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THE VERTICAL GROUND REACTION FORCE DURING JUMP LANDINGS OF PARKOURISTES

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SUMMARY
The aim of this study is to analyze the vertical ground reaction force generated by the drop jump performed by parkouristes. The participants drop from five different heights (20, 40, 60, 80, 100 cm) onto a force platform. From the vertical ground reaction force (vGRF) during the impulse and landing phases of the drop jump, it was calculated some parameters related to intensity and time.

INTRODUCTION
The summation of internal forces results from the external need for the impulsion and absorption mechanical energy and it affects the performance during several motor actions. This summation depends on neuromuscular capacity to absorb the external forces and generate muscles forces [1]. The sport training changes the biomechanical and neuromuscular properties of the muscle. However, there is no information about the effects of parkour training to the biomechanics of lower limb. The aim of this study is to analyze the vGRF generated by the drop jump performed by parkouristes.

METHOD
The participants were nine young male parkouristes (68.9±14.7 kg mass, 1.70±0.07 m height, 20.1±1.3 years old) and eight physically active young male (75,0±9,56 kg weight, 1.75±0.04 m height, 24.8±4.6 years old). The inclusion criterion for the Parkour group was to practice parkour for more than one year. The inclusion criterion for the Control group was to not be sedentary (less than practicing any kind of exercise or sport 3 time/week,30min each session). The exclusion criteria for the both groups were 1) to have any lower limb injury; 2) not be able to perform 30 drop jumps without feeling pain, soreness or fatigue.

The participants performed the drop jump from five different heights (20, 40, 60, 80, 100 cm). For each height, they performed three drop jumps. The order of the heights was random across the participants. Between each height, the participant took one minute rest. The participants drop onto a force platform (BP600900, AMTI USA). The ground reactions forces during the propulsion and landing phases of the drop jump were recorded. The sampling frequency was 1 kHz.

It was calculated the propulsion and landing peak forces, the propulsion and landing impulses, the time to each peak force and the flight time. For each variable, a one-way ANOVA (height) was run. Besides, a regression linear model was run between the variables and height.

RESULTS AND DISCUSSION
During the propulsion phase, the kinetic variables were affected by group ($F_{(1,253)}>18$ $p<0.001$) and stair height level ($F_{(1,253)}>11$ $p<0.001$) and time-force were also affected by group ($F_{(1,253)}>51$ $p<0.001$) and stair height level ($F_{(1,253)}>28$ $p<0.001$). The highest propulsion peak force, propulsion impulse and force-time propulsion peak force occurred for the control and at the 5th stais level. The shortest time for the propulsion peak was observed for the control group and the 4th and 5th stair level.

During the landing phase, only group affected the landing peak force ($F_{(1,253)}=209$ $p<0.001$), propulsion ($F_{(1,253)}=40.2$ $p<0.001$), the force time rate for the landing peak force ($F_{(1,253)}=211$ $p<0.001$). The highest landing peak force and force time rate for the landing peak were observed for the control group; while the highest landing impulse was observed for the parkour group.

The flight time was affected by group ($F_{(1,253)}=78.7$ $p<0.001$). The longest flight time was observed for the parkour group. Although, the parkour group has had the lowest kinetic variables during the propulsion phase, they had longer flight time. And as a consequence, their landing impulse was also larger than the control group. During the flight phase, any body segments rotations reduces the total body momentum and therefore decreases the flight time. Probably, the parkouristes uses a different coordination strategy during the flight phase to keep the body more time on the air. Therefore, that is why they might reach a highest position.

CONCLUSIONS
The Parkour group showed different results for the ground reaction force during drop and jump test. They showed more

flight time, but smaller propulsion impulse and peak force compared to the Control Group.

REFERENCES

1- ISHIKAWA M, KOMI PV. Effects of different dropping intensities on fascicle and tendinous tissue behavior during stretch-shortening cycle exercise. *J Appl Physiol. 2004;96(3):848-52.*

Table 1 – Mean and standard errors of kinetic and force-time parameters during drop and jump test.

	Group	Stair level (m)	Peak (N)	Impulse (N.s)	Time-force rate (kN/s)	Flight time (s)
Propulsion phase	**Parkour**	**0.2**	2951.1 ± 211.7	516.8 ± 27.4	22.7 ± 7.1	0.083 ± 0.012
		0.4	3035.3 ± 211.7	555.1 ± 27.4	25.1 ± 7.1	0.083 ± 0.012
		0.6	3270.5 ± 211.7	589.1 ± 27.4	34.1 ± 7.1	0.084 ± 0.012
		0.8	3425.3 ± 211.7	630.8 ± 27.4	47.6 ± 7.1	0.082 ± 0.012
		1	3774.2 ± 211.7	666.8 ± 27.4	62.9 ± 7.1	0.089 ± 0.012
	Control	**0.2**	2532.4 ± 229.4	572.2 ± 29.7	31.0 ± 7.6	0.100 ± 0.013
		0.4	3160.1 ± 224.5	626.7 ± 29.1	66.3 ± 7.5	0.058 ± 0.013
		0.6	3951.6 ± 224.5	673.5 ± 29.1	96.2 ± 7.5	0.058 ± 0.013
		0.8	4704.6 ± 224.5	719.8 ± 29.1	122.8 ± 7.5	0.055 ± 0.013
		1	5121.4 ± 224.5	775.3 ± 29.1	136.2 ± 7.5	0.055 ± 0.013
Landing Phase	**Parkour**	**0.2**	2418.8 ± 196.7	674.6 ± 32.6	32.2 ± 5.4	
		0.4	2458.6 ± 196.7	642.8 ± 32.6	32.7 ± 5.4	
		0.6	2439.6 ± 196.7	671.0 ± 32.6	30.8 ± 5.4	
		0.8	2605.1 ± 196.7	646.0 ± 32.6	32.6 ± 5.4	
		1	2508.6 ± 196.7	642.5 ± 32.6	30.3 ± 5.4	
	Control	**0.2**	4365.8 ± 213.1	585.9 ± 35.3	77.1 ± 5.9	
		0.4	4442.4 ± 208.6	496.0 ± 34.6	82.2 ± 5.8	
		0.6	4006.9 ± 208.6	498.1 ± 34.6	74.8 ± 5.8	
		0.8	4530.9 ± 208.6	518.0 ± 34.6	94.2 ± 5.8	
		1	4393.5 ± 208.6	503.0 ± 34.6	90.8 ± 5.8	