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Original article

A Correlational Study of the Snatch Phases in Junior Weightlifters of Granma Province

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ABSTRACT

Introduction: The snatch lift is a complex motor dexterity in weightlifting, which requires scientific methods for optimization.

Aim: To conduct a correlational study of the snatch phases to determine the effect of the first pull and transition on the second pull performed by junior weightlifters of the province of Granma, Cuba.

Materials and methods: A linear correlation study of the biomechanical indicators was done, which included the first pull, transition, and the second pull for the snatch.

Results: In the second pull, the vertical speed vector represented the greatest part of the speed component. Besides, the athletes made the trajectory in this phase with a strong tendency to perform vertical movements.

Conclusions: The biomechanical variables of the snatch movement were established in the sample, and the effect of the first pull and transition on the second pull of junior weightlifters from the province of Granma, Cuba.

Keywords: weightlifting, phases, first pull, system

INTRODUCTION

Sports techniques have been studied by several authors, such as Bermejo (2013), who noted that it consists of sequenced movements with a time-space structure that depends on previous knowledge, and whose end is to reach the maximum sports performance. Michael (2019) stated that the utilization of sports techniques produces high results with the least energy waste. Collazo (2007) said that the technique entails a series of patterns adapted and sequenced. Meanwhile, Morante and Izquierdo (2008) argued that it consists of sports movements characterized by their effectiveness and efficiency, the achievement of a dynamic stereotype, and the level of adaptation.

According to Perdomo *et al.* (2018), biomechanics in sports aims to evaluate the sports gesture, analyze the sports practice to enhance performance, develop training techniques, and design complements, materials, and high-performance equipment. It relies on the determination of biomechanical parameters of movement, shown in the kinematic and dynamic characteristics of the motor actions.

Among the kinematic characteristics of the sports movements are the time, space, and space-time elements. They do not involve the cause of movement, the dynamic features that comprise inertia, strength, and energy of movements. Herein, however, these include the causes (strengths) that originate movements.

Zatsiorski and Donskoi (2009) defined the phase as the "least element (time) of the movement systems that includes every movement from beginning to end, which fulfills certain task". The change of phase always coincides with a change in the movement tasks. Moreover, Meinel (1981) detailed that among the essential traits of sport movements the movement phase structure embodies the preparatory phase, which is the optimum preparation for the subsequent phases; the main phase, consisting in a rough fulfillment of the movement task, with an extinction of movement, achieving a system's balance.

To accomplish a sports result, the athlete executes a sport technique or motor action. During the main movement, either cyclical or acyclic, the athlete develops the greatest power, the aim of the initial phase is to 'prepare the system (athlete, athlete-implement, athlete-opponent) so that in this main phase these biomechanical variables manifest; whereas the final phase must produce a state of balance.

Athlete's preparedness is intended for athletes to execute the necessary motor action to achieve victory, and how everything in it moves around the main phase. Then, the bulk of sports training looks to improving the execution during the main phase of motor action, and in turn, it is an indicator of the athlete's assimilation of training.

In weightlifting, two movements are part of the competition: snatching and jerk. Their phases have been studied often by authors such as, Medviedev (2014); Gerrero *et al.* (2019); Ojeda *et al.,* (2020); Arévalo *et al.* (2021), who demonstrated that all the elements and phases of weightlifting exercises are related to one another; hence, inappropriate execution at the beginning of the movement leads to errors in the subsequent phases. A study done by Armas (2019) concluded that regardless of the division of the snatch technique, all the criteria responded to the same kinematic study: the trajectory of the barbell.

According to Cuervo *et al.* (2005) The snatch is a complex motor dexterity in weightlifting, which requires scientific methods for optimization. The main phase of this movement is the second pull, also known as the second phase, load, or pull. Vorobiev (1974) noted that the second phase of traction, load, like the first one, will start with a strong effort (160-180 % of the barbell weight), that continues for 0.15-0.25 seconds. This power is generated because at the beginning of the main phase, the body segments must be in a position where the barbell center and that of the weightlifter should be as aligned as possible to generate a powerful vertical strength.

Also, Biutrago and Jianping (2018) said that at that moment, the start of the main phase, is produced after a pre-extension to exert the maximum strength for a short time, equivalent to a large power that allows the barbell to reach its top height.

