

## **TYPES OF FEET IN MACEDONIAN POPULATION**

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### **Abstract**

The feet are flexible structures of bones, joints, muscles and soft tissues that let us stand upright and perform activities like walking, running or jumping. The feet are divided into three topographic regions: tarsus, metatarsus and phalanges. Muscles, tendons and ligaments run along the surfaces of the feet, allowing the complex movements needed for motion and balance of the human body. There are some positions and differences, compared to the normal feet, which should be compensated in order to move the body properly. Detection of the anatomical differences and abnormalities of the human feet is important because it can cause pain, restrict mobility and disrupt the posture of the human body. Pes-planus or flat foot' is one of the most common conditions observed in adult health practice.

The aim of the study is to determine anatomical differences and to discover possible abnormalities of the human feet.

The study consists of plant prints of adults, taken at the Institute of anatomy, selected by random choice. All of the examinees were above 20 years old. Feet and prints have been observed, analyzed and classified.

The most frequent feet were normal ones, flat feet (fallen arch) was detected in very high percentage, at almost half of the male and female examinees, feet with bunion and hammertoe feet were detected in small percentage only among females.

Humans rely on the proper functioning of the feet in everyday life, with early detection and accommodation of any present structural problems, treated on time properly; we can move forward in proper and comfort locomotion.

**Key words:** feet, plantograms, locomotion

### **Introduction**

The foot presents the distal part of the leg. It helps to perform the two basic important functions of shock absorption and propulsion during bipedal locomotion, both of which require a high degree of stability. The foot bones are serial homologs of the hand bones and each foot individually is comprised of 26 individual skeletal elements as opposed to the hand's 27 individual skeletal elements, indicative of the differing evolutionary roles of both limbs with the digit undergoing reduction and modification in mammals [1]. The feet bones are divided into three parts: tarsals, metatarsals and phalanges. The 7 tarsal bones of the foot help to form the longitudinal and transverse arches of the foot, which is often called the tarsus. The talus articulates superiorly with the distal tibia and fibula and the calcaneus forms the heel of the foot. The two main arches of the human foot are the transverse arches and the medial and lateral longitudinal arches. The functional anatomy of the arches allows the foot to remain stable during the pressures and energy exertion of locomotion but also retain flexibility so that it can grip different surfaces whilst enhancing forward propulsion. The transverse arch is located along the cuneiforms, the cuboid bone and all of the metatarsal bases, and simply forms a domed shaped which strengthens the foot during locomotion. The medial longitudinal arch is the highest of the arches and runs along the instep of the foot, alongside the calcaneus, talus, navicular, and cuneiform bones and up to the first three metatarsals. The lateral longitudinal arch is lower and flatter than the medial arch and runs alongside the calcaneus, the cuboid, and the fourth and fifth metatarsals [2]. The arches are supported in their skeletal frame by a complex arrangement of extrinsic and intrinsic muscles, ligaments and tendons.

The development of foot arch is rapid between 2-6 years of age and becomes structurally matured around 12-13 years of age. There are many causes of flat foot and other foot abnormalities like genetics, congenital, tendon dysfunction, tarsal coalition, lactogenic, posttraumatic arthritis, neuromuscular cause, peroneal spastic flat foot and many more [3]. In young children it is frequent to have ligament weakness and eversion of the foot. The feet are smooth, weak, elongated and heavy. Most

of the children with these kinds of the feet don't have specific symptoms. Some of the children have neuralgias in their feet and hip after long standing, sitting and running, jumping or walking. If the valgus position persists it can result with changes like shortening on the tendon of muscle triceps surae, so children could face difficulties during walking and other activities. Among most frequent foot deformities is planar foot (pes planus) and it means losing the physiological arch of the foot (fig.1, 2.) The reverted feet in young children sometimes is normal deviation in the growing period of growing, with possibility of spontaneous correction. There is no need for specific therapy. There are contrary opinions by different authors, for wearing the orthopedic shoes in early age. According to some authors, these feet are physiological normal for that period of grow and therapy is not necessary. Some authors suggest that wearing orthopedic shoes could be beneficial [4].



Fig.1

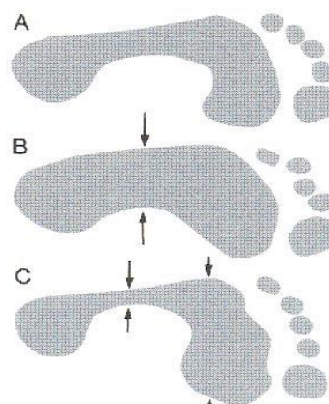


Fig.2

Hammertoe is a deformity of the toe in which toe becomes upward in the middle and bent downward at the end. Hammertoes usually start out as mild deformities and get progressively worse over time. The main causes of hammer toe are the shoes that don't fit properly, foot injuries, rheumatoid arthritis. The toe contains two joints that allow it to bend at the middle and bottom. A hammertoe occurs when the middle joint becomes dislocated. Bunions (hallux valgus), is an enlargement of bone or tissue around the joint at the base of the big toe, as well as in high-arched feet (pes cavus), where the bottom of the foot is overly-arched and hollowed, even when bearing weight. Pes planus has been suggested as a factor in the development of bunions in adolescents[5].

