

Assessing occurrence of flatfoot condition among student population

Navya Khanna, Dinesh Premavathy*

ABSTRACT

Introduction: Flatfoot (pes planus) is a clinical condition associated with unusual biomechanical alterations in medial longitudinal arch. The medial longitudinal arch of foot is impaired, and hence, the entire sole touches the ground making the sole of foot to flatten. The aim of this work was to determine the prevalence of flatfoot among males and females of the student community aged between 18 and 25 by calculating the Chippaux-Smirak index (CSI). **Materials and Methods:** The study included 50 college students. Their ages ranged between 18 and 21 years. Footprints of all the 50 subjects were obtained using simple ink print method. The presence of flatfoot was diagnosed by calculating the CSI. If the CSI is greater than 45%, then the individual is considered flatfooted. **Results:** Of 50 subjects, 25, i.e. 50% had flatfoot with $P < 0.05$. Ten of 25 females (40%) were found to be flatfooted, whereas for males, it was 13 of 25 (52%). **Conclusion:** The study was successful as we concluded with a significant result ($P < 0.05$) about men having quite more significant flatfoot. The foot screening procedure presented in this study provides a strategy for recruiting participants with normal and flatfoot impression. The present study suggests that simple ink print method is a cost effective and easier way of diagnosing flatfoot deformity clinically.

KEY WORDS: Chippaux-Smirak index, Cost effective, Flatfoot, Medial longitudinal arch, Pes planus

INTRODUCTION

The human foot is a multifaceted structure adapted to allow orthograde bipedal stance and locomotion. It is the only part of the body which is in direct contact with the ground.^[1] The human foot has been structurally, functionally evolved and developed to be one of the most remarkable modifications in human evolution.^[2] This advanced modification of foot is attained by its complex anatomical structure which is comprised foot bones, strengthened by ligaments and tendons allowing the foot to support the weight of the body in the erect balanced posture with least weight. These composite anatomical components form a rigid structure called the “arches of foot.”^[3] Three important arches are recognized in the feet which are the medial longitudinal arch, the lateral longitudinal arch, and the transverse arch.^[4] Three types of foot have been proposed based on the structure of the medial longitudinal arch: (a) Normally aligned or normal

foot, (b) low arched or pes planus, and (c) high arched or pes cavus.^[5]

Flatfoot (pes planus) is a clinical condition associated with unusual biomechanical alterations in medial longitudinal arch.^[6] If the medial longitudinal arch is impaired, the sole of foot is getting flattened and the entire sole touches the ground. In the medical world, flatfoot is associated with pronated foot. The position of the foot when it is flexed upward called as dorsiflexed or pronated, turned away from the body (abducted), and the heel is rolled outward (everted) at the same time.^[7] Flatfoot is a complex disorder with varying degrees of deformity and symptoms.^[8] The prevalence of flatfoot has reduced to 13.4% and 27.6% from the previous 21% and 57% over the years.^[9]

The arches of the foot are passively maintained by the plantar aponeurosis and ligaments and dynamically supported by tendons of extrinsic muscles and by intrinsic muscles that run between the pillars of the arches.^[10] This has a significant impact on function of the foot of an individuals and the development of the musculoskeletal disorders. This leads to compression

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Department of Anatomy, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India

*Corresponding author: Dr. Dinesh Premavathy, Department of Anatomy, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Saveetha University, 162, Poonamallee High Road, Chennai - 600 077, Tamil Nadu, India. Mobile: +91-8939307076. E-mail: dinesh801anatomy@gmail.com

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of plantar nerves and vessels, which results in causing severe pain. The causative factors for the occurrence of flatfoot might be due to genetic predisposition, plantar injuries, long-term heavy weight-bearing, obesity, aging, etc.^[11] Eventually, patients with adult acquired flatfoot may develop severe arthritis in the foot and ankle.^[12]

Different procedures can be used to diagnose flatfoot, such as clinical diagnosis,^[13] X-ray studies,^[14] and footprint analysis;^[15] footprint analysis by a pedograph is a simple, quick, cost effective, and readily available method. Three measurements are normally used for footprint diagnosis: Clarke's angle,^[16] Chippaux-Smirak index (CSI),^[17] and Staheli index.^[7] The fundamental premise of these indices is that the height of the arch is related to the footprint.^[11] In contrast, clinical diagnoses using a podoscope require the intervention of experienced clinicians.^[18] The aim of this work was to determine the prevalence of flatfoot among males and females of the student community aged between 18 and 25 by calculating CSI.

MATERIALS AND METHODS

The study included 50 college students. Their ages ranged between 18 and 21 years. Of these, 25 were male and 25 were female. Using simple ink print method, the study was carried down. A thin (1–2 cm width), large piece of sponge of about 30 cm is placed on a tray and diluted ink is poured and wetted. The sponge absorbs all the ink and when the foot is placed, the ink sticks on the surface of the foot. The foot is then placed on a clean white sheet to mark the footprint.

The presence of flatfeet was diagnosed by calculating the CSI. The CSI is defined as the ratio of the length of line H, a line parallel to F at the narrowest point on the foot arch, to the length of line F, the maximum width at the metatarsals ($H/F \times 100, \%$)^[19] if the CSI is greater than 45%, then the individual is considered flatfooted.

RESULTS

The present study has observed that of 50 subjects, 25, i.e., 50% had flatfeet. Ten of 25 females (40%) were found to be flatfooted, whereas for males, it was 13 of 25 (52%) [Figure 1]. The prevalence of flatfoot in females is 40% [Figure 2]. Even though the females have getting flatfoot condition, compare to them males are highly affected by this condition [Figure 3]. This perhaps indicates that women are more careful about their health. People with flexible flatfoot may or may not experience pain in the heel, arch, angle, or outside of the foot. All the subjects had no history of pain. Figures 4 and 5 show the footprints of normal and flatfoot individuals.

