

MORPHOMETRIC STUDY OF PLANTAR ARCH INDEX AND THE PREVALENCE OF FLATFOOT AND ITS RELATIONSHIP WITH TRIBE

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INTRODUCTION

Flat foot (pes planus) is a postural deformity in which the arches of the foot collapse, with the entire sole of the foot coming into complete or near-complete contact with the ground (Pranati *et al.*, 2017). The foot offers stabilization and balance of the body all through gait (Tsung *et al.*, 2003). The morphology and functional development of the foot are influenced by some internal factors such as sex, genetics, and age. Also, external factors such as footwear habits and physical activities also influence foot morphology. According to Jaiswal *et al.* (2018), there are three types of foot arches; the medial longitudinal arch, the lateral longitudinal arch and the transverse arch. These are maintained by posterior tibialis tendon and peroneus longus tendon which cross the plantar surface from medial to lateral and lateral to medial respectively. Hernandez *et al.* (2007) reported that, the assessment of the plantar arch index was proposed by Staheli and Engel and it establishes the relationship between the width of the arch and the heel regions on the footprint measurement. The prevalence of flatfoot decreases with increasing age (Periya and Alagesan, 2017). Though, there have been a lot of studies on the clinical relevance of flatfoot, few studies have been conducted to find the prevalence of flatfoot among the various tribes of the Ghanaian population. Therefore the aim of the present study was to determine the plantar arch index and the prevalence of flatfoot and its relationship with tribe. Specific objectives were:

- To use the plantar arch index to determine the prevalence of flatfoot.
- To determine the prevalence of flatfoot in the left and right feet of the participants.
- To determine the prevalence of flatfoot stratified by sex and tribe.

MATERIALS AND METHODS

The present study was conducted at the Anatomy Department, School of Medicine and Dentistry, Kwame Nkrumah University of Science and Technology. The study was conducted between September 2018 to April 2019. A total of two hundred and seventy-eight (278) participants were recruited for the study. One hundred and seventy-two (172) were males and one hundred and six (106) were females between the ages of sixteen (16) and thirty-four (34) years. Ethical approval and participants informed consent were sought prior to the study. Individuals having open wounds on their feet and those with history of traumatic fracture on the lower limb and orthopaedic surgeries were excluded from the study.

FOOTPRINT ACQUISITION

The ink print method was used to take the footprints of the participants. Horse black endorsing ink was spread uniformly on a thin large piece of foam attached to a wooden board. The participants were then asked to step both their feet gently on the ink-soaked platform with the contralateral foot out of the platform. The stained feet were then transferred onto an A4 plain sheet to obtain the footprint.

MEASUREMENT OF PLANTAR ARCH INDEX

The plantar arch index was calculated by drawing a tangential line connecting the medial forefoot edge and the heel region. The central point of this line was then calculated and a perpendicular line was drawn across the footprint from the central point. The same method was repeated for the heel tangency point. The width of the central region of the footprint was measured as "A" and the width of the heel region was also measured as "B". The value of A was divided by the value of B to find the value of the plantar arch index as shown as follows, Plantar Arch Index (PAI) = A/B (Figure 1) (Hernandez *et al.*, 2007).



Figure 1: An image showing the measurement of central region and heel region of the footprint of (a) normal foot and (b) flat foot (Source: Rithanya *et al.*, 2018)

DETERMINATION OF FLATFOOT

According to the Pediatric Orthopedic Society, a normal plantar arch index is 2 standard deviations (SD) plus the population mean. Thus, plantar arch index value greater than or equal to the sum of 2 standard deviations and the population mean was considered as an indication of flatfoot.

STATISTICAL ANALYSIS

The data obtained were tabulated and coded on the Microsoft Excel Spreadsheet version 2013. The coded data were then analyzed using IBM Statistical Package for Social Sciences (SPSS) version 20.0. Descriptive statistics (mean, standard deviation and range values) for parameters were represented in the analysis. A probability (p) value of 5% (0.05) was considered statistically significant.

RESULTS AND DISCUSSION

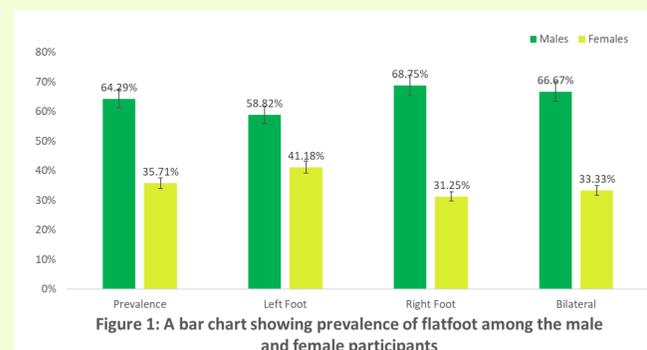
A total number of 278 participants were recruited for this study. They comprised of 172 (61.9%) males and 106 (38.1%) females. The mean age of the participants was 19.73 ± 2.01 years (Range: 16 - 34 years). The mean age of the males and females were 20.15 ± 2.21 years (Range: 17 - 34 years) and 19.04 ± 1.39 years (Range: 16 - 26 years) respectively. Out of the 278 participants, 219 (78.8%) were Akans, 17 (6.1%) were Ewes, 13 (4.7%) were Ga-Dangbes and 29 (10.4%) were participants belonging to other tribes in Ghana.

MEASUREMENT OF PLANTAR ARCH INDEX

Males recorded numerically higher plantar arch indices for both right and left feet than the females. Although, the difference between the left plantar arch index in both sexes was not statistically significant ($p > 0.05$), there was a statistically significant difference between the right plantar arch index among the males and females ($p = 0.009$). Also, there was no significant difference between the left and right plantar arch indices among the Akans, Ga-Dangbes and other tribes with the exception of the Ewe tribe.

PREVALENCE OF FLATFOOT

The prevalence of flatfoot recorded for the study population was 15.1%. The prevalence of flatfoot in the left foot was higher than the unilateral right foot for the study participants. Males and females recorded a prevalence rate of 15.7% and 14.1% respectively. Within the prevalence rate, males recorded 64.29% and females recorded 35.71% prevalence rate. The females recorded higher left flatfoot prevalence rate than the males. However, the males observed a higher prevalence rate for the right foot than the females. Likewise, the prevalence of bilateral flatfoot of the participants was 3.2% with the males (3.5%) recording the higher prevalence rate than females (2.8%). The prevalence rate agrees with studies conducted by Senadheera *et al.*, (2016), Ezeukwu *et al.* (2018) and Pranati *et al.*, (2018).



PREVALENCE OF FLATFOOT STRATIFIED BY TRIBE

Among the tribes, Akans recorded the highest prevalence rate of 71.44%. The remaining tribes (Ga-Dangbes, Ewes and other tribes) recorded the same prevalence rate of 9.52%. The unilateral and bilateral flatfoot prevalence rates among the various tribes are shown in figure 2.



Figure 2: A bar chart showing prevalence of flatfoot among the various tribes

CONCLUSION

The prevalence of flatfoot recorded in the present study was 15.1%. Unilateral left flatfoot prevalence rate was higher than the unilateral right foot. Males recorded a higher prevalence rate of flatfoot than the females. However, the females recorded higher unilateral left foot prevalence than the males and the vice versa was observed for the unilateral right foot. Also, The males recorded a higher bilateral flatfoot than the females. Among the tribes, Ga-Dangbes recorded the highest flatfoot prevalence rate. With the Akans and participants belonging to the other tribes recording the least prevalence rate among the study population.

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