Dynamics of the growth of physical fitness indicators among cadets of the Academy of the Ministry of emergency situations

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Abstract
This article presents the development and implementation of a specialized training program incorporating essential physical exercises aimed at expanding the professional training components of cadets at the Academy of the Ministry of Emergency Situations of the Republic of Uzbekistan. The study focused particularly on the fundamental physical qualities and professional preparedness levels of cadets in the experimental and control groups. The effects of the selected exercises, training load volume, and intensity on the physical condition of the participants were thoroughly investigated. The results obtained at the beginning and at the end of the experiment were compared. Following one year of training, the dynamics of improvements in the cadets' physical condition were assessed. Based on the findings, practical recommendations were developed for organizing physical training sessions according to cadets' individual fitness levels, progressively increasing physical workloads, and regularly monitoring training effectiveness.

Keywords: special training, functional status, anthropometric indicators, fire and rescue sport, training tower, assault ladder, rescuer, specialized flexibility training apparatus, kinematics.

Introduction

A large number of people around the world work in specialized search and rescue services. Their professional activities are often characterized by hazardous conditions, intense physical exertion, high levels of psychological stress, and limited opportunities to control the situation (Taber, Plumb, & Jolemore, 2008, p. 280) [3]. Therefore, rescuers must possess a wide range of skills and abilities to perform their professional duties effectively. These competencies include both physical and social capabilities (Burke, 1997; Henderson, 2010) [6, 7]. High-quality initial professional training is the primary means of developing the knowledge, skills, and competencies required of rescuers. If such training is not organized adequately, the likelihood of professional errors and work-related injuries increases during their subsequent service activities (Moore-Merrell et al., 2008) [4].

The high level of preparedness of rescuers is essential not only for safeguarding their own health but also for protecting the interests of society, which expects qualified professionals to respond effectively to emergency situations. High-quality professional training helps reduce the risk of physical injuries while performing official duties and contributes to the protection of rescuers' psychological well-being [2].

Leading scholars in our region, including *A.A. Kochkarov, R.A. Khamrakulov, S.U. Abduazimov, A.T. Khasanov, T. Moydunov, and A.G. Mirzakulov,* have conducted scientific research on the theory and methodology of developing cadets' professional-applied, physical, and psychological preparedness, as well as their physical fitness qualities in higher military educational institutions.

Researchers from the Commonwealth of Independent States have investigated the professional-physical and psychological preparedness of future rescuers, as well as the physical qualities of athletes participating in fire and rescue applied sports. They have developed methods, training tools, and methodologies for cultivating physical qualities in accordance with the specific requirements of these sports. Furthermore, assessment criteria and normative standards have been established for evaluating technical performance in these disciplines, including climbing to the fourth floor of a training tower using an assault ladder.

Research has also been conducted to substantiate the professional and physical training of rescuers and future rescuers and to improve its effectiveness. Notable researchers in this field include *A.G. Narskin, A.V. Temnov, I.V. Masserova, L.K. Anitsova, G.I. Narskin, B.M. Daniyev, and A.A. Andreyev*. These scholars have demonstrated a correlation between indicators characterizing the physical development of cadets and their overall performance in fire and rescue sports disciplines.

In the current context, the increasing demands of the modern economic and social environment on the physical education system, par-

ticularly on professional-applied physical training at the Academy of the Ministry of Emergency Situations, require comprehensive consideration of several key aspects. These include the development of physical qualities, improvement of physical work capacity, and the formation of professional skills and competencies necessary for the effective performance of future professional duties.

Methods

The study employed the following research methods: theoretical analysis of scientific and methodological literature; generalization of advanced pedagogical experience; pedagogical observations; research conducted under natural educational conditions; ascertaining and formative pedagogical experiments; and mathematical-statistical analysis of the data obtained.

