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RELATIONSHIP BETWEEN FOOT POSTURE AND Q ANGLE IN HALLUX VALGUS PATIENTS.

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Abstract

PURPOSE: *The purpose of this research was to examine the connection between Q angle and foot posture in individuals with hallux valgus who were between the ages of young and middle aged.*

METHOD: *Participants in this cross-sectional study with a diagnosis of hallux valgus ranged in age from 18 to 50 (mean age 35±10yrs) both males and females were recruited from CDA, Chal Foundation, Med spire Foot clinic, Roshan Foot clinic. Data was collected in 6 months. The Foot Posture Index (FPI-6) was used to determine foot posture, standard goniometer was used to measure the Q angle while the subjects were standing comfortably and demographics were recorded.*

RESULT: *The mean Foot posture index was found 6.7±2.8 and the mean Q angle was 18.3±2.3. The Spearman's correlation analysis showed a moderate positive correlation and statistically significant relationship between foot posture and Q angle (r=0.613, p= 0.000).*

CONCLUSION: *The study concludes a significant relationship between foot posture and Q angle in patients with Hallux valgus. This suggests that individuals with altered foot posture in Hallux Valgus exhibit change in Q angle.*

INTRODUCTION

Hallux valgus, also called a bunion, is characterized by lateral and medial deviation of the first metatarsophalangeal joint and the first metatarsal bone It alters the biomechanics of the foot and lower limb extremity, often leading to pain, impaired function, and reduced Quality of life (1).

Global prevalence of hallux valgus:

Hallux valgus affects a significant proportion of the adult population globally, with higher prevalence rates observed among women and older adults. According to a study conducted in 2023, the prevalence of hallux valgus has been reported at around 19% in adults between 18 and 50 years of age (2).According to the result of another research, the prevalence of hallux valgus globally is 23.74% (3).

Prevalence in Pakistan:

According to a Research conducted in Lahore, Pakistan, the Prevalence of Hallux valgus is of 37.5 % in adults (4).

Causes of Hallux Valgus

The development of hallux valgus is recognized as multifactorial, involving complex interaction between anatomical, biomechanical, genetic, and

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environmental factors. Although the precise pathogenesis remains incompletely understood, several contributing elements have been consistently identified in the literature.

Genetic predisposition plays a significant role, with numerous studies indicating a strong familial tendency. Individuals with a family history of hallux valgus are more likely to develop the deformity, suggesting that inherited structural characteristics such as ligamentous laxity, metatarsal length, or first ray hypermobility may contribute to its onset (5).

Biomechanical abnormalities are another key factor. Structural deformities such as pes planus (flatfoot), abnormal pronation patterns, or hypermobility of the first metatarsocuneiform joint can

alter load distribution across the foot, leading to lateral displacement of the big toe at metatarsophalangeal joint and associated medial shift of the first metatarsal. Imbalances in muscle function, particularly between the peroneus longus, tibialis anterior, and intrinsic foot muscles, can further exacerbate this misalignment over time (6).

Footwear choices have been implicated as an external contributing factor. The habitual use of narrow, pointed or high-heeled shoes has been associated with increased prevalence of hallux valgus, particularly among women. Such footwear alters foot mechanics by compressing the toes and shifting weight-bearing forces toward forefoot, promoting the lateral deviation of the great toe (7,8).

Other contributing factors include systemic conditions such as rheumatoid arthritis, which is associated with inflammatory joint changes, and neuromuscular disorders that can affect foot posture and muscle control. Ligamentous laxity, either generalized or localized, and discrepancies in limb length have also been identified as potential contributors to altered foot biomechanics that predispose individuals to the deformity (9).

Overall, hallux valgus arises from the interplay of intrinsic structural factors and extrinsic mechanical influences. Understanding these causative mechanisms is essential for developing effective prevention strategies, improving diagnostic accuracy, and designing comprehensive management approaches that address both local foot deformities and broader lower limb alignment issues.

However, recent research has increasingly pointed toward the critical role of altered lower limb biomechanics, including deviations in foot posture and proximal joint alignments, as significant contributors to the pathogenesis of HV.

Foot posture refers to the alignment and position of the foot. Foot posture affects how weight is distributed across the foot. Particularly heel, arch and forefoot are focused in assessing the foot posture. The general classifications of foot posture and neutral, pronated and supinated.

