Methodology for developing functional abilities of student-athletes specializing in short-distance running through special test trials

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Abstract

This article examines the issues of developing functional abilities of student-athletes specializing in short-distance running. During the research, a set of special tests aimed at assessing speed, speed-strength, anaerobic endurance, and the functional state of the cardiovascular and respiratory systems of athletes was developed and implemented in practice.

The pedagogical experiment was conducted by applying a system of exercises planned on the basis of these tests to the training process. Throughout the experiment, the functional indicators of student-athletes were compared based on initial and final measurements, and their dynamic changes were statistically analyzed.

The research results demonstrated that the systematic use of the special test set serves to significantly increase the level of functional preparedness of student-athletes running short distances. The obtained data are explained to be important for scientifically-based planning of the training process, individualization of workloads, and consistent improvement of sports results.

The materials of the article have practical and theoretical significance for students of higher educational institutions in the field of physical education and sports, coaches, and specialists conducting scientific research in the field of sports.

Keywords: Control, functional capacity, Genche test, Stange test, vital signs.

Introduction

PWC_{170} kgm/min, maximum oxygen consumption (l/min), relative maximum oxygen consumption (ml/kg/min), Harvard step test index, diastolic blood volume l/min, systolic blood volume (ml), heart rate (beats/min), systolic blood pressure (mmHg), diastolic blood pressure (mmHg), pulse pressure (mmHg), mean arterial pressure (mmHg), determination of right and left hand strength (kg), Stange test, Genche test.

Respiratory rate (inhalation and exhalation complex - Genche) is counted for 15 seconds, the result is multiplied by 4, and the heart rate per minute is determined.

Breath holding. Determined based on the Stange test. That is, the subject takes a deep breath and holds it for the maximum possible duration.

The methodology for further improvement of functional indicators was enhanced through the above-mentioned special tests.

Objective of the study: To improve the methodology for increasing the functional abilities of student-athletes running short distances by using a complex of special tests during training.

Research objectives: To restore athletic form by improving the functional indicators during the annual training process of student-athletes running short distances;

Short-distance running events in track and field are considered sports that require athletes to demonstrate speed-strength and speed-strength endurance. This inherently indicates a connection to functional preparedness. Therefore, these factors must be taken into account when planning training loads.

When we studied the training system for short-distance runners, it was revealed that the development of functional training as a research subject has not been studied in our country over the past 10-20 years.

This is one of the most pressing issues in the current system of athlete training and is considered one of the tasks awaiting its solution, having both theoretical and practical significance in the field.

As a result of the studies, it became known that performance depends not only on the level of training but also on the physiological and morphological indicators of each athlete.

Results and discussion

Observations show that when an athlete transitions to the next work action without sufficient recovery, excessive fatigue subsequently occurs.

This situation directly reflects the degree to which the athlete's functional preparedness has been formed or not formed. However, today, various methods and techniques aimed at developing functional preparedness are being applied in sports practice during the process of

Table 1. Functional preparedness indicators of student athletes in the control group at the beginning of the pedagogical experiment, (n = 24)

Full Name	Control indicators								
A.A.	HR	SBP	DBP	Stange	Genchi	VC	MVC	PWC170	HSTI
A.A.	76	128	66.5	51	24.4	4939	3743	1624.6	109
A.D.	79	131	68.9	56	27.9	5023	3758	1627.2	113
B.F.	77	133	70.6	58	29.6	5032	3789	1668.9	116
E.G.	75	131	71.7	53	30.7	5083	3839	1684.8	114
E.A.	70	120	56.8	45	23.1	4688	3878	1709.6	118
G.A	69	117	55.4	43	21.2	4572	3732	1607.7	105.4
H.N.	67	115	54.8	39	19.7	4517	3717	1602.4	103.6
H.F.	68	116	53.2	37	17.2	4429	3684	1547.4	98.8
K.M.	67	126	71.2	36	16.3	5076	3643	1522.6	97.9
M.N.	73	128	53.2	53	15.2	4813	3604	1492.7	95.8
M.E.	74	118	70.9	51	24.2	4913	3738	1691.8	110.7
M.S.	77	129	54.1	56	22.6	4694	3743	1667.4	109
Q.I.	73	131	66.5	58	24.4	4928	3758	1624.6	113
Q.R.	78	133.4	68.9	53	27.9	4984	3789	1627.2	116
R.L.	73	131	70.7	45	29.6	5032	3839	1668.9	114
T.H.	69	120	72.1	51	30.7	5083	3878	1684.8	118
T.S.	71	117	56.8	56	23.1	4688	3732	1709.6	105.4
U.K.	67	115	55.4	58	21.2	4572	3717	1607.7	103.6
U.M.	72	116	54.8	53	19.7	4517	3684	1602.4	98.8
Z.A.	69	127	53.2	45	17.2	4429	3643	1547.4	97.9
Z.Q.	66	116	71.3	43	16.3	5084	3604	1522.6	95.7
Sh.Y.	73	117	53.2	39	15.2	4813	3736	1492.7	113.4
Ch.F.	69	128	70.7	37	24.8	4612	3723	1643.2	104.1
A.A.	71	131	57.4	48.5	17.1	4878	3748	1629.1	115.2
X	71.79	123.93	62.43	48.52	22.47	4808.29	3738.29	1616.97	107.76
sig	3.27	4.44	4.74	4.15	2.14	363.26	245.93	138.43	6.02
V %	4.55	3.58	7.59	8.55	9.52	7.55	6.58	8.56	5.59