The establishment of snatch lift phases has been different. In this study, the proposal of Cuervo (2016) was assumed; as this exercise was split into actions, periods, and phases. Based on the previous, snatch in weightlifting deploys the greatest power of movement during the main phase, and it depends on the execution of the previous phases: first pull and transition. Consequently, the aim of this paper is to conduct a correlational study of the snatch phases to determine the effect of the first pull and transition on th esecond pull, by junior weightlifters from the province of Granma, Cuba.

MATERIALS AND METHODS

The weightlifting competition organized at the National Junior School Games in Cuba, in 2018. The sample population was part of the provincial weightlifting team from Granma. A sample was taken from the snatch attempts (78Kg), by the team members, except the ones who did not execute the movement on this weight. Hence, the sample included seven 15-16-year-old weightlifters of the two sexes.

The materials used in this research were a PS3 Eye camera, Lenovo Laptop AMD-A10, and SPSS, v22. The research took place through a transversal, correlational descriptive study with a non-probabilistic sample. The competition was recorded on video, using a PS3 EYE camera, at 30 fps. The camera was placed on the right side of the platform, 2 m from the edge of the competition platform. The takes were processed through Kinovea v8.24 software, and were started when the weightlifter stood facing the barbell, and ended when the barbell was being lowered following the referee's signal or due to movement fault.

Software Tracker v8.42 was used to record the trajectory and determine the kinematic and dynamic variables of the attempts. The movement was decided on phases, following the criteria of Lukashev (1980) and Medviedev (1997), so the snatch movement was structured in first pull (FP), transition (T), and second pull (SP). The research design was quantitative, correlational and non-experimental. The parameters of each phase were calculated to perform the statistical analyses.

RESULTS AND DISCUSSION

The results shown in Table 1 match those of Garhammer (1993), as to the duration of the second pull, reporting 0.12s, on average. Liu *et al.* (2018) said that the duration of this phase was 0.17s. Reyes *et al.* (2016) argued that the best time in the second pull was 0.27-0.33.

Table 1. Variable statistics by phases

Variables	Phases	M (DE)
Time	FP	0.481 (0.074)
	T	0.105 (0.023)
	SP	0.133 (0.033)
	HMAX	0.971 (0.078)
Speed	FP	1.546 (0.144)
	T	1.387 (0.34)
	SP	2.028 (0.363)
Vertical speed	FP	1.496 (0.112)
	T	-0.118 (0.244)
	SP	1.963 (0.339)
Height	FP	0.41 (0.067)
	T	0.561 (0.064)
	SP	0.772 (0.092)
Vertical power	FP	837.5 (83.7)
	T	1133 (122.7)
	SP	1359.1 (135.9)

Top speeds	FP	1.496 (0.112)
	T	1.378 (0.337)
	SP	1.963 (0.339)

Note: FP: first pull, T: transition, SP: second pull, HMAX: top height.

Source: Made by the authors.

Speed is another variable studied with mean results of 1.546, 1.387, and 2.028 m/s during the first pull, transition, and second pull, respectively. The findings of Liu *et al.* (2018), from the samples of a six-elite weightlifter group and a six-subelite weightlifter group, revealed the linear speed values for the elite athletes (1.05, 1.27, and 1.74m/s), and the subelite athletes (0.71, 1.00, and 1.44m/s).

The barbell height showed these values at the end. FP= 0.41m; T= 0.561m, and SP= 0.772, the vertical distance made was FP= 0.42m; T= 0.151m, and SP= 0.211m. Liu *et al.* (2018) found barbell height values at the end of the phases: FP= 0.5192m; T= 0.6638m, and SP= 0.8990, each phase's distance at 0.5192m, 0.1446m, and 0.2352m respectively (the elite weightlifters). The elite group in this study showed mean final values of FP= 0.4593m, T= 0.5580m, and SP= 0.8160m, and mean vertical distances at 0.4593m, 0.0987m, and 0.2580m, respectively. The results of this research showed values close to those of the elite athletes in the transition phase.

