Test re-test reliability for the highest counter movement jump (CMJ) with dominant, non-dominant and both legs

Participants

In the test-re-test reliability study participated a group of 12 young college students (7 females and 5 males, age 21(2.5) years; body weight 67.3(9.3) kg; body height 171(9.3) cm; recreational activity 4.8(2.5) hours per week). The testing took place in the Biomechanical laboratory 24 hours apart.

Before the testing, participants perform a **standardised five-minutes warm-up:**
Stepping on the 15 cm high bench at the pace of 88 beats per minute. The leading leg should be changed after two and a half minutes.
Followed the stretching of the main muscle groups of both legs (quadriceps, hamstrings, and calf muscle) with each stretch held no longer than 10 seconds.

Determining dominance:

Dominance is determined by the push test. The leg that performed the step is considered the dominant leg.

The order of the vertical CMJ test is usually:
first the vertical CMJ with both legs followed by the vertical CMJ with dominant leg, and finally the vertical CMJ with the non-dominant leg.

Instructions for the participants:

For the bilateral jump: Step onto the force plate with legs hip-width apart and keep arms at the crista iliaca (Figure 1).
For the unilateral jump: Step with one leg into the middle of the force plate, the other leg is held between 90 and 60 degrees of knee flexion and arms are held at the crista iliaca.
Participants are instructed to stand still on the force plate for two seconds and afterwards they receive the instruction to jump as high as they can.

Familiarisation:
Participants perform two test jumps for each jump type.

Rest periods:

There should be minimum of 20-second rest between each repetition.

Between each jump type a two-minute rest is required.

The CMJ can be divided into six phases: the stance phase, the unweighting or countermovement phase, the braking phase, the propulsion phase, the flight phase, and the landing phase. In the countermovement phase, the center of mass is first moved downward until it reaches its lowest point. During the propulsion phase, the ground reaction force is large and corresponds to acceleration. The propulsion phase begins when the concentric contraction follows the eccentric contraction. Changing the velocity from zero in the propulsion phase to a positive value in the take-off phase results in a change in momentum. The change in momentum should be maximised to generate maximum velocity during take-off. The flight phase follows the take-off phase when the jumper is in the air. The landing phase begins when the jumper touches the surface and ends with a standing position (Figure 1).

Figure 1 The unilateral vertical counter movement jump, (a) starting phase, (b) counter movement (unweighting, braking and propulsion, (c) flight, (d) landing, (e) final position.

