A Comparison of Performances by Women at the 1987 and 1998 World Weightlifting Championships

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INTRODUCTION

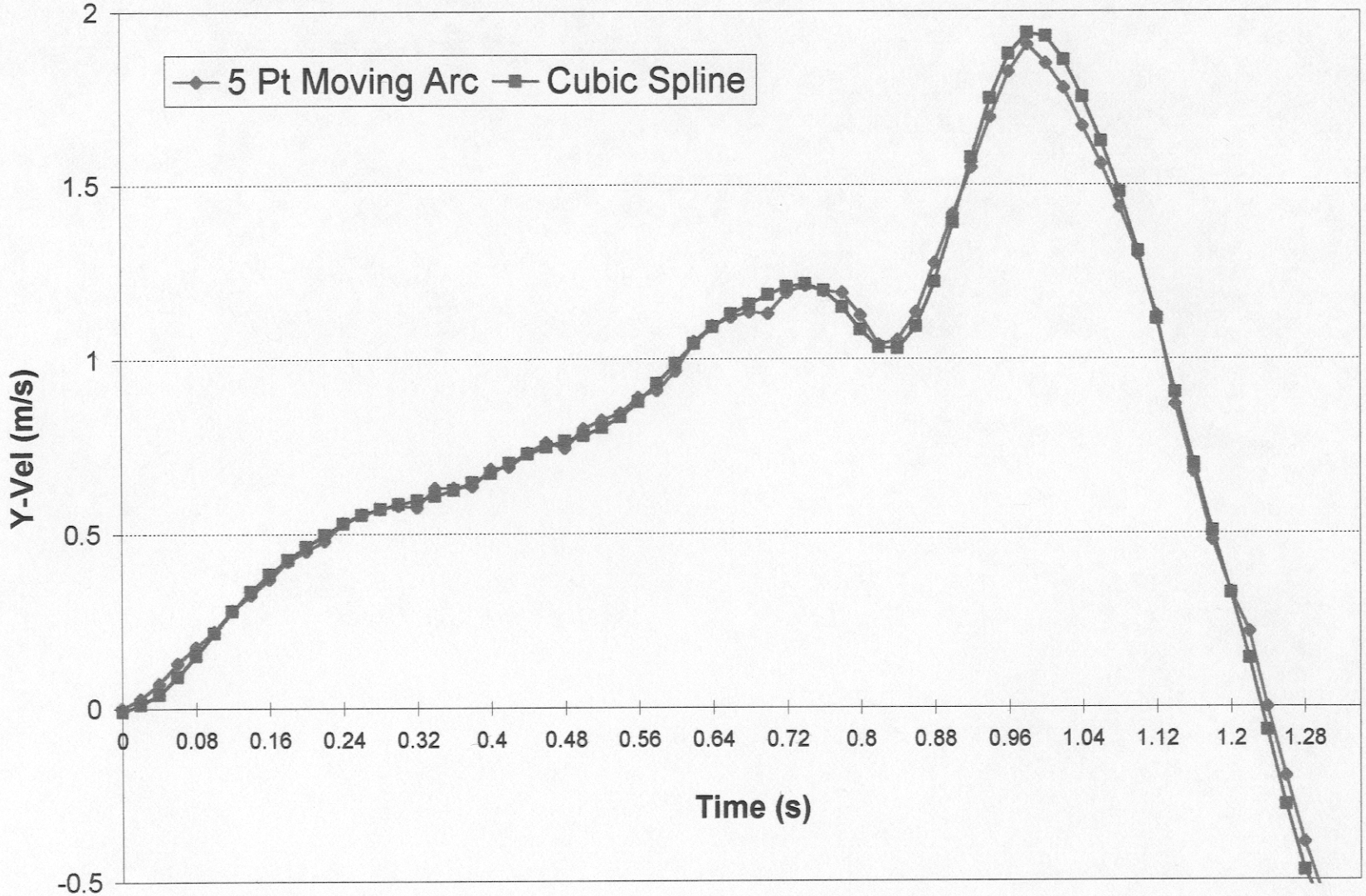
The performances by women in weightlifting (WL) have increased dramatically since the first women's world championship in 1987. This paper investigates the magnitude of increases in weight lifted, and related biomechanical parameters, from 1987 to the 1998 world championships. Power per Kg body mass (relative power) was one of the performance parameters compared due to the large values generated during the competitive lifts, and the importance of developing power output capabilities utilizing WL training methods to improve performance in many other sports.

METHODS

The heaviest weight lifted in the snatch and clean & jerk by the gold medallist in each weight division were (1) filmed at 50 fps using a 16mm LoCam camera at the 1987 women's world WL championships, and (2) video taped at 50 Hz using a PAL video camera at the 1998 world WL championships. The 2D visual records were analyzed using a Graf Pen sonic digitizer for film or a Peak Performance video analysis system. Raw film data were smoothed using a five point moving arc method; video data were smoothed using an optimized cubic spline. These two methods produced equivalent kinematic parameters when compared using raw data for several lifts from the 1998 competition (see, for example, Figure 1). Calculated power values included only the vertical work done while lifting the barbell. Competition weight

divisions changed slightly from 1987 to 1998, so lifts in the six most similar divisions were compared (1987: 48-52-56-60-67.5-75 Kg; 1998: 48-53-58-63-69-75 Kg). The average body mass of the athletes compared was 1.54 Kg heavier in 1998 compared to 1987. Slight modification of a few values originally published for the 1987 lifts [1] were made in order to use exactly the same calculation criteria as for the 1998 lifts. The analysis methods used have been described in previous publications and are summarized by Garhammer [2].

