Original Article

Experimental substantiation of teaching algorithm of technique in weightlifting and powerlifting competitive exercises

OLEXANDR TOVSTONOH[1], MARIIA ROZTORHUI[2], FEDIR ZAHURA[3], BOGDAN VYNOGRADSKYI[4]
[1,2,3,4] Lviv State University of Physical Culture, Lviv, UKRAINE

Abstract:
Fundamentals of teaching the competitive exercises technique in strength sports need to be improved to meet the requirements of sports practice. The research aim is to find out the effectiveness of algorithmization of teaching the competitive exercises technique in strength sports on the example of weightlifting and powerlifting.
It has been established that athletes of experimental groups made significantly (p≤0,05) fewer errors as compared to control groups athletes. Algorithmization of teaching the technique in strength sports contributed to the quality of mastering the competitive exercises technique by athletes at the stage of initial training as compared to the training program of junior sport schools.
Key words: weightlifting, powerlifting, technique, algorithm, training.

Introduction

One of the conditions to achieve a high level of athletic performance is mastering by an athlete of specialized system of movements corresponding to the peculiarities of competitive activities - sport technique [7]. Biomechanical features of competitive exercises technique learned in the early stages of long-term preparation are preserved at later stages of sports perfection. Disadvantages, arising in the course of study of competitive exercise technique, do not allow to fully realize the possibilities of individual athletes during competitive activity [2, 13]. General methodological principles viewing the teaching technique of motor actions have been set out in a large number of scientific studies [7, 9]. At the same time, the specific character of every sport directly determines the peculiarities of technique and methodological approaches to its study [1, 4].

Over the past decades in strength sports in order to teach a technique the system-structural approach is used which consists in building the process of teaching the technique according to kinematic, or reverse kinematic sequence [6, 10, 11]. Furthermore, at the time of carrying out the research (1975-1986) the age of participants in strength sports was 15-16 years, and today it is 11-12 years, which influences both the change in age limits of stages in many-years training and didactic approaches to teaching the technique. In addition, there has been an improvement of biomechanical structure of competitive exercises technique both in weightlifting and in non-Olympic strength sports.

Scientific analysis of literature on the theory and methods of teaching the technique in strength sports indicates the presence of a large number of theoretical and research material on the issues of technical training of athletes [2, 3, 7, 10]. Numerous experts A. Vorobev [13], V. Oleshko [5], L. Ostapenko [6], A. Statsenko [10] and others unanimously state that technical training is the foundation of a high athletic performance in powerlifting and weightlifting.

Within the research [6, 9, 12] biomechanical analysis of competitive exercises technique in weightlifting and powerlifting has been carried out, which formed the basis for its teaching process.

However, current approaches to teaching competitive exercises technique in weightlifting and powerlifting at the stage of initial training are based on surveys of 60-80-ies. In our opinion, they are outdated and need to be improved viewing the age changes of initial training stage in strength sports.

Thus, the important scientific and practical task arose: to justificate theoretical and methodological foundations of teaching the competitive exercises technique in strength sports, particularly in weightlifting and powerlifting.

The aim of the research is to find out the effectiveness of algorithmization of teaching the competitive exercises technique in strength sports, particularly in weightlifting and powerlifting.

Material and methods

In the course of research, we used: theoretical analysis and synthesis of scientific and methodological literature and data collected on the Internet; documentary method; pedagogical observation; pedagogical

Corresponding Author: BOGDAN VYNOGRADSKYI, bvynohrad@ukr.net

----

experiment; methods of mathematical statistics: Shapiro-Wilke test to study a normal distribution; nonparametric criterion of Mann-Whitney.

To achieve this goal a comparative pedagogical experiment involving 42 athletes (22 powerlifters and 20 weightlifters) aged 12-14 years has been conducted. The study was conducted at sport school by the name of Y. Kutenko and sport school "Energy" from March 1, 2014 till September 1, 2014. The athletes were divided into equal experimental and control groups, each including 11 powerlifters and 10 weightlifters.

Athletes in control groups were trained according to the programmes designed for junior sport schools, and representatives of the experimental groups were trained according to the modified programmes for junior sport schools in weightlifting and powerlifting, which included changing the sequence of means of athletes training viewing the designed algorithms [5]. Programmes of athletes training both in experimental and control groups were identical in terms of intensity and the amount of loading. The duration of basic training sessions for athletes in experimental and control groups was 80 min. (for powerlifters: 40 min. - teaching the competitive exercises technique and 40 min. - development of physical qualities and for weightlifters: 60 min. - teaching the competitive exercises technique, 20 min. - development of physical qualities). Total number of training sessions for athletes in all the groups was the same - 79.

