RACIAL AND GENDER COMPARISON OF ANTHROPOMETRIC PARAMETERS OF THE FOOT

J.A. Akambase, T.V. Kokoreva, O.A. Gurova

Department of Human Anatomy, RUDN University, Moscow, Russia

ABSTRACT — This paper takes a new look at the anthropometric parameters of the foot in relation to gender and racial differences. A total of 274 feet of African and European young men and women were examined. Anthropometric parameters of the foot were measured and the foot arches determined using the Shtriter index. In conclusion, we have obtained comprehensive results proving racial and gender differences in anthropometric parameters of foot. We have confirmed that in terms of race or gender, Africans or men are prone to developing flatfoot whilst Europeans or women — high arched foot.

KEYWORDS — parameters, African, European, women, men, race, gender.

INTRODUCTION

The architecture of the human foot has been identified as being complex and has over the years transformed to adapt to different environmental (external) and internal conditions. The foot plays a major role to support the body weight during standing position and also serves as a lever to propel the body forward during movement [1]. The Medial Longitudinal Arch (MLA), the lateral longitudinal arch (LLA), the anterior transverse arch (ATA) and the posterior transverse arch (PTA) constitute the arches of the foot [1]. Anthropometry is the branch of ergonomics that deals with body shape and size. The parts of the human body varies in size and in shape, thus, there is a need to take these variations into consideration whenever a product is designed for their use. The absence of the application of ergonomics principles could result musculoskeletal disorders [2]. In our opinion, the knowledge and understanding of anthropometric parameters of the foot could be relevant in the field of preventive medicine, orthopedics and traumatology, sports medicine, forensic medicine and education.

MATERIAL AND METHOD

A total of 137 healthy young Africans (37 women, 32 men) and Europeans (38 women, 30 men) were consecutively recruited for this cross-sectional study at the medical institute of RUDN University. The participants were between the ages of 18 and 27. Participants who had recently gone through surgery on their foot were exempted. The study and all matters relating to it was done following good clinical practice. All participants, meeting the inclusion criteria voluntarily agreed to join the study and signed an informed consent before being enrolled.

Anthropometric measurement

The subjects' height and weight were obtained using a stadiometer and electronic bathroom scale respectively. Using the formula: weight (kg) divided by square of the height in meter, the Body mass index (BMI) of each subject was calculated. Pedigraphy was used to obtain the footprints of the participants following methods as used by Muzurova L.V. and Kochelaevskaya I.E. [3]. In brief, the subjects were requested to stand upright on the platform of the pedigraph for at least 5 minutes so that the total weight of the body would be evenly distributed across the feet. Next, the investigator helps the participant to get back to sitting position. The investigator controls the foot position on the platform so as to prevent foot slip, a fact that would invalidate the test. In full weight bearing, footprints of both feet were imprinted on A3 sheet using non-irritant blue ink. From the footprints as shown in (Figure 1a.), the following anthropometric parameters were measured from the footprint using a meter rule: Foot Length (FL) L-M, Foot Width D-E, Length of Medial Longitudinal Arch (LMLA) O-G, Length of Lateral longitudinal arch (LLLA) O-F, Width of Anterior Transverse arch (WATA) F-G, and Width of Posterior Transverse arch A-C (WPTA).

The shtriter index

The shtriter index method was used to distinguish the various foot arches (forms of foot) by determining the heights of foot arches. This was achieved by drawing a line tangential to point E and V. Then, a perpendicular line (A-B) is drawn from the mid-point (point B) of the line E-V to the outer lateral edge, point A. Line A-C is marked between point C (which is the intersection between the inner medial edge of the footprint in the arch area and line A-B) and point A, as shown in Figure 1a.

