

IMPROVEMENT OF STRENGTH CAPACITIES OF MIDDLE-DISTANCE RUNNERS AS THE MAJOR FACTOR OF ACHIEVING HIGH SPORTS RESULTS AT THE STAGE OF MAXIMAL REALIZATION OF INDIVIDUAL CAPABILITIES

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Annotation. *Purpose:* the formation of a specific group exercises power orientation. *Material:* the study analyzes scientific and methodical literature, best practices. An analysis of the diaries of qualified middle distance runners. *Results:* group exercises designed to develop strength abilities (maximum, explosive strength, strength endurance) and methods of their use in the annual training cycle. To develop maximum force applied athletes exercise with weights (95-100% of the maximum mass). Recommended special exercises the running and hopping character with weights of 15-20 %, with which the athlete can get from a sedan. Group of exercises should be used in a specially - preparatory period of the annual cycle phase maximum realization of individual opportunities. *Conclusions:* the developed specific group of exercises that in different periods of year-long preparation for the implementation phase of the maximum individual empowerment contributes to the maintenance and implementation of power abilities of athletes.

Keywords: runners, maximum, explosive, strength, endurance, middle-distance, technique.

Introduction

An economic, efficient and relatively long running step, execution of which requires significant strength of the lower extremity muscles and sufficient joint mobility, may be traced in Mohamed Oman (Ethiopia) (1:43,31) and Asbel Kiprop (Kenia) (3:36,28), prize-winners of the XIV Moscow World Championship (2013) in 800 m and 1500 m, respectively [3]. It has been noted, that step length, frequency of motions and pace increased especially during the last 200-300 m of the distance and the movement was realized at the expense of active propulsion after powerful interaction between foot and support [13, 14].

Only two Ukrainian middle-distance runners, Taras Bibik and Natalia Lupu participated in these competitions. The former took the 38th place in 800 m with the result of 1:49,39, whereas the latter finished 7th with the result of 1:59,79. Current situation indicates that the problem consists in preparation of athletes. Coaches tend to insufficiently address special strength preparation, namely the exercises of strength direction, being one of the major constituents determining performance of runners, to a great extent [5, 6]. Application of exercises of specific strength direction (having particular structure, content and regular connections between training and competitive exercises) allows to increase both physical capacities necessary for 800 and 1500 m runners and functional capacities of the body major systems (cardiovascular, respiratory and vegetative nervous systems).

Studies were conducted in accordance with «Summary plan of scientific and research activities in the sphere of physical culture and sport for 2011-2015 of the Ministry of Education and Science, Youth and Sport of Ukraine» in theme 2.2. « Theoretical methodical bases of top level athletes' preparation under conditions of professionalization (on the example of track and field)» (№ of st. registration 0111U001721).

Purpose, tasks of the work, material and methods

Objective of study – improvement of the system of sports preparation of skilled middle-distance runners by means of studying selection and application of exercises, which contribute to development and maintenance of athletes' strength capacities at the stage of maximal realization of individual capabilities.

Task of study – to develop the groups of strength exercises for skilled middle-distance runners at the stage of maximal realization of individual capabilities.

Methods of study: analysis of scientific and methodical literature, generalization of advanced practical experience, analysis of athletes' diaries.

Results of the research

Strength capacities are considered to be one of the major in preparation of middle-distance runners. According to numerous authors, development of these capacities should be given priority in the system of athletes' preparation at each stage. This is due to the fact, that strength fitness is an important component of special endurance. Its significance greatly increases along with the improvement of sports skills of the runners [1, 8–11].

An important constituent of strength preparation is the improvement of athletes' ability to realize strength qualities under conditions of training and competitive activity during middle-distance running, which necessitates provision of specific level of strength fitness [5].

Athletes with sufficiently developed strength capacities may not even realize speed capacities while finishing, despite increased fatigue (when the contact time increases while the efficiency of take-off decreases), but increase running speed as well [4].

Insufficiently developed special strength fitness is distinctively manifested on the final segment of competitive distance, when the athlete decelerates and almost stops. This is the consequence of training process lacking strength preparation.

Availability of high speed potential in athletes is closely associated with their strength fitness. Therefore, strength capacities should be considered above all as the condition, determining speed of motion [10].

Methods of strength preparation of middle-distance runners should envisage specialized muscular activity, preferentially aimed at the development of such types of strength capacities as maximal, explosive, reactive strength, related to accumulation and usage of energy of muscle elastic deformation, local muscular endurance (strength endurance) (Fig.1) [6, 10].