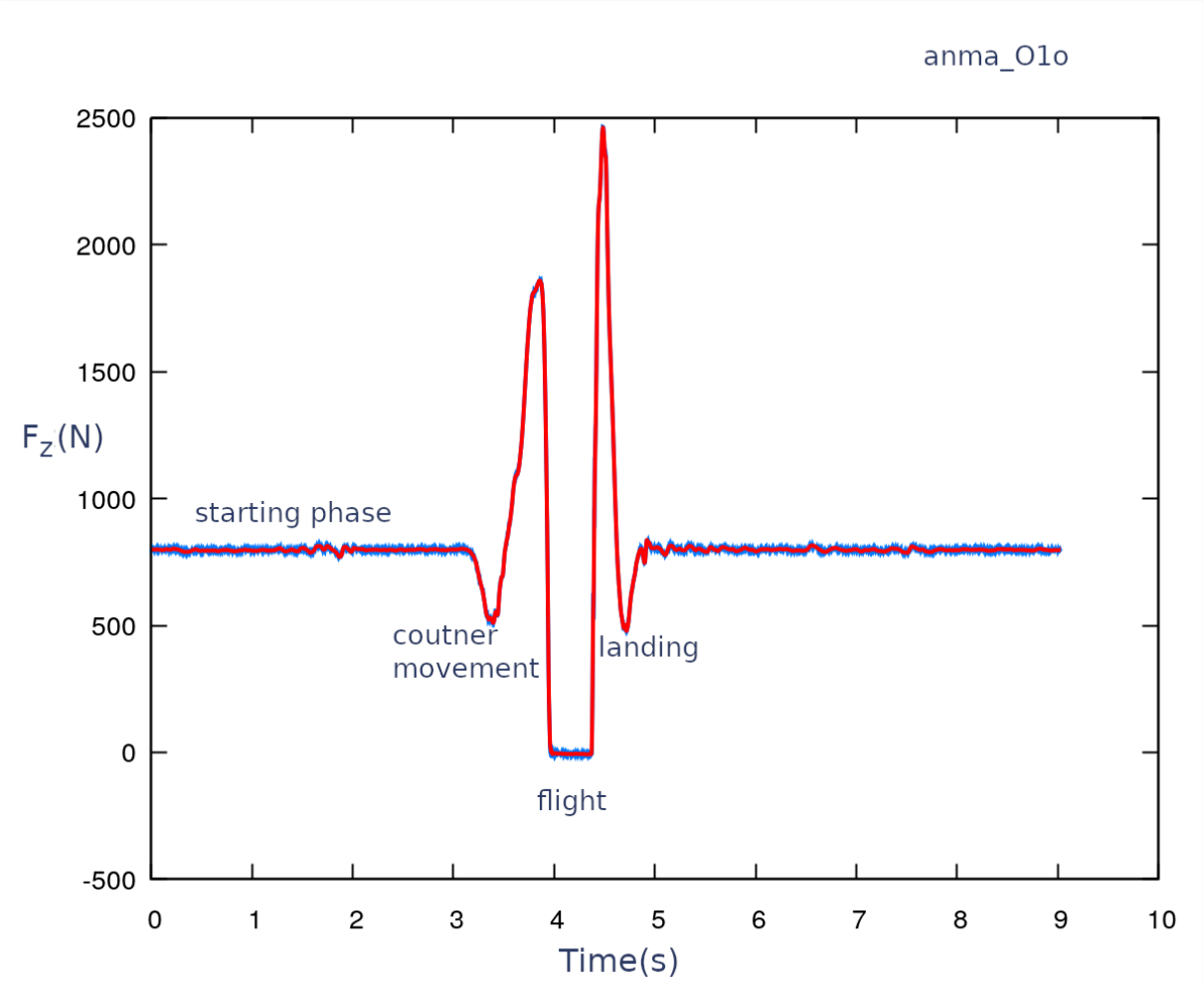

Figure 2 A typical recording of a CMJ with indicated variables that were used for analysis.

Test re-test reliability for the five CMJ variables:

Variable names as given by the program: (i) time from the beginning of the movement to flight (s); (ii) height of the jump (m); (iii) time of flight (s); (iv) energy expended (J); (v) average power (W); (vi) time to maximum force in the landing phase

CMJ variable	Ave (SD) 1st measurement	Ave (SD) 2nd measurement	95% confidence interval	**ICC (2. 1)**	p
Dominant leg					
(i) Tzac.poleta(s)	1.0411	1.0640	0.336- 0.922	**0.752**	0.002
(ii)Vvisina_skoka(m)	0.1303	0.1406	0.520- 0.972	**0.895**	< 0.001
(iii)T_v_zraku(s)	0.3235	0.3365	0.492- 0.968	**0.880**	< 0.001
(iv)Energija(J)	87.0485	93.6286	0.670- 0.984	**0.937**	< 0.001
(v)Povpr.mocP(W)	241.2937	247.1892	0.830- 0.984	**0.947**	< 0.001
(vi)Tmax(s)	0.0913	0.0797	0.164- 0.921	**0.730**	< 0.001
Non-dominant leg					
(i)Tzac.poleta(s)	1.085	1.0270	0.059- 0.860	**0.588**	0.019
(ii)Vvisina_skoka(m)	0.1292	0.1364	0.621- 0.960	**0.868**	< 0.001
(iii)T_v_zraku(s)	0.3216	0.3300	0.565- 0.952	**0.845**	< 0.001
(iv)Energija(J)	85.9400	91.1817	0.672 -0.966	**0.889**	< 0.001
(v)Povpr.mocP(W)	231.7793	247.7575	0.618 - 0.959	**0.867**	< 0.001
(vi)Tmax(s)	0.1181	0.0885	-0.380- 0.623	**0.135**	0.318
Bilateral CMJ					
(i)Tzac.poleta(s)	1.0646	1.0336	0.337- 0.920	**0.748**	0.002
(ii)Vvisina_skoka(m)	0.2836	0.2926	0.580- 0.955	**0.853**	< 0.001
(iii)T_v_zraku(s)	0.47908	0.4856	0.590- 0.956	**0.857**	< 0.001
(iv)Energija(J)	188.7869	195.9707	0.736- 0.974	**0.912**	< 0.001
(v)Povpr.mocP(W)	612.3379	636.3581	0.475- 0.942	**0.812**	< 0.001
(vi)Tmax(s)	0.0787	0.0735	-0.067 - 0.820	**0.493**	0.044

