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# Analysis Of Feet Plantar Pressure Distribution On Padahastasana

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***Abstract***
*The purpose of the study was to analyze foot plantar pressure distribution in Padahasthasana. Seven male students from L.N.I.P.E, Gwalior aged 18 to 22 years were selected as subjects for the present study. All the subjects were free from any injury related to limbs. Each subject was instructed to stand in their stance position on the baropodomertic pressure platform with bare foot focus on the target and perform Padahastasana for 15 seconds. To find out the analysis of feet plantar pressure distribution on Padahasthasana the mean, standard deviation, and t-test were used at the significant level of 0.05. The findings indicated that no significant difference was found between the left foot and right foot in most of the factors of plantar pressure distribution like Arch Index, Maximum pressure, and surface area coverage but in the case of Average pressure significant difference was found.*

***Keyword:*** *Plantar Pressure, Padahastasana, Biomechanics, Yoga, Arch index*

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## I. Introduction

Biomechanics is an applied form of mechanics and the method used to investigate. However, biomechanics has not developed in the wake of mechanics but as a bordering science in other scientific discipline such as anatomy, physiology, and sports technique. When the study of mechanics is limited to living structures, especially the human body, it is called biomechanics. Biomechanics is an interdisciplinary science based on many fundamental physical and life sciences disciplines. Generally, biomechanics is considered to be that aspect of the science concerned with the basic law governing the effect forces have on the state of rest or motion of animals or humans, whereas the applied areas of biomechanics deal with solving practical problems. Anatomists, orthopaedists, space engineers, industrial engineers, biomedical engineers, physical therapists, physical educators, dancers, and coaches are interested in biomechanics and in applying its principles to improve human movement. Professional applications may differ, but the same basic laws of biomechanics provide a common foundation for all.

The term biomechanics combines the prefix bio, meaning "life," with the field of mechanics, which is the study of the actions of forces**.** Within the fields of kinesiology and exercise science, the living organism most commonly of interest is the human body. The forces studied include both the internal forces produced by muscles and the external forces that act on the body. Bio mechanists use the tools of mechanics, the branch of physics involving analysis of the actions of forces, to study the anatomical and functional aspects of living organisms**.**

Foot plantar pressure is the pressure field between the foot and the support surface during everyday locomotor activities. Information derived from such pressure measures is important in gait and posture research for diagnosing lower limb problems, footwear design, sports biomechanics, injury prevention, and other applications. This paper reviews foot plantar sensor characteristics as reported in the literature in addition to foot plantar pressure measurement systems applied to a variety of research problems. Strengths and limitations of current systems are discussed and a wireless foot plantar pressure system is proposed suitable for measuring high-pressure distributions under the foot with high accuracy and reliability. The novel system is based on highly linear pressure sensors with no hysteresis.(Abdul Razak et al., 2012)

Foot structure has a long-established connection to foot function within the research field. Foot formation is described and categorized according to foot kind, The foot arch type is a high arch foot, normal arch foot, and flat arch foot also scientific name is pes caves (high arch foot, and pes planus (flat arch foot). Another study was conducted on foot arches and gave valuable direction in this area in this study researchers lightened the arches. The medial arch is the upper of two longitudinal arches. Its formation made with calcaneus, talus, and navicular. The superior joint surface of the talus, and two extremity or pier rests in standing, tuberoses plantar surface of the calcaneus posterior heads first, second, and third metatarsal bones.

According to swami ram "yoga" is a Sanskrit word. It is derived from the root 'yuj' which means union, joining, harnessing, contact, or connection, in yoga, the embodied spirit is made to become spirit is made to become one with atman by certain methods. The methods vary but the goal is one. Yoga means union with the universal spirit. It is the union between the individual self and the universal self. It is the fusion of a healthy body with a disciplined mind for spiritual development. Yoga is blissful contact with the supreme element, higher than the highest of the known elements. It is the harnessing of one's inherent inner power as well as the vital natural forces from which has emerged. Yoga is an inseparable part of Indian life and culture. It has come down to us from antiquity with unbroken tradition. Asanas are postured patterns and are to be achieved slowly maintained for some time steadily and released again in a low and smooth manner to train the body and mind in such a way that necessary equilibrium is established in overall function.

