

CHARACTERISTICS OF BARBELL TRAJECTORY IN SNATCH, FULFILLED BY ELITE FEMALE WEIGHT-LIFTERS

Antoniuk O.V., Pavlyuk O.S., Chopyk T.V., Pavlyuk E.A.
Khmelnitsky National University

Abstract. *Purpose:* to determine trajectories of elite female weight-lifters' movements. *Material:* 137 elite sportswomen were tested. Analysis of sportswomen's bio-kinematic actions was fulfilled with the help of Weight lifting analyzer 3.0 apparatus, Germany. *Results:* we found correlation of barbell snatch trajectory in respect to different weight categories of sportswomen. General characteristics of barbell trajectory are equal both for men and women. We determined indicators of barbell grip deviation from vertical axis. Optimal barbell trajectory depends on relative length values of body segments and other important factors. *Conclusions:* it was proved that execution of 2nd type trajectory of barbell horizontal movement is the most wide spread and effective. Such type of trajectory is the most often for high sport results off light weight categories (48-58 kg).

Key words: anthropometric, horizontal, barbell movement, trajectory types.

Introduction

The problem of sport movements' training and correction is a central one in theory and practice of sports спорту [4, 10]. Sport movements' training and correction are the most effective if they are realized on the base of modern ideas about weight-lifting exercises' fulfillment [6, 8, 9, and 11].

One of such ideas is trajectory of barbell movement [1, 22]. As on the present moment the way of technical characteristics obtaining, their information potential and objectiveness permit to detect mistakes rather quickly. Such mistakes can be effectively corrected at different stages of sportsmen's training. Reference models were received already in 70-s of 20th century [3]. Such models represent three types of barbell movement trajectory with three kinds of each. They reflect characteristics of snatch and lifting barbell on chest (see fig.1). Since that time, scientists from different countries only have been proving their correctness [13, 17]. Alongside with it searching of more effective trajectories (the most wide spread among weight-lifters) is remaining the permanent subject of their discussions. In some works trajectory (A) [16] is offered; in other – trajectory of B type [14, 25].

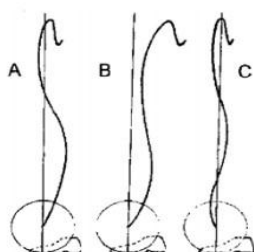


Fig.1. Types of barbell trajectories in snatch.

In his turn Hiskia G. [18] came to conclusion that type C is the most wide-spread. Other scientists [24] also came to conclusion and recommended model C as the best trajectory.

It should be noted that till now scientists have not had commonly accepted opinion about usage of these trajectories. Their conclusions were received from studies, which involved little quantity of sportsmen or sportswomen far from being elite.

Hypothesis: it is assumed that analysis of great number of elite sportswomen will permit to more precisely show one of technical fitness sides (barbell horizontal movement in snatch). It may result in reviewing theoretical and practical principles of sportswomen's technical training.

The purpose of the work is to determine trajectories of elite female weight-lifters' movements.

Material and methods

Participants: in the research we used the data of 137 the strongest in the world sportswomen of the following weight categories: 48kg (n=13), 53kg (n=12), 58kg (n=23), 63kg (n=23), 69kg (n=28), 75kg (n=16), +75kg (n=22).

Organization of the research: analysis of sportswomen's bio-kinematic motor actions was fulfilled with the help of modern apparatus complex, which works on principle of video-grams' automatic processing (Weight-lifting analyzer 3.0, Germany). Collection of these data was carried out at competitions of different levels (Championship of Europe, Budapest; Championship of Europe, Minsk; World Championship, Istanbul; World Championship, Wroclaw). In total we analyzed 238 successful snatches.

Statistical analysis was fulfilled with the help of Microsoft Excel 2010 programs.

Results of the researches

The received in our researches data permit to prove the fact that most of sportswomen practice second type (B) of barbell trajectory (see fig.2).