To confirm the efficiency of algorithmization of teaching the competitive exercises technique in strength sports, errors made by the athletes in the competitive activities have been recorded. Errors of powerlifters were calculated by fixation of judges special error cards. Errors of weightlifters were determined by analyzing the video of athletes' performances in Lviv region championship in weightlifting among cadets. Errors were determined in each competitive exercise in three attempts.

Results

Algorithmization of teaching the competitive exercises technique in weightlifting and powerlifting in the course of pedagogical experiment provided consistent teaching of sequenced exercises technique where one proceeds from simple to more complex coordination exercises performed on the basis of guidelines laid down in scientific publications [8, 11].

Since mastering the technique of competitive exercises both in weightlifting and powerlifting depends directly on the physical fitness of athletes, participants in the experimental and control groups were tested for adequacy of distribution by pedagogical tests (using Shapiro-Wilkie criterion). These tests are standards used for control and removing of athletes from a group of general physical training to a group of initial training according to training programmes for junior sport schools in weightlifting and powerlifting. Estimated value of the criterion in four cases (throw of a 12 kg dumbell to the back with bending backwards, running at 1000m., high jump from place, pulling on the bar, doing press-ups lying on the floor, pulling up of legs while hanging on the crossbar) were less than criterion's critical value, so there is no reason to reject the hypothesis of adequacy of distribution. In running at 30m. adequacy of distribution was not confirmed. Thus, detection of differences in the results of athletes in experimental and control groups was carried out by the non-parametric Mann-Whitney criterion for different samples.

The analysis of the test results before the pedagogical experiment shows that there were not significant differences between athletes of control and experimental groups viewing indicators of physical fitness (p≤0,05) (Table 1, Table 2).

Table 1. Indicators of powerlifters physical fitness before the pedagogical experiment

№	Pedagogical tests	Results of pedagogical tests		t-criterion; Mann-Whitney criterion
		Experimental group (n=11) $\overline{X}$ ±S	Control group (n=11) $\overline{X}$ ±S	
1	Throw of a 12 kg dumbell to the back with bending backwards (m)	5,67±0,75	5,94±0,12	0,13
2	Running at 30 m (s)	4,78±0,35	4,71±0,18	51
3	Running at 1000 m (minutes)	3,30±0,40	3,32±0,48	0,46
4	High jump from place (cm.) after Abalakov	58,76±3,20	58,66±3,40	0,48
5	Pulling on the bar (times)	18,36±2,84	19,36±1,86	0,17

Notes:
1 - critical value of Student's t-criterion is 2.201 for p≤0,05;
2 - critical value of Mann-Whitney criterion is 31 for p≤0,05.

Table 2. Indicators of weightlifters physical fitness before the pedagogical experiment

№	Pedagogical tests	Results of pedagogical tests		t- criterion
		Experimental group (n=10) $\overline{X} \pm S$	Control group (n=10) $\overline{X} \pm S$	
1.	Running 30 m high start (s)	5,57±0,20	5,63±0,24	0,29
2.	Long jump from place (sm)	186,38±11,68	185,20±6,49	0,19
3.	Doing press-ups lying on the floor (times)	24,10±6,37	21,90±4,89	0,20
4.	Pulling up of legs while hanging on the crossbar (times)	8,30±3,03	7,10±2,13	0,16

Notes:

1 - critical value of Student's t-criterion is 2.114 for p≤0,05.

The analysis of the quality of mastering the technique of the first part of clean & jerk after the pedagogical experiment shows that athletes of experimental group made fewer errors than the control group athletes (Table 3).

Table 3

Errors of weightlifters in experimental and control groups in the first part of clean & jerk in the course of competitive activity

Phases of the first part of clean & jerk	Experimental group (n=10) $\overline{X} \pm S$	Control group (n=10) $\overline{X} \pm S$	P
phase 1	32,0±0,60	36,0±0,70	> 0,05
phase 2	33,0±0,93	32,0±0,68	> 0,05
phase 3	30,0±0,61	36,0±0,77	> 0,05
phase 4	25,0±0,79	37,0±0,67	< 0,05
phase 5	21,0±0,51	41,0±0,69	< 0,01
phase 6	26,0±0,47	47,0±0,81	< 0,01
Σ errors	167,0±2,02	229,0±2,67	< 0,01

Notes:

1 - critical value of Mann-Whitney criterion is 74 for p≤0,01.