Results and discussion

To determine the physical fitness indicators of cadets selected from the 2nd Battalion of the Academy of the Ministry of Emergency Situations (MES), the experimental and control groups underwent a series of assessment tests covering seven physical fitness components. Initial testing was conducted at the beginning of the study, followed by interim assessments after each training phase and final control tests upon completion of the research.

At the beginning of the experiment, the control group cadets demonstrated the following average results: 4.77 ± 0.79 in the 30-metre sprint, 33.53 ± 5.23 in the 200-metre run, and 99.73 ± 17.57 in the 600-metre run. In the test involving throwing a 2-kilogram medicine ball overhead with both hands from a one-step approach, the average result was 9.13 ± 1.42. The standing long jump result was 215.00 ± 35.74, while the average flexibility score measured using the Special Flexibility Training Apparatus was 8.78 ± 1.55. The result in the set of exercises performed on the horizontal bar was 3.55 ± 0.59.

The cadets in the control group followed the existing training programmes and participated in 45-minute morning physical exercise sessions every day, except Saturdays and Sundays. The test results obtained from the control group cadets at the beginning and at the end of the study were compared to determine changes in their physical fitness indicators (see Table 1).

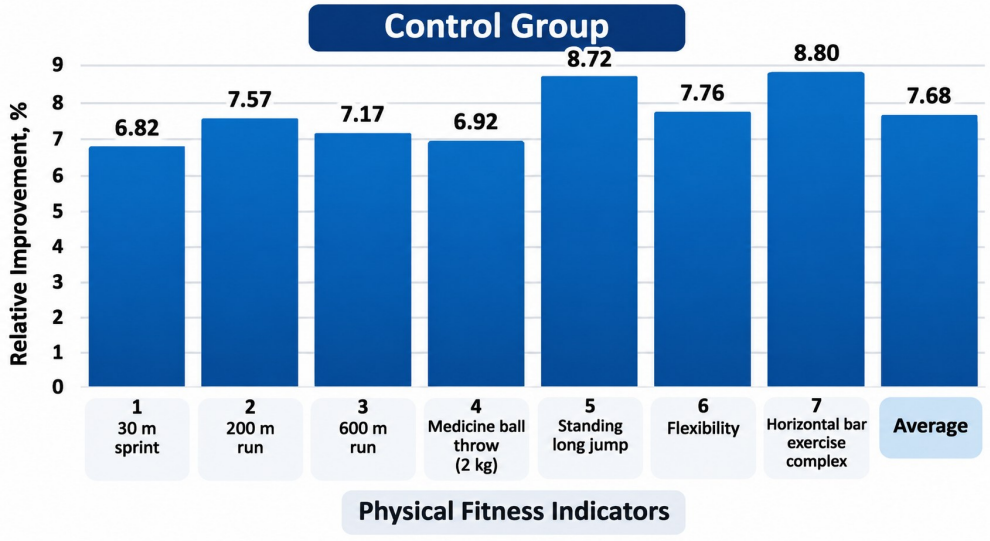
Table 1. Comparison of the Statistical Characteristics of Physical Fitness Indicators Recorded at the Beginning and at the End of the Experiment in the Control Group Cadets (n = 32)

No.	Tests	Initial mean (X)	SD (σ)	CV (%)	Final mean (X)	SD (σ)	CV (%)	Absolute improvement	Relative improvement (%)	t	P
1	30 m sprint time (s)	4.77	0.79	16.62	4.44	0.73	16.44	0.33	6.82	1.71	>0.05
2	200 m run time (s)	33.53	5.23	15.60	30.99	4.78	15.43	2.54	7.57	2.03	<0.05
3	600 m run time (s)	99.73	17.57	17.62	92.59	16.12	17.41	7.15	7.17	1.70	>0.05
4	2 kg medicine ball throw (overhead) (cm)	9.13	1.42	15.61	9.76	1.50	15.42	0.63	6.92	1.72	>0.05
5	Standing long jump (cm)	215.00	35.74	16.62	233.75	38.35	16.41	18.74	8.72	2.02	<0.05
6	Flexibility (cm)	8.78	1.55	17.61	9.46	1.65	17.42	0.68	7.76	1.71	>0.05
7	Horizontal bar exercise complex (repetitions)	3.55	0.59	16.59	3.87	0.63	16.40	0.31	8.80	2.04	<0.05
8	**Average**							**4.34**	**7.68**		