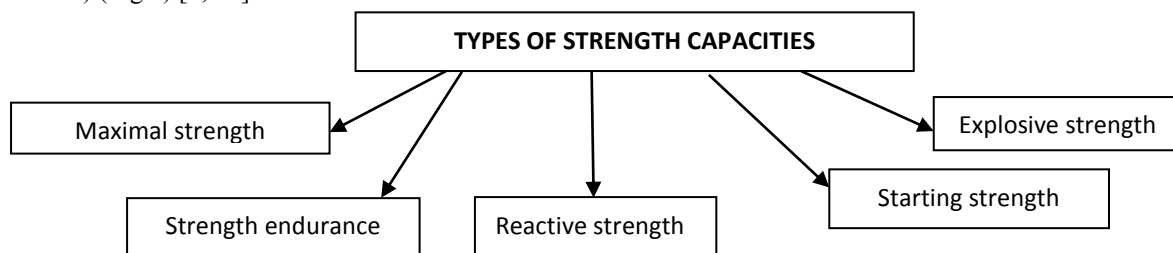


Fig. 1. Scheme of the types of strength preparation of middle-distance runners

In the course of training process both general and special strength should be developed. In case of properly organized methods, the development of these capacities improves intermuscular coordination, thus providing realization of strength potential of synergistic and antagonistic muscles, which should be well coordinated.

During strength manifestations, intermuscular coordination is improved at the expense of involvement of numerous muscles into mutual activity; restriction of activity in joints of antagonists; rational sequence of involvement into activity of muscles of kinematic chain; enhancement of the activity of muscles providing fixation in joints, in which motion is not required; selection of optimum amplitude of working motion [1, 15]. Therefore, the problem that has arisen, may be solved by feat of properly organized selection of exercises of preferential direction (speed, speed-strength) and, accordingly, for the development of general, explosive strength, strength endurance and special strength.

In the course of strength capacity improvement it is very important to properly apply the methods of their development both during long-term preparation and the period of annual training cycle at a definite stages: special preparatory, stage of direct preparation for competitions and competitive period. The above will permit to improve the body functional state and thus, athletic performance.

Strength preparation of middle-distance runners within the frames of both one- and two-cycle design of year-round training may be divided into three stages [9].

1. Stage of general strength preparation: development of the whole muscular system, irrespective of middle-distance running, by making use of diverse strength exercises, in which all types of dynamic and static strength are manifested.

2. Stage of all-round, task-oriented strength preparation: preferential development of strength of muscles, subjected to major and additional loads during running, by feat of various means incompatible with specific running structure but close to it in the character of neuromuscular tensions.

3. Stage of special strength preparation: development of strength of muscles, subjected to major loads during running, along with other important physical quality, and by feat of means maximally close in structure and character of neuromuscular tensions to middle-distance running.

Energy supply of strength efforts is realized at the expense of both alactate and glycolytic anaerobic process [2]. From the angle of provision of the most crucial for middle-distance runners strength qualities and the duration of their maintenance within the competitive period, the most efficient appears to be two-cycle planning of strength preparation. It envisages gradual increase of the volume of means of different strength direction during the first three months of preparatory period, its decrease to a minimum during the fourth month and secondary greater increase by the end of the period followed by volume reduction at the competitive period. It is noteworthy, that sharp increase of the level of special endurance manifestation occurs sometime (3-4 weeks) after significant reduction of strength exercise volume [9-12].

Utilization of means of alactate anaerobic direction increases the velocity of muscle contractions at the expense of improved neuromuscular coordination, and augments muscle strength as a result of actomyosin content increase in it. At the same time, the amount of phosphocreatine and other energy substrates utilized in anaerobic reactions tends to increase in muscle. These alterations permits the athlete to start running the competitive distance relatively fast without significant increase of lactic acid level, to accelerate when necessary and to make the finish effectively [7, 9].

Muscle strength is related to the content of structural proteins being the substrate of muscle contraction and relaxation. They do not belong to the major sources of energy but continuously renew their content, breakdown and resynthesize. Strenuous strength training significantly increases breakdown of proteins and some other structures of muscles; their recovery requires up to 2-3 days. Synthesis of the most intensively breaking down in the process of activity proteins, involved in muscle relaxation, is especially enhanced. Therefore, strength training results in both an increase of muscle strength and an improvement of their ability for more complete and fast relaxation after contraction.

