BIOMECHANICS OF STANDING LONG JUMP WITH HADNHELD WEIGHT

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INTRODUCTION: Many studies had proved that extra weights was held in the hands of the athletes during the long jump competition(Minetti ＆ Ardigo 2002; Lenoir, Clercq ＆ Laporte, 2005), and some researchers found that extra weights would increase the jump distance, but those studies did not point out the joint moment and power. The purpose of this study was to investigate the biomechanical difference between unloaded and loaded groups, and to understand the joint moment and power of standing long jump.

METHODS: Fourteen male physical education students (height 174.64±6.21 cm, weight 73.07 ± 11.32 kg) participated the study, and performed no load, light load (L load, load 2-4kg), heavy load (H load, load 6-8kg），super heavy load (S load, loag10-12kg) standing long jumps. A Redlake high speed camera(125Hz) was synchronized with a Kistler force platform(1250Hz) to collect the data, and Dempester's study (1955) was used to calculate the human body parameter. We use one way ANOVA to analyse the kinematic and kinetic data, and the variables were calculated by SPSS for Windows (Version 12.0, Chicago, IL) with alpha level of 0.05.

RESULTS AND DISCUSSION: The jumping distance was enhanced in the L loaded and H loaded groups, the result was familiar to other studies, and if the jumper jumped carrying too heavy weight, the performance was decreased. Besides, the horizontal CM takeoff velocity in L load and H load groups increased with load. In vertical CM takeoff velocity, it decreased with load, especially when they jumped with super heavy load (10kg-12kg). In our study, there was no significant difference between groups in joints moment. In the peak joints power, it decreased with load, and the S load group significantly less than the other three groups.

The study indicated that the light load and heavy load groups had greater jump distance than no load group. The horizontal body CG takeoff velocity and horizontal impulse were enhanced with load. However, the vertical body CG takeoff velocity, peak hip and ankle joint angular velocity, and peak lower extremity joints power were decreased with load.

Table1：Kinematic and Kinatic variables of jumping performances (*p < .05)

	No load	L Load	H Load	S Load
Distance (cm) ＊	267.9±18.57	278.2±14.62	281.5±11.84	269.9±18.89
Horizontal Velocity (m/s) ＊	2.84±0.32	3.11±0.23	3.15±0.22	3.10±0.29
Vertical Velocity (m/s) ＊	2.30±0.54	2.08±0.56	1.89±0.41	1.75±0.36
Horizontal impulse (N.s)＊	253.8±37.0	281.9±34.0	294.9±32.7	302.3±37.4
Peak Horizontal Force (N)	736.5±99.8	784.1±70.2	821.3±65.2	778.7±101.6
Peak Vertical Force (N)	1671.5±189	1694.6±202	1684.6±155	1643.5±180

Table2：Peak joint moment and power of jumping performances (*p < .05)

	No load	L Load	H Load	S Load
Peak Ankle moment (N.s)	322.6±49.6	330.9±52.8	337.1±73.9	327.9±72.6
Peak Knee moment (N.s)	-262.6±44.8	-273.9±72.6	-264.1±65.7	-264.2±75.6
Peak Hip moment (N.s)	454.9±111.1	435.2±118.5	434.1±120.9	407.9± 94.7
Peak Ankle power (watt/BW) ＊	31.18 ±3.84	30.96 ±4.56	28.77 ±3.68	23.65 ±2.71
Peak Knee power (watt/BW) ＊	11.43 ±1.88	9.96 ±1.34	9.59 ±1.55	7.02 ±2.29
Peak Hip power (watt/BW) ＊	37.33 ±8.21	33.19 ±6.00	32.09 ±3.71	27.59 ±4.29

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