Formula in calculating shtriter index:

Shtriter index = (AC/AB) × 100%

Hence, base on the value of the shtriter index, the foot can be grouped into the following category:

1) Very high-arched foot — 0–36%;

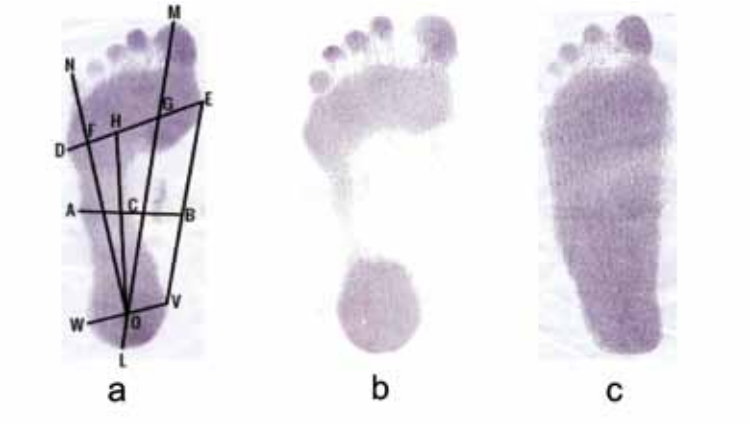

Fig. 1. a – Plantogram / Normal Arched foot; b – High-Arched foot; c – Flatfoot

2) High-arched foot — 36.1–43%;
3) Normal-arched foot — 43.1–50%;
4) Low-arched foot — 50,1–60%
5) Flat-arched foot (flatfoot) — 60.1–70%

Flattening Index of foot. The flattening index is also used to determine height of the foot arch. It is the ratio of width of the posterior transverse arch to the width of the foot. From figure1a, Flattening index = AC/DE.

Statistical analysis.

The obtained data for the measured parameters were statistically analyzed using Excel. The confidence interval was set at 95%. In all statistical tests, a p-value (two tailed) <0.05 was considered as statistically significant. The unpaired t-test was used to compare the measured parameters.

RESULTS AND DISCUSSION

All anthropometric measurements were thoroughly checked for significant differences. Broadly speaking, all the anthropometric parameters of the foot were significantly higher (P<0.05) in males than in females across both races. This is in consistent with previous study by [4] and also confirms sexual dimorphism with respect to race. Furthermore, racial comparison of African (14.2±0.12) and European (13,5±0.10) women demonstrated a significant difference (p<0.05) in LMLA, also in the case of African (15.6±0.13) and European (14.9±0.11) men . The present study revealed a significant difference (p<0.05) in LLLA and WPTA between African (14.4±0.12; 3.7±0.12) and European (13.9±0.09; 2.9±0.14) men, however, the analysis did not identify any significant difference (p>0.05) in LLLA between African (12.8±0.08) and European (12.7±0.09) women but reported significant difference (p<0.05) in WPTA, 3.4±0.13 and 2.5±0.01 respectively. Throughout this paper the following modifications were made on the grouping of foot arches (foot forms) based on Shtriter index (SI): Very High-Arched Foot and High-Arched foot were combined and given a common name – High-Arched Foot (HAF) (Figure 1b), Low-Arched foot and Flat-Arched foot – Flat Foot (FF) (Figure 1c), meanwhile Normal Arched Foot (NAF) (Figure 1a) remained unchanged. In this present study, based on Shtriter index, (33%, 16%, 51%) African women, (25%, 22%, 53%) African men, (74%, 8%, 18%) European women and (50%, 17%, 33%) European men reported HAF, NAF and FF respectively. The results of this study indicate that, Africans or men are more likely to develop flatfoot compare to Europeans. This concurs well with [5].

CONCLUSION

Our work has led us to conclude that distinction in anthropometric parameters of the foot in terms of race and gender is a fact and not a myth. This paper has highlighted the importance of anthropometric measurements. The findings might not be transferable to other ethnic groups or race that were not considered in this current study. Future work should focus on enhancing the quality of the device used in measuring the anthropometric parameters of the foot.

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