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INVESTIGATIONS ON *IN VIVO* HUMAN HEEL PAD THICKNESS

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Introduction

The human heel pad thickness is one of the intrinsic factors which must be taken into account when investigating the biomechanics of the heel pad [Rome, 1998; Uzel, 2006]. In fact, heel pad thickness has been reported to be an important factor in determining stresses observed in healthy as well as pathological feet [Rome, 1998; Uzel, 2006]. Furthermore, the heel pad compressibility index (HPCI), indicating the ability of the heel pad to be compressed, is also an important parameter.

Methods

134 healthy subjects (66F, 68M) were enrolled in the present study. All participants were volunteers. The subject characteristics are shown in Table 1. For each subject the dominant foot was scanned, in both loaded and unloaded conditions with a 14 MHz 3D US (LogicE9, GE Healthcare). In unloaded condition the subject was lying down. In loaded condition the subject was standing on a Plexiglas platform with all the body weight on the dominant foot. The scan was made through the Plexiglas plate. The heel pad thickness was measured from 3D-block in the acquisition plane. The HPCI was then found as [Kanatli, 2001, Prichasuk, 1994; Prichasuk et al., 1994]:

$$HPCI = LHPT/UHPT \quad (1)$$

The statistical analysis was performed with the program R. A linear regression model was fitted to the data to investigate whether there was a correlation between HPCI and the intrinsic factors: age, gender, weight, height and duration of physical activity. The model included HPCI as a response variable and the intrinsic factors as explanatory variables. In the linear regression model the significance of each factor was evaluated by using the sum of squares. A P-value <0.05 was chosen as significant.

	All	Females	Males
Age (years)	36.0±14.4	36.7±14.4	36.6±14.4
Weight (kg)	71.7±13.7	64.2±9.2	79.2±12.8
Height (m)	173.7±9.8	166.8±5.7	180.4±8.3
BMI (kg/m^2)	23.6±3.1	23.0±2.7	24.3±3.3
Sport (h/week)	3.9±3.9	4.7±4.1	3.3±3.6

Table 1: Characteristics grouped according to the gender given as mean ± SD.

Results

The linear regression model showed that gender (P-value=0.048) and interaction between gender and age (P-value=0.029) were statistically significant, while age was not a significant variable (P-value= 0.444). Table 2 shows results for UHPT, LHPT and HPCI. A statistically significant difference between males and females was found in weight, height and hours of physical activity (P-value<0.05), while no statistically significant difference in age and BMI was found (P-value>0.05). A statistically significant difference between males and females was found in UHPT and LHPT (P-value=0.0006 and 0.007, respectively), while no statistically significant difference was found in HPCI (P-value= 0.889).

	Females	Males
UHPT (mm)	14.59±2.02	15.80±1.88
LHPT (mm)	8.65±1.55	9.35±1.47
HPCI (%)	59.29±6.94	59.30±7.38

Table 2: Results grouped according to the gender given as mean ± SD.

Discussion

Literature shows discordant results when dealing with heel pad biomechanics. The main reasons are the different methodologies applied and the different number of subjects investigated. Our study confirms that the interaction between gender and age plays a significant role on HPCI, as indicated by [Ozdemir, 2004]. [Prichasuk, 1994; Prichasuk et al., 1994; Hsu, 1998; Turgut, 1999] reported that age has a significant effect on HPCI, while [Prichasuk et al., 1994; Turgut, 1999; Ozdemir, 2004] indicated the weight as a significant factor.

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