

Prevalence of Foot Pronation in General Population of Surat City

Dhairav Shah¹, Hitanksha Mahyavanshi², Pinal Parmar³

¹Head Physiotherapist, Asiya Physiotherapy and Rehabilitation Clinic, Surat

^{2,3}Assistant Physiotherapist, Asiya Physiotherapy and Rehabilitation Clinic, Surat

Corresponding Author: Dhairav Shah

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ABSTRACT

Background: Pronated foot is common deformity in general population. The present study was undertaken to investigate the prevalence of pronation among general population in Surat city and to find out the association of pronated foot with different age groups and gender.

Methods: A total of 150 volunteers of age 21 to 70 years were investigated for the presence of pronated foot using Foot Posture Index (FPI-6). The data obtained was subjected to statistical analysis using EPI info software.

Result: Females were seen having more pronated foot than males in the study. 41 to 50 years old had more pronated foot compared to other age groups in their right foot while 51 to 60 years olds were seen having more pronated foot in their left foot.

Conclusion: The study revealed that females had more pronated and supinated foot compared to males. In comparison between both genders, males had more pronated foot on their dominant side and more supinated foot on their left side while females had more pronated foot on their left side

Keywords: general population, volunteers, foot posture index.

INTRODUCTION

Pronation of the foot involves eversion and inward rotation of the heel, abduction of the forefoot with outward rotation at the tarsometatarsal joints and inward rotation at the midtarsal joints, and medial rotation of the talus causing medial rotation of the leg in relation to the foot, and dorsiflexion of the subtalar and midtarsal joints, resulting in a decrease in the medial longitudinal arch.⁽¹⁾ Pronation of the subtalar joint in the weight bearing foot results in eversion of the calcaneus; the talus adducts and plantar flexes relative to the calcaneus. The leg follows the talus in a transverse plane and medially rotates. In a sagittal plane, the leg also moves to some extent with the talus. As the talus plantar flexes, the proximal aspect of the tibia moves forward to flex the knee slightly. In pronation of the foot produced by

medial rotation of the tibia, rear foot and midfoot inwardly rotate (pronate) and the forefoot outwardly rotates (supinates) on the midfoot. Plantar fascia and plantar ligaments become taut as they absorb the ground reaction forces.⁽¹⁾

Pronation of the foot could be related to hallux valgus which is the deformity of the first ray of the foot. It has the prevalence of about 21% which is common in adulthood. This biomechanical alteration can affect area which is knee. Example, Osteoarthritis of the medial compartment. Thus, pronation influences the intensity and time of lumbopelvic muscle activation, which will give lower backpain or other abnormalities at that level.⁽²⁾ Obesity, high impact sports activity such as basketball, injury that affects the alignment of the joints in the foot, nerve problem that prevents them from

feeling when the arch is collapsing for example due to diabetes, it can also occur due to pregnancy.

When the arch of the foot collapses excessively downward or inward it is defined as overpronation. In overpronation, when the foot turns excessively in from its neutral line, it is called as a dysfunctional movement. In standing when the ROM exceeds 5 degrees of angle from the subtalar neutral position and 15 degrees when walking, it is defined as overpronation. In overpronation, the medial aspect of the foot makes contact with the ground earlier than normal in stance phase. Subtalar joint instability is a foot deformity that causes the foot to be in the motion and position of over supination and overpronation that leads to misalignment of leg and the foot in humans. This occurs due to internal rotation and acute inversion of the foot. To allow side to side movement of the ankle and foot is the main function of subtalar joint. The subtalar joint allows for pronation and supination movement. This movement helps in walking on uneven surfaces. While walking or running, normal humans tend to overpronate and oversupinate the joint and also in activity of daily living. This can lead to subtalar joint instability and foot problems such as misalignment of the foot, gait deviation and abnormality of foot arch.⁽³⁾

