

# FREQUENCY OF NORMAL PLANTAR FASCIA THICKNESS IN THE POPULATION OF PAKISTAN BY ULTRASONOGRAPHY

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## ABSTRACT

**OBJECTIVES:** To assess the frequency of normal plantar fascia thickness in the population of Pakistan by ultrasonography. **MATERIALS & METHODS:** This was a retrospective cross-sectional study conducted in the ultrasound department of Dr. Ziauddin Hospital, Clifton campus, Karachi from 06-02-2022 to 06-08-2022 for a period of six months. A total of 177 healthy individuals presenting with heel pain (VAS >3) for the first time, 18 to 70 years of age of both genders, were included. Patients having chronic or acute heel pain, morning heel stiffness and a history of surgical intervention of foot or trauma were excluded. Using a high-frequency transducer of a Toshiba ultrasound machine, the thickness of the plantar fascia was measured at the point 0.5 cm distal to its origin from the calcaneal tuberosity, by placing the transducer over the plantar aspect of the heel just medial to midline presence or absence of normal plantar fascia thickness was noted. **RESULTS:** Total 177 of participants included. The age range in our study was from 18 to 70 years with a mean age of 42.33 – 8.58 years. The majority of the patients 113 (63.84%) were between 18 to 45 years of age. Out of 177 patients, 98 (55.37%) were male and 79 (44.63%) were females with male to female ratio of 1.3:1. In our study, frequency of normal plantar fascia thickness in the local population by ultrasonography was found in 160 (90.40%) patients. The mean plantar fascia thickness was 2.68 – 1.05 mm. **CONCLUSION:** This study concluded that the frequency of normal plantar fascia thickness in the population of Pakistan by ultrasonography was found in 90.40% of patients.

**Keywords:** plantar fascia, ultrasonography, thickness.

## Introduction

The term plantar aponeurosis or fascia refers to a multi-layered fibrous tissue that is located on the sole of the foot.<sup>1</sup> It is composed of a 2 to 4 mm thick and resilient band of connective tissue that's located on the underside of the foot. This region helps in forming the foot's longitudinal arch,<sup>2</sup> which is designed to distribute weight around the medial tubercle of the calcaneus.

A heel lift can help shift pressure to the forefoot. The plantar fascia is a structure that originates from the

part of the foot that's located near the medial process of the calcaneal tubercle. It then inserts into the first to fifth metatarsal head's plantar ligamento capsular complex.<sup>3</sup> The origin is the most vulnerable part of the fascia and is prone to injury. The fascia extends along the sole, this is the part of the foot that supports the foot's arch.<sup>4</sup>

The role of ultrasonography in musculoskeletal imaging has dramatically increased and is widely accepted. It is not only non-invasive and radiation-

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free but also cost-effective and easily available. Although MRI is more efficient when considering soft tissue injuries nevertheless Ultrasound has equivalent accuracy.<sup>2</sup> The technique of examination differs slightly. With the patient in the prone position and foot resting on the table perpendicular to the leg. Linear transducer being placed over the heel at the attachment of plantar fascia where it leaves the calcaneal tuberosity with effective results.<sup>4</sup>

Granado et al<sup>5</sup> suggested that metatarsophalangeal joint extension can affect the assessment of plantar fascia thickness and they further emphasized that it should be measured with toes at rest. However, it can also be performed in a supine position without significant variation.<sup>8</sup>

Unfortunately, there is no such investigation other than history and examination to diagnose and treat plantar fasciitis. The fact that it exhibits thickening makes size evaluation by ultrasound of plantar fascia, a way to confidently identify the disease. The average measurement of plantar fascia according to research is less than 4 mm in 92% of healthy individuals who never experienced heel pain before. The plantar fascia of both feet showed no variation.<sup>6</sup>

Plantar fasciitis is a common cause of heel pain occurring commonly due to chronic stress on the heel due to a sedentary lifestyle, improper footwear, or obesity<sup>9</sup> requiring long term medication to relieve pain. Manual physical therapy has proven effective in long term management.<sup>7</sup>

## Methodology

This was a retrospective cross-sectional study conducted in the ultrasound department of Dr. Ziauddin Hospital, Clifton campus, Karachi from 06-02-2022 to 06-08-2022 for a period of six months. Study was duly approved by ethical review board. A total of 177 healthy individuals who came to ultrasound department without any prior history of heel pain or tenderness on physical examination, 18 to 70 years of age of both genders were included in this study. Patients having chronic or acute heel pain, morning heel stiffness, a history of surgical intervention of foot or trauma and patients with improper history or known co-morbid were excluded. The purpose and procedure of study was explained using a high-frequency

linear transducer of a Toshiba ultrasound machine, the thickness of plantar fascia was measured at the point 0.5 cm distal to its origin from the calcaneal tuberosity, by placing the transducer over the plantar aspect of the heel just medial to midline and presence or absence of normal plantar fascia thickness was noted.

