Musculoskeletal markers in the toes: population data from early twentieth century, Lisbon, Portugal

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Introduction

Hypertrophy of the ligaments' and tendons' insertion in bone due to continued mechanical stress is usually referred to as Musculoskeletal Stress Markers (MSM) (Weiss, 2003). They have been used to reconstruct past lifestyles of populations and activity patterns (Hawkey and Merbs, 1995). However, the relation between activity patterns and MSM is not well understood (Weiss, 2003). Differences between sex and age groups are well documented. In most studied samples, males have greater MSM than females and older individuals have greater MSM (Weiss, 2003).

This study wishes to determine the frequency of ridges of tendon attachment (digital flexors) on the medial and lateral sides of the proximal phalanges of the lateral four toes and tentatively associate the presence of the ridges with sex, age and occupation.

Materials and Methods

Sample

The studied sample comprises 197 individuals drawn from the Lisbon Identified Skeletal Collection (National Museum of Natural History, Lisbon, Portugal). Ages range from 18 to 94 years (98 males, 99 females) (Fig 1. - sex and age). All individuals were born in Portugal and are from an early twentieth century urban population.

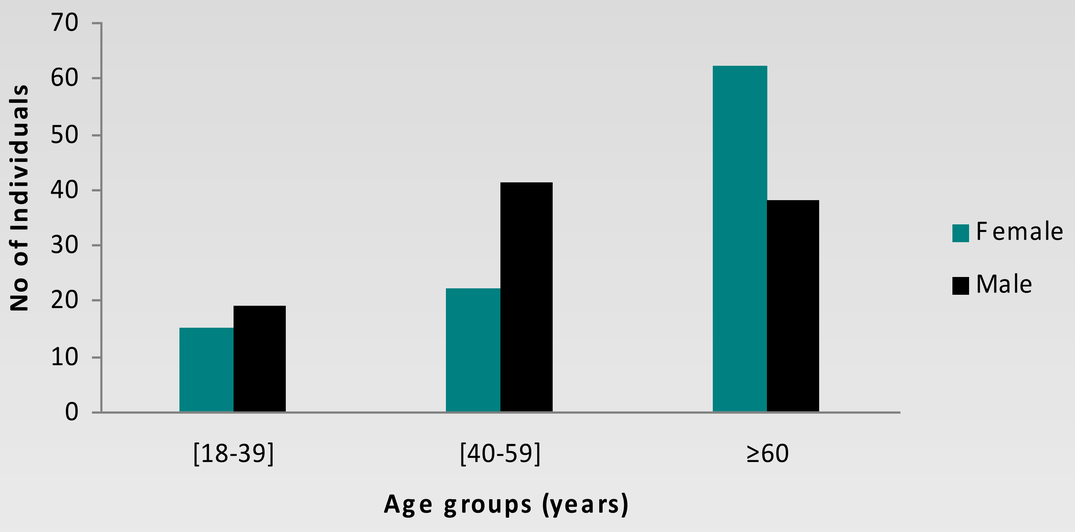

Figure 1. Age and sex distribution of the sample (males, 102; females, 103).

Recording of the ridges

All available proximal pedal phalanges (from the second to the fifth toe) were observed macroscopically on the medial and lateral sides. Ridges were recorded as present or absent (Fig.2). Phalanges were not sided.

Figure 2. Proximal pedal phalanges (plantar view). **A** - phalanges showing the ridges of tendon attachment (digital flexor) on the medial and lateral sides (arrows). **B** –phalanges without ridges.

Analysis

Skeletal preservation was calculated as the mean percentage of observed phalanges out of the total number of expected phalanges, from the second to fifth toe.

Prevalence was calculated as the percentage of individuals showing ridges at least in one phalange. Frequency was calculated as the percentage of phalanges with ridges out of the total number of observable phalanges. Prevalence and frequency were determined for each sex, age group ([18- 39]; [40-59]; ≥60 years) and male occupational category (manual/non-manual). Since age distributions were not identical between sexes and occupational groups, prevalences and frequencies were age-adjusted: female age distribution was adjusted to the male age distribution; non-manual age distribution was adjusted to the manual age distribution.

Sex and age differences in prevalence and frequency were assessed using contingency tables. The effect of occupational category was not evaluated for females, because they are mostly *doméstica* (housewives/housekeepers).

Results

- Skeletal preservation was 54.2% out of the total expected phalanges.
- Frequency and prevalence:
  - are higher in the male sample than in the female sample (Tab.1);
  - tend to be higher in older age groups (Tab. 2);
  - do not differ between male occupational categories (Tab. 3).

Table 1. Frequency and prevalence for female and male samples

	Male (%)	Female (%)	
		Unadjusted	Adjusted
Frequency**	46.9	36.6	33.2
Prevalence*	73.5	61.6	60.0

* p<0,05
** p<0,01

Table 2. Frequency and Prevalence in age groups

		[18-39]	[40-59]	≥60
Male (%)				
	Frequency**	38.9	36.3	61.0
	Prevalence	73.7	65.9	81.6
Female (%)				
	Frequency**	13.2	32.1	43.9
	Prevalence**	26.7	68.2	67.7

* p<0,05
** p<0,01

Table 3. Occupational categories frequency and prevalence (males)

		Manual (%)	Non manual (%)
[18-39]			
	Frequency	50,0	29.4
	Prevalence	77.8	66.7
[40-59]			
	Frequency	33	39.7
	Prevalence	57.1	65.0
≥60			
	Frequency	61.7	55.8
	Prevalence	86.7	87.5
All ages			
	Frequency	47.0	43.9
	Prevalence	71.1	72.8

* p<0,05
** p<0,01

Discussion and Conclusion

We found differences in prevalence and frequency between males and females, and between age groups, but no differences were found between occupational categories. These results may have been influenced by low preservation or incompleteness of skeletons. However, there is no reason to suspect that preservation affects phalanges with these skeletal changes differently.

Reported higher prevalence and frequency of the ridges in males than in females can be explained by differential occupational activities: usually men have physically more demanding activities (Weiss, 2003).

Enthesopathies are often the result of mechanical stress in the bone (Weiss, 2003) but can also be caused by inflammatory or degenerative diseases (Benjamin *et al.*, 2002). Even though these diseases can affect all age groups, they are usually more prevalent in older individuals (Marques, 2007). This fact may explain the higher prevalence and frequency of the reported enthesopathies in older individuals.

Prevalences and frequencies do not seem to differ between occupational categories (manual/non-manual). This is probably due to the fact that this specific skeletal marker results from a combination of day-to-day activities which involve flexing the toes: digital flexors are concerned in producing the thrust from the toes when demand arises, such as walking, running or climbing stairs (Palastanga *et al.*, 2006). These changes have previously been described as a structural reinforcement of the diaphysis, resulting from an adaptation to preserve the strength of the bone (Kohler *et al*., 1993). The value of these infrequently reported specific skeletal changes to determine past activity patterns is limited, since they seem to be unreliable as sources of information about any specific activity. Nonetheless, results indicate a relatively high frequency of these changes in a modern type urban population which may serve as comparative data for other contemporaneous or archaeological populations and aid in the future understanding of its origin and development.

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