Concentric Power Differences during Take-off between Young Male and Female Team Handball Players

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1 OBJECTIVES

Differentiating gender related manifestations of power through two-legged taking-off kinetic chains was main objective of this research.

Basic techniques of exertion of power while jumping in team handball have major impact on individual and group tactics efficiency. Potential within individual player's performance rise proportionally with greater variability, versatility and control of timing, intensity, function, structure etc. of concentric, eccentric and elastic component of muscular contraction. It is the case for individual sports like athletics (Čoh et al., 2013.), or gymnastics (Medved et al., 1995), therefore those are functionally reflected in specific take-off, throwing/shooting and sprinting techniques in team sports.

Hypothesis of this research was that from certain age arising gender related differences in observed characteristics are measurable by the height of jump, but by average concentric power as well.

2 METHODS

Participants were 41 young team handball player (24 male and 17 female) 16±1 yr., all member of national selection preparing for international tournaments (European Championships) in year 2006/7.

Tensiometric Platform (Kistler factory) and standard Quattro Jump protocol was used to collect data (variables in table 1.) and to produce figures.

Concentric, eccentric and elastic component of take–off were assessed trough Squat Jump (HSJ, PSJ), Countermovement Jump (HCMJ, FI, PCMJ, STR, FIBR), Continuous Jumps (HCJ, PCJ, KCJ) (BW and DELTAH included in formulas).

Data was processed by statistical package Statistica for Windows 5.0 (StatSoft, Inc.). Basic measures of central tendency and dispersion, Pearson product-moment correlation, and t-test for independent samples were used to assess data, to produce figures, and to test main hypothesis.

Table 1: Sample of Variables.

Symbol	Designation	Formula
HSJ (cm)	Rise of center of gravity	Maximum of s(t) during flight time - Squat Jump
PSJ (W/kg)	Average concentric power	Pavg = avg (P(t)) from the time when v(t) becomes positive until takeoff
HCMJ (cm)	Rise of center of gravity	Maximum of s(t) during flight time – Countermovement Jump
FI (%bw)	Instantaneous Force	Fi = F(ecc/con transition) - Fbw
PCMJ (W/kg)	Average concentric power	Pavg = avg (P(t)) from the time when v(t) becomes positive until takeoff
STR (%)	Prestretch benefits	Effect of Prestretch [%] = (hf(CMJ) / hf(SJ) * 100%) –100%
FIBR (%FT)	Percentage Fast Twitch Fibres	Proprietary algorithm of Prof. Carmelo Bosco (estimation)
HCJ (cm)	Rise of center of gravity	Maximum of s(t) during flight time - Continuous Jumps
PCJ (W/kg)	Average concentric power	Pavg = avg (P(t)) from the time when v(t) becomes positive until take-off
KCJ (kN/m)	Leg Pseudo Stiffness	k = abs((Fi + BW) / delta h)
BW (kg)	Body Weight	Mass
DELTAH (m)	Jump height difference	s(jump start) – s(ecc/con transition)

3 RESULTS

Within all processed signals (figure 1. – example: best performance), descriptive statistics (table 2. – Whole sample, male and female), and quadratic diagram (figure 2 - results in Squat Jump presented with results in Countermovement Jump and

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Continuous Jumps.) reveal inconsistencies which were objective of the analysis.

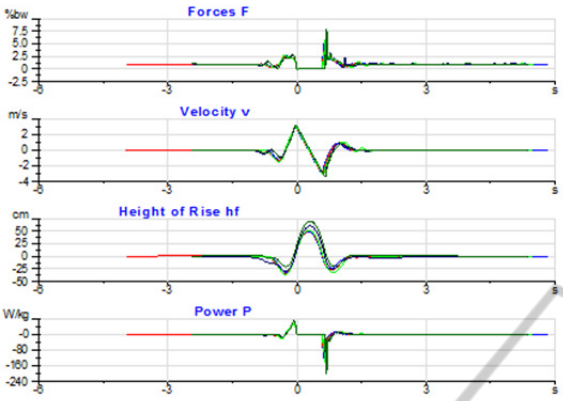

Figure 1: Signal for highest individual result (example: HCMJ = 70.1 cm).

Table 2: Descriptive statistics; T-test of differences between male and female subjects (t/p-values).

M±S	n=41	M(n=24	F(n=17)	t	p
HSJ	40,2±5,	43,5±4,	35,6±3,	5,7	0,0
PSJ	23,0±3,	23,3±2,	19,2±2,	3,7	0,0
HCM	53,2±7,	57,7±5,	46,7±5,	6,2	0,0
FI	0,97±0,	0,97±0,	0,97±0,	0,1	0,9
PCMJ	25,6±5	28,0±3,	22,3±4,	4,4	0,0
STR	33,1±8,	33,2±9,	33,0±7,	0,0	0,9
FIBR	36,2±9,	39,7±8,	31,2±7,	3,2	0,0
HCJ	39,5±6,	42±5,2	36±5,6	3,5	0,0
PCJ	41,6±6,	43,1±6,	39,5±6,	1,7	0,0
KCJ	22,3±7,	23±7,7	21,3±6,	0,7	0,4

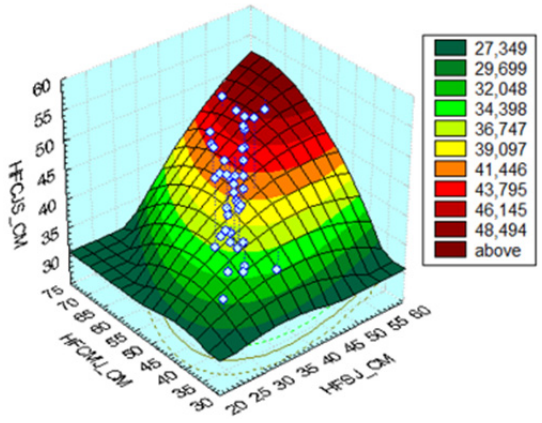

Figure 2: Quadratic surface – results of HSJ vs. HCMJ vs. HCJS.

Variables were distributed normally under theoretical Gauss distribution (K-S d=0,07-0,13, p> 0.20). Correlations between rise of center of gravity (in HSJ, HCMJ and HCJ) and average concentric power (PCMJ, PCJ) were statistically significant in range 0.52-0.83.

4 DISCUSSION

T-test (table 2.) confirmed hypothesis of existing differences in average concentric power between male and female subjects (PSJ: t=3,75, p<0,01; PCMJ: t=4,46, p<0,01; and with lower level of significance PCJ: t=1.77, p<0,08).

Indirectly, differences in concentric, eccentric and elastic component of take–off were confirmed with statistical significance in variables HSJ (t=5,76, p<0,01), HCMJ (t=6,29, p<0,01), and HCJ (t=3,50, p<0,01).

Although estimated by standard Bosco protocol, observable statistically significant difference in percentage of used fast twitching fibres FIBR (t=3,26, p<0,01) go in line with previous results.

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