However, it should be noted that in the first and third phases of the first part of clean & jerk significant differences in the number of errors between the athletes of control and experimental groups were not found. Nevertheless, (p≤0,05) there were definitely fewer errors of weightlifters in experimental group in the three subsequent phases as compared to the control group athletes. The total number of errors of athletes in the experimental group in the first part of clean & jerk (167.0) is by 37.1% less compared to the number of errors of the control group representatives (229.0). This clearly indicates a better mastery of technique of the first part of clean & jerk by athletes of the experimental group who were trained according to algorithmirized programmme.

In the second part of clean & jerk the errors were defined in each of the four phases of movement in three attempts (Table 4). Excellent mastering of the first part of competitive exercise technique (Table 3) by athletes of experimental group probably was a prerequisite for more effective implementation of the second part (Table 4). In particular, the performance of the first and second phases of the second part of clean & jerk they made significantly (p≤0,01) fewer errors than the control group athletes. In carrying out the third and fourth phases of the advantage was on the side of athletes of the experimental group, but it was not confirmed statistically (p≤0,05). The total average number of errors that was made by athletes in the second part of clean & jerk during official events in the control group was 159,0 ± 1,54, and in the experimental group 117,0 ± 1,03, which is 35.9% less than that of their colleagues.

Table 4. Errors of weightlifters in experimental and control groups in the second part of clean & jerk in the course of competitive activity

Phases of the second part of clean & jerk	Experimental group (n=10) $\overline{X} \pm S$	Control group (n=10) $\overline{X} \pm S$	P
phase 1	26,0±0,47	41,0±0,69	< 0,01
phase 2	21,0±0,60	44,0±0,83	< 0,01
phase 3	31,0±0,60	32,0±0,68	> 0,05
phase 4	39,0±0,51	42,0±0,72	> 0,05
Σ errors	117,0±1,03	159,0±1,54	< 0,01

Notes: 1 - critical value of Mann-Whitney criterion is 74 for p≤0,01.

-- 321

JPES ®   www.efsupit.ro

The analysis of the obtained results clearly indicates a higher level of mastering the competitive exercise technique by athletes of the experimental group as compared to the control group members.

The analysis of error detection made by powerlifters doing competitive exercises while performing in official events indicates that significant differences ($p \leq 0,05$) between indicators of the control and experimental groups athletes was in favor of the latter (Table 5).

On the basis of results of pedagogical control of competitive activity it has been revealed that members of the experimental group made a smaller number of errors in squats by 73.7% in the bench press - by 85.0%, thrust is - by 76.9% compared with the control group athletes. This gives reason to confirm that algorithmization of teaching the competitive exercises technique in powerlifting proved to be more effective than the corresponding technique in weightlifting.

Table 5. Errors of powerlifters in experimental and control groups in competitive exercises in the course of competitive activity

№	Competitive exercises	Experimental group (n=10) $\overline{X} \pm S$	Control group (n=10) $\overline{X} \pm S$	P
1.	Squats	22±1,00	38±1,69	26
2.	Bench Press	20±1,00	37±1,50	28
3.	Deadlift	13±0,60	23±0,94	27

Notes:
1 - critical value of Mann-Whitney criterion is 34 for $p \leq 0,05$.

The effectiveness of implementing into the training process of algorithmization of teaching the competitive exercises technique is also confirmed by the results of error analysis made by powerlifters both of experimental and control groups, providing unsatisfactory evaluation of judges (Fig. I).
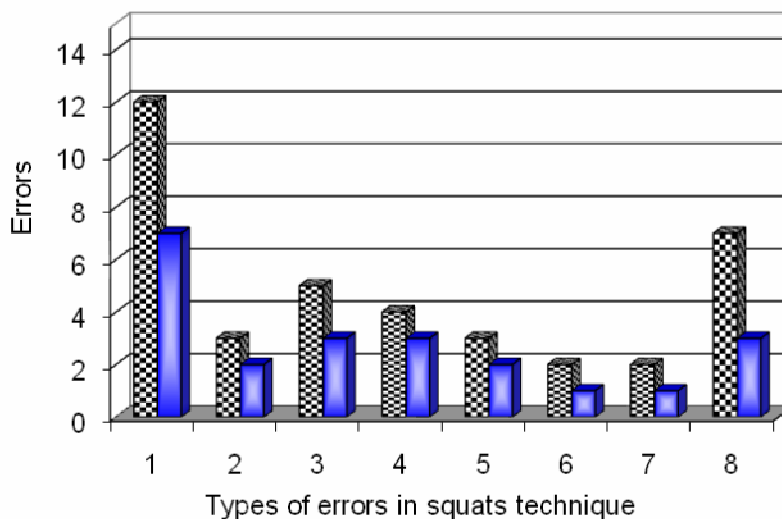