In the context of asanas, yoga resembles more of a physical exercise, which may lead to the perception that yoga is another kind of physical exercise. This article explores the commonalities and differences between yoga and physical exercise in terms of concepts, possible mechanisms, and effectiveness for health benefits.(Govindaraj et al., 2016)

The system of yogic exercises developed by the Indian rishis and yogis is based on exact principles. There are no vague doctrines hear. It impacts every practitioner's definite oratorical knowledge, fine health, longevity, vim, and vitality. The human body can always made healthy using proper yogic exercises. Asanas are capable of preserving the health not only of the brain and the spinal cord but also of all the cranial and spinal nerves spreading throughout the body. Thus we can say that the ordinary muscular need of a civil life is entirely satisfied by yogic possession.

It is also the third pose of Suryanamaskar, the sun salutation sequence. It is believed to reduce tamas, which means heaviness or inertia in the body. This pose's name comes from the Sanskrit pada which means "foot," hasta meaning "hand" and asana meaning a "seat" or "posture. " the English name for padahastasana is gorilla pose or hand under foot pose.

## II. Materials And Methods

**Selection of Subject**

7 male students from Lnipe Gwalior aged 18 to 22 years were selected as subjects for the present study. The subjects were free from any injury related to limbs.

**Selection of Variables:**

The static plantar pressure distribution by left foot as well as right foot were selected for this study are follows –

1. Arch index of both legs
2. Maximum pressure of both legs.
3. Average pressure of both legs.
4. Surface area coverage

**Tools/Techniques**

Seven subjects were purposefully chosen from among the male yoga students in Lnipe, Gwalior to gather data. For 15 seconds, each participant was to stand in their stance position on the baropodometric pressure platform, focus their bare feet on the target, and execute padahastasana.

**Data Analysis**

Using the t-test at the significant level of 0.05, the mean, standard deviation, and distribution of feet planter pressure on Padahasthasana were analyzed.

## III. Result

**Table 1: Descriptive Statistics of Left Foot and Right Foot Arch Index.**

| ARCH INDEX | | |
|---|---|---|
| | LEFT FOOT | RIGHT FOOT |
| MAEN | 16.3 | 17.97 |
| STANDARD DEVIATION | 9.94 | 8.386 |

The average arch index for left-footed players is 16.3, while the average arch index for right-footed players is 17.97. The standard deviations for left- and right-footed players are 9.94 and 8.38, respectively.

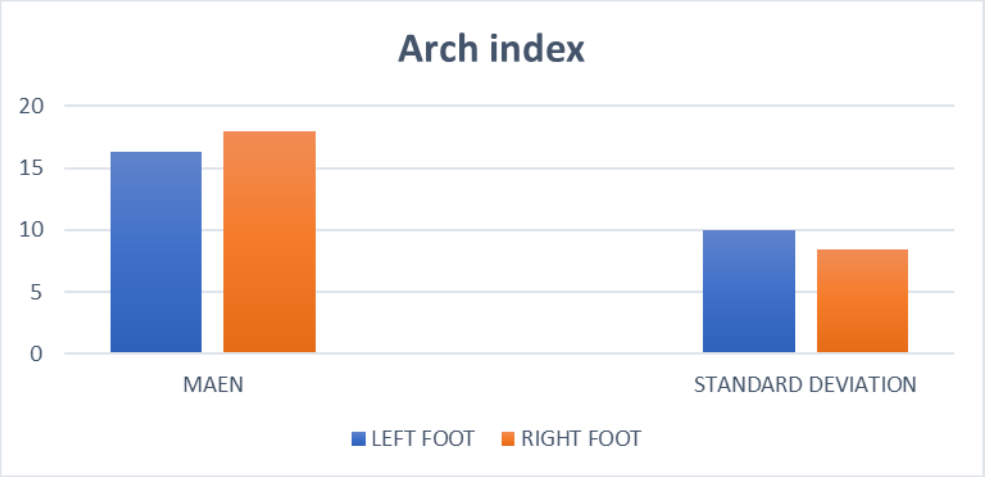


**Table 2: Analysis by T-test of Left Foot and Right Foot Arch Index**

| Arch index | Left | Right |
|---|---|---|
| Mean | 16.34 | 17.97429 |
| Variance | 98.74983 | 70.33156 |
| Observations | 7 | 7 |
| Hypothesized Mean Difference | 0 | |
| df | 12 | |
| t Stat | -0.33253 | |
| P(T<=t) one-tail | 0.372614 | |
| t Critical one-tail | 1.782288 | |
| P(T<=t) two-tail | 0.745227 | |
| t Critical two-tail | 2.178813 | |

Analysis of the left foot and right foot students' arch indices was done, as shown in the t-test table above. The t crucial two-tail value is 2.17, while the t stat value is 0.33. Since there is no discernible difference between the left and right feet included in the study, the null hypothesis in this instance is "failed to reject" since the "t stat" value is smaller than the "t critical two tail."