Foot Posture Index (FPI) was created by Redmond AC followed by Crosbie J and Ouvrier RA. Redmond AC in 1998 was arthritis research campaign lecturer in the academic unit of musculoskeletal disease at the university of Leeds. Throughout his career he had worked in foot related research and clinical podiatry, mostly in lower limb clinics and multidisciplinary gait. In the clinical setting, FPI was conceived as a part answer to the recurring clinical problem of assessing posture variable's reliability and gait. In 1996, work firstly started on various iterations of the FPI, with a more formal approach to the development of the FPI as part of his PhD candidature in the faculty of medicine at the

university of Sydney. FPI provides quantitative measurements of the typical deviations of foot posture and is sensitive enough to detect any structural dysfunction in rearfoot, midfoot and forefoot in the transverse, sagittal and frontal planes. FPI -6 is a revised version of FPI which is derived from the original eight item scale. Due to lack of unidimensionality, two items were discarded in the new version.

FPI 6 have moderate to good intra-rater (0.81 to 0.91) and inter-rater (0.62 to 0.91) reliability as well as instrument validity (64%) in measuring foot posture.⁽⁴⁾

It is a diagnostic clinical tool which is aimed at qualifying the degree to which a foot can be considered to be in neutral, supinated and pronated position.⁽⁵⁾⁽⁶⁾⁽⁷⁾⁽⁸⁾ Its use does not require sophisticated equipment as it is reliable, multidimensional, valid and easily accessible.⁽⁹⁾

Following are the components of Foot Posture Index-

1. Palpation of the head of the talus.
2. Observation of the curves above and below the lateral malleoli.
3. The extent of the inversion/eversion of the calcaneus.
4. The bulge in the region of the talonavicular joint.
5. The congruence of the medial longitudinal arch.
6. The extent of abduction/adduction of the forefoot on the rearfoot.

The selection of Foot Posture Index (FPI-6) is because it is proved to be the most relevant for evaluating foot posture which includes six components for evaluation that is found on three-dimensional observations and also gives detailed quantitative data of foot postural variation.⁽¹⁰⁾

There are several studies in different countries about the prevalence of flat foot with the help of the Foot Posture Index among various populations. Studies have been carried out among general population, traffic police, physiotherapy students. There Is a study conducted by Raquel Sanchez-Rodriguez et.al in Spain about modification of pronated foot posture after a program of

therapeutic exercises. Another study was about prevalence and incidence of flat foot due to prolonged standing among traffic police in Navsari: A cross-sectional study. They concluded that the effect of prolonged standing is responsible for causing of flat foot in traffic police of Navsari district with normal BMI and overweight BMI almost equally. There is a study on prevalence of flat foot among 18-25 years old physiotherapy students: cross sectional study that asserted that there was no significant difference according to gender and there is no correlation of BMI with arch index. As there are no studies done on prevalence of foot pronation among general population in Surat city, hence, this study aims to investigate the foot pronation among general population in Surat city. The purpose of the study is to find out the percentage of volunteers who have pronated foot as well as to find out the significant difference according to gender.