Enhancement of strength capacities is also associated with ability for fast mobilization of chemical energy of

energy-rich phosphorous compounds contained in muscles and its conversion to mechanical energy. This is achieved at the expense of enhancing activity of enzymatic systems, which serve as catalysts in the process of adenosine triphosphoric acid (ATP) and adenosine diphosphoric acid (ADP) formation and determine muscle potential to replenish ATP stores [1].

Strength exercises are used at the stage of maximal realization of individual capabilities to develop maximal and explosive strength and strength endurance. The group of integrated impact is also used, which combines the types of strength preparation of middle-distance runners and is characterized by variety of means different in specific structure of running but close in character of neuromuscular tensions (Fig.2).

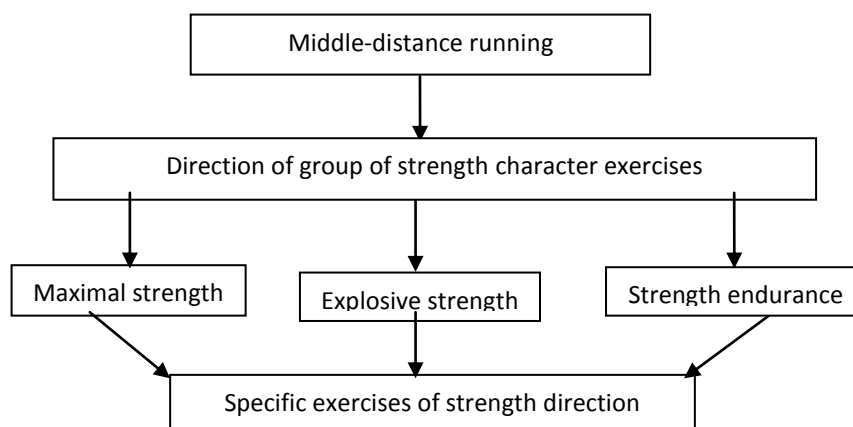


Fig. 2. Algorithm of strength preparation of middle-distance runners

Exercises for maximal strength development in middle-distance runners are presented in Table 1 with indication of the methods of their application. Number of sets, repetitions per set, duration of rest intervals and method of exercise execution as well as mass of free weights and intensity (%) are specified. Repeated method of exercise execution is used.

Exercises for maximal strength development are usually recommended during preparatory period at the stage of overall physical conditioning. The influence of maximal strength in combination with high velocity of muscle contractions is tremendous for achievement of high performances in middle-distance running [5].

Table 1

Exercises for maximal strength development in middle-distance runners

Exercise	Mass of free weights, %*	Intensity, %	Number of sets	Number of repetitions per set	Rest interval duration, min
Shoulder press from squat position	95 – 100	98	1 – 3	1 – 3	3 – 4
Half-squats with free weights on shoulders	97 – 100	98	2	1 – 2	3 – 5
One-leg squats with free weights on shoulders	10	85	3	4 – 5	3 – 4
Calf raise with free weights on shoulders	98 – 100	98 – 100	3 – 4	8 – 10	2 – 3
Two hand lift of free weights waist high	90 – 95	90	3 – 4	2 – 4	3 – 4
Bench-press	98 – 100	98	1 – 2	1 – 2	3 – 4
Leg press	90 – 98	90	3 – 5	2 – 3	3 – 4
Hip free weight lift while standing on one leg	70 – 80	90	3	4 – 6	1 – 2
Pull-ups	98 – 100**	98 – 100	2 – 3	Close to maximal	4 – 5
Free weights lift from	80	90	3 – 4	4 – 6	2 – 3

squat position while standing on two parallel benches (hand weights)					
Handstand push-up	85	90	3 – 5	Close to maximal	3 – 4
Leg elevation with ball between feet in supine position (the same – on abdominal)	5 – 7	90	3 – 4	As above	2 – 3
Free weight chest fly in supine position	80 – 85	95	3 – 4	As above	2 – 3
Lying triceps extensions	80 – 85	95	3 – 4	As above	3 – 4
Free weights lift from lunge position (free weights between legs)	85	90	3 – 4	3 – 5	2 – 3

Note: * percent of free weights maximal mass, with which the athlete may stand up from squat position <90° in knee joints.

** percent of maximum repetitions the athlete may do.

Table 2 contains exercises contributing to explosive strength development in middle-distance runners as well as the methods of their application with indication of free weights mass, intensity, number of sets and repetitions per set, duration of rest intervals. Repeated method of exercise execution is used.