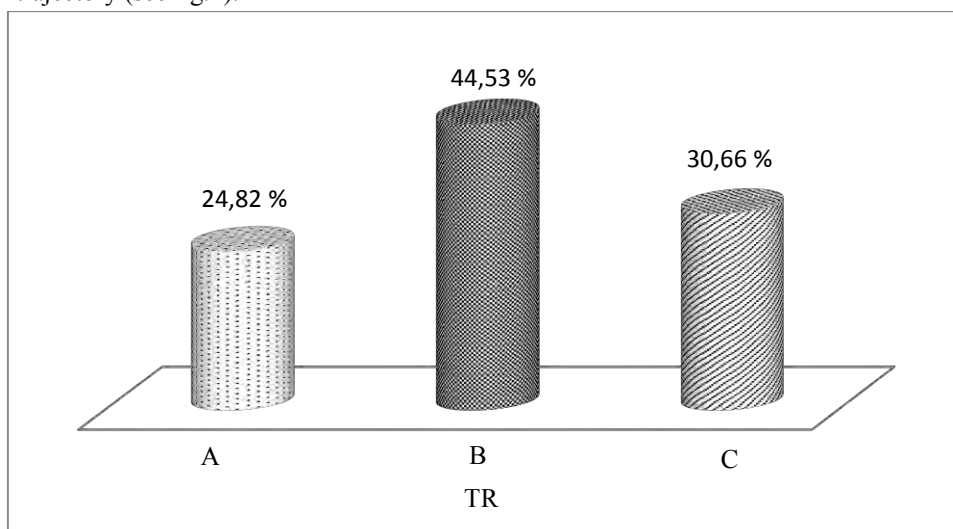


Fig.2. Types of barbell trajectories, used by elite sportswomen for snatch fulfillment: TR - type of barbell trajectory.

Evident prevalence of second type (B) application (44.53%), comparing with type A (24.82%) and type C (30.66%) was determined (see fig.3). As we can see in figure 3 sportswomen of 48 kg category mainly use trajectory B (69.23%). C-type takes only 23.08% and A-type – 7.69%.

The same situation was observed in 53 kg category. The tendency of B-type prevalence in snatch (B, 58.33%) is remaining. Type C takes second place (25%) and type A – third (16.67%).

These data change a little in categories 58 and 63 kg. In these categories sportswomen lift barbell the most often by second type (B): 52.27% and 43.48% respectively. The second place is taken by trajectory A with percentage of 30.43% in both categories.

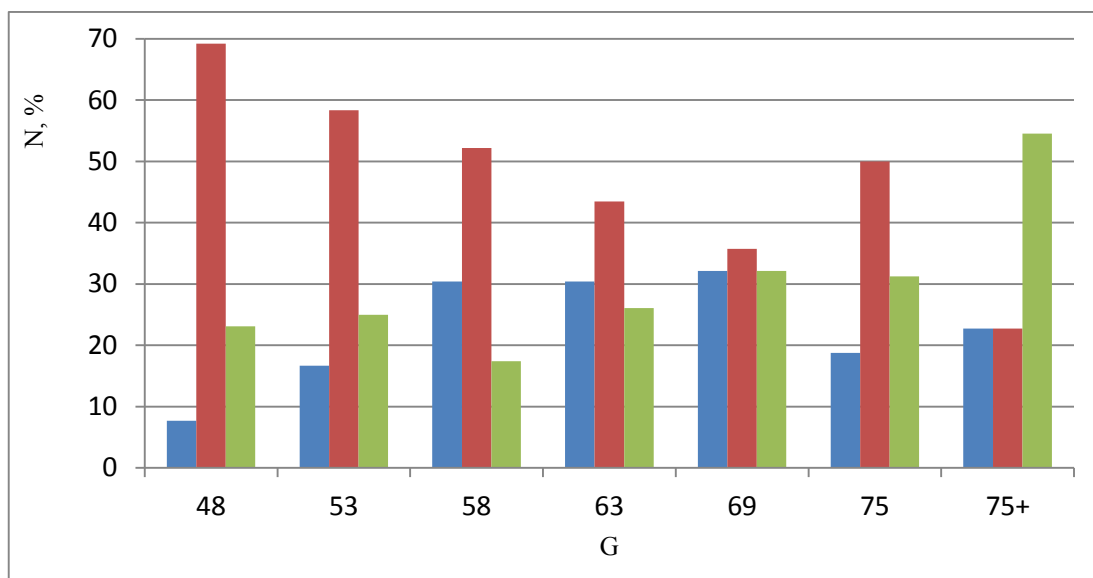


Fig.2. Barbell trajectory in snatch, fulfilled by different weight categories' sportswomen: G – weight category; N – quantity of sportswomen;

■ – type A; ■ – type B; ■ – type C

The third position by frequency of fulfillment is engaged by trajectory C: weight category (17.39%); weight category 63 kg (26.09%). In weight category 69 kg second type (B, 35.71%) prevails. It is by 3.57% more than trajectories A and C. Diagram of trajectories types' usage on 75 kg categories are similar to diagrams in categories 48 kg and 53 kg: trajectory (B) (50%), trajectory (A) (18.75%) and trajectory (C) (31.25%).

Data analysis in category above 75 kg showed that sportswomen, mainly, apply third type (C) in snatch. I.e. from 22, 12 sportswomen lift barbell by third type of trajectory – C (54.55%).

Discussion

Analysis of successful attempts in snatch showed that mainly sportswomen apply type B for lifting barbell. It coincides with the data of other authors [3]. General characteristics of barbell trajectories are equal for men and women. It coincides with the data of other researches [15, 17, and 21].