Hallux valgus alters the alignment, load distribution and biomechanics of the foot, often leading to compensatory changes in the posture and gait. A study found that all participants with hallux valgus had flatfoot, with severity ranging from mild to severe, and observed that most participants also exhibited excessive inward rolling of the rearfoot while bearing weight. Hallux valgus is often linked with dysfunction of the posterior tibial tendon, which may disrupt normal muscle function in the foot and it may lead to prolonged pronation. Because of which the foot becomes more flexible and less stable, increasing its risk of injury from mechanical stress (10).

The Foot Posture Index (FPI) is a validated clinical tool that quantitatively assesses the foot's static posture. It facilitates the multidimensional assessment by examining several anatomical landmarks, providing a score that indicates whether the foot is neutral, pronated, or supinated. Recognizing the critical role of foot posture in loading forces and stresses, the foot posture index serves as a tool for assessing the biomechanics associated with hallux valgus (11).

Simultaneously, the Quadriceps Angle (Q angle) is the angle formed by a line drawn from the ASIS to the center of the patella and to the tibial tubercle from patella. It represents the general alignment of the lower extremity (12). An increased Q angle has

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been associated with a range of lower extremity pathologies, including patellofemoral pain syndrome, anterior cruciate ligament injuries, and foot-related disorders, mainly due to its impact on lower limb alignment and the mechanics of the kinetic chain(13) . Hallux valgus has a tendency to exert an effect on the movement pattern of lower extremity and pelvis.

Poor foot posture can cause abnormal biomechanics throughout the kinetic change. As Q angle reflects the alignment between hip, knee and foot, so they both are inter-related. Excessive pronation can increase the Q angle by causing internal tibial rotation. Evaluating both provides a comprehensive picture of lower limb biomechanics.

Despite emerging evidence suggesting that foot posture and proximal lower limb alignment are interdependent components of a unified kinetic chain, there remains a paucity of literature specifically exploring their relationship in the context of hallux valgus. Studies have been conducted on Foot Posture and Q angle in HVpatients but no study has been conducted on relationship between them so there is need to explore this phenomenon. Understanding the potential correlation between FPI and Q angle in HV patients may offer novel insights into the biomechanical understandings of the deformity and guide the development of more targeted preventive and therapeutic strategies. The research is important for physiotherapists as it explores how foot posture and lower limb alignment interacts in hallux valgus, enabling in early detection and focused intervention.

Figure 1 Hallux valgus; lateral deviation of first ray

Significance of the study

This study holds considerable importance, both clinically and scientifically. While hallux valgus is usually managed by focusing on the foot itself, through methods like orthotic devices, physical therapy, or surgery, the idea that factors higher up the leg, such as abnormalities in the Q angle, might play a role in how the deformity develops and progresses encourages us to think more broadly. It suggests that management should not

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only target the foot but also take into account how the entire lower limb functions together (14).

If a link between the Foot Posture Index and Q angle in people with hallux valgus is established, it could improve how clinicians assess patients. Instead of concentratingsolely on visible foot issues,

they might start evaluating overall lower limb alignment, leading to more complete and effective care. This could help guide the design of treatment plans that address both foot posture and the mechanics of the leg above it, possibly improving patient outcomes and lowering the risk of the deformity returning after surgery.

From a research standpoint, understanding how foot posture and Q angle relate in this group of patients would add valuable insights to our knowledge of how different parts of the lower limb interact. It would also emphasize the benefit of working across disciplines, bringing together expertise from podiatry, orthopedics, and physical therapy to better manage musculoskeletal problems.

LITERATURE REVIEW

Kamil Yilmaz et al in 2025 conducted a study to see the difference between Q angle in healthy and hallux valgus patients. Hallux valgus was measured using a standard goniometer and Q angle. Finding of the study shows that there is a relationship between Hallux valgus and Q angle in comparison to healthy individuals (15).

Ezcan Tutus et al., in 2024, conducted a study to examine the relationship between body image perception, quadriceps angle, and hallux valgus. The Manchester scale and goniometer were used for data collection to measure Q angle and hallux valgus. Based on these findings, it was concluded that quadriceps angle and body image impact healthy individuals with hallux valgus, which can cause difficulty in performing activities of daily living (16).

