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Original Article

Peculiarities of barbell motion trajectory during snatch lift of elite female weightlifters

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Abstract:
The article deals with the analyses of use of a trajectory type in the snatch lift for elite female weightlifters. It has been noted that the available scientific researches of the analyses of lifting performance concern male athletes in most cases. The differences in build, physical development, physiological aspects etc. between male and female weightlifters call for specific research for every group. Aim: to define types of trajectory in snatch lift for elite female weightlifters. Results: the analyses of successful tries in barbell snatch lifting during competitions in international tournaments showed correlation of elite weightlifters' grasp of qualification of horizontal component of barbell motion trajectory in sagittal plane in compliance with different weight categories. The given research showed significant advantage of using first type (A) of barbell motion trajectory in snatch lift by female weightlifters. It has been defined that the second type of trajectory (B) in snatch lift is more used by female weightlifters in lightweight categories (48-58 kg). It has been found that female athletes (53) and female athletes in heavyweight category (75+) use the third type of barbell motion trajectory (C).
Key words: cross triathlon, training load, aerobic threshold, anaerobic threshold.

Introduction

The research of rational sports techniques, pattern of muscles strength change, and methods of improvement of results for certain drills is an integral part of progressive development of any kind of sports, including weightlifting [6, 21]. Trajectory of the horizontal component of barbell motion in sagittal plane in snatch lift and jerk weightlifting is one the most studied technique parameters in weightlifting [21, 24, 27].

However, the analyses of references by native and foreign authors showed that the researches of barbell motion trajectory are mostly done in a more complicated coordination motion plane, namely barbell jerk and another motion – pushing from the chest. This is probably caused by the fact that snatch lift technique by the coordination component is simpler, while being similar to the jerk by the biomechanical structure [3, 24, 1]. We consider fundamental researches of elite weightlifters by A. Vorobiyov to be another reason. These researches defined three types of barbell motion trajectory with three sub-types in each that reflect patterns of both jerk and snatch lift. (fig. 1) [28].

Another important fact is that scientists have paid attention to the question of which motion trajectory is the most efficient and popular among male and female weightlifters. So, a number of scientists [28, 2] advise to use trajectory A, while W. Baumann et al. [4, 15, 26] suggest type B to be the best one. Others [13, 26] state, based on the results of their researches, that type C is more widely used than others. Moreover, scientists [20] also recommend using type C as the best one.

It should be noted that scientists still have no unanimous opinion about which trajectory is the most efficient. Moreover, the results were obtained from the researches mostly done with male weightlifters based on the results of first competition drill (jerk). Also, it should be noted that modern sport is characterized with increasing number of women's events. Certain kinds of sports that have been earlier considered only for men, including weightlifting, grow in popularity nowadays. Competition increases along with sports achievements. However, scarce scientific researches based on female athletes became an obstacle for the realization of educational and training process. Coaches use data obtained mainly from men's achievements.

On the other hand, it should be noted that women's body, morphologic structure, functional capabilities, physical development, psychological component etc. differ significantly. At the same time, elite sports results depend on many factors. A slight deviation, a miss, and faults in training process may result in loss of a medal on a tournament.

The facts mentioned before prompted us to conduct our own research and define barbell motion trajectories, namely in snatch lift for elite female weightlifters.

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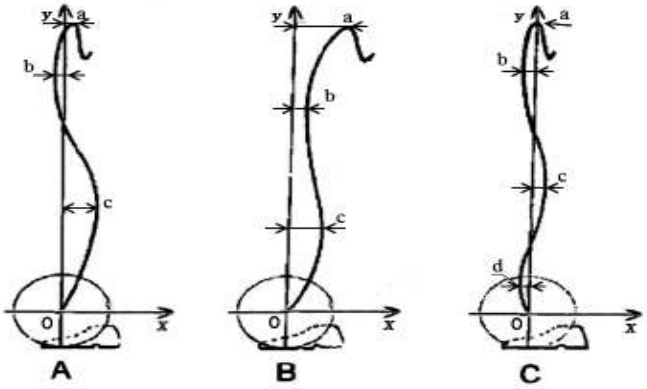

Fig. 1. Types of Barbell Motion Trajectories in Snatch Lift

Materials and Methods

Participants

Data on 140 elite women weightlifters, participants of Europe and World championships, have been used in the research. The data were obtained during Europe Championship in Budapest; Europe Championship in Minsk; World Championship in Istanbul; World Championship in Wroclaw. A total of 304 successful snatch lift attempts have been analyzed. Weight categories included: 48 kg – 13; 53 kg – 12, 58 kg – 24, 63 kg – 23, 69 kg – 31, 75 kg – 17, +75 kg – 20.

