

## STRUCTURE OF ENGINEERING AND CLEAN AND JERK IN WEIGHTLIFTING HIGH QUALIFICATION OF DIFFERENT SEXES

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**Annotation.** Investigate the structure and propulsion technology breakthrough in weightlifting qualifications of different sexes with a weight bar in the area of 92-100% intensity. The study involved 220 men and 116 women. Video performed motor actions lifters, allowing the athlete to register force interactions with the keeper. Set the trend in the same type of force interaction with the bar for athletes of both sexes. Athletes apply maximum efforts in the final phases of acceleration and support the squat, the minimum - in the phase of depreciation. Established the distinctive features art by women lifting a barbell in the snatch and clean and jerk. The acceleration of the rod in the final phase of acceleration is considerably higher than that of men. It is proved that the structure of motor actions during the implementation of competitive exercises the same type of weightlifters of different sexes have distinctive features. This involves using a differentiated approach in the development of programs to improve technical skill separately for men and for women.

**Keywords:** weight lifters, men, women, structure of exercises, techniques, clean, jerk.

### Introduction

Permanent rising of sports achievements' level in weight-lifting and increasing rivalry in world sports sphere cause demand in searching new, additional reserves of weight lifters sportsmanship's increasing [3, 4, 8, 12, 14].

Increment of sports results in weight-lifting depends on many factors, among which the level of special physical preparedness and efficiency of athlete nervous-muscular system's coordination work are the most important. Weight-lifting exercises are very complicated by their technique because lifting of extreme for a sportsman loads is connected with maximal straining of torso, upper and lower limbs muscles, quick change of their operational modes, alternating of straining and relaxing of muscles in very short periods of time and in certain sequence; all these are called dynamic structure of technique of competition exercise [1, 6, 11, 12, 13].

Main moment of competition weight-lifting exercises is lifting of weight, applying the method, which is stipulated by competitions' rules. Lifting of weight of extreme value illustrates in the best way physical nature of emerging, changing and influencing of inertial forces on sports results, that can give answer to a number of important questions, concerning formation and improvement of dynamic structure of the fulfilled exercise's technique.

With movement of weight at changing speed there appears inertia force, which is expressed by value  $m\dot{a}$  (where  $m$  – mass of moving body and  $\dot{a}$  – acceleration). Vector of inertia force is directed to opposite to acceleration side, i.e., if mass moves upward with acceleration, then vector of inertia force is directed downward, and on the contrary, if mass moves upward with deceleration (vector of acceleration points downward), inertia force will be directed upward, again to the side, opposite to acceleration. Therefore at the moment, when speed or direction of weight's movement changes, inertia force appears and starts influencing on other acting forces [3].

Inertia forces are often called dynamic forces because they are alternative both by value and by direction and they appear only with movement of bodies at alternating velocity, i.e. with acceleration. Inertia force, in sum with static weight  $P$  makes dynamic weight –  $P \pm m\dot{a}$ , which, by absolute value, can significantly differ from static weight. The case, when direction of weight forces' and inertia forces coincide is of special interest. In such moments sportsman manifests muscular strain, which is significantly higher than it is required for overcoming static weight. The above described gives understanding of role of inertia forces in the process of weight-lifting technique's improvement and accentuates the need in constant control of their influence on quality of the fulfilled actions and motion tasks in the process of training.

Recent time, in connection with application of PC and OE registration and exercises' analyzing methods in highest level sports there are widely spread informational systems, which permit to evaluate and control bio-dynamic parameters of best world sportsmen's techniques not only in the process of direct registration in the process of athlete's performance at competition but as well in delayed mode. Such approach to studying of techniques of world leading sportsmen was successfully used by many specialists in track and fields (Yu.V. Verkhoshanskiy, 1988; R.F. Akhmetov, 2006; V.I. Bobrovnik, 2007; V.V. Gamaliy, 2004–2010 et al.), in swimming (Yu.M. Shkrebtiiy, 2009; V.N. Platonov, 2011), in rowing (A.Yu. Dyzchenko, 2008), outdoor games (N.A. Nosko, 2000-2012; V.M. Kostiukevich, 2006 et al.). In weight-lifting such researches were carried out both by domestic and foreign specialists [1, 5, 9, 11, 13].