Wataru Kawakami et al in 2024 did a study in order to see the relationship between hallux valgus with foot posture, gait and kinematics of foot. Data was collected by using three-dimensional motion capture system. Additionally, leg heel angle and navicular height were also assessed. Finding of the study states that there is a association between foot posture, gate and foot kinematics with hallux valgus foot deformity (17).

Imam Akram et al in 2024 did a study in order to see the comparison of Q angle and hallux valgus in high heel and no heal wearers. Data was collected by using a goniometer for measuring HV angle and Q angle. Findings of the study shows that Hallux valgus seemed to be more prevalent in high heels than non-heel wearers. Furthermore, more it was seen that no impact of wearing high heels with respect to Q angle (18).

Busra Sacli Eksilmez et al in 2024 did the study in order to investigate the physical performance as well as foot function in women with hallux valgus. Data was collected by using the American Orthopedic Foot and Ankle Society Hallux Metatarsophalangeal Interphalangeal Joint Scale, Foot Function Index andManchester scale. Findings of the study show that women with moderate to severe hallux valgus have poor foot function and performance. On the contrary, patients with mild hallux valgus had better physical performance and foot function (19).

Meiko Yokozuka et al in 2023 data study in order to determine the range of motion of the ankle as well as the morphology of the hind foot. Data was collected by using the heel floor angle. Additionally, range of motion such as eversion, inversion, plantar flexion and dorsiflexion was alsoassessed. Findings of this study state that in patients with hallux valgus decrease in arch height is seen along with a more pronated and everted foot (20).G. Aydin Yağcioğlu and M. Karapinar in 2023 conducted a study to compare foot posture, pain, function, and quality of life in individuals with pes planus and hallux valgus. A total of 31 participants were clinically assessed using the Foot Posture Index (FPI-6), Foot Function Index (FFI), American Orthopedic Foot and Ankle Society (AOFAS) score, and SF-36 questionnaire. Results indicated that patients with pes planus had significantly worse foot posture and more foot pain than those with hallux valgus ($p<0.05$). No significant differences were found in quality of life or functional outcomes ($p>0.05$). This study

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concluded that pes planus leads to more pain and foot posture issues compared to hallux valgus (21). Aftab Ahmed Baig et al in 2021 data study in order to determine the Q angle and hallux valgus deformity in medical students. Data was collected by using an inverse goniometer for measuring these two angles. Finding of the study shows that a low prevalence of hallux valgus was seen among female university students. Furthermore, it was seen that there is no relationship between the Q angle and hallux valgus deformity (22)

Matthew S. Conti et al in 2021 trader study in order to see the relationship between hallux valgus and first metatarsal pronation. Data was collected with the help of the PROMIS score and CT scan. Findings of the study state that there is a relationship between first metatarsal pronation and hallux valgus (23).Tobiasz Zlobinski et al in 2021 did the study in order to determine the pain and foot anthropometry in hallux valgus patients. Data was collected by using a baropodometric platform and a 3D scanner. Finding of the study shows that foot length, foot pressure and posture with surface seen to be impacted in patients with hallux valgus (24).

There is limited research directly linking Q angle and foot posture in patients with hallux valgus. Most studies focus on these factors separately or compare them with other conditions like flat feet or the effects of high heels. There is a need for studies that explore how foot posture affects Q angle in people with Hallux valgus. This can help better understand the condition and improve treatment strategies.

RATIONALE

Although much of the current research tends to concentrate solely on the foot, like joint hypermobility, altered metatarsal angles, and footwear habits, with limited attention given to how alignment higher up the leg might relate to the hallux valgus. One such factor is the quadriceps angle (Q angle), which represents the alignment between the hip, knee, and tibia, and has a known influence on lower limb biomechanics through the entire kinetic chain.

Studies specifically investigating the connection between the Q angle and Foot posture in Hallux valgus patients are limited. The relationship between proximal alignment, such as Q angle, and distal foot, as measured by the Foot Posture Index (FPI), remains unclear in this specific group of patients. This creates a noticeable gap in both clinical understanding and biomechanical knowledge.by investigating this relationship across a wide age range, the current study aims to address several unanswered questions. If a correlation between Q angle and FPI is found, it could encourage clinicians to broaden their assessment rather than focusing exclusively on foot-level issues and consider the alignment of the entire lower limb. This, in turn, might lead to the development of more comprehensive treatment plans that consider both foot posture and proximal limb mechanics, possibly improving clinical outcomes and lowering the chance of deformity recurrence after treatment.

