SPORT TK-EuroAmerican Journal of Sport Sciences

https://revistas.um.es/sportk Online ISSN: 2340-8812

Received: **02/12/2022.** Accepted: **10/02/2023.** Published: **28/03/2023**

Relationship between kinetic variables of weightlifters to lift the barbell to its maximum height in the snatch lift and kinetic variables in the stage of dropping the barbell

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ABSTRACT

The objective of the present research was to study the relationship between kinetic variables of weightlifters to lift the barbell to its maximum height in the snatch lift and kinetic variables in the stage of dropping the barbell. The research sample consisted of 6 Iraqi national team weightlifters. The instruments used in this study were weightlifting tools, 1-meter-long drawing scale, Rustameter device to measure the height, two Canon video cameras, a scale to measure the weight of weightlifters, an attempt scoreboard, and a portable personal computer. Regarding the attempts for the snatch lift, three attempts were given to each weightlifter according to international weightlifting regulations, and the best successful attempt was analysed. The statistical analyses were carried out with the Statistical Package for the Social Sciences (SPSS), version 23. There were three significant correlations between the work done dropping the barbell and the momentum, energy and power lifting the barbell ($p<0.05$). In conclusion, the increase of the momentum, kinetic energy, work done, and power has a positive role in the process of lifting the barbell to its maximum height in the snatch lift and dropping the barbell.

KEYWORDS

Kinetic variables; Weightlifters; Barbell; Snatch lift

1. INTRODUCTION

Weightlifting activity is one of the events that witnessed a rapid development in digital levels due to training software based on many sciences (Jabbar Abd, 2023), including biomechanics, and the present study through kinematic analysis, as the study of mechanical variables of the kinetic path of the barbell in weightlifting, is one of the many biomechanical studies. These variables can only be

known and measured accurately through kinematic analysis of the lift. This includes kinetic path analysis for the barbell, in terms of the elevation of the barbell from the ground and its deviation from the imaginary line of gravity at specific points, as well as the speed of the barbell. Also variables that combine the two, such as the speed of the barbell at each stage of the lift, as well as the kinetic variables of the barbell such as work, momentum, and kinetic energy of the barbell, and the analysis of the kinematic path of the column of the barbell is important because it is the true indicator of performance and the ideal expression of the extent to which the weightlifter is investing his biomechanical capabilities. In fact, through the curve of the kinetic path of the column of the barbell, we can judge the extent of the trainer's mastery of the performance in a scientific manner and the extent of the impact of the exercises performed by the weightlifter to develop the performance.

The importance of the present study is determined through the kinetic analysis of the path of the column of barbell for the Iraqi national team in the snatch lift, through which it is possible to identify the strengths and weaknesses of the technical performance of the snatch lift for the Iraqi team and its causes, by studying some of the kinetic variables of the kinetic path of the barbell and placing these reasons in front of the administrators, workers and supervisors of the Iraqi team.

The success of the attempt at lifting barbell depends mainly on the art of performance as well as on the other physical, psychological and mechanical aspects. If the weightlifter does not have good performance art, he will not be able to optimize his biomechanical properties. The failure of the attempts increases with the increase in technical errors committed by the weightlifter. The researchers refer that committing these mistakes, which negatively affect the technical performance of the Olympic lifts, including the snatch lift, is the failure of the weightlifter to possess momentum and kinetic energy in his body parts, which has an effect on the heights and deviations that the barbell will reach, including the maximum height the barbell will reach, which will negatively affect the stage of dropping the barbell and reaching the lowest point in the squatting position (Al-Obaidi, 1997).

The researchers found that this problem deserves scientific investigation and proof through scientific and technical observation, by studying this case to reach results that serve the sport and improve the performance of Iraqi weightlifters. Accordingly, the objective of the present research was to study the relationship between kinetic variables of weightlifters to lift the barbell to its maximum height in the snatch lift and kinetic variables in the stage of dropping the barbell.

2. METHODS

2.1. Design and participants

The researcher used the descriptive approach due to its relevance and the nature of the research. The research sample consisted of 6 Iraqi national team weightlifters. Table 1 shows some of the sample specifications.