Fig. 1. The number of errors made by athletes of experimental and control groups in squats in the process of competitive activity: CG; EG;

1 no right angle between the knee and hip joints during the execution of the third phase; 2 steps till command of the chief judge "to the rack" during the execution of the seventh phase (return of the barbell to the rack); 3 double rising from the bottom of the sitting, or any downward movement when rising up; 4 error in taking the vertical position of not fully straightened in knee joints legs during the first and seventh phases; 5 high or low placement of the barbell on the back; 6 no fixed position of the barbell on the back after removing the barbell from the rack; 7 wide or narrow grip of a barbell; 8 contracted knees while performing the fifth phase (rising).

As can be seen in Fig. I athletes of the experimental group received less unsatisfactory ratings by judges than powerlifters of control group. Of particular note is their advantage in the manifestation of such errors as: the absence of a right angle between the knee and hip joints during the execution of the third phase; steps till command of the chief judge "to the rack" during the execution of the seventh phase; double rising from the bottom of the sitting, or any downward movement when rising up.

Dicussion

Thus, the results of pedagogical experiment strongly suggest that algorithmization of teaching the competitive exercises technique both in weightlifting and powerlifting allows to confirm the quality of athletes technical preparation. Viewing the comparative analysis of the number of errors made in the competitive activity by athletes of experimental and control groups we can conclude that athletes of the experimental groups were better in mastering the competitive exercises technique as compared to control groups athletes.

Conclusions

1. Analysis of the pedagogical experiment suggests that weightlifters who were taught the competitive exercises technique based on algorithms made significantly ($p \leq 0,05 - 0,01$) fewer errors in phases 4-6 of the first part of clean & jerk and in phases 1- 2 of the second part of clean & jerk and in the total number of errors as compared to the control group athletes.

2. Based on the analysis of the obtained data it has been revealed that powerlifters of the experimental group made significantly ($p \leq 0,05$) fewer errors in squats, bench press and deadlift.

3. Application of the suggested algorithms of teaching the competitive exercises technique both in weightlifting and powerlifting allows to significantly increase the effectiveness of the training process in comparison with available programmes for junior sport schools.

References

Amzãr E. L. (2007). Study concerning the use of algorithmic type programming in the technical preparation of the junior III volleyball girl players. *Journal of Physical Education and Sport*, 7, 27-31.

Dvorkin L. S. (2005). *Weightlifting* [in Russin] Moskow: Sovetskiy sport, 600.

Khaled M. Computer simulation of the biomechanical diagnosis of weightlifting [Electronic resourse]. – URL:: http://www.ub.uni-konstanz.de (date of appeal: 8.03.2015).

Mateescu A. D. (2008). Contributions regarding the technical preparation of the female junior voleyplayers III (13-14 years) through the global method. *Journal of Physical Education and Sport*, 8, 72-78.

Oleshko V. G., Putsov O. I., Tkachenko K. V. (2011). Weightlifting: Weightlifting: curriculum programs for children and youth sports schools [in Ukrainian]. *Kyiv* : NOK, 80.

Ostapenko L. A. (2002). Powerlifting. The features of the training process in the selection and initial training [in Russin]. Moskow: *Fyzkultura y sport*, 150.

Platonov V. N. (2004). The system of training athletes in olympic sports. General theory and its practical applications [in Russin]. Kyiv : *Olimpiyskaya literatura*, 2004, 808.

Roztorhuy M. S. (2013). The algorithm for training competitive exercises in weightlifting on the initial and base stage of preparation / *Dnieper sports bulletin* [in Ukrainian]. 3, 86–90.

Sokolov L. N., Rodyonov V. Y. (1981). The technique of training [in Russin]. Moskow: Fizkultura i sport, 96–117.

Stetsenko A. I. (2008). Powerlifting. Theory and methods of teaching [in Ukrainian]. Chernigiv : ChNU, 460.

Tovstonoh O., Zahura F. (2013). Algorithms of weightlifters technique learning on the stage of initial training. Physical activity, health and sport [in Ukrainian]. Lviv, 2(12), 70–76.

Ulăreanu M. V., Potop V. (2010). Comparative analysis of the reps number within two training macrocycles of the weightlifting olympic team. *Journal of Physical Education and Sport*, 29 (4), 86 – 89.

Vorobiev A. N. (1977). Sport of weightlifting. Essays on the physiology and sports training [in Russin] Moskow: *Fizkultura i sport*, 255.

--- 323

JPES ®   www.efsupit.ro