LITERATURE REVIEW

1. **Miss. Tejashree Bhoir et.al (2014)** conducted a study titled, "Prevalence of flat foot among 18-25 years old physiotherapy students: cross." The purpose of this study was to find out prevalence of flat foot in population of 18–25-year-old physiotherapy students and to find out correlation of BMI with arch index. 80 physiotherapy students participated in the study. They concluded that prevalence of flat foot in population of 18-25years old physiotherapy student was 11.25% and all subjects were affected with bilateral flatfeet. There was no significant difference according to gender and there is no correlation of BMI with arch index.
2. **Sayali Tribhuvan et.al (2019)** conducted a study titled, "Correlation between foot posture index (FPI) and knee osteoarthritis (OA) in elderly individuals." The study purpose was to determine correlation between foot posture index and knee osteoarthritis in elderly individuals. Sample size in this study was of 100 participants. They concluded that there is positive correlation between knee osteoarthritis and foot posture index. The abnormal foot posture was commonly seen in patients with OA knee grade 3 and 4.
3. **Barbarah Kelly Goncalves De Carvalho et.al (2017)** conducted a survey titled, "The influence of gender and body mass index on FPI -6 evaluated foot posture of 10- to 14-year-old school children in Sao Paulo, Brazil: A cross sectional study." the purpose of the study was that differences will be observed in the FPI-6 values, depending on the age, gender, BMI and the highest score of FPI-6 will occur in male adolescence with high BMI and younger age. They concluded that there were differences between the 11- and 13-year groups and with regard to BMI, there were higher scores for the group with normal BMI. Therefore, a higher BMI in adolescence is not inductive of a pronated foot type.
4. **Sweta Chandan, et.al (2018)** conducted a study titled, "Cross- sectional study of foot posture index, navicular drop and arch index in kathak dancers. The need of the study is to see whether there is deviation in foot posture of kathak dancers. 100 healthy kathak dancers were selected with the age group of 18 to 25 years old. They conducted that there is deviation in the post posture of kathak dancers.
5. **Anand Heggannavar et.al (2016)** conducted research titled, "Effect of foot posture index associated with body mass index and standing balance in healthy population: An observational study." the purpose of the study was to find the effect of the foot posture index associated with body mass index and standing balance in healthy population. Age between 18 to 30 years were recruited in the study with 30 participants. They concluded that there is no effect of foot posture index

- associated with body mass index and standing balance in healthy population.
6. **Twinkle Dabholkar et.al (2020)** conducted a study titled, “Quality of life in adult population with flat feet.” The purpose of the study was to determine the impact of flat foot on foot related health and quality of life, among the population of 20- to 40-year-old individuals with bilateral flexible flat feet. 100 individuals suffering with flexible flat feet were taken in the study. They concluded that the quality of life as measured on the revised foot function questionnaire (FFI-R) is affected in individuals with flat feet in the age group 20 to 40 years. The most reported affected domains were pain, activity limitation and social domain.
 7. **Hamid Mansourpour et.al (2019)** conducted a study titled, “Relationship between foot posture index and musculoskeletal disorders.” The need of the study is to determine the relationship between foot posture index and musculoskeletal disorders and its correlation with age, gender and weight. A total of 309 individuals were enrolled in this study with age over 30. They assert that in adults with musculoskeletal disorders, they may need medical assistance such as proper foot orthosis and other measures to treat and improve patients’ quality of life as well as physical therapy.
 8. **Raquel Sanchez-Rodriguez et.al (2020)** conducted a study titled, “Modification of pronated foot posture after a program of therapeutic exercise.” The purpose of this study was to establish a protocol of exercise for the short and extrinsic foot and core muscles, lasting 9 weeks, and to evaluate the possible modification of the foot posture in adult subjects with pronated feet. 36 healthy adults with pronated feet were randomly taken in this study. They concluded that performing an intrinsic and extrinsic foot and core muscle strengthening exercise protocol for 9 weeks improved the hyper pronation in this sample of adults with pronated feet, resulting in the foot posture becoming closer to neutrality.
 9. **Dr. Amit S. Patel, et.al (2021)** conducted a study titled, “Prevalence and incidence of flat foot due to prolonged standing among traffic police in Navsari: A cross sectional study.” The purpose of the study was to assess the foot posture index in traffic police of Navsari and objective is to find effect of normal BMI and overweight on long static standing duty hours on medial arch of foot based on WHO classification of BMI. 128 traffic police of Navsari district were taken as study samples. They concluded that effect of prolonged standing is responsible for causing of flat foot in traffic police of Navsari district with normal BMI and overweight BMI almost equally
 10. **G. Pavan Kalyan Reddy, et.al (2021)** conducted a study titled, “Prevalence of flat foot among medical students and its impact on quality of life and functionality.” The need of the study was to investigate the prevalence of flat foot among medical students and to find out the association of flat foot with age, gender, body mass index, foot length and its impact on quality of life and functionality. Total of 300 medical students of age group 17 to 23 years were taken in this study. They assert that flat foot is associated with BMI, weight and slightly associated with foot length, height and it is not associated with age and gender. Flat foot affected the quality of life and functionality of the students whose BMI is more.