Descriptives for all variables at all three jumps

DOMINANT LEG

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	N-1-Tzac.poleta(s)	1.041167	12	.2222287	.0641519
	N-2-Tzac.poleta(s)	1.064083	12	.3050834	.0880700
Pair 2	N-1-visina_skoka(m)	.130319	12	.0344283	.0099386
	N-2-visina_skoka(m)	.140647	12	.0341275	.0098518
Pair 3	N-1-T_v_zraku(s)	.323500	12	.0420638	.0121428
	N-2-T_v_zraku(s)	.336500	12	.0399670	.0115375
Pair 4	N-1-Energija(J)	87.048543	12	28.1019711	8.1123403
	N-2-Energija(J)	93.628604	12	28.7062513	8.2867810
Pair 5	N-1-Povpr.mocP(W)	241.293766	12	112.9315989	32.6005445
	N-2-Povpr.mocP(W)	247.189206	12	120.5292716	34.7938037
Pair 6	N-1-Tmax(s)	.091333	12	.0245998	.0071014
	N-2-Tmax(s)	.079750	12	.0208376	.0060153

NON-DOMINANANT LEG

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	N-1-Tzac.poleta(s)	1.085417	12	.2896871	.0836255
	N-2-Tzac.poleta(s)	1.027083	12	.2580875	.0745035
Pair 2	N-1-visina_skoka(m)	.129265	12	.0378029	.0109128
	N-2-visina_skoka(m)	.136467	12	.0428892	.0123810
Pair 3	N-1-T_v_zraku(s)	.321667	12	.0460737	.0133003
	N-2-T_v_zraku(s)	.330000	12	.0510419	.0147345
Pair 4	N-1-Energija(J)	85.940013	12	29.5224463	8.5223962
	N-2-Energija(J)	91.181706	12	34.5362775	9.9697646
Pair 5	N-1-Povpr.mocP(W)	231.779386	12	80.8742927	23.3463973
	N-2-Povpr.mocP(W)	247.757571	12	118.7297519	34.2743271
Pair 6	N-1-Tmax(s)	.118167	12	.0726546	.0209736
	N-2-Tmax(s)	.088583	12	.0242279	.0069940

BOTH LEGS

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	N-1-Tzac.poleta(s)	1.064667	12	.2694403	.0777807
	N-2-Tzac.poleta(s)	1.033667	12	.1927468	.0556412
Pair 2	N-1-visina_skoka(m)	.283673	12	.0537847	.0155263
	N-2-visina_skoka(m)	.292654	12	.0693220	.0200115
Pair 3	N-1-T_v_zraku(s)	.479083	12	.0444716	.0128378
	N-2-T_v_zraku(s)	.485667	12	.0551285	.0159142
Pair 4	N-1-Energija(J)	188.786975	12	50.2681196	14.5111562
	N-2-Energija(J)	195.970792	12	61.7938669	17.8383528
Pair 5	N-1-Povpr.mocP(W)	612.337975	12	162.3580199	46.8687233
	N-2-Povpr.mocP(W)	636.358103	12	255.0868391	73.6372276
Pair 6	N-1-Tmax(s)	.078750	12	.0223042	.0064387
	N-2-Tmax(s)	.073500	12	.0148171	.0042773