### Material and methods

This study was conducted at the institute of anatomy in Skopje, Macedonia, in September 2018. The examinees were 54 males and 66 females. All of the examinees were above 20 years old. Informed consent was obtained from all of the subjects. After that examinees were assessed for arch index and foot posture index. For arch height, foot print method was used. Each examinee feet were rolled with blue ink and then each of them was asked to stand on the white paper on the floor, than the middle third of the feet was inspected and classified according to the height of the navicular bone. Foot posture was also examined, subjects were put in a standing position and the foot was observed in anterior, posterior and medial directions. We assessed the feet by observing the foot in standing position on the horizontal base, we inspected: the curves above and below lateral malleoli, the congruence of the medial longitudinal arch, the extent of abduction and adduction of the forefoot and the extent of inversion and eversion of the calcaneus. Hammer toe is often very obvious in a foot exam. Samples were divided regarding gender. Statistical analysis was done.

### Results

Results are shown in charts and tables. Percentage of flat feet found in males and females are shown on fig.3. We have shown different types of feet found among the examinees in our study on fig.4. In the tables 1-6 we have shown statistical analysis of the feet differences found in males and females.

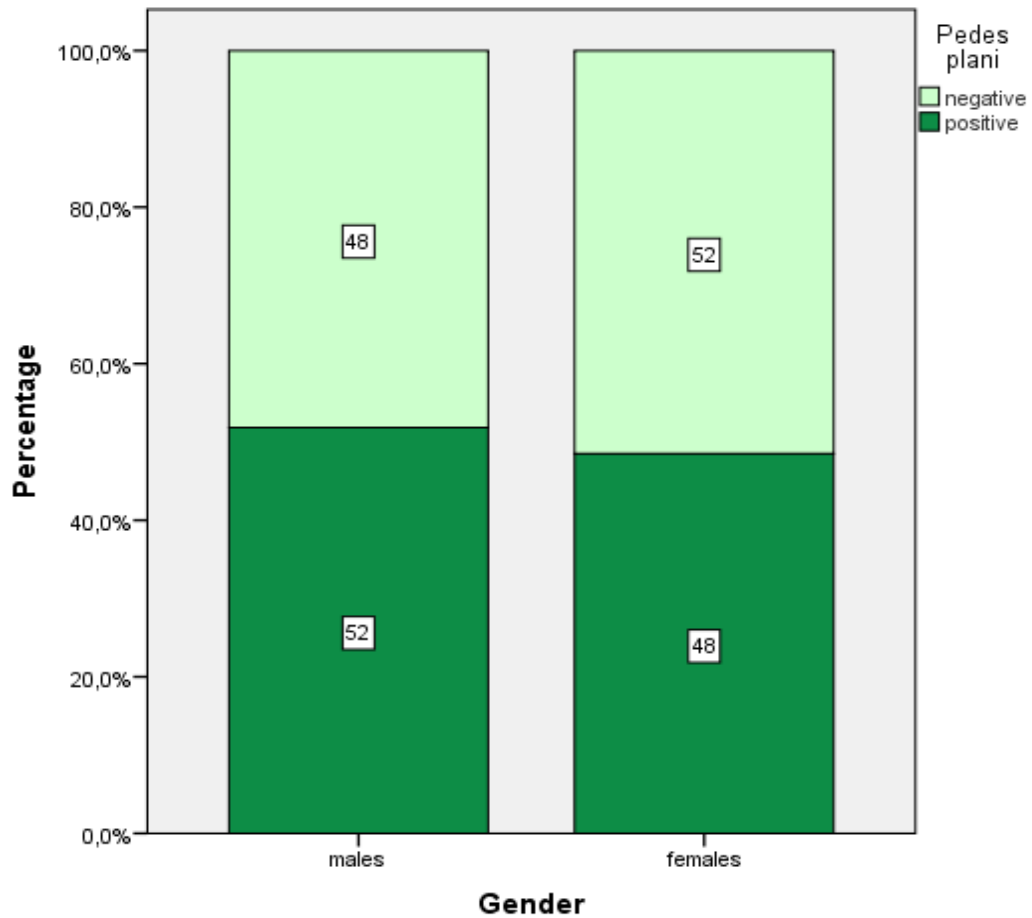


Figure 3. Gender differences of flat feet

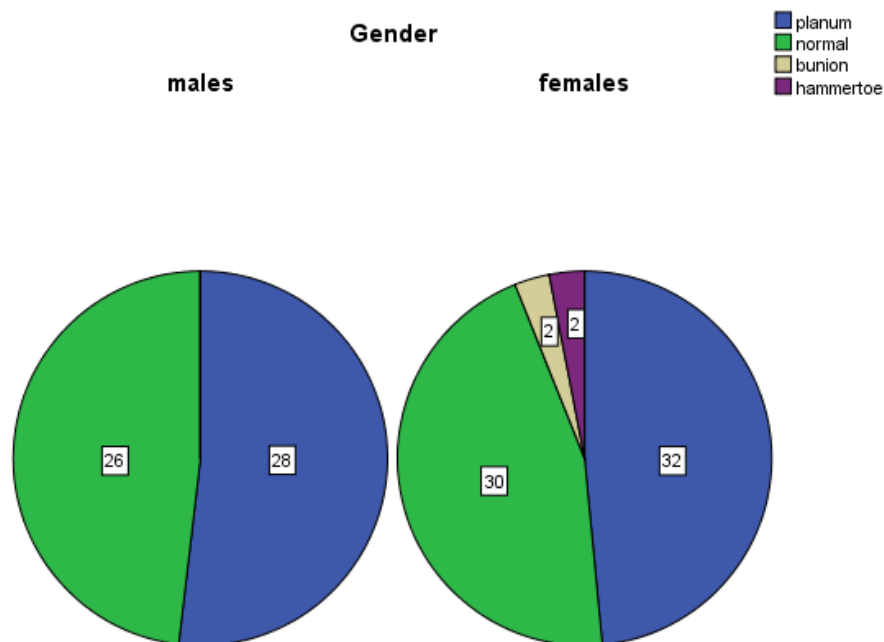


Fig.4 Types of feet in Macedonian population

Table 1. Flat feet in males

		Pes_pl <sup>a</sup>			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	negative	26	48,1	48,1	48,1
	positive	28	51,9	51,9	100,0
	Total	54	100,0	100,0	

a. Gender = males

Table 2. Normal feet in males

		Pes_norm <sup>a</sup>			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	negative	28	51,9	51,9	51,9
	positive	26	48,1	48,1	100,0
	Total	54	100,0	100,0	

a. Gender = males

Table 3. Flat feet in females

		Pes_pl <sup>a</sup>			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	negative	34	51,5	51,5	51,5
	positive	32	48,5	48,5	100,0
	Total	66	100,0	100,0	

a. Gender = females

**Table 4.** Normal feet in females

		<b>Pes_norm<sup>a</sup></b>			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	negative	36	54,5	54,5	54,5
	positive	30	45,5	45,5	100,0
	Total	66	100,0	100,0	

Table 5.Bunion feet in females

		<b>Pes_bunion<sup>a</sup></b>			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	negative	64	97,0	97,0	97,0
	positive	2	3,0	3,0	100,0
	Total	66	100,0	100,0	

a. Gender = females

Table 6.Hammertoe in females

		<b>Pes_hammertoe<sup>a</sup></b>			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	negative	64	97,0	97,0	97,0
	positive	2	3,0	3,0	100,0
	Total	66	100,0	100,0	

a. Gender = females