The relative differences (expressed as percentages) between the arithmetic mean values of the physical fitness indicators recorded among the control group cadets at the beginning and at the end of the experiment are presented in the form of a diagram in Figure 1 below. The findings indicate that no substantial differences were observed in the physical fitness levels of the control group cadets between the beginning and the end of the experiment. The physical training of the control group cadets was conducted through regular academic physical education classes and other sports activities.

At the beginning of the experiment, the experimental group cadets demonstrated the following average results: 4.85 ± 0.82 in the 30-metre sprint, 32.61 ± 5.21 in the 200-metre run, and 98.44 ± 17.69 in the 600-metre run. In the

Fig 1. Diagram of the relative improvement (%) in the mean arithmetic values of physical fitness indicators among the control group cadets during the experimental period



test involving throwing a 2-kilogram medicine ball overhead with both hands from a one-step approach, the average result was 8.81 ± 1.41. The standing long jump result was 211.31 ± 35.86, while the average flexibility score measured using the Special Flexibility Training Apparatus was 9.01 ± 1.62. The result in the horizontal bar exercise complex was 3.63 ± 6.62.

control group (CG) was 0.21 seconds. This difference was statistically significant ($t = 3.27$; $P < 0.01$).

In the 200-metre run, the control group cadets recorded an average time of 30.99 ± 4.78 seconds, while the experimental group achieved 27.78 ± 4.21 seconds. The difference between the groups was 3.21 seconds, indicating a statis-

Table 2. Comparison of the statistical characteristics of physical fitness indicators recorded at the beginning and at the end of the experiment in the experimental group cadets (n = 32)

No.	Tests	Initial mean (X)	SD (σ)	CV (%)	Final mean (X)	SD (σ)	CV (%)	Absolute improvement	Relative improvement (%)	t	P
1	30 m sprint time (s)	4.85	0.82	16.98	4.23	0.68	16.13	0.62	12.77	3.27	<0.01
2	200 m run time (s)	32.61	5.21	15.99	27.78	4.21	15.15	4.83	14.81	4.08	<0.001
3	600 m run time (s)	98.44	17.69	17.97	85.01	14.56	17.13	13.43	13.65	3.32	<0.01
4	2 kg medicine ball overhead throw (m)	8.81	1.41	15.98	9.94	1.51	15.14	1.13	12.85	3.11	<0.01
5	Standing long jump (cm)	211.31	35.86	16.97	248.01	39.98	16.12	36.70	17.37	3.87	<0.001
6	Flexibility (cm)	9.01	1.62	17.98	10.30	1.76	17.13	1.29	14.29	3.04	<0.01
7	Horizontal bar exercise complex (repetitions	3.63	0.62	16.97	4.29	0.69	16.14	0.66	18.28	4.05	<0.001
	Average							**8.38**	**14.86**		