**Table 3: Descriptive Statistics of Left Foot and Right Foot Maximum Pressure.**

| MAXIMUM PRESSURE | | |
|---|---|---|
| | LEFT FOOT | RIGHT FOOT |
| MEAN | 35.27857 | 33.964286 |
| STANDARD DEVIATION | 5.49347 | 8.987988 |

The maximum pressure on the left foot was found to be 35.27 kPa, while the maximum pressure on the right foot was found to be 33.96 kPa. The standard deviation for boys with left feet was found to be 5.49, while the standard deviation for boys with right feet was found to be 8.98.

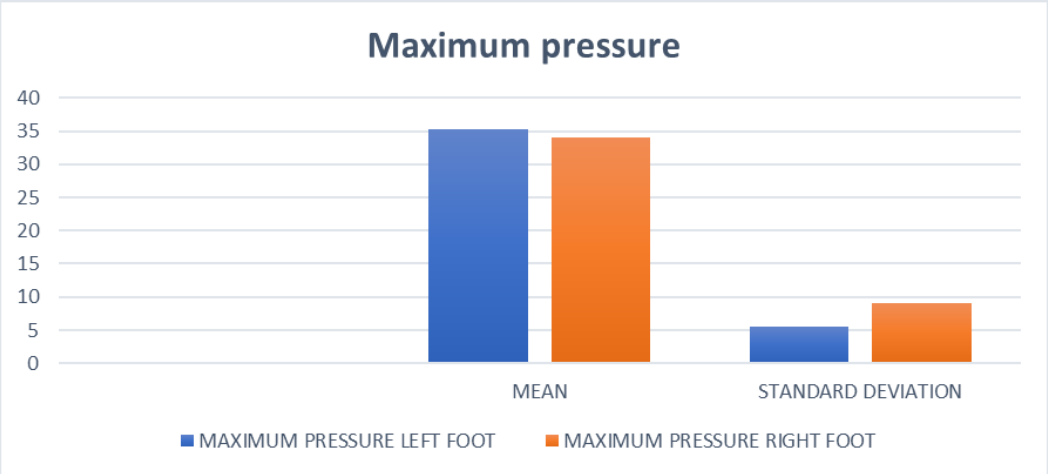

**Table 4: Analysis by T-test of Left Foot and Right Foot Maximum Pressure.**

| Maximum Pressure | Left | Right |
|---|---|---|
| Mean | 35.2786 | 33.9643 |
| Variance | 30.1782 | 80.7839 |
| Observations | 7 | 7 |
| Hypothesized Mean Difference | 0 | |
| df | 12 | |
| t Stat | 0.3301 | |
| P(T<=t) one-tail | 0.37407 | |
| t Critical one-tail | 1.81246 | |
| P(T<=t) two-tail | 0.74813 | |

An analysis was conducted on the greatest pressure exerted by students on their left and right feet, as shown in the t-test table above. The t crucial two-tail value is 2.22, while the t stat value is 0.33. Since there is no discernible difference between the left and right feet included in the study, the null hypothesis in this instance cannot be rejected because the "t stat" value is smaller than the "t critical two tail."

**Table 5: Descriptive Study of Left Foot and Right Foot Average Pressure.**

| AVERAGE PRESSURE | | |
|---|---|---|
| | LEFT FOOT | RIGHT FOOT |
| MEAN | 9.1 | 7.3285714 |
| STANDARD DEVIATION | 1.191638 | 1.4091537 |

The average pressure in the left foot was found to be 9.1 kPa, while the average pressure in the right foot was found to be 7.32 kPa. The standard deviation for boys with left feet was found to be 1.19, and the standard deviation for boys with right feet was found to be 1.40.