Organization of the research

The analysis of bio-kinematic characteristics of motion of elite women weightlifters was done via modern complex based on the use of automated systems of videograms processing on the basis of "Weightlifting analyzer 3.0" video-computer complex (Germany). Defining the type of barbell motion trajectory during snatch lifting became an important stage in our research. The basic motion of the grip end was done in sagittal plane. The analysis was performed by the three types of barbell motion trajectory (fig. 1). Type A is a type of trajectory, according to which the barbell approaches weightlifter's body in the first stage of the pull (point c) immediately after the first pull. In the second stage of pull, the barbell moves away from the female athlete (point b) cross the vertical axis drawn from the initial point of barbell movement and approaches the female athlete while crossing the vertical axis again, finishing the "hook" motion at the moment of taking position at the barbell (point a). Type B is the grip motion trajectory of the barbell, which approaches the female athlete in the first stage of pull and moves away from her in the second stage of pull without crossing vertical axis Y and finishes its motion with a wide "hook" approaching the female athlete again. Type C is the type of trajectory of the barbell, which moves away from the female athlete at the moment of the first pull (from the vertical, point d), then crosses the vertical axis and approaches the female athlete in the first stage of pull and then moves away from her gain, crossing the vertical axis for the second time, then crosses the vertical axes for the third time in the motion towards the female athlete and finishes the motion with a "hook" of a certain width.

Statistical analysis

Statistic analysis of the materials of research has been done via Microsoft Excel 2010 software.

Results

The results of the research show data that reflect the way of weightlifters' grasp of high-qualification types of horizontal displacement of barbell in snatch lifting (fig. 2).

From the total amount of female athletes analyzed, 42.9% use the first type (type A) of barbell motion trajectory in snatch lift. At the same time, types B and C are used equally – 28.6%.

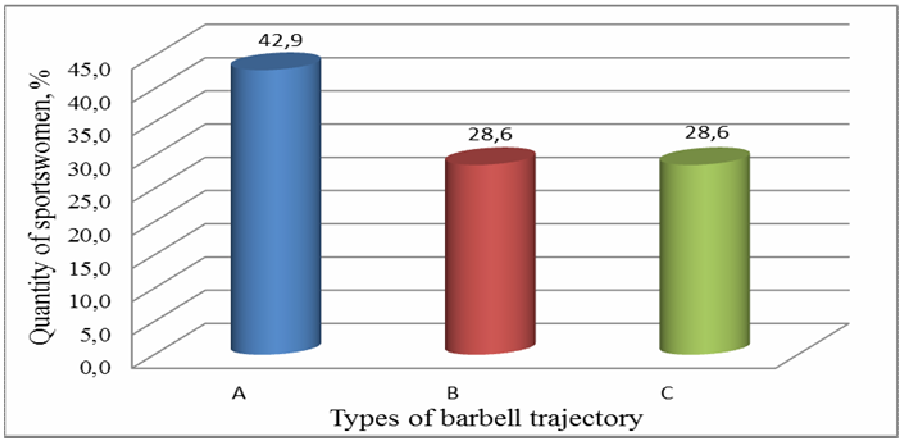

Fig. 2. Types of Barbell Motion Trajectory in Snatch Lift for Elite Female Weightlifters

Analysis of data by weight categories showed the following (fig. 3): in the weight category, type A is more widely used (46.2%), while type B is used by 38.5% of female weightlifters, and type C – by 15,4 %

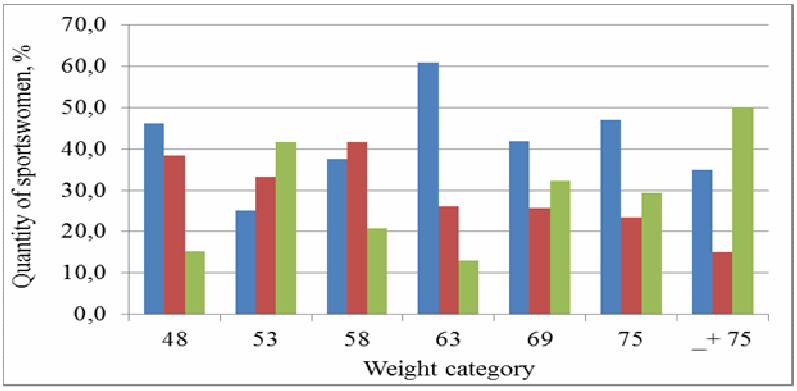

Fig. 3. Barbell Motion Trajectory in Snatch Lift Done by Elite Female Weightlifters in Different Weight Categories – type A; – type B; – type C

In weight category 53, the use of trajectory types differs significantly from other weight categories. Type A is used by only 25% of female weightlifters, while type B – by 33.3% and type C – by 41.7%

The analysis of weight category 58 showed quite another correlation of the use of trajectory types. In this weight category, type B is used by 41.7% of female weightlifters, while type A and C – by 37.5% and 20.8% respectively.