### Discussion

Flexible flatfoot is generally physiological, does not cause symptoms, does not require treatment and appears early in the decade of life. Rigid flatfoot is a pathological flat foot that usually causes pain, limitations, and requires treatment. In this condition, a person does not have a curvature of the foot, either in a weight-bearing position or weight-bearing. According to some foot and ankle specialist, the flatfoot is encountered pathology in adult period of time. The true prevalence of flat foot is unknown, primarily because there is no consensus on the strict clinical or radiographic criteria for defining a flat foot. According to some authors over 97% of the children of the 18 month old, are with pes planus, flat foot percentage is from 20% up to 60% in children from 2-6 years, and that percentage is decreasing with aging [6]. In nearly 23% of the adult population collapse of the medial longitudinal arch of the foot can be seen according to Turkish study [7]. In Indian study in adults percentage of the flat foot was lower than in our study only around 15% [8]. Staheli used the footprint technique to evaluate the shape of the plantar surface in 882 asymptomatic feet in normal people aged 1–80 years. He demonstrated that most infants are flatfooted, that the arch develops spontaneously during the first decade of life in most children, and that flatfeet are within the normal confidence limits for arch height in adults as well as children [9]. In Serbian study it was found that 78, 9% of subjects have flat feet, but that age, sex and body mass index do not have a significant influence on prevalence of this deformity. Since the prevalence of flat feet is so high, it can be stated that it is the lead postural deformity of contemporary humans, although many authors emphasize the problem of overestimating the prevalence, severity and need for flat foot treatment. Due to the small number of cases for hammertoe and bunion feet we won't be comparing results in this study. We think it is the result of a big age difference among the examinees; only few of

them were above 40 years old, the other examinees were around 20 years old. We plan on correcting that matter in our next study.

### Conclusion

Differences in the prevalence of the flat foot are mainly due to the different methodology at detection. From our study we concluded that, prevalence of flat foot in a population above 20 years old 51.9% in males and 48.5% in females with 3% hammertoe and 3% bunion in female examinees. All subject affected were with bilateral flat foot, bunion or hammertoe. For treatment of hammer toe medical advice is suggested along with avoid wearing shoes that are small and narrow. Differences on the feet can cause pain in the feet, ankles, or lower limbs, one or both feet becoming more flat, the feet feeling rigid, stiff, heavy, and unwieldy. Flat feet can also cause an uneven distribution of body weight. This may result in shoes wearing down unevenly or more quickly than usual, especially on one side, which can lead to further injuries. In some cases appropriated treatment should be advised and applied. In most cases these feet are physiological, asymptomatic and don't require any treatment.

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