Table 1. Sample characteristics

Weightlifter	Height (cm)	Weight (kg)	Age (years)	Years of training	Weight lifted in the test (kg)	Weight lifted at last competition (kg)	Percentage of weight lifted from the maximum weightlifter achievement
1	170	67	21	7	112	115	97.39
2	164	71	20	9	114	120	95.00
3	171	72	20	4	110	122	90.16
4	169	81	21	7	130	135	96.30
5	180	80	21	5	110	115	95.65
6	176	92	20	4	126	135	93.33
Average	171.67	77.17	20.50	5.71	117.00	123.67	94.64
SD	5.61	9.06	0.55	1.98	8.74	9.20	2.58

2.2. Instruments and procedures

The instruments used in this study were weightlifting tools, 1-meter-long drawing scale, Rustameter device to measure the height, two Canon video cameras, a scale to measure the weight of weightlifters, an attempt scoreboard, and a portable personal computer.

The two Canon video cameras were placed at a distance of 3.5 m from the left and right sides in order to calculate the kinematic variables of the barbell, and the height of the camera's lens was 1 m from the ground level. The cameras were installed with the special holder (stand) for each camera, and the frequency of the two cameras was 60 fps.

Linear momentum was calculated using the formula (momentum = mass x velocity) ($M = m \times v$) M (kg × m / sec) (Omar & Abdul Rahman, 2011). Linear kinetic energy was calculated using the law (kinetic energy = 1/2 mass x velocity^2) E (kg × m / sec) ($E = 1/2\ m \times v^2$) (Al-Hashemi, 1999). Work done was calculated by using the following formula (work = force x displacement) (W = force x displacement). Power was calculated using the law (power = work / time) (P = work/time) (Omar & Abdul Rahman, 2011).

Regarding the attempts for the snatch lift, three attempts were given to each weightlifter according to international weightlifting regulations, and the best successful attempt was analysed, which represented in the range of 90-100% of the maximum achievement of the weightlifter out of the three attempts. This is because the weight lifted, especially in competitions, ranges between 90-100% of the weightlifter capacity, and the barbell in these proportions keeps its path roughly parallel to the vertical line, because the difficulty of lifting the weight leads to postural adaptations in the body of the weightlifter to reduce as much as possible the joints that hinder movement (Al-Tikriti, 1985).

2.3. Statistical analyses

The statistical analyses were carried out with the Statistical Package for the Social Sciences (SPSS), version 23. With SPSS, the researchers calculated arithmetic means, standard deviations, percentages, and simple correlation coefficient (Pearson).

3. RESULTS AND DISCUSSION

The results are presented in tables 2 and 3. Table 2 presents average and standard deviations of all kinetic variables in the moment of lifting the barbell to its maximum height and in the moment of dropping the barbell. Table 3 presents the relationships between all the kinetic variables.

Table 2. The kinetic variables

	Drop the barbell				**Lift the barbell to its maximum height**			
	Momentum (kg×(m/sec)^2)	**Energy (joule)**	**Work (joule)**	**Power (j/sec)**	**Momentum (kg×(m/sec)^2**	**Energy (joule)**	**Work (joule)**	**Power (j/sec)**
Average	3390.92	75622.47	20004.00	33228.38	104.45	3773.59	7885.80	7121.27
SD	504.75	27831.09	2908.67	4945.93	11.35	520.11	696.79	1110.80

Table 3. The relationship between the kinetic variables

		Drop the barbell			
Lift the barbell		Momentum ($kg\times(m/sec)^2$)	Energy (joule)	Work (joule)	Power (j/sec)
Momentum ($kg\times(m/sec)^2$)	R	-0.31	-0.49	-0.87	-0.39
	p	0.555	0.327	0.023*	0.442
Energy (joule)	R	-0.06	-0.29	-0.91	-0.19
	p	0.918	0.584	0.011*	0.725
Work (joule)	R	-0.56	-0.61	-0.57	-0.57
	p	0.246	0.196	0.233	0.241
Power (j/sec)	R	-0.31	-0.49	-0.87	-0.39
	p	0.555	0.327	0.023*	0.442

** $p<0.05$*

As it can be observed in Table 3, the results of the research indicated the existence of three significant correlations between the work done dropping the barbell and the momentum, energy and power lifting the barbell ($p<0.05$). The researcher refers the reason to the fact that the amount of momentum, kinetic energy, work and power for the barbell were not at a high level, which led to a decrease in the maximum height of the barbell. This increased the burden on the weightlifter, which caused an increase in the work performed for the weightlifter in the process of dropping the barbell. Therefore, an inverse (negative) relationship appeared, because these are basic mechanical factors in weightlifting (Gourgoulis et al, 2000).

4. CONCLUSIONS

The increase of the momentum, kinetic energy, work done, and power has a positive role in the process of lifting the barbell to its maximum height in the snatch lift and dropping the barbell.

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AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

FUNDING

This research received no external funding.

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