Overall, this research aims to fill an important gap by exploring how Q angle and foot posture interact in patients with hallux valgus. The findings could contribute meaningful insights that support more holistic, interdisciplinary management strategies in clinical practice.

RESEARCH OBJECTIVES

The study has the following objectives:

To evaluate the average foot posture in hallux valgus patients

To evaluate the average Q angle in hallux valgus patients

To investigate the relationship between foot posture and Q angle in hallux valgus patients

HYPOTHESIS

HYPOTHESIS: The following theories can be developed in light of the literature currently in publication:

Alternative Hypothesis: There is a significant relationship between foot posture and Q angle in the patients with hallux valgus.

Null Hypothesis: There is no significant relationship between Foot posture and Q angle in patients with hallux valgus.

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OPERATIONAL DEFINITIONS

HALLUX VALGUS:

A hallux valgus, also called (Bunions), is one of the most prevalent forefoot abnormalities. The head first metatarsal shifts medially while the proximal phalanx deviates laterally in HV, which is caused by the abduction of the first metatarsus, known as metatarsus primus Varus. The exact etiology is unclear, though. Women are typically more likely than males to experience Hallux Valgus.

FOOT POSTURE INDEX:

The Foot Posture Index (FPI) is a multi-plane, multi-segment, validated observational assessment tool that uses a structured scoring system to measure foot posture. With a numerical score that ranges from -12 (extremely supinated) to +12 (strongly pronated), it assesses six-foot alignment characteristics and is a dependable tool for use in clinical research and demographic investigations involving foot mechanics and musculoskeletal alignment.

Q-ANGLE:

The Q angle, also known as the quadriceps angle, is the angle created by two lines: one that runs from the patella's center to the tibial tuberosity and the other from the ASIS to the patella's center. It functions as a biomechanical indication of knee alignment and patellofemoral joint loading and shows the force vector applied to the patella by the quadriceps muscle group.

METHODOLOGY:

Research Design

This was an analytical cross-sectional study.

Study Duration

The Study was completed within 6 months' time frame, starting from January till June 2025.

Study Settings

Data was collected from CDA Hospital, Chal foundation, Roshan foot clinic and Med Spire Foot Clinic, Islamabad.

Sample Size

With a variance of.05 and a confidence interval of 0.95, the sample size was determined using an online sample size calculator for designing clinical research.58 is the sample size.

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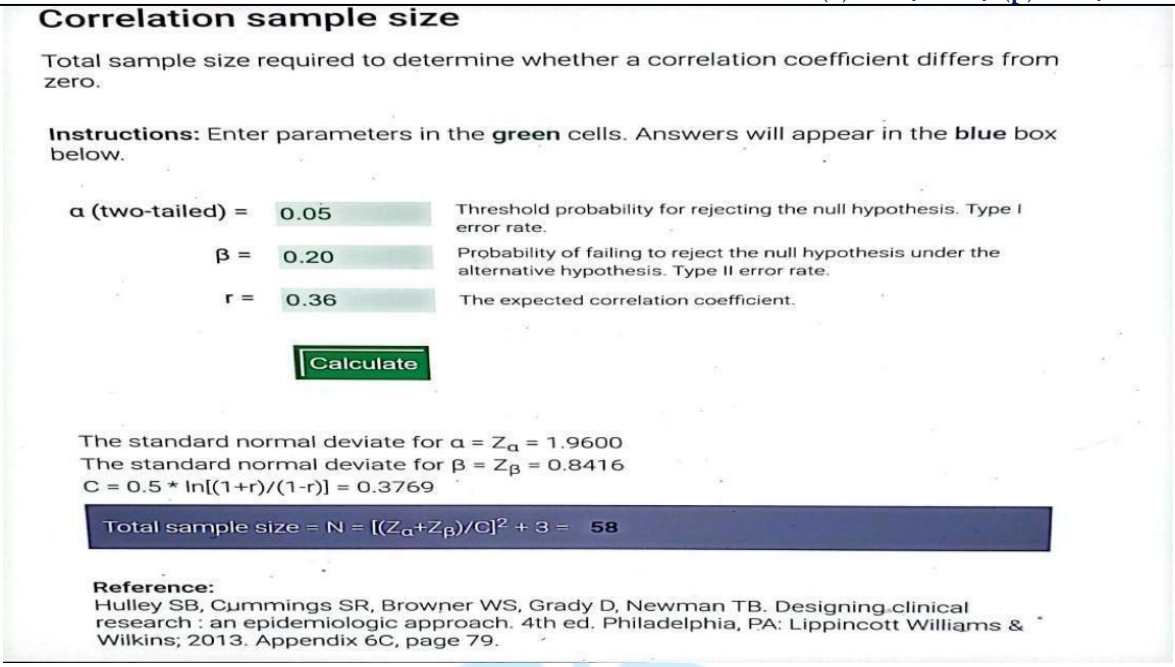

