

## Study of Arches of Foot in North Indian Population: A Non-Randomized, Cross-Sectional, Single-Center Study

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### Abstract

**Background:** Arches of foot represent a serious public health problem which is related to working life because these deformities negatively influence the human productivity and the quality of life of affected patients. There is insufficient evidence over prevalence of arches of foot in North Indian population.

**Objective:** Objectives of this non-randomized, cross-sectional, single-center study was to assess prevalence of arches of foot in North Indian population.

**Materials and Methods:** This single-center study was carried out within the anatomy department, Katihar medical College, Katihar, Bihar, India from December 2021 to March 2023. The study participants were asked to sign a consent form to participate in the study. The baropodometric analysis was performed to diagnose flatfoot and hollow foot, and additional information such as gender and the age were recorded. We calculated percentages, means and standard deviation. The Chi-square test, and the calculation of Odds Ratio were used to identify differences due to these variables (sex and age). The collected data were organized and processed by software Epi info. The level of significance was set at  $p < 0.05$ .

**Results:** 125 cases of hollow feet and 125 of flat feet were diagnosed. Maximum study population of either gender belonged to age group  $>20$  years. Patients with hollow feet had an average age of 42.4 years (SD 17.6); patients with flat feet an average age of 29.88 years (SD 20.4). The most numerous cases were in the age group of  $>20$  years old for both flat feet and hollow feet.

**Conclusion:** This study has provided the prevalence of pes planus and pes cavus among the individuals belonging to Katihar Medical College, Katihar, Bihar, Northern region of India as a baseline data and for the comparison to other regions of the country.

**Keywords:** Prevalence Study, India, Arches of Foot.

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### Introduction

The deformities of foot namely flatfoot (pes planus) and high arch (pes cavus) can cause difficulty in walking and problems with posture in all age groups and lead to even more serious health problems for seniors.

[1] These deformities can also cause pains in the regions of the feet, calf, and waist. They can affect daily activities such as walking and remaining standing for a long time. [2]

Pes cavus is a descriptive term representing a spectrum of foot deformities that may have varied aetiologies and clinical presentations. [3] The cavus foot is defined as one in which there is an increase in height of the medial longitudinal arch of the foot that does not flatten on weight bearing. [4] Perhaps more commonly discussed than the pure cavus deformity is the cavovarus foot, and these two terms are often used interchangeably as well as “claw foot” and “hollow foot”. [5]

Pes planus (“flatfeet”) is described as the loss of the medial longitudinal arch of the foot, valgus deformity of the heel and medial talar prominence. The deformity is usually asymptomatic and resolves spontaneously in the first decade of life, or occasionally progresses into a painful rigid form which causes significant disability. [6] Several factors have been identified to contribute to the etiology of flatfoot. These factors include ligamentous laxity, equinus deformity of the foot, tibial torsional deformity, presence of the accessory navicular bone, congenital vertical talus and tarsal coalition. [7]

Baropodometrical digital techniques map the pressures exerted on the foot plant during both static and dynamic loadings. [8] It allows to record plantar imprints and ground reaction forces in the support area during quiet standing (upright position), divided by feet (right and left) and subdivided in three regions named

“forefoot”, “midfoot” and “backfoot” for each foot. [9]

There is insufficient evidence over prevalence of arches of foot in North Indian population. In view of the above, the objective of this study was to assess prevalence of arches of foot in North Indian population.

### Methods

We conducted a cross sectional study from December 2021 to March 2023, on 250 individuals of Katihar Medical College, Katihar, Bihar, India. The study participants were asked to sign a consent form to participate in the study. The baropodometric analysis was performed to diagnose flatfoot and hollowfoot, and additional information such as gender and the age were recorded. We calculated percentages, means and standard deviation. The collected data were organized and processed by Epi info.

### Results

From 2021 to 2023, we performed 1512 static and dynamic baropodometric tests and radiological exams of the feet in different positions in order to detect, evaluate and verify the presence of feet pathologies or postural disorders. 782 patients were screened for suspected foot deformities: 125 cases of hollow feet and 125 of flat feet were diagnosed.