conducting sports training. In our study of short -distance runners, we measured the following indicators: minute blood volume (MBV, l/min), systolic volume (SV, ml), heart rate (HR, beats/ min), arterial blood pressure (SBP, DBP, PBP, MABP), Stange test (seconds), vital capacity (VC, l/min), energy load capacity (kgm/min), work capacity (PWC 170 kgm/min), work capacity according to GSTI (number of step-ups on a 50-cm platform in 1 and 5 minutes), and maximum oxygen consumption (MOC, ml/ min). According to our findings, the functional indicators of the subjects in the control group involved in the experiment showed that the average heart rate fluctuated at 71.79±3.27 beats per minute. When measuring arterial blood pressure, the average systolic pressure was 123.93±4.44 mm Hg, while the average diastolic pressure was 62.43±4.74 mm Hg.

Another respiratory function test, known as the Stange test, involves taking a deep breath and holding it. On average, the subjects managed to hold their breath for 48.52±4.15 seconds during this test. The subsequent Genche test involves exhaling deeply and then holding the breath. The control group of subjects maintained this state for an average of only 22.47±2.14 seconds, which indicates that the respiratory organs were not well-developed according to both the Stange test and the Genche test results.

In the practice of assessing the functional capabilities of the respiratory system, indicators reflecting the vital capacity of the lungs are widely used. When we determined the vital capacity of the lungs in the subjects of the control group, it was found that this indicator averaged 4808.29±363.26 ml.

In a study of maximum oxygen consumption (MOC), the average maximum oxygen consumption of this group of subjects before the study was 3739.29 ±245.93 ml/min.

Table 2. Functional readiness indicators of student athletes in the experimental group (n=24) at the beginning of the pedagogical experiment

TG	HR	SBP	DBP	Shtange	Genche	VLC	MPCR	PWC170	GSTI
A.A	74	127	66.4	52.3	24.8	4906	3703	1669	112
A.A	77	129	67.6	55.6	27.3	4966	3736	1684	118
A.D	72	132	69.4	58.3	25.3	4947	3816	1739	114
B.F	69	131	66.7	56.8	26.7	4984	3794	1728	121
E.G	66	121	65.8	59.2	29.4	5013	3837	1603	106
E.A	63	116	60.8	48.2	21.26	4876	3619	1574	101
G.A	65	114	58.9	46.9	19.34	4826	3578	1549	104
X.N	62	115	56.8	44.4	16.46	4782	3544	1513	98
X.F.	66	124	55.3	41.3	17.83	4746	3489	1486	100
K.M	71	127	53.8	39.7	20.44	4727	3517	1783	116
M.N	73	117	68.4	46.4	24.8	5089	3773	1764	111
M.E	75	122	65.3	51.1	22.3	5118	3866	1562	108
M.S	71	131	66.9	55.6	24.2	4906	3703	1669	112
Q.I	76	133	68.3	58.3	27.6	4924	3736	1684	118
Q.R	68	129	68.9	56.8	25.3	4947	3816	1739	114
R.L	72	118	67.6	59.2	26.7	4984	3794	1728	121
T.X.	77	116	65.9	48.2	29.4	5013	3837	1603	106
T.S.	71	114	61.3	46.9	21.26	4876	3619	1574	101
U.K	77	115	59.7	44.4	19.34	4826	3578	1549	104
U.M	69	125	58.4	41.3	16.46	4782	3544	1514	98
Z.A	76	114	55.8	39.7	17.83	4746	3489	1486	100
Z.Q	72	116	54.1	45.4	20.1	4727	3517	1783	116
Sh.Y	73	124	67.8	41.2	24.6	4834	3793	1641	107
Ch.F	71	132	68.4	48.9	20.9	4847	3631	1634	110
X	71.13	122.83	63.28	49.47	22.89	4891.75	3681.21	1635.83	109.04
sig	3.54	4.89	5.04	4.44	2.28	389.94	256.78	146.84	6.51
V %	4.98	3.98	7.96	8.97	9.96	7.97	6.98	8.98	5.97