Analysis of scientific-methodic literature shows that in weight-lifting some specialists [7, 9, 11] studied dynamic and kinematic structure of weight-lifters (female) jerk's technique. Other authors [5, 6, 13] dynamics of force influences in different phases of movement, muscles' response to value of load in competition's conditions. However these researches were conducted, as a rule, in laboratories, without considering of sex distinctions, qualification level and sportsmen's weight categories.

Practical experience accentuates insufficiency of researches of weight-lifters technical skillfulness parameters' study with consideration of individualization of competition exercises techniques' structure, fulfilled by sportsmen of different weight categories. It was assumed that studying of dynamic structure of lifting of maximal weight with the help of specialized computer video-registering systems for analyzing of highly qualified weight-lifters' movements will permit to increased efficiency of their competition exercises.

The work has been fulfilled as per combined plan of SRW of NUPESU by subject 2.0 "Management of training process of qualified sportsmen in power kinds of sports and martial arts on the base of up-to-date technologies of evaluation, simulation and correction of main training characteristics" for 2011-2015.

#### Purpose, tasks of the work, material and methods

The purpose of the research was studying of structure of snatch's and jerk's techniques of highly qualified weight-lifters of different sex with weight in intensity zone of 92–100 %.

We carried out video-recording of motion actions of weight-lifters at international and national competitions with the help of computer complex «Weightlifting analyzer 3.0» (Germany). Technical characteristics of this complex permitted to obtain analog and quantitative information about characteristics of the fulfilled exercise.

The registered characteristics of techniques of competition exercises, fulfilled by highly qualified weight-lifters in intensity zone of 92-100% are presented in fig. 1.

In researches 220 men and 116 women took part. In total 450 men's snatches and 557 jerks were analyzed. And, correspondingly, 348 and 406 of women's weight lifting. In order to compare indicators of technique of exercises' fulfillment by weight-lifters with different body mass and relative muscles' strength, they were divided into groups: among men, the first group – weight categories up to 56, 63, 69 kg (the level of relative strength -2.8-2.6 conv. un.) the second – up to 77, 85, 94 kg (2.6 0 2.4 conv.un. – relative strength); the third group – up to 105 kg and more (2.3 – 1.8 cinv.un.). Among women, the first group – up to 45, 53,58 kg (3.2-2.1 conv.un.); the second group – up to 63, 69 kg (2.1-1.2 conv.un.) and the third group – up to 75 kg and more (1.9-1.8 conv.un.) Analysis of physical exercises' technical characteristics was carried out as per phase structure, which was offered in works [8, 12]. Calculation of power interactions of a sportsman with weight was fulfilled on the basis of assumption that maximal force, which influences on immovable weight, and is taken as 100%.

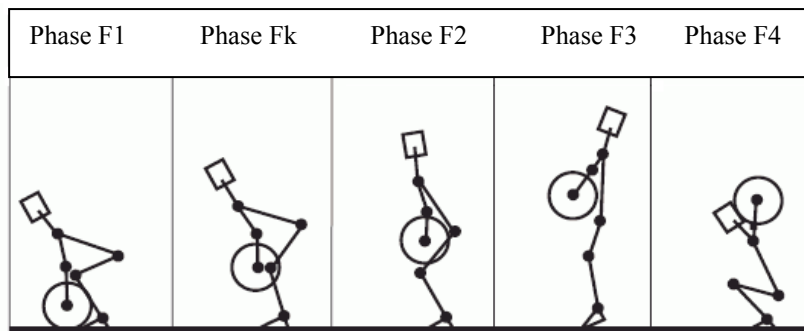


Fig.1. Phase structure of snatch and moments of time, in which power interactions of sportsman and weight were registered, during fulfillments of exercises by highly qualified weight-lifters:

$F_{1\text{ PPA}}$  – force, applied to weight in phase of preliminary acceleration, H;

$F_K$  – force, applied in the moment of first maximal legs unbending in knee joints (moment between phase of preliminary acceleration and phase of amortization), H;

$F_{2\text{ PA}}$  – force, applied to weight in phase of amortization, H;

$F_{3\text{ PFA}}$  – force, applied to weight in phase of final acceleration, H;

$F_{4\text{ PSS}}$  – force, applied to weight in phase of supporting squat.

#### Results of the researches

Analysis of bio-dynamic characteristics of male weight-lifters' technique in snatch and jerk shows that some force parameters have certain trend to changes in the process of competition exercise's fulfillment. For example, in snatch (see fig. 2a) value of maximal force, applied to weight in phase of preliminary acceleration ( $F_{1\text{ PPA}}$ ) the force of sportsmen from the third group increases, in comparison with the first group, by 4.2%, and in the phase of final acceleration ( $F_{3\text{ PFA}}$ )- by 2.2% ( $p \leq 0.005$ ). Change of force, applied to weight in the second and third phases ( $F_K$  and  $F_{2\text{ PA}}$ ), have opposite trend, i.e. it reduces in the third group in comparison with the first by 2.1 and 7.7% correspondingly ( $p \leq 0.005$ ). In phase of supporting squat the value of force interactions remains practically unchanged.

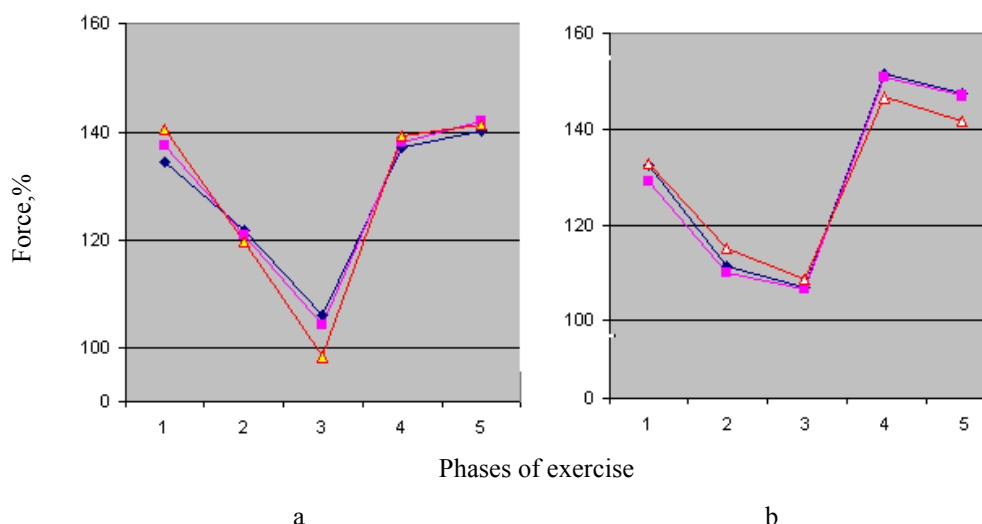


Fig.2. Dynamic of force, applied to weight in different phases of snatch of highly qualified weight-lifters:  
a –men; b – women; 1 –  $F_{1\text{ PPA}}$ ; 2 –  $F_K$ ; 3 –  $F_{2\text{ PA}}$ ; 4 –  $F_{3\text{ PFA}}$ ; 5 –  $F_{4\text{ PSS}}$

- ◆ – first group of weight categories;
- – second group of weight categories;
- △ – third group of weight categories;

Women manifest clear trend to reducing of force increment with increasing of sportswomen’s body mass in the bordering moment between phases of preliminary acceleration and phase of amortization ( $F_K$ ), as well as during phase of amortization ( $F_{2\text{ PA}}$ ). In other phases of exercise changes of characteristics of force, applied by sportswomen to weight, were statistically not confident (see fig.2 b).

