ISB 2013 BRAZIL
XXIV CONGRESS OF THE INTERNATIONAL SOCIETY OF BIOMECHANICS
XV BRAZILIAN CONGRESS OF BIOMECHANICS

EFFECTS OF BAREFOOT RUNNING IN THE VERTICAL GROUND REACTION FORCE IN MEN

[1,2] Thiago Toshi Teruya, [1]Fernanda de Ávila Amaral, [3]Bruno Mezêncio, [3]Julio Cerca Serrão, [3]Alberto Carlos Amadio and [1]Luis Mochizuki
[1]Escola de Artes, Ciências e Humanidades, Universidade de São Paulo, mochi@usp.br
[2]Marcos Paulo Reis Assessoria Esportiva
3Escola de Educação Física e Esporte, Universidade de São Paulo

SUMMARY
The aim this study was to evaluate the effects of barefoot running in the neuromuscular activation and inhibition in young adults males. The participants performed drop and jump test from different stair heights and run. After they performed drop and jump test again.

INTRODUCTION
Running has been practiced and gain many followers in Brazil. The number of running races and runners increase every year. The barefoot running is a controversial topic and is associated with several controversies. There is limited information and evidences about acute effects of barefoot running for shod runners and sedentary people. The aim this study was to evaluate the effects of barefoot running in the neuromuscular activation and inhibition in young adults males.

METHODS
Eight shod runners males participated of this study (75,0±9,56 kg weight, 1,75±0,04 m height and 24,8±4,64 years old). They were not adapted for the barefoot running. All participants accepted the conditions of the study. They performed the drop and jump test from 5 different stair heights (0.2, 0.4, 0.6, 0.8 and 1.0 m height) and landed on a force platform (0.6 x 0.9 m, BP600900 model, AMTI) barefoot. The participants were randomly separated into shoes (79,9±5,35 kg weight, 1,76±0,01 m height and 23,75±2,5 years old) and barefoot groups (71,0±11,91 kg weight, 1,73±0,06 m height and 26,0±6,37 years old).
The ground reaction forces (GRF) and forces moments during the propulsion and landing phases of the drop and jump test were recorded at 1 kHz sampling frequency. The participants performed the drop and jump test immediately before and after the exhaustion protocol.
For the exhaustion protocol, each participant (with or without shoes) ran on a treadmill until they were not able to pace the treadmill speed. The initial speed was 2 km/h and the initial inclination was zero. Every 37.5 s the speed increased 1 km/h and the inclination increased 1%. The exhaustion test ended up when the he was not able to run on the treadmill under the ongoing speed and inclination conditions. All the participants reported their feelings about exhaustion and lower limb pain.
Some parameters of the vertical GRF signal were analyzed: propulsion and landing force peaks, the time to reach each peak, the propulsion and landing impulses from the foot contact until the peak, the flight time and the GRF time rate during propulsion and landing phases. The three-way ANOVA was applied to check the effect of stair height, group and exhaustion.

RESULTS AND DISCUSSION
The flight time was only affected by exhaustion ($F_{(1,238)}$=36.4 $p<0.001$). The group affected the kinetic variables ($F_{(1,238)}$>29 $p<0.001$) and the time-force variables ($F_{(1,238)}$>4 $p<0.04$). Only during propulsion phase, the stair height level affected the kinetic variables ($F_{(4,238)}$>22 $p<0.001$) and time-force variables ($F_{(4,235)}$>28 $p<0.001$). Exhaustion affected the propulsion peak force ($F_{(1,238)}$=8.5 $p=0.004$), the time to the propulsion peak force ($F_{(1,238)}$=11.3 $p<0.001$), and time force rates during the propulsion ($F_{(1,238)}$=10.4 $p<0.001$) and landing phases ($F_{(1,238)}$=7.1 $p=0.008$). The post hoc test Tukey showed that the highest propulsion peak occurred before the exhaustion, for the 4th and 5th stair heights and for the shoes group. The highest propulsion impulse was observed for the highest stair and barefoot group. The highest landing peak force occurred for the shoes group. The highest landing impulse was produced by the barefoot group. The flight time decreased with the exhaustion. The highest force-time rate for the propulsion peak occurred after the exhaustion, for the 4th and 5th stairs level, and for the shoes group. The highest force-time rate for the landing peak occurred after the exhaustion and for shoes group. The shortest time to the propulsion peak force occurred after exhaustion, for the 4th and 5th stair levels and for the shoes group. The shortest time to the landing peak force occurred for the shoes group. Exhaustion decreases the jump height and the propulsion peak force and increases the force-time rates. Running barefoot decreases the force peaks and the force-time rates but increases the impulse. There are few studies about the acute effects of barefoot running and about in the neuromuscular activation and inhibition. Some studies suggest that strength exercises do not affect performance in plyometric jumps and flexibility exercises can affect the performance in plyometric jumps [1].

CONCLUSIONS

Running barefoot leads to different biomechanical behavior during the drop and jump test compared to shod running. Two biomechanical strategies were found for the barefoot runners: lowering the ground reaction force and increasing the impulse.