The given group of means is recommended to be used at the stage of overall and special physical conditioning of the preparatory period of annual training cycle at the stage of maximal realization of individual capabilities.

Table 2

Exercises for explosive strength development in middle-distance runners

Exercise	Mass of free weights, %*	Intensity, %	Number of sets	Number of repetitions per set	Rest interval duration, min
Barbell snatch	35 – 45	90	3 – 4	4 – 5	3 – 4
Barbell clean and jerk	50 – 60	75 – 90	3 – 4	3 – 4	4 – 5
Two leg hopping with shoulder weights	35 – 40	90 – 100	2 – 3	10 – 15	3 – 4
Feet-to-feet jumps with hand weights (30 m) against the clock	4	90 – 95	3 – 4	–	4 – 5
One leg hopping with hand weights (30 m) (with 10 m run)	3 – 4	90 – 98	3 – 4	–	4 – 5
Two leg forward jumps with hand weights (30 m) against the clock	4 – 5	85 – 90	3 – 4	–	3 – 4
Two leg jumps over hurdles against the clock (10 h., distance between hurdles 2,00 m; height 91,4 cm)	–	90 – 95	4 – 5	10	2 – 3
One leg hops over hurdles against the clock (10 h., distance between hurdles 2,00 m; height 91,4 cm)	–	90	4	10	2 – 3
Hopping on one foot while	7 – 10	80	4 – 5	15	3 – 4

other is on support with hand weights ($h_{\text{support}} = 40\text{-}60\text{ cm}$)					
Leaping off the height with hand weights ($h_{\text{support}}=50\text{-}70\text{ cm}$) followed by quick upward take-off	3 – 5	85 – 90	10	1	3
Uphill running (30 m)	-	90 – 95	6 – 7	1	3
20 m crouch start running against the clock	-	90 – 95	4 – 5	1	2-3
Running in place with shoulder weights (6 s)	20	90	3 – 4	Maximal	2
Two hand forward-upward shot throw	5	95	10 – 15	1	1
Two hand backward-upward shot throw	5	95	10 – 15	1	1

Note: * percent of free weights maximal mass, with which the athlete may stand up from squat position $<90^\circ$ in knee joints.

The ultimate objective of strength preparation of middle-distance runners is the achievement of high level of strength endurance, i.e. athlete's ability for multiple manifestation of required in value motor efforts [8, 10]. Therefore, exercises aimed at the development of strength endurance (Table 3) may be mainly used both at the beginning of the stage of special physical preparation and during precompetitive stage of the competitive period of annual training cycle. The above will allow athletes to strengthen locomotorium muscular system and sufficiently develop major functional systems (cardiovascular and respiratory) being of tremendous importance for 800 m and 1500 m runners. Interval method of exercise execution is used.

Table 3

Exercises for strength endurance development in middle-distance runners

Exercise	Mass of free weights, %*	Intensity, %	Number of sets	Number of repetitions per set	Rest interval duration, min
Shoulder press from squat position (knee joint angle $>90^\circ$) against the clock	25 – 35	70	4	8 – 10	3
Two leg forward jumps with hand weights (30–40 m)	5 – 7	90	4 – 5	–	2 – 3
Upward jump off with shoulder weights	30	80 – 90	3 – 4	15	1 – 2
Lunge-walk with shoulder weights (50 m) against the clock	30	90	3 – 4	8 – 10	2 – 3
Barbell jerk with change of feet position against the clock	20	90	3 – 4	15	1 – 2
Single leg stand up from squat position	–	90	3 – 4	12 – 15	1 – 2
Uphill jumping (80 m) with hand weights against the clock	5	90	2 – 3	–	2 – 3

Taking to elevation (h =50 cm) in a step with hand weights	10	80 – 90	2 – 3	15 – 20	2 – 3
Rope climbing without legs (4 times in a row without support touching) against the clock	–	95	4 – 5	4	1 – 2
Hip flexion touching the bar with toes against the clock from horizontal bar or Swedish wall hang	–	85 – 90	3 – 4	15 – 20	1 – 2
Push-ups (angle of elbow joints <90°)	–	80	3 – 4	30 – 40	1 – 2
Trunk extension while lying across pommel horse with hand weights and fixed legs	7 – 10	80 – 90	2 – 3	15 – 20	1 – 2
Hip free weight lift while standing on one leg	15 – 20	90 – 95	3 – 4	10 – 12	2 – 3
Forward bend with shoulder weights (angle of hip joint ≤ 90°)	30 – 35	90	3 – 4	10 – 12	1 – 2

Note: * percent of free weights maximal mass, with which the athlete may stand up from squat position <90° in knee joints.