The main distinctive feature of dynamic structure of women’s fulfillment of snatch is the fact that maximal power influence on weight is demonstrated by them in phase of final acceleration, while men do it in phase of supporting squat (see fig. 2).

Analysis of power characteristics’ dynamics of lifting weight on chest shows (see fig.3 a) that they also have certain peculiarities. We found that increment of force action on weight increases with increasing of body mass in phase of preliminary acceleration ( $F_{1\text{ PPA}}$  – by 5. 8 %,  $p \leq 0. 005$ ), final acceleration ( $F_{3\text{ PFA}}$  – 4. 5 %,  $p \leq 0. 005$ ) and supporting squat ( $F_{4\text{ PSS}}$  – by 10. 2 %,  $p \leq 0. 001$ ). Force, applied to weight in phase of amortization ( $F_{2\text{ PA}}$ ) has trend to reducing (by 10.2%) and in the bordering moment between the phase of preliminary acceleration and phase of amortization statistically does not change ( $F_K$ ).

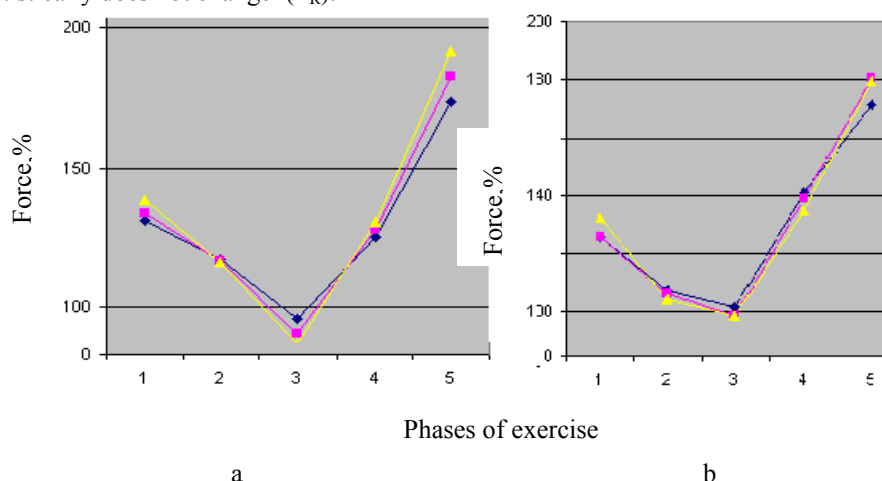


Fig.3. Dynamic of force, applied to weight in different phases of weight’ lifting on chest by highly qualified weight-lifters:

- ◆ – first group of weight categories;
- – second group of weight categories;
- △ – third group of weight categories;

The dynamics of power interactions, with weight's lifting on chest by women, (see fig. 3 b) differ from men's. For example, increasing of force is observed only in phase of preliminary acceleration ( $F_{1\text{ PPA}}$  – by 5.3% in the third group, in comparison with the first group  $p \leq 0.005$ ), then the force, applied in phases  $F_K$ ,  $F_{2\text{ PA}}$ , and  $F_{3\text{ PFA}}$  have opposite trend, i.e. it reduces by 2.8, 2.6 and 4.2% in the third group ( $p \leq 0.005$ ) in comparison with the first.

In the opinion of leading experts in weight-lifting [8, 12] efficient technique of lifting of weight is intrinsic to those athletes, maximal force of whose is manifested at the beginning of phase of final acceleration ( $F_{3\text{ PFA}}$ ), but not in phase of preliminary acceleration. We obtained data, which prove this opinion only partially, because significant part of sportsmen demonstrates maximal power interactions with weight in phase of preliminary acceleration. For example, in snatch in first two groups of weight categories the quantity of such cases was about 30% and for heavy weight categories (105 kg and more) reaches 64.1%.

