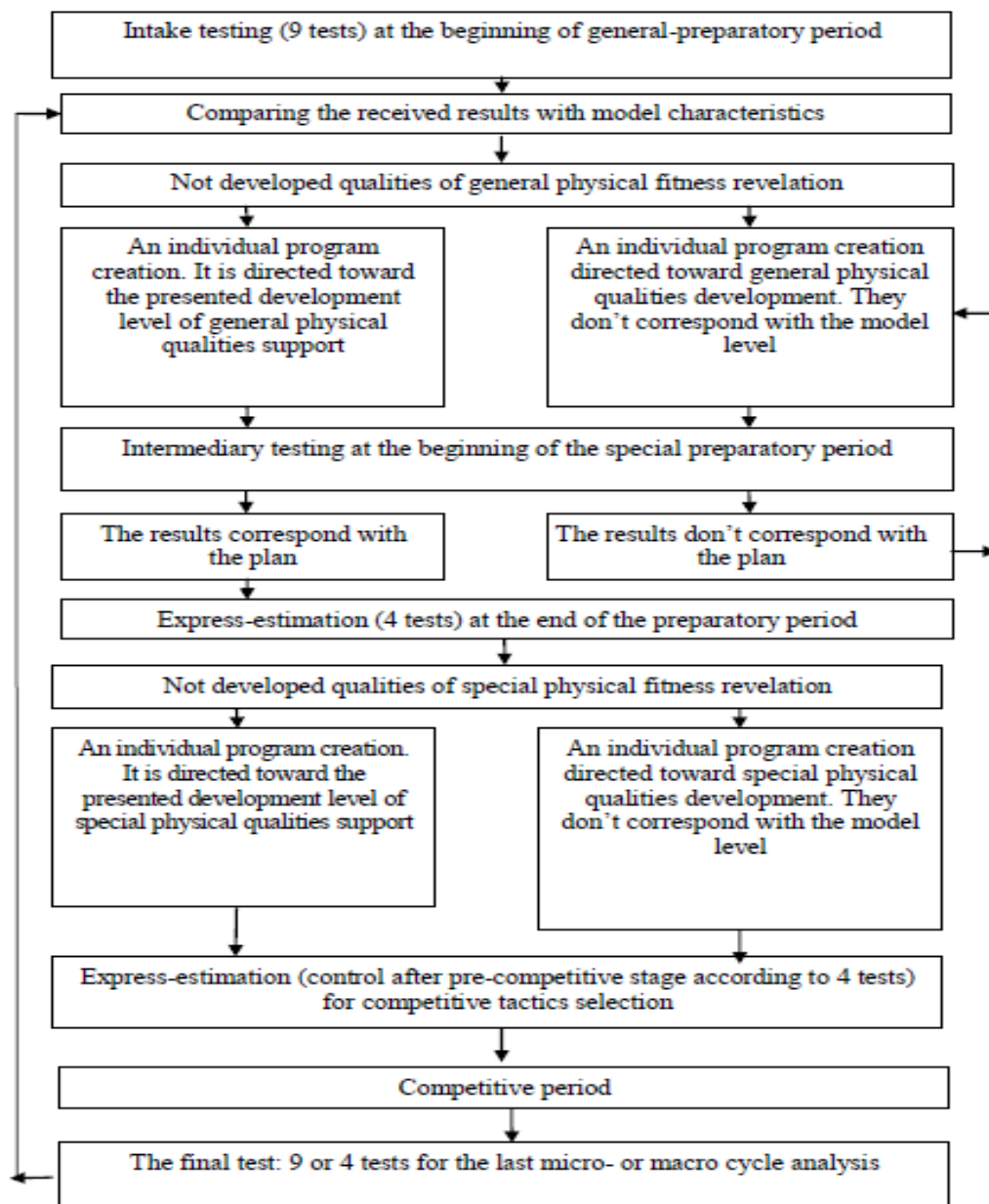


Fig. 1. The scheme of model characteristics of general and special physical fitness use in qualified climbers, who specialize in speed climbing at different stages of a yearly cycle

Table 3

Load distribution in the program of physical training with an individualized approach

Physical quality	Generally adopted program, hours	Experimental program for not developed physical quality development, hours			
		Speed power of hands	Speed power of legs	Flexibility	Quickness
Speed power of hands	5	7	4	4	4
Speed power of legs	5	4	7	4	4
Flexibility	1	1	1	3	1
Quickness	2	1	1	2	4

Results and discussion

34 qualified rock climbers took part in the experiment. The athletes specialized in speed climbing and 10 of them had MS, World-class athlete (WCA) and Merited Master of Sports (MMS) categories, 24 athletes had category CMS, who formed 100% of the main and reserve staff of the national team of Russia and youth team of Russia. Two experimental groups (EG-1, EG-2) and two control groups (CG-1, CG-2) were formed.