The works of American scientists showed inconsistency in barbell snatch trajectories in weight category 69 kg. More over less that half of sportswomen lifted barbell by trajectory A. It was proved in our previous works [19].

In the whole, in fig. 2 we can notice certain tendency of movement trajectories' usage. The highest percentage of fulfillment of B type is observed in 48 kg weight category. This percentage gradually reduces with weight categories' increasing. Percentage of trajectories A and C fulfillment grows with weight categories' increasing. From this diagram we can see that in 69 kg category balance between trajectories types' fulfillment exists. With further growth of weight categories correlation again changes. Many scientists try to explain this phenomenon by influence of body anthropometric sizes [2, 12, and 23]. For example, Garhammer J. [16] found that optimal trajectory depends on relative lengths of body segments and other important factors. Specialists in other kinds of sports support the opinion that technique of exercises' fulfillment is influenced by constitutional and typological features of sportsmen's bodies [5, 7]. Though, the role of anthropometric factors in determination of optimal barbell trajectory has not been cleared up yet [19].

It is necessary to pay attention to indicator of barbell deviation from vertical axis. By the data of authors [20] ineffective barbell lifting results in great energy losses. It is reflected in barbell excessive horizontal movements. In our opinion this characteristic has not been studied sufficiently. It opens prospects of further researches with paying attention to main three types of barbell trajectories.

Conclusions

We proved that usage of second type barbell horizontal movement (B) by sportswomen is the most widespread and effective for achievement high sport results.

Sportswomen of light weight categories (48-58 kg) use type B the most often.

It was determined that many sportswomen of the heaviest weight category (+75kg) use C type of barbell trajectory.

Acknowledgement

The research has been fulfilled in compliance with topic: “Psychological-pedagogic system of specialist’s personality formation” (2014 – 2017), code of the work 10 – 2014TC, state registration number 0114U005266. Order of Khmelnytsky national university №18KH dt. 01.09.2014. Index UDK 37.013.77:159.98.

Conflict of interests

The authors declare that there is no conflict of interests.

References

1. Antoniuk OV. *Udoskonalennia tekhnichnoi pidgotovlenosti vazhkoatletok visokoi kvalifikacii riznikh tipiv tilobudovi. Kand. Diss.* [Perfection of elite female weight-lifters, having different body constitutions, technical fitness. Cand. Diss.], Kiev; 2012. (in Ukrainian)
2. Antonyuk OV, Putsov SO, Kononets BV. Prostorovo-chasovi kharakteristiki strukturi rukhu rivka u vazhkoatletok z urakhuvanniam antropometrichnikh pokaznikiv [Space-time characteristics of female weight-lifters’ snatch structure, considering anthropometric indicators]. *Pedagogics, Psychology, Medical-Biological Problems of Physical Training and Sports*, 2011;4:7–11.
3. Vorob'ev AN. *Tiazheloatleticheskij sport* [Weight-lifting], Moscow: Physical Culture and Sport; 1977. (in Russian)
4. Gamalij VV. *Biomekhanichni aspekti tekhniki rukhovikh dij u sporti* [Bio-mechanical aspects of motor techniques in sports], Kiev: Scientific opinion; 2007. (in Ukrainian)
5. Gaverdovs'kij IuK. *Obuchenie sportivnym uprazhneniiam* [Training to sport exercises], Moscow: Physical Culture and Sport; 2007. (in Russian)
6. Dvorkin LS. *Tiazhelaia atletika* [Weight lifting], Moscow: Physical Culture and Sport; 2005. (in Russian)
7. Laputin AM, Gamalij VV, Arkhipov AA, Kashuba VO. *Biomekhanika sportu* [Biomekhanika sportu], Kiev: Olympic Literature; 2001. (in Ukrainian)
8. Maliutina AN. *Znachenie ritmo-vremenoj struktury v tekhnike ryvka u zhenshchin-tiazheloatletok. Kand. Diss.* [Importance of rhythm-time structure in snatch technique of female weight-lifters. Cand. Diss.], Malakhovka., 2008. (in Russian)
9. Oleshko VG. *Modeliuvannia, vidbir i oriientaciia v sistemii pidgotovki sportsmeniv. Dokt. Diss.* [Modeling, selection and orientation in system of sportsmen’s training. Dokt. Diss.], Kiev; 2014. (in Ukrainian)
10. Platonov VN. *Sistema podgotovki sportsmenov v olimpijskom sporte* [System of sportsmen’s training in Olympic sports], Kiev: Olympic Literature; 2004. (in Russian)
11. Poletaev PA. *Modelirovanie kinematičeskikh kharakteristik sorevnovatel'nogo uprazhneniia "ryvok" u tiazheloatletov vysokoi kvalifikacii. Kand. Diss.* [Modeling of kinematic characteristics of competition exercise “snatch” of elite weight-lifters. Cand. Diss.], Moscow; 2006. (in Russian)
12. Tovstonog O, Mocherniuk V. Osoblivosti tekhniki vikonannia rivka vazhkoatletami v zalezhnosti vid ikhnikh antropometričnikh danikh [Specific features of snatch fulfillment by weight-lifters, depending on their anthropometric data]. *Visnik Chernigivs'kogo derzhavnogo pedagogičnogo universitetu*, 2010;81:673 – 678. (in Ukrainian)
13. Antonio U. *Weightlifting. Sport for all sports*. Calzetti & Mariucci Publishers: Topografia Mancini; 2011.
14. Baumann W, Gross V, Quade K, Galbierz P, Schwirtz, A. The snatch technique of world class weight lifters at the 1985 world championships. *Int J Sport Biomech*, 1998;4: 68–89.
15. Campos J, Poletaev P, Cuesta A, Pablos C, Carratalá V. Kinematical analysis of the snatch in elite male junior weightlifters of different weight categories. *J Strength Cond Res*. 2006;20(4):843–850.
16. Garhammer J. Biomechanical profile of Olympic weightlifters. *Int J Sport Biomech*, 1985;1:122–130.
17. Hasan Akkusx. Kinematic analysis of the snatch lift with elite female weightlifters during the 2010 World Weightlifting Championship. *J Strength Cond Res*, 2012;26(4): 897–905.
18. Hiskia G. Biomechanical analysis of world and Olympic champion weightlifters performance. In: *Proceedings of the Weightlifting Symposium*. A. Lukacsfalvi and F. Takacs, eds. Budapest, Hungary: IWF;1997. P. 137–158.
19. Hoover DL, Carlson KM, Christensen BK, Zebas CJ. Biomechanical analysis of women weightlifters during the

