POWER OUTPUT IN WOMEN WEIGHTLIFTERS DURING THE PULL PHASE OF THE SNATCH

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The purpose of this study was to determine and describe the power outputs in the snatch lift during the pull phase for American women competing in the national championships. Ten female lifters in the 69 kg class were filmed and analyzed using a Peak5 2D Motion Analysis. Power output values were based on calculations of total work done by the athlete divided by the time (Garhammer, 1993). The total power output values varied from 1095.54 W to 1875.90 W. These values were comparable to figures reported by Garhammer, 1991. Knowing power production values may be important in developing specific types of training programs.

KEY WORDS: weight lifting, snatch, power output, female weightlifters

INTRODUCTION: The 2000 Olympic Games in Sydney, Australia will feature women's weightlifting competition for the first time ever. The two lifts that comprise this event are the clean and jerk and the snatch. Of the two lifts, the snatch is the more explosive. The snatch is performed in one continuous movement. First, the athlete pulls the bar to chest height. The moment before the bar descends, the athlete drops into a squat position. Then the athlete stands up with the bar overhead and the arms held straight. She must wait for the referee's signal before dropping the weight.

Performance levels can be measured by looking at the power output. There have been several studies describing the power output of males (Garhammer, 1979; Garhammer, 1980; and Garhammer, 1985). Garhammer (1991) later published power output data on world class female athletes who competed in the first Women's World Weightlifting Championships. At that time the greatest amount of weight lifted by a woman in the 69 kg class was 77.5 kg. In the 1999 USA Weightlifting Championships, five of the ten competitors exceeded this limit, two were just under (75 kg), and two were considerably under the record (65 kg and 57.5 kg). It was the purpose of this study to determine and describe the current level of power outputs in the snatch lift during the pull phase for American women competing in the national championships.

METHODS: A Peak5 2D Motion Analysis video system was used for the filming and analysis procedures. The filming occurred at the 1999 USA Men's and Women's Weightlifting Championships held in St. Joseph, Missouri (USA). All women's events were filmed, but only the 69 kg class (n=10) was analyzed. This class was considered to be one of the elite classes with the potential of setting the national record. The leveled camera was placed at a perpendicular to the competitive platform, and was set to record at 60 fps. Analysis of the films was completed with the Peak5 software package.

Power output values were calculated from the kinematic film using the method described by Garhammer (1993). This was based on calculations of the total work done by the athlete divided by the time. The total work done in lifting the barbell upward against the gravitational pull was determined from the relationship of $W=\Delta ME$, which is the sum of the object's kinetic (KE) and potential energy (PE). This work output was then added to the work done in lifting the body's center of mass for a total average power output during the pull phase.

RESULTS: Table 1 illustrates power outputs for the 69 kg class participants during the pull phase of the snatch.

The 98 kg lift was the national record at the time of the competition. After this competition was completed, the subject who lifted the 98 kg weight went on to set another national record at 100 kg. The world record at the present time is 111 kg by an athlete from China. During the first USA National Weightlifting Championships, the highest weight lifted was 77.5 kg. The power output value for that lift was 1509 W (Garhammer, 1991).

Table 1 Power Output Values for Female Weightlifters

Lifter	Wt (Kg)	Vmax (m/s)	Time (t)	Ymax (m)	P_1 (W)	P_2 (W)	Total (W)
A	98	1.56	.64	.81	1240.52	394.44	1634.97
B	95	1.64	.88	.71	816.30	295.83	1112.13
C	92.5	1.72	.56	.70	1367.94	507.15	1875.09
D	92.5	1.72	.64	.64	988.42	394.45	1382.87
E	82.5	1.56	.88	.80	845.25	322.73	1167.99
F	75	1.92	.56	.82	1162.06	443.76	1605.82
G.	75	1.95	.64	.78	993.27	394.45	1387.73
H	65	1.66	.64	.70	662.70	355.01	1130.78
I	65	1.33	.48	.53	704.92	507.15	1212.08
J	57.5	1.66	.56	.60	651.78	443.76	1095.54

Note: Wt Lifted (kg) is best attempt; Vmax is maximum vertical velocity (m/s) of barbell during the pull phase; Time is time from bar lift-off until Vmax is reached; Ymax is maximum bar height (m); P_1 is power (W) output in lifting the barbell; P_2 is the power (W) achieved in lifting the body center of mass; Total output is the total average power output (W) while lifting the barbell from the floor to maximum vertical velocity.

In general, the power output values for the pull phase during the snatch agree with the values found by Garhammer (1991). This is considering the changes in weight lifted from the first competition to the present competition. However, there were several unusual findings. The lifter C had a higher power output than the eventual winner, but it should be noted that her time of lift to the maximum vertical position was very short in comparison to the other lifters. The lifter B (95 kg) had a lower average power output than expected, but that is explained by the long duration of the bar lift and height of the individual. She was the tallest competitor. In both cases, P_1 was not as high as the other top finishers. Other differences may be explained by technique variability, especially as it relates to the work of the body center of mass.

In order to compare these results with that of Garhammer (1991), we felt it necessary to film at a similar speed. As Garhammer pointed out, slower speeds may make it difficult to pinpoint exactly where the maximum velocity is reached and the time over which the lift took place. Another potential error is in the positioning of the camera. This may cause measurement error when using the bar as a marker for analysis. We felt that this was not the case in our study since the camera was positioned at least 10m away from the platform.

CONCLUSION: Knowing that high power production is essential for lifting heavier weights, a coach or athlete can develop a training program specific to that goal. This may especially be true where power outputs seem low in comparison to desired levels. Ideally, the relative power output in relation to body weight would also be included. Additionally, information on power outputs such as calculated here may assist athletes in perfecting their technique.

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