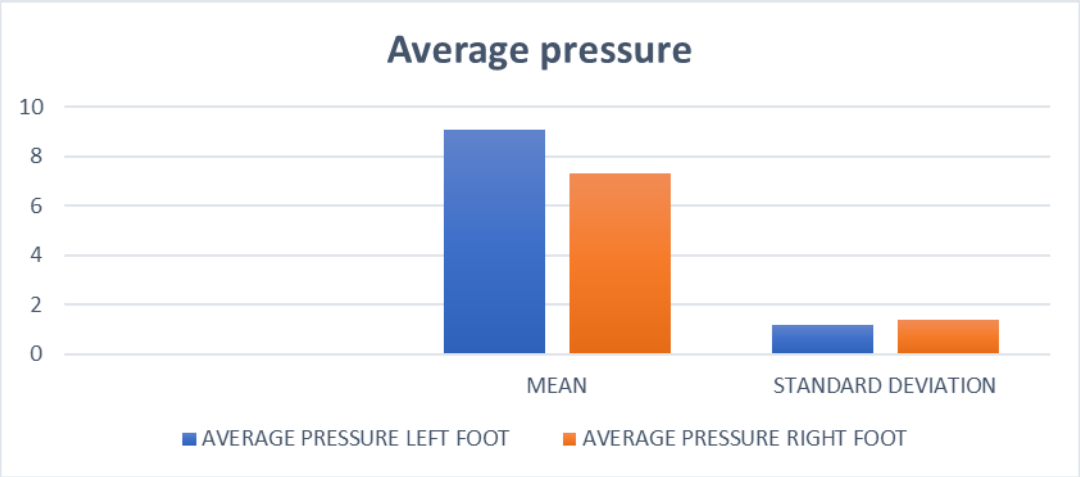


**Table 6: Analysis by T-Test of Left Foot and Right Foot Average Pressure.**

| Average pressure | Left | Right |
|---|---|---|
| Mean | 9.1 | 7.32857 |
| Variance | 1.42 | 1.98571 |
| Observations | 7 | 7 |
| Hypothesized Mean Difference | 0 | |
| df | 12 | |
| t Stat | 2.53962 | |
| P(T<=t) one-tail | 0.01298 | |
| t Critical one-tail | 1.78229 | |
| P(T<=t) two-tail | 0.02596 | |
| t Critical two-tail | 2.17881 | |

Analysis of the average pressure of players who dominate with their left and right feet was done, and the results are shown in the t-test table above. The t crucial two-tail value is 2.17, while the t stat value is 2.53. Since there is a substantial difference between the left and right feet included in the study, the null hypothesis is rejected in this instance since the "t stat" value is greater than the "t critical two tail."

**Table 7**: **Descriptive Study of Left Foot and Right Foot Surface Area Coverage.**

| SURFACE AREA COVERAGE | | |
|---|---|---|
| | LEFT FOOT | RIGHT FOOT |
| MEAN | 110.5714 | 117.42857 |
| STANDARD DEVIATION | 20.0238 | 20.533364 |

The average surface area coverage of the left foot was measured at 110.57 cm2, while the right foot was discovered to be 117.42 cm2. The standard deviation for boys with left feet was determined to be 20.02, and the standard deviation for boys with right feet was 20.53.