REFERENCES

1. GONZÁLEZ-RAVÉ JM, et al. Acute effects of heavy-load exercises, stretching exercises, and heavy-load plus stretching exercises on squat jump and countermovement jump performance. *Journal of Strength and Conditioning Research*. 23 (2):472-479 2009.

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

Stair level (m)		Peak force (N)		Impulse (N.s)		Flight time	Time force rate	
Barefoot		Propulsion	Landing	Propulsion	Landing		Propulsion	Landing
0.2	pré	2062.4 ± 255.4	3976.8 ± 313.3	641.9 ± 33.2	683.1 ± 45.3	0.53 ± 0.02	13880.3 ± 11873.4	62764.3 ± 11254.5
	pós	3045.1 ± 266.7	4790.2 ± 327.2	496.2 ± 34.7	479.9 ± 47.3	0.55 ± 0.02	49711.3 ± 12401.3	92746.2 ± 11754.9
0.4	pré	2394.8 ± 255.4	4210.7 ± 313.3	727.0 ± 33.2	605.2 ± 45.3	0.53 ± 0.02	36411.3 ± 11873.4	74221.4 ± 11254.5
	pós	3925.4 ± 255.4	4674.1 ± 313.3	526.3 ± 33.2	386.7 ± 45.3	0.54 ± 0.02	96378.4 ± 11873.4	90354.5 ± 11254.5
0.6	pré	3477.3 ± 255.4	3811.9 ± 313.3	751.6 ± 33.2	598.1 ± 45.3	0.53 ± 0.02	81092.0 ± 11873.4	69098.0 ± 11254.5
	pós	4426.0 ± 255.4	4202.0 ± 313.3	595.3 ± 33.2	398.1 ± 45.3	0.55 ± 0.02	111449.1 ± 11873.4	80543.0 ± 11254.5
0.8	pré	4446.2 ± 255.4	4090.3 ± 313.3	805.6 ± 33.2	545.5 ± 45.3	0.52 ± 0.02	114467.6 ± 11873.4	91623.3 ± 11254.5
	pós	4962.9 ± 255.4	4971.5 ± 313.3	634.0 ± 33.2	490.4 ± 45.3	0.56 ± 0.02	131153.9 ± 11873.4	96931.7 ± 11254.5
1.0	pré	4675.0 ± 255.4	3978.5 ± 313.3	870.0 ± 33.2	573.1 ± 45.3	0.54 ± 0.02	115138.2 ± 11873.4	82932.6 ± 11254.5
Shoes								
	pós	5567.9 ± 255.4	4808.6 ±313.3	680.7 ± 33.2	433.0 ± 45.3	0.56 ± 0.02	157367.6 ± 11873.4	98737.4 ± 11254.5
0.2	pré	2309.0 ± 255.4	4228.3 ± 313.3	632.1 ± 33.2	600.7 ± 45.3	0.49 ± 0.02	71693.3 ± 11873.4	99723.1 ± 11254.5
	pós	3109.3 ± 255.4	4927.2 ± 313.3	461.5 ± 33.2	460.8 ± 45.3	0.48 ± 0.02	41517.7 ± 11873.4	107171.9 ± 11254.5
0.4	pré	2676.4 ± 255.4	4072.3 ± 313.3	707.1 ± 33.2	452.8 ± 45.3	0.49 ± 0.02	59557.6 ± 11873.4	79503.3 ± 11254.5
	pós	4373.0 ± 255.4	4726.2 ± 313.3	505.5 ± 33.2	439.2 ± 45.3	0.47 ± 0.02	101812.2 ± 11873.4	110883.8 ± 11254.5
0.6	pré	3715.9 ± 255.4	4242.0 ± 313.3	741.7 ± 33.2	581.2 ± 45.3	0.50 ± 0.02	86257.6 ± 11873.4	94057.4 ± 11254.5
	pós	5086.9 ± 255.4	4917.2 ± 313.3	540.7 ± 33.2	448.2 ± 45.3	0.47 ± 0.02	128278.6 ± 11873.4	111288.3 ± 11254.5
0.8	pré	4678.7 ± 255.4	3917.9 ±313.3	792.7 ± 33.2	502.5 ± 45.3	0.48 ± 0.02	125701.7 ± 11873.4	79643.8 ± 11254.5
	pós	5509.2 ± 255.4	4639.5 ± 313.3	603.6 ± 33.2	468.6 ± 45.3	0.50 ± 0.02	151478.1 ± 11873.4	109639.1 ± 11254.5
1.0	pré	5063.2 ± 255.4	3639.0 ± 313.3	843.8 ± 33.2	486.3 ± 45.3	0.48 ± 0.02	131982.7 ± 11873.4	65252.8 ± 11254.5
	pós	5814.5 ± 255.4	5097.4 ± 313.3	646.1 ± 33.2	444.6 ± 45.3	0.50 ± 0.02	181096.5 ± 11873.4	118027.1 ± 11254.5