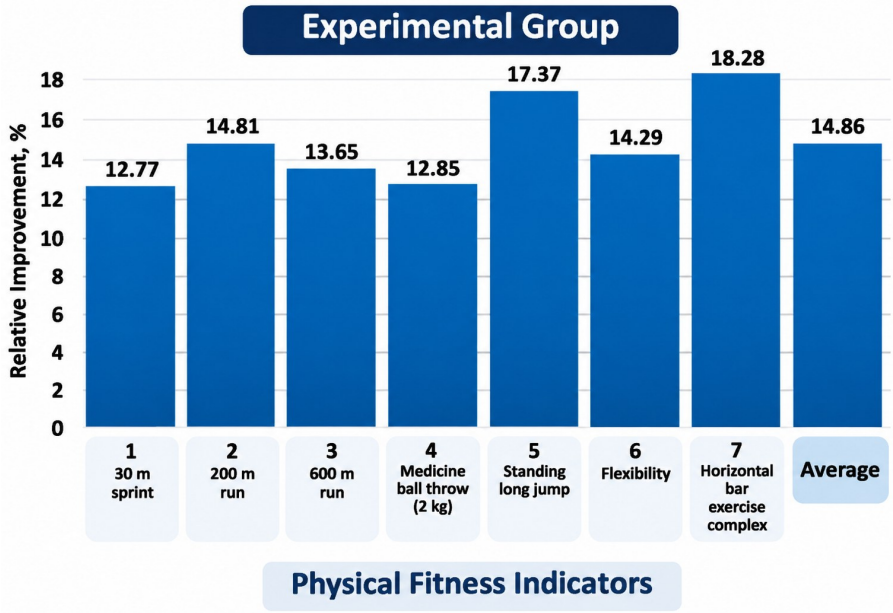
The experimental group cadets participated in training sessions four days per week according to the specialized programme developed by the researchers (see Table 2).

At the end of the experiment, the 30-metre sprint time in the control group was 4.44 ± 0.73 seconds, whereas the experimental group achieved 4.23 ± 0.68 seconds. The difference between the experimental group (EG) and the

tically significant difference ($t = 4.08$; $P < 0.001$).

In the 600-metre run, the experimental group recorded an average time of 85.01 ± 14.56 seconds, compared with 92.59 ± 16.12 seconds in the control group. The difference between the groups was 7.58 seconds. Statistical analysis confirmed that this difference was significant ($t = 3.32$; $P < 0.01$).

Fig 2. Relative growth diagram of the average physical fitness performance indicators of the experimental group cadets during the experiment (in %)



In the 2-kilogram medicine ball overhead throw using both hands from a one-step approach, no substantial difference was observed, although some improvement was evident. The experimental group achieved an average distance of 9.94 ± 1.51 metres, while the control group recorded 9.76 ± 1.50 metres. The difference between the groups was 0.18 metres. Statistical analysis indicated a significant difference ($t = 3.11$; $P < 0.01$).

Positive changes were also observed in the subsequent tests. In the standing long jump, the experimental group achieved an average result of 248.01 ± 39.98 cm, while the control group recorded 233.75 ± 38.35 cm. The difference between the groups was 14.26 cm. This difference was statistically significant ($t = 3.87$; $P < 0.001$).

The sixth test assessed the average flexibility score using the Special Flexibility Training Apparatus. The experimental group achieved 10.30 ± 1.76 cm, whereas the control group recorded 9.46 ± 1.65 cm. The difference between the groups was 0.84 cm. This difference was statistically significant ($t = 3.04$; $P < 0.01$).

The seventh test involved a complex of exercises performed on the horizontal bar. The experimental group achieved an average result of 4.29 repetitions, compared with 3.87 repetitions in the control group (SD = 0.69 and 0.63, respectively). The difference between the groups was 0.42 repetitions, indicating a statistically significant difference ($t = 4.05$; $P < 0.001$).

The relative improvements in the arithmetic mean values of the physical fitness indicators of cadets in the experimental and control groups throughout the study period were compared (see Figure 3).The figure illustrates improvements across all seven physical fitness indicators among the cadets in the experimental group.