The experiment was carried out during the following period: since February, 2019 till April, 2020. The results of the experiment are presented in table 4. In order to define statistically valid changes in effectiveness we used Student's t-test. During mathematical data of competitive activity, personal record of an athlete, general and special physical fitness handling we revealed the index within the zone of statistical significance-a personal record of an athlete.

The result became validly better in the EG-1 and EG-2 ($P_0 < 0.01$). The competitive result of a high jump and forward lean is within the zone

of statistical significance in the EG-1, the results of a broad jump in EG-2 and CG-2 ($P_0 < 0.05$). The other results of the express-estimation in the groups of respondents didn't show validly significant differences.

For the effectiveness estimation we took into account two indices: record time of competitive distance overcoming during the competitions and during the training lessons. At the competitions we took into consideration the best time during the whole competition. The record time at the training lessons was registered during the training camps.

Abstraction from pre-starting state helps an athlete to show the ability to develop maximal speed of the competitive distance overcoming without the fear of making a mistake. During the competitions tactical elements with the orientation toward the opponent are realized. It gives an athlete an opportunity to regulate the speed of climbing (not achieving maximal speed) for strength preservation and the risks decrease. In the EG-1 and EG-2 we achieved the changes of the record time among all respondents.

Table 4

Validity of general and special physical fitness differences in control and experimental groups before and after the experiment

Parameter of effectiveness	Indices at the beginning and the end of the pedagogical experiment CG-1				Indices at the beginning and the end of the pedagogical experiment EG-1			
	Before ($\bar{x} \pm \sigma$)	After ($\bar{x} \pm \sigma$)	Po	t*	Before ($\bar{x} \pm \sigma$)	After ($\bar{x} \pm \sigma$)	Po	t*
Competitive result, sec.	6,22 ± 0,9	6,02 ± 0,3	Po>0.05	0,8	6,44 ± 1,3	5,85 ± 0,2	Po<0.05	3,7
Personal record, sec.	5,77 ± 0,2	5,74 ± 0,2	Po>0.05	0,2	5,72 ± 0,1	5,59 ± 0,1	Po<0.05	4,3
High jump, cm	69 ± 3	72 ± 4	Po>0.05	1,7	68 ± 4	76 ± 9	Po<0.05	3,8
Lafaye test for 2 hands, cm	117 ± 28	121 ± 36	Po>0.05	1	108 ± 14	108 ± 7	Po>0.05	0,2
Forward lean, cm	12 ± 6	13 ± 7	Po>0.05	0,2	12 ± 6	14 ± 6	Po<0.05	2,8
Tapping-test 30 sec, quantity	244 ± 16	243 ± 17	Po>0.05	0,5	248 ± 26	253 ± 29	Po>0.05	0,1
Parameter of effectiveness	Indices at the beginning and the end of the pedagogical experiment CG-2				Indices at the beginning and the end of the pedagogical experiment EG-2			
	Before ($\bar{x} \pm \sigma$)	After ($\bar{x} \pm \sigma$)	Po	t**	Before ($\bar{x} \pm \sigma$)	After ($\bar{x} \pm \sigma$)	Po	t**
Competitive result, sec.	6,22 ± 0,6	6,08 ± 0,5	Po>0.05	0,2	7,72 ± 0,1	7,16 ± 0,1	Po<0.05	2,3
Personal record, sec.	5,77 ± 0,1	5,75 ± 0,1	Po>0.05	0,8	5,72 ± 0,2	5,59 ± 0,1	Po>0.05	1,2
High jump, cm	69 ± 4	72 ± 5	Po<0.05	2,4	68 ± 4	76 ± 9	Po<0.01	4,2
Lafaye test for 2 hands, cm	117 ± 26	121 ± 32	Po>0.05	1	108 ± 14	100 ± 7	Po>0.05	0,7
Forward lean, cm	12 ± 6	13 ± 7	Po>0.05	0,6	12 ± 6	14 ± 6	Po>0.05	0,8
Tapping-test 30 sec, quantity	215 ± 21	222 ± 28	Po>0.05	0,1	232 ± 18	225 ± 22	Po>0.05	0,2

In the average record time of climbing in the EG-1 at a training lesson validly improved ($r = 0,91$ $P < 0,01$) for 0,072 sec., or by 1,27%.