Figure 2: Sample size calculation

Sampling Technique

A Purposive sampling technique was used to select participants.Sample Selection:

Inclusion Criteria

Males and females aged 18-50 with hallux valgus in at least one foot.

Participants must have a clinical diagnosis of hallux valgus, confirmed by imaging studies (e.g. X rays) or physical examination (digital photography method, Angle measurement using goniometer).

Exclusion Criteria

Foot congenital anomalies ‘

Previous foot trauma or foot surgery (one year)

Musculoskeletal disorders (Rheumatoid arthritis, Osteoarthritis, gout).

Severely obese patients i.e., BMI ≥ 30.0

Knee deformities

DATA COLLECTION INSTRUMENTS

Self-Structured Questionnaire:

Demographics information including BMI, education level, comorbidities, effected side, grade of hallux valgus etc was gathered through self structured Questionnaire.

Posture Index (FPI-6):

Tool: Standardized FPI-6Appraisal Guide (11).

Assessment Position: Member stands unshod in loose bipedal position, arms at sides, eyes confronting forward.

Assessment Position: Member stands unshod in loose bipedal position, arms at sides, eyes confronting forward.

Marking write (for anatomical points of interest in case needed). Observer surveys **six** criteria:

Talar head palpation.Supra and infra sidelong malleolar curvature.

Calcaneal frontal plane position.

Bulging within the locale of the talonavicular joint.

Height and consistency of the average longitudinal arch.

Abduction/adduction of the forefoot on the rear foot.

Each thing scored from -2 (supinated) to +2 (pronated), add up to score ranges from -12 to +12.

Procedure:

Observe and palpate the taking after 6 criteria (each scored from -2 to +2):

Talar head palpation.

Supra and infra sidelong malleolar curvature.

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Calcaneal frontal plane position.
Bulging at the talonavicular joint.
Height and compatibility of the average longitudinal arch.
Forefoot abduction/adduction on the rear foot

Scoring:
Total FPI-6 score = whole of six items.
Range: -12 (profoundly supinated) to +12 (profoundly pronated).
Average of calculated three readings is considered as final score.

Interpretation:
-12 to -1: Supinated
+1 to +5: Neutral
+6 to +12: Pronated

Q-Angle Measurement
Q-angle measurement was used in this study to assess lower limb alignment and any possible correlation with foot posture in people with hallux valgus. The angle created by drawing two lines, one from the center of the patella to the tibial tuberosity and the other from the ASIS to the center of the patella is known as the quadriceps angle, or Q-angle.To represent functional lower limb alignment, measurements will be made when the participants are standing comfortably erect, barefoot, with their feet shoulder-width apart and their toes facing forward. Anatomical features such as the tibial tuberosity, patella center, and ASIS will be palpated and marked with a skin-safe marker (25).
After that, the angle on affected leg was measured using a conventional portable goniometer. In order to decrease measurement error and increase dependability, three readings were collected, and the average was noted.