Figure 1: Comparison of Cubic Spline and 5 Point Moving Arc Values.
(KL 105 KG Snatch Lift)



RESULTS

Figure 2 shows the comparison of weight lifted and selected kinematic and power values for snatch lifts between 1987 and 1998. Figure 3 shows the comparison of weight lifted and selected kinematic and power values for clean lifts between 1987 and 1998. Film of the 56 Kg division gold medalist's clean for 1987 was not available for analysis.

Figure 2: Snatch Lift Performance Comparisons - 1987 and 1998 Women's World WL Championships

1987 - SNATCHES			Complete SN Pull		SN Second Pull		MAX	MAX
Wt Class (Kg)	Athlete Mass (Kg)	Snatch (Kg)	Relative Power (W/Kg)	Duration (s)	Relative Power (W/Kg)	Duration (s)	Vy (cm/s)	Y (cm)
48.0	47.15	75.0	18.2	0.74	34.8	0.22	199	96
52.0	51.70	67.5	15.5	0.76	26.9	0.24	199	103
56.0	55.65	75.0	14.6	0.86	27.3	0.24	194	104
60.0	59.65	75.0	17.2	0.66	30.1	0.22	221	101
67.5	64.35	77.5	16.1	0.70	29.7	0.10	196	107
75.0	74.25	90.0	16.6	0.72	29.4	0.20	215	110
Average =	58.79	76.7	16.3	0.74	29.7	0.20	204.0	103.5

1998 - SNATCHES			Complete SN Pull		SN Second Pull		MAX	MAX
Wt Class (Kg)	Athlete Mass (Kg)	Snatch (Kg)	Relative Power (W/Kg)	Duration (s)	Relative Power (W/Kg)	Duration (s)	Vy (cm/s)	Y (cm)
48.0	47.25	80.0	17.2	0.80	37.5	0.18	192	94
53.0	52.65	92.5	20.1	0.80	43.8	0.16	204	102
58.0	57.00	92.5	18.2	0.74	42.3	0.08	193	94
63.0	61.79	102.5	19.5	0.80	43.1	0.14	208	104
69.0	68.90	110.5	15.8	0.90	36.2	0.16	187	101
75.0	74.36	105.0	14.2	0.96	34.1	0.14	194	109
Average =	60.33	97.2	17.5	0.83	39.5	0.14	196.3	100.7

Figure 3: Clean Lift Performance Comparisons - 1987 and 1998 Women's World WL Championships

1987 - CLEANS			Complete CL Pull		CL Second Pull		MAX	MAX
Wt Class (Kg)	Athlete Mass (Kg)	Clean (Kg)	Relative Power (W/Kg)	Duration (s)	Relative Power (W/Kg)	Duration (s)	Vy (cm/s)	Y (cm)
48.0	47.15	95.0	16.2	0.84	29.3	0.22	148	76
52.0	51.70	90.0	16.5	0.82	32.0	0.18	169	85
56.0	55.65	85.0						
60.0	59.65	105.0	17.0	0.72	31.9	0.14	164	78
67.5	64.35	102.5	15.6	0.80	25.9	0.14	148	84
75.0	74.25	120.0	18.7	0.72	27.9	0.18	167	88
Average =	58.79	99.6	16.8	0.78	29.4	0.17	159.2	82.2

1998 - CLEANS			Complete CL Pull		CL Second Pull		MAX	MAX
Wt Class (Kg)	Athlete Mass (Kg)	Clean (Kg)	Relative Power (W/Kg)	Duration (s)	Relative Power (W/Kg)	Duration (s)	Vy (cm/s)	Y (cm)
48.0	47.25	102.5	16.3	0.88	37.0	0.18	155	75
53.0	52.65	117.5	17.2	0.96	37.4	0.18	161	84
58.0	57.00	115.0	17.4	0.74	33.3	0.10	144	71
63.0	61.79	122.5	17.2	0.82	37.4	0.12	157	81
69.0	68.90	130.0	15.6	0.88	33.0	0.14	157	84
75.0	74.36	125.0	14.5	0.92	26.0	0.12	134	86
Average =	60.33	118.8	16.4	0.87	34.0	0.14	151.3	80.2

DISCUSSION

From 1987 to 1998 the average snatch lift increased from 76.7 to 97.2 Kg (27%), and the clean & jerk increased from 99.6 to 118.8 Kg (19%). During this period (1) relative power output values during complete pulls for both snatch and clean lifts changed little, even though the duration of the pull for each type of lift increased by approximately 0.1 seconds (12%) in 1998; and (2) second pull power values increased 33% for the snatches and 16% for the cleans while the duration of the second pulls decreased by 30% for snatches and 18% for cleans in 1998. Maximum vertical bar velocities and heights decreased about 8 cm/s and 2 to 3 cm respectively for both lifts in 1998. These results indicate that the large improvements in performance are

connected to changes in technique during the second pull. It is interesting to note that recently published research by Gourgoulis et al. [3] showed that highly skilled elite male lifters completed their snatch lifts with a lower maximum bar height and vertical velocity compared to lesser skilled elite female lifters. This is the same pattern found in the current study when comparing these parameters between the higher level performances of the women in 1998 compared to 1987. Additional analyses should compare the joint kinematics of the athletes during the pulling motion, along with stature and segment length differences, to gain a better understanding of the technique changes that have occurred between 1987 and 1998.

REFERENCES

1. Garhammer, J. A comparison of maximal power outputs between elite male and female weightlifters in competition. Int J Sport Biomechanics 7: 3-11, 1991.

2. Garhammer, J. A review of power output studies of Olympic and Power lifting. J Strength Cond Res 7(2): 76-89, 1993.

3. Gourgoulis, V. et al. Comparative 3-Dimensional Kinematic Analysis of the Snatch Technique in Elite Male and Female Greek Weightlifters. J Strength Cond Res 16(3): 359-366, 2002.