During the period of competitive stage there were 4 competitions of All-Russian level. The members of the national team of Russia took part in these competitions. At the end of the season the result improved among all respondents. Only one athlete had the result decrease in the main start of the season (Championship of Russia, 2021) in the EG-1, which is connected with technical mistake in qualification round. It should be noted that at the competitions one of the respondents improved the existing world record for 0,04 seconds.

The level of physical fitness among the respondents of EG-1 validly increased. According to the results of the express-estimation in the experimental group 4 respondents achieved a model level and only one respondent achieved the level of slight mismatch with the model level. We consider that it is connected with his initial level of fitness. In the CG-1 only two respondents achieved model level, the rest 3 respondents preserved the same level.

In the groups of athletes, who had CMS category there were validly significant results differences. In the EG-2 the effectiveness in competitive activity validly increased in the average from 7,69 to 6,92 seconds. In the CG-2 we revealed no valid differences in competitive activity effectiveness. 8 respondents from the EG-2 achieved correspondence with model level of general and special physical fitness. Two respondents from the EG-2 achieved a slight level of mismatch with model level. In the CG-2 only 4 people achieved a model level, other athletes preserved the same level.

Conclusion

Substantiated pedagogical conditions for educational-training process organization using model characteristics of general and special physical fitness of qualified rock climbers, who specialize in speed climbing, in the experimental group provided valid time of climbing change at a competitive distance ($P < 0,01$).

The experimental groups trained according to individual programs of physical training, based on not developed physical qualities improvement. The control groups trained according to the traditional

program of physical training.

We recommend using model characteristics and evaluation scales of general and special physical fitness in training qualified rock climbers, who specialize in speed climbing.

References

1. Vavaev A.V. *Fizicheskie I fiziologicheskie karakteristiki elitnogo skalolaza: monografiya* [Physical and physiological characteristics of an elite rock climber: monograph]. Moscow: Sport. 2019:130 [In Russ.].
2. Kozlov A.A. The basis of psycho-emotional state model characteristics and the profile of football players' psychic readiness formation. *Pedagogiko-psihologicheskie I mediko-biologicheskie problemy fizicheskoy kul'tury I sporta = Russian Journal of Physical Education and Sport*. 2020; 15(4): 71-77. DOI: 10.14526/2070-4798-2020-15-4-71-77 [In Russ., In Engl.].
3. Pozdeeva E.A., Kletsov K.G. Model estimation of the performing mastery of cheerleaders: aspects of judging objectivization. *Pedagogiko-psihologicheskie I mediko-biologicheskie problemy fizicheskoy kul'tury I sporta = Russian Journal of Physical Education and Sport*. 2021; 16(3): 5-10. DOI: 10.14526/2070-4798-2021-16-3-5-10 [In Russ., In Engl.].
4. Moshkina N.A. Questions of planning a yearly cycle of training swimmers. *Pedagogiko-psihologicheskie I mediko-biologicheskie problemy fizicheskoy kul'tury I sporta = Russian Journal of Physical Education and Sport*. 2019; 14(1): 94-101 DOI: 10.14526/2070-4798-2019-14-1-94-101 [In Russ., In Engl.].
5. Shunko A.V. Modeling competitive activity among qualified rock climbers. *Izvestiya TulGU. Fizicheskaya kul'tura. Sport*. 2021; 3: 150-158 [In Russ.].
6. Shunko A.V., Kravchuk T.A. Model of general and special physical fitness of the qualified climbers, who specialize in speed climbing. *Fizicheskaya kul'tura: vospitanie, obrazovanie, trenirovka*. 2021; 2: 10-13 [In Russ.].
7. Laffaye G., Collin J.M., Levernier G., Padulo J. Upper-limb power test in rock-climbing. *International journal of sport medicine*. 2014; 35 (8): 670-675.
8. Ozimek M., Krawczyk M., Rokosowski R. Evaluation of the level of anaerobic power and its effect on speed climbing performance in elite climbers. *TRENDS in Sport Sciences*. 2018; 25(3): 149-158.
9. Reveret L., Chapelle S., Quaine F., Lergeneur P. 3D visualization of body motion in speed climbing. *Frontiers in Psychology*. 2020; 11: 15-28.

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