In a test to determine the work capacity of short -distance runners (PWC 170), the athletes in the control group recorded an average result of 1616.97±138.4. The average result of the Harvard step test index in the conducted research experiment was 107.76±6.02 (m). In determining the functional preparedness of the subjects in the experimental group, the heart rate showed an average of 71.13±3.54 beats before the study. Measurement of arterial pressure showed that the average systolic pressure was 122.83±4.89 (mm Hg). The average diastolic pressure was 63.28 ±5.04 (mm Hg). In the Stange test, which involves deep breathing and breath-holding, the subjects recorded a result of 49.47±4.44 (sec). In the Genche test, which involves exhaling fully and holding the breath, this experimental group of subjects recorded an average result of 22.89±2.28 (sec). In the test for determining the vital capacity of the lungs, the result was 4891.75±389.94 (ml). According to the results of the MOC tests, it was recorded at the beginning of the study that the average was 3681.21±256.78 (ml). In the work capacity test, it was established that the pedal was rotated 1635.83±146.84 times. In the final Harvard step test, it was found that the subjects of the experimental group ran an average distance of 109.04±6.51 (m). When comparing the obtained results for both groups, no significant differences were observed.Data on statistical reliability assessments based on the calculation of Student's critical values are presented in detail in Table 2.

According to it, at the beginning of the

Table 3. Comparative ratios of functional preparedness indicators of student-athletes in the control (n = 24) and experimental (n = 24) groups at the beginning of the experiment

Research head	Control group			Experimental group						
test	$\overline{X}$	σ	V,%	$\overline{X}$	Σ	V, %	Absolute	Relative, %	t	P
1	71.79	3.27	4.55	71.13	3.54	4.98	0.67	0.93	0.68	>0.5
2	123.93	4.44	3.58	122.83	4.89	3.98	1.10	0.89	0.82	>0.4
3	62.43	4.74	7.59	63.28	5.04	7.96	0.85	1.37	0.60	>0.5
4	48.52	4.15	8.55	49.47	4.44	8.97	0.95	1.96	0.77	>0.4
5	22.47	2.14	9.52	22.89	2.28	9.96	0.42	1.88	0.66	>0.5
6	4808.29	363.26	7.55	4891.75	389.94	7.97	83.46	1.74	0.77	>0.4
7	3738.29	245.93	6.58	3681.21	256.78	6.98	57.08	1.53	0.79	>0.4
8	1616.97	138.43	8.56	1635.83	146.84	8.98	18.86	1.17	0.46	>0.6
9	107.76	6.02	5.59	109.04	6.51	5.97	1.28	1.19	0.71	>0.4
								1.40		

pedagogical experiment, we can see that the functional indicators of the student-athletes in the control and experimental groups are very close to each other.

To determine the functional state of our student-athletes in both groups, we used a special set of tests and conducted a comparative analysis of them.

The data of statistical reliability estimates based on the calculation of the critical values of Student's t-distribution for these absolute differences are analyzed in Table 3.

However, when comparing the data provided by other scientists, significant differences were observed between them. As can be seen from the obtained functional indicators, the suboptimal formation of the cardiovascular and respiratory systems, in other words, indicates insufficient development of functional reserve capabilities. Therefore, taking this situation into account yields good results.

The results of the test complex selected to determine functional readiness indicators show that at the beginning of the experiment, the functional indicators in both groups are very similar to each other. This is presented in Table 2.