MATERIALS & METHODS

All volunteers were explained the purpose of the study. The informed consent was taken from the volunteers prior to the assessment. A survey was conducted using Foot Posture Index (FPI-6). The assessment

contains each factor of different planes in rearfoot and forefoot.

The study was conducted in private clinics and tertiary care hospitals in Surat city. Volunteers meeting the inclusion criteria were selected for the study.

Total of 150 volunteers participated in the study by convenient sampling method. Performa was filled by interviewing the volunteers which include information about age and gender. A written consent was personally given to fill in the details.

Inclusion Criteria-

1. Male and female
2. General population.
3. Age 18 to 65 years.
4. Volunteers willing to participate in study.

Exclusion Criteria-

1. Volunteers with unstable/post operative ankle joint, Contracture (ankle joint) and Congenital deformities of foot.
2. Unwilling volunteers.

STATISTICAL ANALYSIS

Data entry was carried out in Microsoft Excel and analysis was carried out by EPI info software.

RESULT

In total 150 volunteers were evaluated from which 67 volunteers were males and 83 were females. Normal feet were found in both left and right feet in excess than pronated and supinated foot.

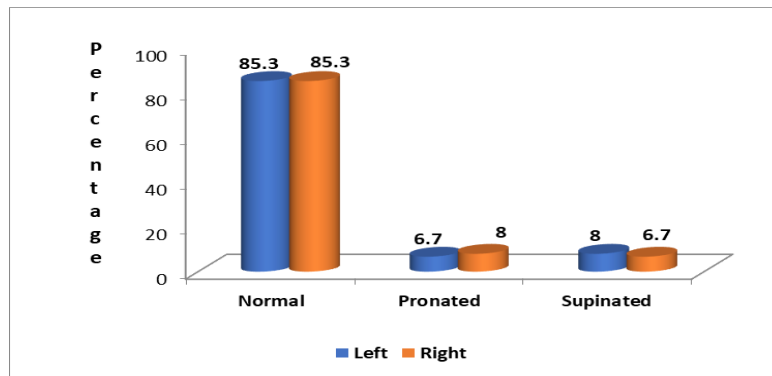


Figure 1- Foot posture in both feet.

There were more males at the age group of 21 to 30 and more females at 41 to 50 age group.

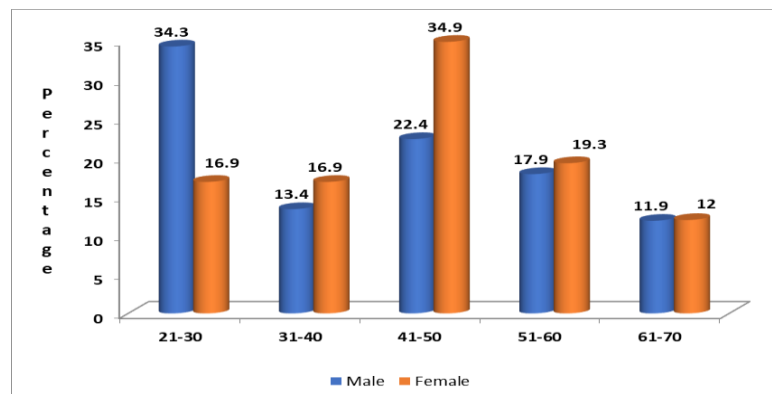


Figure 2- Distribution of age among gender.

Figure 3 illustrates the distribution of foot posture index score of right foot which is highest in 31 to 40 age group which is normal. Pronated foot was found highest in the age group of 41-50. While supinated foot indicates highest at the age group of 21-30.

