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# STRENGTH: DEVELOPING A PHYSICAL QUALITY

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**Abstract.** The article analyzes the theoretical foundations, types and physiological mechanisms of strength and evaluates modern methods of its development from the standpoint of the professional and applied training of cadets at the University of Public Security. On the basis of a review of the scientific and methodological literature, pedagogical observation and control testing, a 12-week periodized model of strength training is proposed. The findings show that gradually increasing the training load, combining methods in a logical sequence and planning recovery increase the effectiveness of strength training.

**Keywords:** strength, physical quality, maximal strength, explosive strength, strength endurance, training load, cadet, physical training.

## 1. INTRODUCTION

Raising a healthy and physically robust generation and promoting physical culture and sport are among the priorities of our country's state policy. Among the main physical qualities that determine the motor capabilities of the human body — strength, speed, endurance, flexibility and agility — strength occupies a special place, since it serves as the foundation for the development of all the others.

The professional activity of law enforcement officers often takes place in extreme situations: detaining and restraining a person, overcoming obstacles, rescuing a victim from a dangerous place and moving heavy loads all require a high level of strength training. For this reason, the purposeful and systematic development of strength in cadets of higher education institutions is an urgent pedagogical task.

Many studies in the theory of physical education have examined the essence, developmental patterns and methods of strength (Zatsiorsky, Verkhoshansky, Matveev, Platonov and others). However, most of the existing literature focuses on the preparation of athletes, and the organization of strength training that takes into account the academic workload and the duty and service regime of cadets in professionally applied programs has not been sufficiently covered. This scientific and methodological gap determines the relevance of the present study.

Zatsiorsky defined strength as the mechanical effect produced by muscle tension and distinguished its relative and absolute indicators. Verkhoshansky substantiated the need for wave-like variation of load and the use of special exercises in strength training. Matveev and Platonov developed the principles of dividing the training process into periods and of determining the ratio between training volume and intensity. Foreign studies (Haff, Triplett) pay particular attention to progressive loading, exercise sequencing and recovery planning in strength and conditioning. Nevertheless, adapting these approaches to the conditions of cadets at law enforcement higher education institutions requires a separate analysis.

A distinctive feature of cadet training is that cadets train under a heavy academic workload, strict discipline requirements and the demands of performing service duties at the same time. Under such

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conditions, poorly organized strength training can lead to excessive fatigue, injury and reduced motivation. Strength training should therefore be scientifically grounded, individualized and planned step by step.

**The aim of the study** is to analyze the theoretical foundations of strength development and to substantiate a model of strength training suited to the professional and applied preparation of cadets.

**Research objectives:**

- to clarify the essence, types and physiological foundations of strength;
- to carry out a comparative analysis of the effectiveness of strength development methods;
- to develop a periodized model of strength training for cadets;
- to define criteria for monitoring and assessing strength training.

**Research hypothesis:** if strength training is organized on the principles of gradually increasing the load, combining methods in sequence and planning recovery, cadets' strength indicators will increase steadily and the risk of injury will decrease.

## 2. MATERIALS AND METHODS

The following methods were used in the study:

1. **Analysis of the scientific and methodological literature.** The main sources on the theory and methodology of physical education, sports physiology and strength training were studied.
2. **Pedagogical observation.** In the physical training sessions held at the department, the structure of the load, the selection of exercises and the recovery periods were observed.
3. **Control tests.** Standard tests were selected to assess the different manifestations of strength (Table 2.1).
4. **Pedagogical experiment.** A procedure for testing the proposed model in practice was developed: experimental and control groups, with initial and final measurements.
5. **Mathematical and statistical methods.** The arithmetic mean (X), standard deviation (σ) and standard error of the mean (m) were to be calculated, and Student's t-test was to be used to assess the reliability of differences between groups.

**The object of the study** was defined as cadets of the University of Public Security (aged 18–22, medically examined and cleared for physical exercise). The experiment is conducted with an experimental group and a control group over 12 weeks, with three sessions per week. The control group trains according to the department's work program and the experimental group according to the proposed model. All participants are briefed on training safety rules, and the principles of voluntary participation and confidentiality are observed.