Specific group of exercises focused on improvement of middle-distance runners' strength capacities, which has been formed on the basis of groups of means of different preferential strength direction, calls particular attention (Table 4). Repeated method of exercise execution is used. It differs from previous groups in:

1) methods of exercise usage: increase of intensity, decrease of the number of sets and repetitions per set, increase of rest interval and reduction of free weight mass;

2) specific exercises, which may be used in case of a certain correction of the methods of each exercise execution both during precompetitive stage of annual training cycle competitive period and in between competitions during the competitive period. This group of exercises includes those with and without free weights.

- with free weights – half-squats with shoulder weights, calf raises; bench press, etc.;
- without free weights – pull-ups, jumps, hops, uphill running, etc.

Specific group exercises may be used selectively both during preparatory and competitive period, namely five-seven days before competitions depending on tasks set by the coach.

Table 4

Specific group of strength direction exercises

Exercise	Mass of free weights, %*	Intensity, %	Number of sets	Number of repetitions per set	Rest interval duration, min
Half-squats with shoulder weights	97 – 100	98	2	1 – 2	3 – 5
Calf raises with shoulder weights	98 – 100	98 – 100	1 – 2	3 – 4	2 – 3
Bench press	98 – 100	98	1 – 2	1 – 2	2 – 3
Pull-ups	98 – 100	98 – 100	1 – 2	Close to maximal	1 – 2
Leg elevation with ball between feet in supine position (the same – on abdominal)	5 – 7	90	1 – 2	Close to maximal	1 – 2
Free weights lift from lunge position (free weights between legs)	90	95	1 – 2	1 – 2	1 – 2

Barbell snatch	80 – 90	95	1 – 2	1 – 2	1 – 2
One leg hopping with hand weights (30 m) (with 10 m run)	3 – 4	95 – 98	1 – 2	–	2 – 3
Two leg forward jumps with hand weights (30–40 m) against the clock	4 – 5	95 – 100	1 – 2	–	2 – 3
Two leg jumps over hurdles against the clock (10 h., distance between hurdles 2,00 m; height 91,4 cm)	–	90 – 95	1 – 2	10	1 – 2
Leaping off the height with hand weights ($h_{\text{support}}=50-70$ cm) followed by quick upward take-off	2 – 3	95 – 100	4 – 5	1	1
Uphill running (30 m)	–	98 – 100	2	1	2 – 3
Two hand forward-upward shot throw	5	98 – 100	4 – 5	1	1
Two hand backward-upward shot throw	5	98 – 100	4 – 5	1	1
Two leg forward jumps with hand weights (30–40 m)	3 – 5	98 – 100	1 – 2	1	2 – 3
Barbell jerk with change of feet position against the clock	10 – 20	98 – 100	1 – 2	10	3 – 4
Uphill jumping (80 m) with hand weights against the clock	3 – 5	98 – 100	1 – 2	–	2 – 3
Rope climbing without legs (4 times in a row without support touching) against the clock	–	98 – 100	1 – 2	4	1 – 2

Note: * percent of free weights maximal mass, with which the athlete may stand up from squat position $<90^\circ$ in knee joints.

Conclusions.

1. Development of the main types of strength capacities (maximal, explosive strength and strength endurance) represents today one of the major directions for improvement of training process of skilled middle-distance runners.

2. Exercises with weights, constituting 95-100 % of maximal mass with which the athlete may stand up from squat position, should be used for maximal strength development in middle-distance runners at the stage of maximal realization of individual capabilities.

3. Competitive exercise performance in middle-distance running in anaerobic and aerobic-anaerobic regimes of energy supply requires sufficiently developed strength endurance, which is developed by means of special exercises of both running and jumping character with free weights of 15-20 %, with which the athlete may stand up from squat position. The group of exercises should be applied during special preparatory period of annual cycle of the stage of maximal realization of individual capabilities.

4. The group of exercises of specific character contributing to strength capacity maintenance and realization during special preparatory stage of competitive period and the competitive period itself of annual cycle of the stage of maximal realization of individual capabilities by skilled middle-distance runners is more rational.

Further studies should be focused on formation of the groups of exercises of speed and speed-strength character with the development on this basis of specific group of exercises and recommendations concerning their application during annual training cycle of the stage of maximal realization of individual capabilities.

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