The mean vertical power varied between 837.5W in the first pull, 1133W in the transition, and 1359.1W in th esecond pull; the body weight-related power of the athletes was 23.380W/Kg. The study done by Garhammer (1993) found that the mean power in the second pull (final pull) was 55.8W/Kg, since the body weight and the weight lifted influenced the result of the relative power.

The top vertical speed, occurring at the end of the second pull, was around 1.963m/s in this group, above the values found by Liu *et al.* (2018), in which the value of the elite weightlifters was 1.74m/s, whereas Campillo *et al*. (1999) found a mean of 2.17m/s (90% maximum result). Moreover, Reyes *et al.* (2016) determined that the top vertical speed of the barbell was 2.31m/s in the men, and 2.43m/s in the women, with optimum values suggested between 1.60 and 2.50m/s. Bartonietz (1996) measured maximum barbell speeds of 1.75 and 1.90m/s. Byrd and Pierce (2002) found that the average vertical speed was 2.007 m/s.

In the application of Pearson's linear correlation analyses (Table 2), significant correlations were observed among some of the variables studied. There were correlations above 0.70, with 95 and 99% correlations between the time used and the first pull and the time in the maximum height phase, between the first pull and the height. Other significant correlations were found between speed and the first pull, and the variation of vertical speed during the transition.

Table 2. Linear correlation matrix

	FP_t	T_t	ITB	Hmax_t	FP_V	T_V	SP_V	FP_Vy	T_Vy	SP_Vy	FP_h	T_h	SP_h	FP_N	T_N	SP_N
FP_t	1.00															
T_t	-0.59	1.00														
ITB	0.00	0.24	1.00													
Hmax_t	***0.78****	-0.11	0.43	1.00												
FP_V	0.10	-0.49	-0.63	-0.51	1.00											
T_V	0.24	-0.44	-0.68	-0.30	***0.89*****	1.00										
SP_V	0.27	0.03	0.64	0.27	0.09	-0.04	1.00									
FP_Vy	0.49	-0,66	-0,52	-0,13	***0.92*****	***0.89*****	0.21	1,00								
T_Vy	0.22	-0.43	-0.69	-0.32	***0.90*****	***1.00*****	-0.04	***0.88*****	1.00							
SP_Vy	0.26	0.04	0.69	0.30	0.02	-0.12	***1.00*****	0.15	-0.13	1.00						
FP_h	***0.83****	-0,68	0,15	0,56	0,30	0,44	0.48	0,62	0.42	0,45	1.00					
T_h	0.65	-0.35	0.03	0.41	0.42	0.63	0.52	0.65	0.62	0.46	***0.87****	1.00				
SP_h	0.52	-0.19	0.50	0,49	0.11	0.25	0.78*	0.34	0.23	0.75	***0.81****	***0.88*****	1.00			
FP_N	-0,35	-0,26	-0.09	-0.65	0.63	0,56	0,18	0.44	0.56	0.12	0.18	0,29	0,28	1,00		
T_N	0.25	-0.40	**-0.70**	-0.31	***0.93*****	***0.98*****	0.03	***0.92*****	***0.98*****	-0.06	0.39	0.59	0.21	0.49	1.00	
SP_N	0.15	0.23	0.64	0.25	-0.05	-0.24	***0.94*****	0.03	-0.24	***0.95*****	0.22	0.28	0,57	-0.02	-0.13	1,00

The study also reported positive correlations above 0.8 between the height of the first pull, transition height (0.87*), and the second pull height. Likewise, the linear correlation was near 1 between the variation of height when transitioning and the variation of height in the second pull.

The power during the second pull was positively and strongly linked to the phase's speed, which, in turn, had a perfect positive correlation (1.00), with 99% significance of the vertical speed of this phase. It proved that in the second pull, the vertical speed vector represented the greatest part of the speed component. Besides, the athletes made the trajectory in this phase with a strong tendency to perform vertical movements.

CONCLUSIONS

The biomechanical variables of the snatch movement were established in the sample.

The effect of the first pull and transition on the second pull performed by the junior weightlifters of the province of Granma, Cuba.

The results of the biomechanical variables measured were compared to the results of other research studies, with similar results.

In the second pull, the vertical speed represents most of the speed, and the weightlifters made most of their trajectory in this phase with a strong tendency to verticality.

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