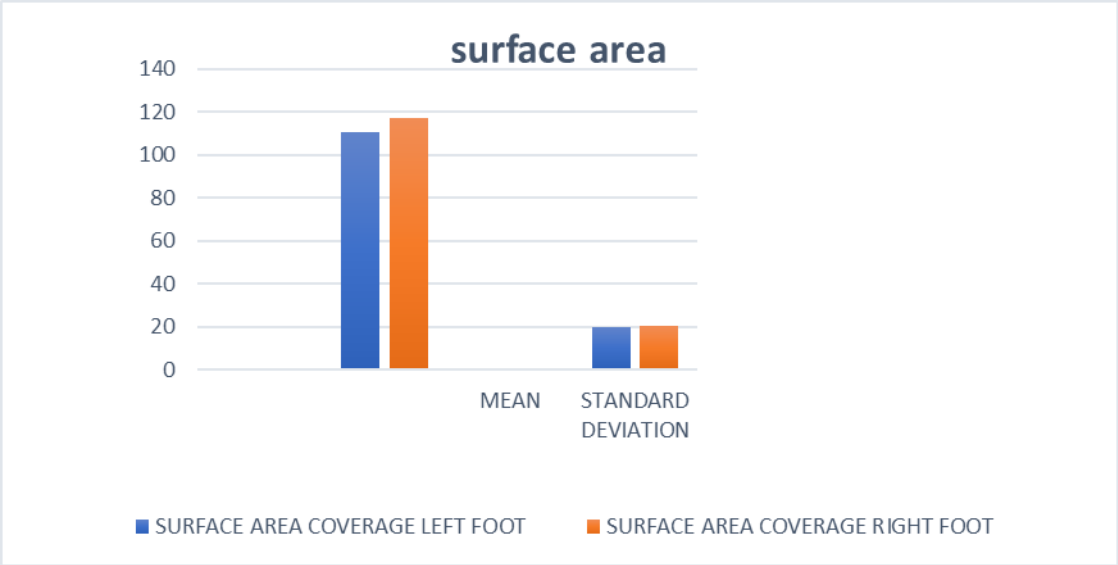


**Table 8**: **Analysis by T-test of Left Foot and Right Foot surface area coverage**

| **Surface area** | **Left** | **Right** |
|---|---|---|
| Mean | 110.5714 | 117.4286 |
| Variance | 400.9524 | 421.619 |
| Observations | 7 | 7 |
| Hypothesized mean difference | 0 | |
| Df | 12 | |
| T stat | -0.63257 | |
| P(t<=t) one-tail | 0.269442 | |
| T critical one-tail | 1.782288 | |
| P(t<=t) two-tail | 0.538884 | |
| T critical two-tail | 2.178813 | |

Students' left and right foot surface area coverage was analyzed and the results are shown in the t-test table above. The two-tail t critical value is 2.17, and the t stat value is 0.63. Since there is no discernible difference between the left and right feet included in the study, the null hypothesis in this instance cannot be rejected because the "t s that" value is less than the "t critical two tail."

## IV. Discussions

The loading of human foot on the ground surfaces is not constant. In Figure 5, the results show an ever changing of pressure on each region of foot for one of the test subjects. The changes are not consistent and unpredictable. It may change to an extend range of 55% of the pressure in a span of 10 seconds. This was observed on every test subjects despite being instructed to stand still (Masani et al., 2013). There was no significant difference in most factors of plantar pressure distribution (PPD) between the Left foot and Right foot except average pressure. Studies show Arch Index was similar in both feet after performing Padahastasana. previous

studies by Obrien & Tyndyk reported that the preferable normal arch this produced a low plantar pressure distribution in all cases.(Obrien & Tyndyk, 2014).Previous studies by Periyasamy in 2011 reported that no significant differences were detected when comparing the PPD of men and women of both feet on flat surfaces and mentioned that there were no differences among genders in the midfoot contact area. (Periyasamy et al., 2011) So here Surface area coverage was almost similar because of the different foot region of the subjects.(Gurney et al., 2008). A previous study in adults by Klimiec in 2016 found the highest PPD to be at the hindfoot region followed by the forefoot region and hallux. Lastly, the midfoot region exerted the least pressure of all.(Klimiec et al., 2016).So this study shows Maximum pressure was also similar in both feet after performing padahastasana may be cause of hindfoot region produced maximum force.A previous study state that The average distribution of pressure of both feet of all the test subjects on flat plane. According to the chart, hindfoot exerts the most pressure which is nearly one third of the entire foot pressure combined. The second highest plantar pressure exerted is the medial forefoot which is 19%, followed by central forefoot, 18%. Lateral forefoot exerts 17% of the plantar pressure and Hallux exerts 10%. Lastly, Lateral Midfoot exerts the least pressure of the foot which is 4%. The order from highest PPD to the lowest is as followed: HF > MF > CF > LF > HA > LM. This study discovers that the loading pressure of the right foot varies with the left foot. Remarkable differences were seen in the result as right foot exerted more pressure generally in every region of the foot as to compare with left foot respectively.(Ang et al., 2018). Here average pressure of the left foot exerted more force as compare to left foot after performing padahastasana in every region of the foot.

## V. Conclusion

It was concluded, within the confines of the current investigation, that there were no appreciable variations observed in the trams of the arch index, maximum pressure, and surface area coverage of the left and right feet. Although there was a slight but noticeable variation in the average pressure of the left and right feet.

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