Table 2.1. Control tests for assessing strength

| Manifestation of strength | Control test | Unit of measurement |
|---|---|---|
| Relative strength (upper body) | Pull-ups on the horizontal bar | repetitions |
| Strength endurance (arms) | Push-ups | repetitions |
| Strength endurance (abdominals) | Sit-ups (1 minute) | repetitions |
| Explosive strength (legs) | Standing long jump | cm |

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| Manifestation of strength | Control test | Unit of measurement |
|---|---|---|
| Explosive strength (arms) | Two-handed medicine ball throw (3 kg) | m |
| Static strength | Handgrip dynamometry; plank | kg; seconds |

## 3. RESEARCH RESULTS

### 3.1. The essence and types of strength

The analysis of the literature established that strength is the ability to overcome external resistance, or to counteract it, through muscle contraction (tension). Depending on the muscle working regime, strength is manifested in static (isometric), dynamic (overcoming and yielding) and plyometric regimes. According to the way it is manifested, maximal strength, explosive (power) strength, strength endurance and relative strength are distinguished. For the professional activity of cadets, relative strength and strength endurance are especially important, because in many cases they have to perform movements involving their own body weight for a long time.

### 3.2. Physiological foundations of strength

It was established that strength depends on three groups of factors. The first is the structure of the muscle: its physiological cross-sectional area and the proportion of fast-twitch fibers. Under the influence of strength exercises, muscle fibers thicken — hypertrophy occurs. The second group consists of neuromuscular factors: the number of motor units recruited, their synchronization, the frequency of impulses and intermuscular coordination. In the first 4–8 weeks of training, the increase in strength occurs mainly through neuromuscular adaptation. The third group consists of energy factors: in short-term, high-power work, the creatine phosphate and glycolytic systems play the main role.

### 3.3. Comparative analysis of strength development methods

The analysis showed that six methods are mainly used in strength training. Their main parameters and predominant effects are summarized in Table 3.1.

Table 3.1. Comparative characteristics of strength development methods

| Method | Load (% of max) | Repetitions | Rest | Main effect |
|---|---|---|---|---|
| Maximal strength | 85–100 | 1–5 | 3–5 minutes | Absolute strength, neuromuscular adaptation |
| Repetition (hypertrophic) | 60–80 | 8–12 | 1.5–3 minutes | Muscle mass, general strength base |
| Dynamic | 30–60 | 3–6 (fast) | 2–3 minutes | Explosive (power) strength |
| Plyometric | body weight / height | 5–10 | 2–3 minutes | Use of elastic energy, jumping ability |
| Strength endurance | 30–50 | 15–30 or more | 30–60 seconds | Sustaining strength, circuit training |

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| Method | Load (% of max) | Repetitions | Rest | Main effect |
|---|---|---|---|---|
| Isometric | 70–100 | 5–10 seconds | 1–2 minutes | Static strength, low joint stress |

The comparative analysis showed that no single method develops all manifestations of strength equally. The repetition method lays the foundation for beginners, whereas the maximal and dynamic methods become effective once a certain preparatory base has been formed. Because of the high risk of injury, plyometric and maximal loads should be used only after the technique has been mastered and after an adequate warm-up.

Strength exercises were found to fall into four groups: exercises with external weights (barbell, dumbbell, kettlebell, rubber resistance bands); exercises with one's own body weight (pull-ups, push-ups, squats, plank); exercises against a partner's resistance (pushing contests, carrying a partner, wrestling elements); and exercises on machines. In cadet training, exercises with one's own body weight and against a partner's resistance are advantageous because they require no special equipment, suit group sessions and are close to professional movements. Multi-joint basic exercises (squats, pull-ups, bench press, rows) engage many muscle groups at once and are the most effective for increasing general strength; isolation exercises are added as a supplement to fill in lagging muscle groups.

It was also found that the effectiveness of training depends on the load parameters: the weight lifted, the number of repetitions and sets, the duration of rest between sets, the speed of execution and the number of sessions per week. Since the recovery period for one muscle group is 48–72 hours, it is advisable to split three sessions as "upper body — lower body — whole body" or "pull — push — legs".

**3.4. A 12-week periodized model of strength training**

On the basis of the analysis and pedagogical observation, a three-stage model for cadets was developed (Table 3.2). The model is based on the principle of reducing volume while increasing intensity, with recovery provided for every fourth week.