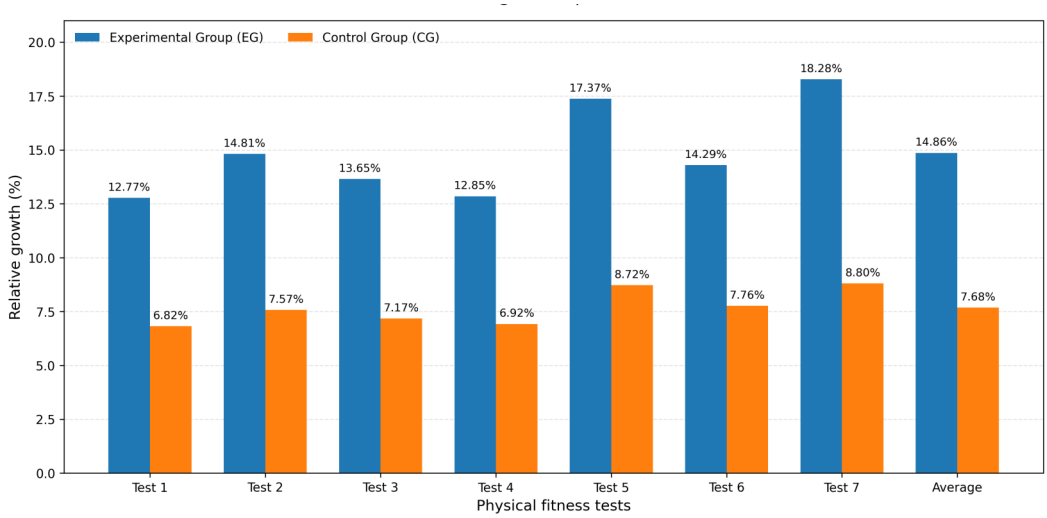
At the end of the experiment, statistically significant improvements were recorded in all seven indicators. Specifically, the 30-metre sprint improved by 12.77% ($P < 0.01$), the 200-metre run by 14.81% ($P < 0.001$), and the 600-metre run by 13.65% ($P < 0.01$). The overhead throw of a 2-kilogram medicine ball using both hands from a one-step approach improved by 12.85% ($P < 0.01$). The standing long jump improved by 17.37% ($P < 0.001$), flexibility measured using the Special Flexibility Training Apparatus increased by 14.29% ($P < 0.01$), and performance in the horizontal bar exercise complex improved by 18.28% ($P < 0.001$).

These findings demonstrate the effectiveness of the developed training programme in improving the physical fitness indicators of the experimental group cadets.

Conclusion

The unpredictable nature of physical workloads encountered during search-and-rescue and firefighting operations highlights the need to prepare cadets for a wide range of pos-

Fig 3. Comparative analysis of the dynamics of changes in the statistical characteristics of physical fitness test results among cadets in the control (n = 32) and experimental (n = 32) groups during the pedagogical experiment



sible situations. The comprehensive integration of modern methodologies, training tools, and technologies into the educational process is a key factor in achieving high performance and improving effectiveness in the selected professional field.

The professional and physical training process of cadets creates favourable conditions for developing physical qualities and improving functional capabilities. The use of modelling methodologies and other training approaches to enhance cadets' professional and physical preparedness ensures greater training effectiveness.

The results of the tests demonstrated that completing a specialized professional and physical training course, performing combined exercises, and carrying out occupational tasks contributed to improving cadets' special preparedness. Cadets who experienced difficulties in completing the prescribed training workloads were permitted to reduce the number of repetitions or decrease the intensity of the exercises. However, no such difficulties were observed after the first and second training phases.

Significant improvements were identified in the physical fitness indicators of the cadets in the experimental group. Specifically, the average results were 4.10 ± 0.08 in the 30-metre sprint and 30.90 ± 1.20 in the 200-metre run. The result in the 600-metre run was 1.33 ± 0.02. In the 2-kilogram medicine ball overhead throw using both hands from a one-step approach, the average result reached 10.30 ± 0.29. The standing long jump improved to 238.20 ± 6.23, while the overall flexibility score, assessed using the Special Flexibility Training Apparatus, reached 12.90 ± 1.21. A result of 13.35 ± 2.90 was also recorded in the gymnastics bench exercise. Furthermore, the results of the horizontal bar exercise complex, consisting of pull-ups, touching the horizontal bar with the tips of the feet, and performing a pullover onto the bar, improved to 5.30 ± 0.73.

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