The analysis of weight category 63 shows apparent popularity of type A – 60.9%. Type B is used by only 26.1% of female weightlifters and type C – by 13%

The diagrams of trajectory types used by female weightlifters in weight categories 69 and 75 look similar. In weight category 69, type A is used by 41.9% of female weightlifters, type B – by 25.8% and type C – by 32.3%. In weight category 75, type A is also the most popular with 47.1%. Type B is used by 23.5% and type C – by 29.4%.

Female weightlifters in weight category 75+ use type C – 50% in most cases. Type A is used by 35% and type B – by 15%.

Discussion

Our research revealed similarity of the basic characteristics of barbell motion trajectory in snatch lift for elite female weightlifters with the ones used by male weightlifters, which has been proven by the authors studying the jerk [2, 5, 12, 15, 17].

The analysis of successful tries in snatch lifting during world tournaments showed that elite female weightlifters, in most cases, use trajectory type A, which proves the conclusions of authors [28, 7, 19]. According to their research, this trajectory is the most efficient, while use of type B is less efficient and is less frequently used by the athletes, which also corresponds to the results of researches concerning female weightlifters. However, there is another point of view as to the use of the second type of trajectory by the male and female weightlifters. Recent studies, though dedicated more to the analysis of the jerk, show that type B is used more frequently [8, 10, 14, 15, 18].

Regularity of the use of different trajectory types is shown in figure 3.

As we see, type A is more used by the female weightlifters in all weight categories. Type B is mainly used in lightweight categories (43-63 kg). Type C is more frequently used by the female weightlifters in heavyweight categories 69, 75, and 75+ kg. The results show that bigger weight categories result in the change of trajectory types.

It should be noted that our results match the ones by certain scientists [28, 4, 7] and contradict the results of others [13, 26]. G. Hiskia, for instance, in the analysis of barbell motion trajectory during Europe Championship, states that type C was used almost in half of tries, attempted by both men (48,5%) and women (52,1%) with the jerk lift [12]. Type A is less frequently used by both men (8,5%) and women (22,4%).

The research by Stephen J. Rossi et al. [26] done with male athletes with average weight of 84 ± 14.2 kg (n=23) also shows predominance of the use of type C in snatch lift (from the left side – 86.4%, from the right side – 77.3%) over other types (type A – 9.1% from the left side) and (type B – 13.6% from the left and the right side). The author tried to explain this divergence with the difference of the applied methods of motion trajectory research. Stephen J. Rossi et al. and G. Hiskia used the V-Scope measurement system, while J. Garhammer [7], W. Baumann [4] and we used the method of video analysis. However, according to the aforementioned results, there are significant differences in the indices of measurement of the left and right side of the barbell grip, which makes neither method more preferable.

Many scientists try to explain the divergence of the use of motion trajectory types by female weightlifters in jerk, as well as in snatch lift with anthropometric body size [3, 19]. Garhammer J., for instance, states that optimal trajectory depends on relative length of body segments and other important factors, such as muscles attachment points [14]. Scientists who study other kinds of sports [9, 16, 23] also stick to the idea that the technique is influenced by build and typological peculiarities of athlete's body. However, the role of anthropometric factors in defining optimal barbell trajectory is still not clear [14].

Another important factor for weightlifting, according to authors [28, 1, 11, 25] is rational placement of athlete's body parts in every single moment of the motion, starting with the initial position and finishing with squat position.

Index of barbell grip deviation from the vertical axis should also be acknowledged. According to authors [11, 22], inefficient weightlifting, muscles application and significant loss of energy are caused by excessive horizontal motions of the barbell. We assume that this feature is not quite studied and analyzed, which gives ground for researches that will allow further subdivision of the three basic types of barbell motion trajectory.

Conclusions

The conducted research showed that elite female weightlifters use type A of barbell motion trajectory in snatch lifting more often.

It has been revealed that type B is more often used by female athletes in lightweight categories (48-58 kg) in snatch lifting.

It has been found that female weightlifters in weight categories 53 and 75+ use type C more often.

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