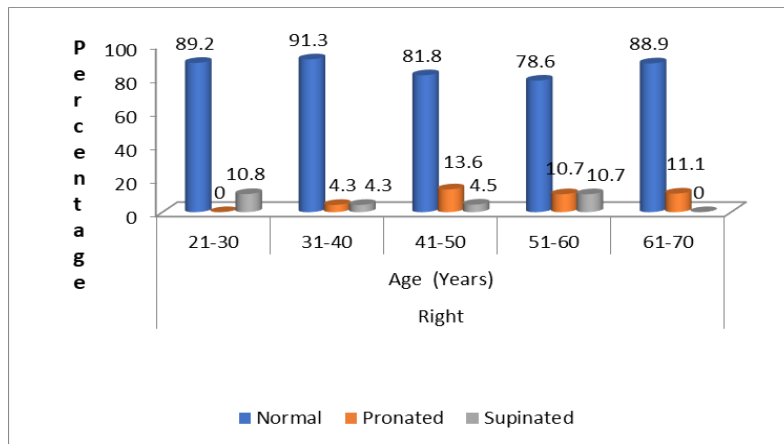


Figure 3- Distribution of foot posture index in right foot.

About the distribution of foot posture index in left foot it indicates that in the age group of 31-40, normal foot was found, while both supinated and pronated foot was more in 51 to 60 age group.

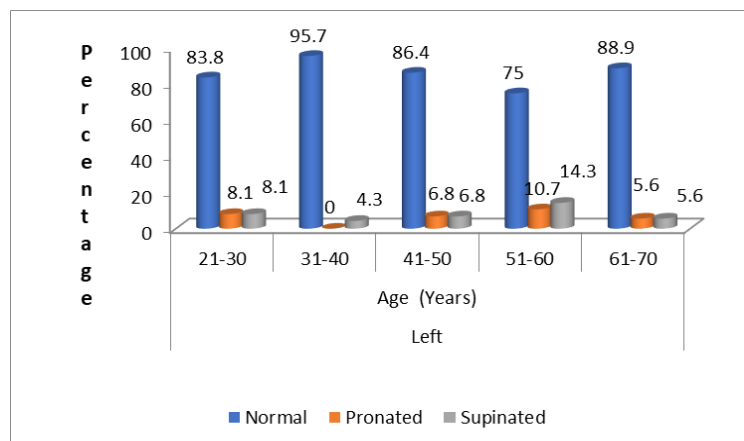


Figure 4- Distribution of foot posture index in left foot.

Males got highest normal and supinated scores in their left foot., while they got more pronated score on their right foot. In case of females, more normal scores were on right foot, they got more pronated scores on left foot, while supinated scores were equally distributed in both left and right foot.

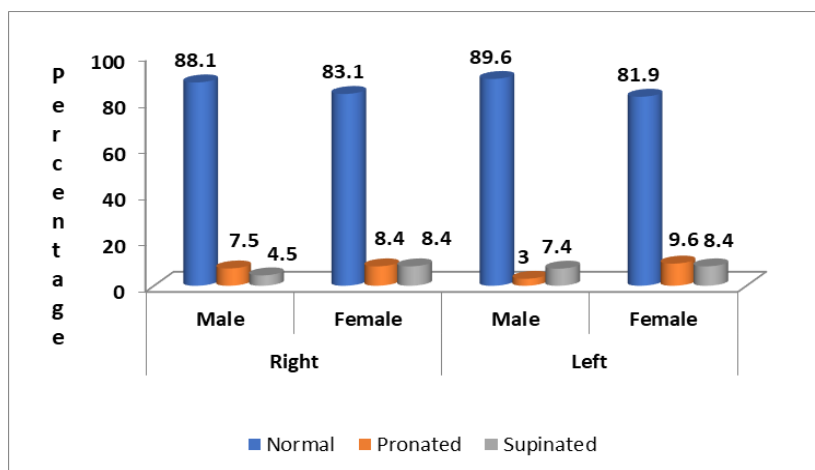


Figure 5- Distribution among both foot in genders.

DISCUSSION

This paragraph will illustrate about the percentage of volunteers with normal, pronated and supinated foot postures. Normal foot was found highest on both left and right foot with 85.3%. on left side pronated foot were 6.7% and on right with 8%. 6.7% volunteers had right supinated foot while 8% had left supinated foot. Similar study was done by Shweta Chandan and et.al (2018) where they found that 3 of the subjects had supinated foot, whereas 7% of the subjects had normal foot and 35% of the subjects had pronated foot followed by 65% of the subjects with excessive pronated foot.