When we analyzed the data provided for each test in the table, it was found that the results recorded at the beginning of the experiment for the tests taken from student athletes in both the control and experimental groups were similar. Specifically, for the first test measuring heart rate, at the beginning of the pedagogical experiment, the results of student athletes in the control group were ± σ = 71.79 ± 3.27 beats per minute (coefficient of variation V = 4.55%), while in the experimental group these indicators were ± σ = 71.13 ± 3.54 beats per minute (coefficient of variation V = 4.89%). Additionally, it was determined that the absolute difference in the arithmetic mean values of the results between the control and experimental groups for these test indicators was 0.66, and their relative difference (compared to the corresponding indicator of the control group) was 0.92%.

However, the results of determining the functional state showed that the functional state of the student-athletes in both groups was equal. Nevertheless, comparative analysis revealed that it lags behind the data provided by leading scientists. This necessitates the development of functional training in sessions with these athletes. If functional preparedness is well developed, then the effectiveness of training will undoubtedly be at a high level.

Based on the results obtained at the beginning of the experiment, the smallest significant difference between the tests determining the studied level of functional development of students in the control and experimental groups was observed in the 2nd test (0.89%), while the largest relative difference was observed in the 4th test (1.94%). The overall average relative difference for the studied 9 functional tests was found to be 1.40%.

The results recorded in the control and experimental groups for tests aimed at determining functional capabilities show

unsatisfactory changes. These changes were observed to be unreliably positive at significance levels ranging from P > 0.6 to P > 0.4, and within the interval of t = 0.46 to t = 0.82.

Furthermore, it was determined that the coefficient of variation based on the test results in the control group ranged from V = 3.58% to V = 9.52%, while in the experimental group, these indicators ranged from V = 3.98% to V = 9.96%. These values were found to be in the satisfactory positive and upper parts of the gradation. At first glance, all the results appear satisfactory; that is, based on the data from figures and tables, a comparative analysis might suggest that the functional indicators of all students are well-developed. But is this truly the case? When analyzing the results obtained by world scientists and observations, differences in physiological indicators between the groups are observed. This indicates that it is necessary to improve the functional readiness of student-athletes in short-distance running during training sessions. The results of functional readiness tests were found to be insufficient as a functional reserve for student-athletes. Therefore, developing this functional component to the required level increases the possibility of effective training management.

Conclusion

Analysis of the pedagogical experiment results showed that during the annual training process, the functional indicators of student-athletes in the experimental group improved by an average of 4.72%. These positive dynamic changes clearly confirm the effectiveness of the specialized training methodology applied during the experiment.

According to the analysis of the data presented in the diagram, it was determined that the relative growth in arithmetic mean values across 9 functional readiness indicators of student-athletes in the control and experimental groups differed significantly during the pedagogical experiment. Specifically, the relative growth observed in the experimental group was at least 1.516 times and at most 2.260 times higher, averaging 2.013 times greater than the control group across all indicators.

Additionally, the results obtained at the end of the pedagogical experiment (retest) for tests characterizing the studied functional readiness indicators were analyzed, including their main statistical characteristics, arithmetic mean values of group results for each test, as well as absolute and relative differences compared to the control group. The obtained absolute differences were evaluated based on the critical values of Student's t-distribution, confirming the statistical reliability of the results. These data are systematically presented in Table 4.

Overall, the conducted pedagogical experiment scientifically validates the high effectiveness of the developed methodology in improving the functional preparedness of student-athletes in short-distance running, and demonstrates the expediency of its widespread implementation in the training process.

References

McArdle, W. D., Katch, F. I., & Katch, V. L. (2015). *Exercise physiology: Nutrition, energy, and human performance* (8th ed.). Lippincott Williams & Wilkins.

Haugen, T., Breitschädel, F., & Seiler, S. (2019). Sprint mechanical variables in elite athletes: Practical applications. *International Journal of Sports Physiology and Performance, 14*(8), 1005–1012. https://doi.org/10.1123/ijspp.2018-0795

Spencer, M., Bishop, D., Dawson, B., & Goodman, C. (2005). Physiological and metabolic responses of repeated-sprint activities. *Sports Medicine, 35*(12), 1025–1044. https://doi.org/10.2165/00007256-200535120-00003

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