Table 3.2. A 12-week periodized model of strength training

| Stage | Weeks | Main objective and methods | Load characteristics |
|---|---|---|---|
| I. Adaptation | 1–4 | Teaching technique, general strength base; repetition method, circuit training, bodyweight exercises | Load 50–70%, 10–15 repetitions, 3 sets; rest 1–2 minutes |
| II. Development | 5–8 | Increasing strength; repetition and maximal methods, dynamic exercises, exercises against a partner's resistance | Load 70–85%, 4–8 repetitions, 3–5 sets; rest 2–4 minutes |

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| Stage | Weeks | Main objective and methods | Load characteristics |
|---|---|---|---|
| III. Applied integration | 9–12 | Explosive strength and strength endurance; plyometrics, combining with professional and applied exercises; final tests | Mixed load; volume reduced in week 11; control tests in week 12 |

The weekly training structure was planned as follows: day 1 — upper body and pulling exercises; day 2 — legs and trunk muscles; day 3 — whole body, explosive strength and professional and applied exercises. At least one full day of rest is kept between sessions. Each session consists of a preparatory part (10–15 minutes), a main part (40–60 minutes) and a final part (5–10 minutes). Explosive and complex exercises are performed at the beginning of the session, before fatigue accumulates, and strength endurance exercises at the end.

**3.5. Monitoring and assessing strength training**

Control tests, using the tests listed in Table 2.1, are conducted three times: at the initial (week 1), intermediate (week 6) and final (week 12) measurements. The results are recorded in each cadet's physical training card, and the training load is adjusted individually according to the intermediate results. The effectiveness of the model is assessed by comparing the growth rates (in percent) of the experimental and control groups and the statistical reliability of the difference between the groups ($p<0.05$).

**4. DISCUSSION**

The results of the study are consistent with the generally accepted scientific principles of strength training. As Zatsiorsky and Kraemer note, the increase in strength occurs in the early stage through neuromuscular adaptation and in later stages through muscle hypertrophy. The priority given to technique in Stage I of the proposed model takes this pattern into account: before moving on to heavy loads, the movement skill and intermuscular coordination are formed.

The principle of wave-like variation of load and recovery planning, emphasized in the works of Verkhoshansky and Platonov, is applied in the model by reducing volume every fourth week. This helps prevent excessive fatigue and the state of "load plateau". Given that cadets train under a heavy academic workload, planning recovery periods is especially important.

Unlike programs designed for athletes, strength training for cadets should have a professional and applied orientation. Elements such as carrying a partner, climbing over an obstacle and controlling a resisting partner ensure that strength can be applied in real situations. For this reason, Stage III of the model is devoted to integrating strength exercises with professional and applied movements.

According to the scientific literature, the highest strength indicators are usually observed between the ages of 20 and 30, which means that the age of cadets is a favorable period for the purposeful development of strength capabilities. At the same age, however, cases of exceeding the appropriate load and striving for heavier weights without mastering the technique are common. Therefore, the role of the instructor is not limited to setting the load; it also includes forming in cadets a culture of training, the habit of monitoring their own condition and the skill of safeguarding their health.

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Particular attention should be paid to the recovery process: muscles grow stronger not during training but during rest. Seven to nine hours of sleep a day, a balanced and nutritious diet, adequate fluid intake, stretching after training and light aerobic activity accelerate recovery. Conversely, neglecting rest leads to overtraining, a decline in strength indicators and an increased risk of injury.

In the final assessment of results, it is advisable to take into account not only absolute indicators but also each cadet's progress relative to his or her initial level. This approach allows cadets with a lower initial level of fitness to see their own achievements, increases their interest in training and fosters a healthy competitive atmosphere within the group.

**Limitations of the study.** This work relies mainly on theoretical and methodological analysis; the effectiveness of the proposed model must be confirmed statistically through a large-scale pedagogical experiment. In addition, cadets' individual characteristics (initial fitness, body build, recovery rate) may significantly affect the results, so the load must always be adjusted individually.

**Practical recommendations.** It is recommended to strictly observe safety rules in training (warm-up, spotting, correct breathing, technique control), to take medical examination results into account and to pay attention to sleep and nutrition. The following mistakes reduce effectiveness: striving for heavier weights without learning the technique, increasing the load too quickly, training without sufficient rest, neglecting certain muscle groups and training without monitoring.

## 5. CONCLUSION

On the basis of the results of the study, the following conclusions were reached:

- Strength is the foundation of all physical qualities and is of decisive importance in the professional training of law enforcement cadets; its maximal, explosive, endurance and relative manifestations should be developed in harmony.
- No single method can develop all manifestations of strength; it is more effective to combine the repetition, maximal, dynamic, plyometric and isometric methods and the strength endurance method in sequence.
- Strength training should be based on the principles of consistency, gradual increase of load, individualization, balanced development of muscle groups and recovery.
- The proposed 12-week periodized model (adaptation, development and applied integration stages) takes into account cadets' academic workload and professional needs, and it is recommended that it be tested in a pedagogical experiment.
- Regular control testing and recording of results make it possible to manage the training load individually and to assess its effectiveness.

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