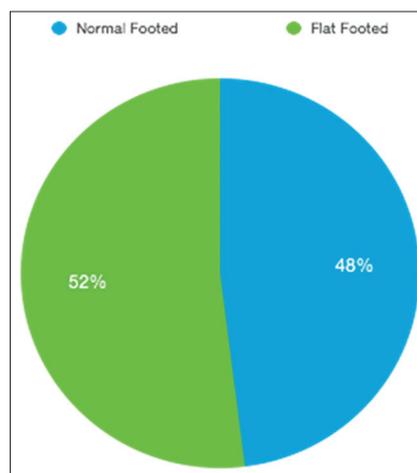


Figure 1: Prevalence of flatfoot in males

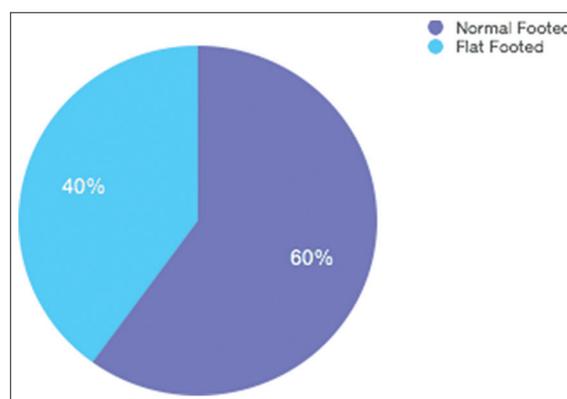


Figure 2: Prevalence of flatfoot in females

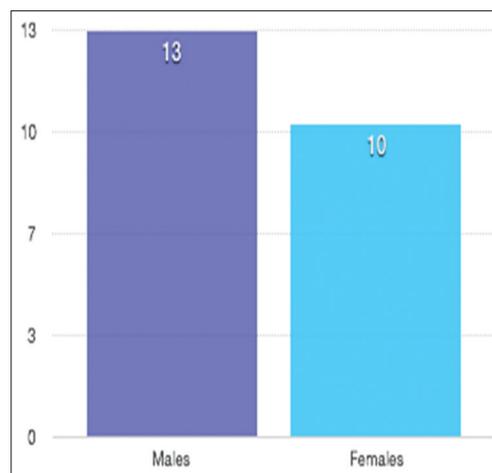


Figure 3: Prevalence of flatfoot between male and female

DISCUSSION

The foot has two primary functions: To provide a strong and stable support for the body.^[20] The deformation experienced by the medial longitudinal arch during support makes feet to be the region suffering the highest variations in a human body.^[21] These functional features make the clinical examination of this particular region complex. Our present study



Figure 4: Normal feet impression



Figure 5: Flatfeet impression

shows the prevalence of flatfeet to be 40% in women and 52% in men aged from 18 to 21. Pita-Fernández *et al.* reported the prevalence of flatfoot to be 18.85% (20.65% in women and 17.05% in men).^[22] Dunn *et al.* reported the prevalence of flatfoot to be 19.0% (20.1% in women and 17.2% in men)^[23] and in another study conducted by Nguyen *et al.* reported 18.5% (20% in women and 17% in men) as the prevalence of flatfoot.^[24]

The subjects having elevated percentage of flatfoot are the result of the fact that outdoor games and other physical activities among children and adolescents are rapidly decreasing in the modern world with growing number of overweight and childhood obesity. In some cases, such flatfeet in children because minor postural difficulties and thus continue with ages prevailing until it causes severe detrimental effects. This variation in the prevalence rate of flatfoot may also be due to the age limit set in these studies. The upper and lower age limit set for our study was 21, whereas in other cited studies was from 40 and above, in which fixed upper age limit was not set, thereby making a wide variation in age limit. In this condition, the base of the

feet is always in touch with the surface of the ground. Pressure on the surface can exert the nerve endings and muscles, which results in foot pain. We find more males prone to flatfeet perhaps because they carry heavier load for longer period. Our study adopted the method of CSI^[19] to assess the footprints using simple ink print method.

Although there are people considering footprint a poor evaluation approach,^[25] almost an uncountable number of authors who advocate its use: Gervis,^[26] Engel and Staheli,^[27] Viladot,^[28] Cavanagh and Rodgers^[7] and Nurzynska,^[10] Viladot,^[29] Volpon,^[30] and Chen *et al.*,^[31] among others. The correlation between X-ray studies and footprint shows that the footprint is effective for individual studies and population-based investigations,^[32] to determine plantar arch height,^[33] others also consider that footprints present several approach failures.^[34] Measuring plantar arch index and navicular vertical height were used to assess medial arch of the foot.^[35] Simple ink print method is cost effective and easier method of diagnosing flatfeet compared to other techniques like radiography.^[36] It is, in fact, simple, easier to apply, and portable. This method is also non-invasive and does not involve radiation and, hence, can be applied to any kind of people immaterial of their age, conditions such as pregnancy. Thus, it could be used clinically to diagnose flatfeet.

CONCLUSION

Most subjects have flexible, painless flatfeet that require no treatment. The study concluded that when compare to female, male individuals were highly susceptible to get flatfoot. The foot screening procedure presented in this study provides a strategy for recruiting participants with normal and flatfoot impression. The present study thus suggests that this simple ink method is very easier way to assess foot deformity.

CONFLICTS OF INTEREST

None.

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