**Table 1: Composition of the 250 students screened for suspected foot deformities**

| Age groups in years | Male | Percentage | Female | Percentage |
|---------------------|------|------------|--------|------------|
| >20                 | 35   | 28         | 35     | 28         |
| 30-40               | 30   | 24         | 30     | 24         |
| 41-50               | 30   | 24         | 30     | 24         |
| >50                 | 30   | 24         | 30     | 24         |
| Total               | 125  | 100%       | 125    | 100%       |

The above Table 1 shows the composition of our sample. There were four ranges of age group (>20 years, 30-40 years, 41-50 years and >50 years) considered in our study. Maximum study population of either gender belonged to age group >20 years.

**Table 2: Cases of hollow feet per age and gender**

| Age groups in years | Male | Percentage | Female | Percentage |
|---------------------|------|------------|--------|------------|
| >20                 | 21   | 35         | 25     | 35.7       |
| 30-40               | 18   | 30         | 10     | 14.3       |
| 41-50               | 17   | 28.3       | 15     | 21.4       |
| >50                 | 4    | 6.7        | 20     | 28.6       |
| Total               | 60   | 100%       | 70     | 100%       |

**Table 3: Cases of flat feet per age and gender**

| Age groups in years | Male | Percentage | Female | Percentage |
|---------------------|------|------------|--------|------------|
| >20                 | 22   | 36.7       | 26     | 43.3       |
| 30-40               | 19   | 31.7       | 11     | 18.3       |
| 41-50               | 15   | 25         | 10     | 16.7       |
| >50                 | 4    | 6.7        | 13     | 21.7       |
| Total               | 60   | 100%       | 60     | 100%       |

Above Table 2 and Table 3 show the cases of pes cavus and pes planus per age and gender. Patients with hollow feet had an average age of 42.4 years (SD 17.6); patients with flat feet an average age of 29.88 years (SD 20.4). The most numerous cases were in the age group of >20 years old for both flat feet and hollow feet. Dividing patients in “younger” and “older” (> 60 years) according to WHO, there was difference in the prevalence of hollow feet and flat feet: the young age is a risk factor for flat feet but protective for hollow feet.

### Discussion

In our study we identified cases of pes planus and pes cavus: the young age and male gender represented a risk factor for the disease. Our results are partially in line with literature: in some studies [10,11,12] the prevalence varied to as high as 67% in males [13] and 49% [14] in females to as low as 14.2% and 15%. Three studies [13,15,16] investigated associations with age, all finding that prevalence of pes planus decreases with increasing age. However, there are some studies with opposite results: Pita Fernandez et al [17] in their study, showed that female gender, and age were associated with the prevalence of flatfoot. The study conducted by Dunn [18] described how podological pathologies increased with age, while others describe how flatfoot decreases with age after

adjusting for other covariables or indicate that neither age, gender, nor BMI are related to flatfoot.

As showed by Derya Atamturk [19] pes cavus, tends to emerge in later years, especially in age group of 50-59 years, but its prevalence is higher in males (2.0% vs 0.4% in females). In fact, pes planus is often an acquired disease, caused by neurological disease, and hereditary sensorimotor neuropathies. Although the most common condition causing pes cavus is a sensorimotor neuropathy, especially Charcot-Marie-Tooth disease, other very important conditions must be considered, such as tumors or birth defects of the spinal cord (diastematomyelia, syringomyelia, etc.). So when it appears to be acquired pes cavus, an examination by a neurologist is usually required.

Flatfoot and hollowfoot, at the same time, are a serious public health problem which is related to working life because these deformities negatively influence the productivity of employees. Some studies investigated the Quality of life of patients with foot deformities. A 6-year follow-up of the North Staffordshire Osteoarthritis Project found a progressive reduction in all SF-36 component scores as the severity of hallux valgus increased, a condition usually associated with flat foot. Kothari et al [20] and Lopez et al [21] evaluated the impact of

foot arch height on quality of life of children showing that arch height has a negative impact on their quality of life. It would be interesting to continue our study evaluating through the SF-36 questionnaire the quality of life for patients affected by pes planus and by pes cavus, in order to complete the previously published studies and to establish the real impact of these diseases on the lives of affected patients. [22]

### Conclusion

This study has provided the prevalence of pes planus and pes cavus among the individuals belonging to Katihar Medical College, Katihar, Northern region of India as a baseline data and for the comparison to other regions of the country.

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