## STATISTICAL ANALYSIS:

Statistical analysis was performed using SPSS version 20.0. Age, duration of pain, weight and plantar fascia thickness were presented as mean and standard deviation. Frequency and percentage were calculated for gender, side affected, occupation (field/office/driver/other), hyperuricemia (yes/no), place of living (rural/urban) and normal plantar fascia thickness (yes/no). Effect modifiers like age, gender, side affected, ethnicity, occupation (field/office/driver/other) and place of living (rural/urban) were controlled through stratifications. Post-stratification chi square was applied to see their effect on outcome and p-value  $\leq 0.05$  was taken as significant.

## Results

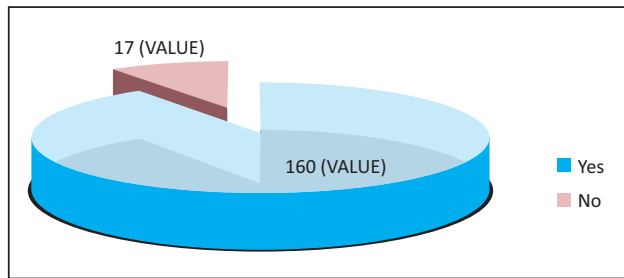
Total 177 patients in our study. The age range in this study was from 18 to 70 years with a mean age of 42.33 – 8.58 years. The majority of the patients 113 (63.84%) were between 18 to 45 years of age. Out of 177 patients, 98 (55.37%) were male and 79 (44.63%) were females with male to female ratio of 1.3:1. The mean duration of pain in our study was 5.92 – 2.43 days. Our study shows mean BMI was 27.68 – 3.05 kg/m<sup>2</sup>.

The distribution of patients according to a place of living, out of 177 patients rural was 65 (36.72%) and urban were 112 (63.28%). The distribution of patients according occupation such as Field were 59 (33.33%) Office were 68 (38.42%) Driver & other were 50 (28.25%) described in (Tab.1).

The distribution of patients according to the side affected side and ethnicity in our study the right were 105 (59.32%) Left were 72 (40.68%). Sindh were 68 (38.42%), Punjab were 48 (27.12%), KPK were 34 (19.21%), Balochistan were 14 (7.91%), Kashmir were 13 (7.34%).

In our study, the frequency of normal plantar fascia thickness in the local population by ultrasonography was found in 160 (90.40%) patients (Fig.2). Mean plantar fascia thickness was 2.68 – 1.05 mm. Stratification of normal plantar fascia thickness with respect to age groups and gender are shown in (Tab.1):

(Tab.2) have shown the stratification of normal plantar fascia thickness with respect to duration of pain. Stratification of normal plantar fascia thickness with



**Figure 1:** Frequency of normal plantar fascia thickness in the local population by ultrasonography (n=177)

	Normal plantar fascia thickness		p-value
	yes	no	
<b>Age (years)</b>			
18 - 45	100	13	0.254
46-70	60	4	
<b>Gender</b>			<b>p-value</b>
Male	90	8	0.469
Female	70	9	
<b>BMI (kg/m<sup>2</sup>)</b>			<b>p-value</b>
≤ 27	79	7	0.52
> 27	81	10	
<b>Ethnicity</b>			<b>p-value</b>
Sindh	59	9	0.036
Punjab	40	8	
KP	34	0	
Balochistan	14	0	
Kashmir	13	0	
<b>Place of living</b>			<b>p-value</b>
Rural	62	3	0.086
Urban	98	14	
<b>Occupation</b>			<b>p-value</b>
Field	51	8	0.395
Office	62	6	
Driver & others	47	3	

**Table 1:** Stratification of normal plantar fascia thickness with respect to demographics

respect to a place of living and occupation is shown in (Tab.1). (Tab.3) have shown the stratification of normal plantar fascia thickness with respect to the side affected and ethnicity respectively.

Normal plantar fascia thickness measured on ultrasound in our study is shown in (Fig.3).

Duration (days)	normal plantar fascia thickness		p-value
	yes	no	
≤ 7	110	16	0.028
> 7	50	01	

**Table 2:** Stratification of normal plantar fascia thickness with respect to duration of pain

Side affected	normal plantar fascia thickness		p-value
	yes	no	
Right	93	12	0.320
Left	67	05	

**Table 3:** Stratification of normal plantar fascia thickness with respect to side affected



**Figure 2:** Ultrasound image shows normal plantar fascia thickness

## Discussion

Heel pain is a common issue that orthopedic clinics see in their patients. However, it is important that the surgeon is able to identify the multiple causes of this condition and come up with a treatment plan that will address them. Sometimes, diagnostic procedures are necessary after the examination and clinical history.<sup>8</sup> One of the most common causes of heel pain is the condition known as Plantar Fasciitis. This condition can be confirmed using various imaging techniques, such as magnetic resonance imaging and ultrasound.<sup>9</sup> MRI is usually the preferred method of assessment for the treatment of this condition.<sup>10</sup>