- snatch. *J Strength Cond Res*, 2006;20: 627–633.
20. Isaka T, Okada J, Funato K. Kinematic analysis of the barbell during the snatch movement of elite Asian weight lifters. *Journal of applied biomechanics*, 1996;12:508-516.
 21. Korkmaz S, Harbili E. Biomechanical analysis of the snatch technique in junior elite female weightlifters. *Journal of Sports Sciences*, 2016;34(11):1088-1093.
 22. Musser Leslie J. *The effect of anthropometry on barbell trajectory for elite female weightlifters at the 2009 pan american championships*. PhD diss., California state university: Long Beach; 2010.
 23. Musser LJ, Garhammer J, Rozenek R, Crusemeyer JA, Vargas EM. Anthropometry and barbell trajectory in the snatch lift for elite women weightlifters. *J Strength Cond Res*, 2014;28(6): 1636–1648.
 24. Nejadian SL, Rostami M, Naghash A. Cost evaluation of different snatch trajectories by using dynamic programming method. 8th Conference of the International Sports Engineering Association. *Procedia Engineering*, 2010;2: 2563–2567.
 25. Schilling B, Stone M, O'Bryant H, Fry AC, Coglianese R, Pierces K. Snatch Technique of Collegiate National Level Weightlifters. *Journal of Strength and Conditioning Research*, 2002;16(4):551-555.

Information about the authors:

Antoniuk O.V.; <http://orcid.org/0000-0003-1483-7883>;
antonyuk.o@gmail.com; Khmelnytsky National University; Institutskaya
str. 11, Khmelnytsky, 29016, Ukraine.

Pavlyuk O.S.; <http://orcid.org/0000-0003-0016-2416>;
okspavluk@ukr.net; Khmelnytsky National University; Institutskaya str.
11, Khmelnytsky, 29016, Ukraine.

Chopyk T.V.; <http://orcid.org/0000-0003-1460-2953>;
tanya.chopik@mail.ru; Khmelnytsky National University; Institutskaya str.
11, Khmelnytsky, 29016, Ukraine.

Pavlyuk E.A.; <http://orcid.org/0000-0002-4041-4457>;
ev_pavluk@mail.ru; Khmelnytsky National University; Institutskaya str.
11, Khmelnytsky, 29016, Ukraine.

Cite this article as: Antoniuk O.V., Pavlyuk O.S., Chopyk T.V., Pavlyuk E.A. Characteristics of barbell trajectory in snatch, fulfilled by elite female weight-lifters. *Pedagogics, psychology, medical-biological problems of physical training and sports*, 2016;6:4–8. doi:10.15561/18189172.2016.0601

The electronic version of this article is the complete one and can be found online at: <http://www.sportpedagogy.org.ua/html/arhive-e.html>

This is an Open Access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited (<http://creativecommons.org/licenses/by/4.0/deed.en>).

Received: 06.10.2016

Accepted: 01.11.2016; Published: 30.11.2016