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## INFLUENCE OF THE GENDER ON IMPACT FORCES IN RUNNERS WITH PLANTAR FASCIITIS

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### SUMMARY

Higher mechanical load on heel in patients with plantar fasciitis has been well-described in the current scientific literature. This excessive load and plantar fascia stretching promote thickening and inflammatory responses [3,4] followed by degeneration and fragmentation of the plantar fascia [6]. However, Huerta and Garcia (2007) [7] found that asymptomatic men have greater thickness of the plantar fascia at its insertion (calcaneal) than women. This anatomical disadvantage of the plantar fascia in female associated with a higher vertical force, commonly received during running practice, could accelerate the onset of plantar fasciitis in women compared to men. Poh *et al.* (2009) [8] found that female runners with plantar fasciitis have higher rates of vertical force. However, the authors emphasize the importance of studies with men, given the high prevalence of plantar fasciitis in male runners [9]. Thus, the objective of this study was to investigate the influence of gender on the impact forces during running in runners with plantar fasciitis. Forty-five male ( $n=24$ ) and female ( $n=19$ ) runners with plantar fasciitis were studied. The plantar pressure was evaluated by Pedar X system during running in a 40 meters track at  $12\pm 5\%$  km/h. No differences were found between the groups (female and male) for the impact rates (20-80% of the 1<sup>st</sup> vertical peak; 0-100% of the 1<sup>st</sup> vertical peak) and maximum force in rearfoot, midfoot and forefoot ( $p > 0.05$ ). It is concluded that gender difference did not affect the pattern of plantar loading and impact forces during running in runners with plantar fasciitis.

### INTRODUCTION

It is notable in the current scientific literature the importance given to clinical research of plantar overload, particularly in the region of the calcaneus in patients with plantar fasciitis, one of the primary risk factors to your development [1,2]. The general agreement in the literature is that the mechanical overload on the calcaneus and the excessive stretching of the plantar fascia, promotes thickening of the fascia, which initiates an acute inflammatory response [3,4]. The repetitive impact of the heel can hinder and prevent the normal healing tissue [5], resulting in a chronic process followed by degeneration and fragmentation of the plantar fascia without inflammatory response [6].

Huerta and Garcia (2007) [7] found that asymptomatic men have greater thickness of the plantar fascia at its insertion (calcaneal) than women. This anatomical disadvantage of the plantar fascia (less thick at its insertion) in females associated with higher vertical forces could accelerate the onset of plantar fasciitis in women runners compared to men. Poh *et al.* (2009) [8] found that women runners with plantar fasciitis have higher rates of vertical force. However, the authors emphasize the importance of studies with men given the high prevalence of plantar fasciitis in male runners [9]. Therefore, the present study aimed to answer the following question: Would women with plantar fasciitis present higher plantar loads than men during running? Thus, our objective was to investigate the influence of gender on the load rate of the foot during running in runners with plantar fasciitis.

### METHODS

Forty-five runners with plantar fasciitis were evaluated: female ( $n=19$ ) and male ( $n=24$ ). The plantar pressure was evaluated by Pedar X system during running in a 40 meters track at  $12\pm 5\%$  km/h. Runners used a standardized neutral running footwear. All runners exhibited a heel strike pattern of running. The load rate (body weight per seconds) was defined and calculated as the load rate between 20-80% and 0-100% of the time of the first peak of the vertical force. All variables were normalized by the body mass. To analyze the plantar loads, the maximum normalized force was calculated in a temporal series in three plantar areas: rearfoot, midfoot, and forefoot. The data were processed in a custom written Matlab function. Groups were compared by repeated measures ANOVA, followed by Tukey post hoc test ( $p < 0.05$ ).

### RESULTS AND DISCUSSION

No differences between groups (female and male) were found for demographic and anthropometric characteristics (Table 1). As shown in Table 2 and 3, no significant differences were found between groups regarding impact forces (20-80%; 10-100%) and maximum force over the rearfoot, midfoot and forefoot ( $p > 0.05$ ).

Table 1: Descriptive statistics (means±SD) and comparisons between groups regarding their demographic anthropometric and training characteristics.

Variables	Females (n=19)	Males (n=24)	p-values
Age (years)	44.0±9.1	46.0±7.0	0.188
Body mass (kg)	57.8±9.5	78.0±9.2	0.200
Height (m)	1.58±6.1	1.76±4.6	0.100
Body mass index (kg/m <sup>2</sup> )	23.4±2.9	25.5±2.0	0.304
Training volume (Km/week)	39.0±9.8	43.0±10.0	0.210
Practice time (years)	6.3±4.0	7.4±5.5	0.160

ANOVAs one-way. Statistical difference  $p < 0.05$ .

Table 2- Mean, standard deviation and comparison between groups in load rate of the foot during running.

Variables	Females	Males	p-valor
Load rate (20 -80%) (BW/s)	0.81±0.17	0.77±0.22	0.764
Load rate (0-100%) (BW/s)	1.18±0.34	1.01±0.26	0.147

ANOVAs one-way. Statistical difference  $p < 0.05$ .

Table 3- Mean, standard deviation and comparison between groups of maximal vertical forces during running.

Variable	Group	Rearfoot	Midfoot	Forefoot
force (N)	Female	1.39±0.32	0.47±0.20	1.58±0.62
	Male	1.24±0.42	0.45±0.12	1.39±0.28
	p	0.280	0.851	0.254

ANOVAs one-way. Statistical difference  $p < 0.05$ .

The relevance of this study was to understand that injuries such as plantar fasciitis are not affected by gender regarding the plantar loads. Contradictorily, Queen *et al.* (2010) [10] observed that men without any injury on the feet have a higher maximum force in midfoot and forefoot regions when compared to female. Our hypothesis that the impact forces could be higher in female and this accelerate the risk of onset of plantar fasciitis (due to lesser thickness of the plantar fascia) [7] was not confirmed. In this study, the inflammatory process of the plantar fascia (fasciitis) did not show changes between gender on the variables of impact forces. A possible explanation for these findings may come from a recent study Fukano and Fukubayashi (2011) [11] that described a greater dynamic mobility of the plantar arch in females compared to males. This may have minimized a possible increase in the impact forces over the heel in females, which resulted in a similar load pattern in both genders during running. Further studies are needed with more focus on the dynamic extensibility of the plantar fascia between men and women in the presence of injuries such as plantar fasciitis.

## CONCLUSIONS

The gender difference did not affect the pattern of plantar loading and impact forces during running in runners with plantar fasciitis.

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