However, ultrasound can be used in the diagnosis of this disease. In addition to being quick and easy to perform, ultrasound can also be used to diagnose the condition of Plantar Fasciitis. Radiographic features are increased thickness and hypoechoic appearance.<sup>11,12</sup> Various studies have been conducted on the sonographic evaluation of this condition.<sup>13,14,15,16</sup>

The objective of this study was to analyze the frequency of normal fascia thickness in the local population. The study was conducted on patients who were aged 18 to 70 years old. Mean age of 42.33 – 8.58 years. The majority of them 113 (63.84%) were aged between 18 to 45 years. Out of the 177 patients, 98 (55.3%7%) were male, while 79 (44.63%) were female. The study revealed that the average level of normal fascia thickness in the local population was 2.68 – 1.05 mm by ultrasound. As per research, the average level of normal tissue thickness in healthy individuals is less than 4 mm in 92% who never suffered from heel pain.

Kamel et al noted that the average level of the normal tissue thickness in the subjects was 2.4 – 0.64 mm in healthy subjects. However, they did not specify the exact measurement site. Another study by Ozdemir et al measured the thickness of the plantar fascia 5 mm distal to its attachment site at calcaneus using ultrasound and the measurement was 2.5 mm in control healthy subjects (n=22). In the study led by Cardinal et al, the researchers measured the thickness of the plantar fascia at its proximal end near its insertion point in the calcaneus in the bilateral feet of 15 healthy individuals. They found that the mean thickness was 2.6 mm – 1.13 with a range of 1.6-3.8 mm.

However, due to the lack of a standardized measurement method, Pascual et al assessed plantar fascia at four different places including 1 cm proximal to the insertion, at the insertion, 1 cm, and 2 cm distal to its insertion site. The researchers found varying levels of thickness at all sites; 1.99 – 0.65 at 1 cm proximal to the insertion point, 3.33 – 0.69 mm at insertion, 2.7 – 0.69 mm at 1 cm distal from the insertion and 2.64 – 0.69 mm at 2 cm distal from the insertion. At these four different sites, they found statistically significant variation in plantar fascia thickness.

We noted that the average level of thickness in the subjects was 2.68 – 1.05 mm. This was similar to the findings of previous studies conducted by Ozdemir

et al, and Kamel et al in their normal control subjects. However, it was lower than those of the researchers by Uzel et al and Pascual et al. Heel pain is a common complaint that can be seen in orthopedic clinics. The factors that can trigger this condition include the working environment, socioeconomic status, and geographical variation.

In a study on patients with a type of foot disease known as plantar fasciitis, Wall et al found that the mean thickness of the fascia was 5.7 – 1.6 mm which was 0.5 mm distal to the anterior edge of medial tubercle of the calcaneus. In another study, Karabay and colleagues found that the average level of the plantar fascia in the feet was 4.79 mm in symptomatic feet. A slightly different result was appreciated on the symptomatic subjects and revealed that the fascia thickness was 4.75 – 1.52 mm.

The meta-analysis conducted by the by McMillan et al<sup>22</sup> (11 studies, 379 patients with chronic plantar heel pain, and 434 control subjects) revealed that the average level of the plantar fascia in the subjects with chronic heel pain was 2.16 mm (95% confidence interval, 1.60-2.71 mm) compared to the control group, those with this condition had a higher likelihood of having a thickness of greater than 4 mm (100 times higher compared with the control group).<sup>22</sup>

The researchers also noted that a higher value of the fascia was found in men than in women. This could be because of the anatomical difference between men and women. Another reason why the value of the fascia was similar in both the right and left feet was that because both lower limbs are used equally in routine activity, unlike the upper limbs.

The findings of the studies were consistent with the findings of Uzel et al,<sup>13</sup> who found a mild correlation between the thickness of the tissue and various factors such as age, sex, and BMI at <0.0001 level. However, the Uzel et al noted that the relationship between the fascia and these variables was moderate. Same result was found by Pascual et al.<sup>14</sup>

In another study, Karabay and colleagues found that the average level of the plantar fascia in symptomatic feet was 4.79 mm. However, the results of the study by Akfirat and colleagues were slightly different. They noted that the tissue's thickness was 4.75 – 1.52 mm in symptomatic heels.

Unfortunately, not only obesity, sedentary lifestyle, improper shoe wear and many other factors possess

risk towards tendinopathy, altering the thickness of plantar fascia leading to plantar fasciitis.

Age, gender and diverse ethnic groups have different tendencies to get plantar fasciitis. With special emphasis on these factors, we would like to assess its size in healthy population. For the purpose of study only those healthy individuals will be recruited who have never experienced heel pain before.


## Conclusion

This study concluded that the frequency of normal plantar fascia thickness in the local population by ultrasonography was found in 90.40% of patients. Also, the plantar fascia thickness did not vary between the left and right foot of the same individual; and, on average, the plantar fascia is thicker in males, older individuals, and those with higher BMIs than in females, younger individuals, and those with lower BMIs.

**Conflict of Interest:** None

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