According to the study, percentage of volunteers among males were 34.3% while females were 16.9% of the age group of 21 to 30 years. At 31 to 40 years males were 13.4% and females were 16.9%. Males were 22.4% while females were 34.9% with the age group of 41 to 50 years. Volunteers among 51 to 60 years, 17.9% were males and 19.3% were females. Lastly, males were 11.9% and females were 12% between 61 to 70 years. Similar study was done by Sayali Tribhuvan and et al (2019) where age wise distribution of male and female was carried out, they found that males were 13% and females were 21% at the age group between 60 to 65 years. Between 66 to 69 years, males were 13% and females with 16% and with the age 70 and above males were 24% while females were 13%.

This paragraph will describe about the percentage of normal, pronated and supinated right foot according to various age groups. Volunteers between 21 to 30 years were found that 89.2% had normal foot while 10.8% had supinated foot. According to analysis no pronated foot were seen in this age group. In age group between 31 to 40 years, we found that 91.3% had normal foot while 4.3% volunteers had pronated foot 4.35 had supinated foot. 81.8% has normal foot while 13.6% had pronated foot and 4.5% had supinated foot, these finding were found in volunteers who fall under 41 to 50 years. Between age 51 to 60 years,

78.6% volunteers fall under category of normal foot while both pronated and supinated foot had the similar finding with 10.7%. In 61-to-70-year age group 88.9% had normal foot while 11.1% had pronated foot. There were no volunteers with supinated foot in this age group. It could be seen from the above readings that the highest volunteers fall under the category of normal foot at 31 to 40 years, pronated foot were found most in volunteers who had 41 to 50 ages, while supination was highest in 21 to 30 years old volunteers.

This paragraph will elaborate about the percentage of normal, pronated and supinated left foot among various age groups. Among 21 to 30 age group, 83.8% volunteers had normal foot while 8.1% had pronated foot while similar population had supinated foot. 95.7% had normal foot, 4.3% had supinated foot and no pronated foot was found in the volunteers who were between 31 to 40 years. Volunteers between 41 to 50 years had normal feet with 86.4%, while supinated and pronated feet had similar findings of 6.8%. 75% had normal foot ,10.7% had pronated foot and 14.3% had supinated foot whose ages were between 51 to 60 years. Among 61 to 70 age group, 88.9% had normal foot, 5.6% with pronated foot and 5.6% with pronated foot. It is readily apparent that 31 to 40 years old volunteers had highest percentage of normal foot, 51 to 60 years old had more percentage of pronated as well as supinated foot.

Below readings will throw some light on percentage of males and females who had more normal, pronated and supinated, right and left foot. In males, 88.1% had normal foot on right side while on left side, they had 89.6%. 7.5% had pronated foot on right and 3% had on their left foot. Supinated foot was found more on left foot in males with 7.4% while 4.5% on their right foot. Conversely, in females, normal foot was more on right foot with 83.1% and 81.9% on left foot. In right foot, 8.4% and 9.6% in left foot had pronated foot. Supinated foot with 8.4% were found in both left and right foot. It can be concluded from the above

readings that; females are more affected with pronated and supinated foot than males while males had more normal feet compared to females.

Limitation of this study is large number of samples could be collected but due to the constrained time and geographic area it was limited. Male and female ratio is not equal.

CONCLUSION

The study revealed that females had more pronated and supinated foot compared to males. In comparison between both genders, males had more pronated foot on their dominant side and more supinated foot on their left side while females had more pronated foot on their left side. More pronated feet were found among volunteers whose age were between 41 to 50-year-old and majority of supinated feet were found in individuals whose age fall between 21 to 31 years of their dominant foot. On left side both pronated and supinated feet were found more in individuals which age 51 to 60 years.

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Conflict of Interest: None

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