Analysis of technical characteristics of weight lifting on chest showed that quantity of lifting with applying of big forces in phase of preliminary acceleration is still more significant in comparison with snatch; here also sportsmen of heavy weight categories are leading – their quantity of such lifting reaches 66.7%.

For women of all three weight categories mean indicator of lifting in snatch, when sportswomen applied maximal force to weight in phase of preliminary acceleration, was 10.5%, while in heavy category (more than 75 kg) the quantity of such lifting increases three times (up to 37.5%). Similar trend is observed among women with lifting of weight on chest; here sportswomen of heavy category (more than 75 kg) make 56.2% of lifting with maximal force application in phase of preliminary acceleration.

Thus, comparative analysis of bio dynamic characteristics of forces application's techniques by phases in snatch and jerk of different sex weight lifters shows that they differ by motion structure of the fulfilled exercise. This conclusion obliges coaches to consider these specificities when developing methods of exercises techniques' improvement for separately sportsmen and sportswomen.

Analysis of the obtained data witnesses, that the level of force increment by phases in jerk is much lower than in snatch. Sportsmen and sportswomen apply maximal force in phase of supporting squat and in phase of final acceleration, minimal force – in phase of amortization.

Also it should be noted the peculiarity of bio dynamic structure of weight lifting in snatch and jerk by women. Increment of forces, applied by them in phase of final acceleration, relative to static weight is much higher than increment of men's forces in the same phase. For example, in snatch force increment of woman in this phase was – 149.6% against men's 138.3%, and in jerk, correspondingly – 138.4% against против 127.9%.

#### Summary

1. We have studied dynamic of forces' application in the process of competition exercises' fulfillment (snatch and first stage of jerk – lifting of weight on chest) by the strongest weight-lifters in competition conditions.

2. The level of forces' increment by phases, independent on sex of weight-lifters, is much lower in jerk than in snatch. It is connected with high accelerations of weight and dynamic weight in snatch, in comparison with the same factors in lifting on chest that, naturally, causes higher increments of sportsmen's forces.

3. The researches established single-type trend of changing of power interaction with weight intrinsic to sportsmen and sportswomen with fulfillment of competition exercises. Both sportsmen and sportswomen apply maximal forces on phases of final acceleration and supporting squat, minimal – in phase of amortization.

4. We have established distinctive features in techniques of snatch's and jerk's fulfillment by women. Women demonstrate much higher acceleration of weight in phase of final acceleration than men, and, as a result, in snatch women's dynamic weight was in this phase 149.6% against men's 138.3% and in jerk– 138.4% against 127.9%.

5. Both sportsmen and sportswomen of heavy weight categories (men of 105 kg and more and women of 75 kg and more) in both exercises apply more forces in phase of preliminary acceleration than if phase of final acceleration. Evidently it is connected with additional consumption of muscular energy and forces not only for lifting weight but also for acceleration of own body mass.

6. It has been proved that dynamic structure of motion techniques of both men and women in separate phases of competition exercise have distinctive features. Dynamic of forces' changing, determined by weight mass, in some phases is different for men and women. It witnesses that the structure of motion priorities with fulfillment of competition exercises of one type have substantial distinctive features for sportsmen and sportswomen. Such situation obliges coaches to develop differentiated method of training skillfulness for men and women.

*Further prospects* imply studying of peculiarities of snatch and jerk techniques' structure, fulfilled by weight lifters in conditions of training process with weight of 60-70% and 81-90%.

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**Cite this article as:** Oleshko V.G., Gamaliy V.V., Antoniuk O.V., Ivanov A.V. Structure of engineering and clean and jerk in weightlifting high qualification of different sexes. *Pedagogics, psychology, medical-biological problems of physical training and sports*, 2013, vol.7, pp. 39-44. doi:10.6084/m9.figshare.736502

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Received: 25.05.2013  
Published: 30.07.2013