DATA COLLECTION PROCEDURE

The enrollment of participants with a confirmed diagnosis of hallux valgus between the ages of 18 and 50 years was the first step in the data collection process for this cross-sectional study, which examines the association between foot posture and Q-angle in young to middle-aged adults with the condition. Prior to enrollment informed consent was taken from all the participants and the collection of demographic information age, sex and BMI. Eligibility was determined on the basis of predefined exclusion criteria including the presence of congenital foot deformity, Musculoskeletal disorder, any history of past foot trauma or mental illness. Although the sample size was 58, data was successfully collected from 48 Participants(50 feet) (26–28). The Foot Posture Index (FPI-6) was used to measure participant's foot posture following informed permission. This tool assesses six aspects of foot alignment while standing comfortably: forefoot abduction/adduction, talar head palpation, calcaneus inversion/eversion, bulging at the talonavicular joint, congruence of the medial longitudinal arch, and curvature above and below the lateral malleoli. In order to classify foot posture as supinated, neutral, or pronated, each criterion is given a score between -2 and +2, with the total values ranging from -12 (extremely supinated) to +12 (strongly pronated). For the purpose of measuring Q-angle, (13) participants with stood with their feet shoulder-width apart and barefoot to represent a functional alignment. Following the identification and marking of anatomical landmarks such as the ASIS, center of the patella, and tibial tuberosity, the angle formed by the lines connecting the ASIS to the patella and the patella to the tibial tuberosity was measured using a standard goniometer. Three measurements of each lower limb were made, and the average was noted.

ETHICAL CONSIDERATION

This study has been reviewed and ethically approved by the institutional Review Board and Ethics Committee, Shifa International Hospital. All participants were provided with clear and comprehensive information regarding the study's purpose, procedures, potential risks, and benefits, and written informed consent was obtained before participation. Participation will be entirely voluntary, with the right to withdraw at any point

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without any consequences or loss of benefits. Confidentiality was strictly maintained by assigning anonymized identification codes and securely storing all personal and clinical data.

RESULTS

The study comprised a total of 48 Participants (50 feet) who had been diagnosed with hallux valgus. The primary objective was to determine the relationship between Foot Posture, assessed using Foot Posture Index (FPI), and Q angle and foot posture, as measured by the Foot Posture Index (FPI).

The mean age of the participants was 35±10 years with minimum age of participants 21 and maximum age of participants 50 years. According to Body mass index 23 (46 %) participants lie in normal range and 27 (54%) were overweight. The mean Q angle was 18.3±2.3 and Mean Foot posture index was 6.7±2.8.

The data was not distributed normally so spearman's correlation test was applied. According to the Spearman's correlation test applied between Foot posture and Q angle shows a moderate positive correlation among Foot posture and Q angle which is statistically significant (r = 0.613, p = 0.00).

The means foot posture tends to alter the Q angle. From a biomechanical perspective, this positive correlation supports the idea that excessive foot pronation may contribute to proximal changes in the limb alignment, possibly through internal tibial rotation.

Table 1 Mean statistics of age

Variable	Mean ± SD
Age (years)	35 ± 10

Table 2:Frequency Satistics of Demographic Data

Sr. No	Characteristics of Participants		Frequency (n)	Percentage (%)
1	Gender	Male	14	29
		Female	34	70
2	Number of feet	Male	14	28
		Female	36	72
3	Body Mass Index	Normal (18.5-24.9)	23	47
		Overweight (25-29.9)	25	52
4	Background	Urban	44	91

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		Rural	2	8
5	**Marital Status**	Married	41	85
		Unmarried	7	14
6	**Education Level**	Primary Education	10	20
		Secondary education	18	37
		Higher Education	20	41
7	**Employment Status**	Employed	17	35
		Unemployed	31	64
8	**Comorbidities**	Hypertension	22	30
		Diabetes	10	20
		other	16	33
9	**Smoker**	Yes	9	18
		No	39	81
10	**Exercise**	Yes	29	60
		No	19	39
11	**Effected side**	Left	18	36
		Right	28	56

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		bilateral	4	8
12	Physical Therapy or orthotic treatment	Physical Therapy	11	26
		Orthotic treatment	19	38
		None	18	36
13	Grade of Hallux Valgus	Mild	23	48
		Moderate	14	28
		Severe	13	26

Table 3 Mean statistics of foot posture index and Q-angle

Variables	Mean± SD
Foot posture index (score)	6.7±2.8
Q angle (degrees)	18.3±2.3

Graphical Representation of Demographical Data

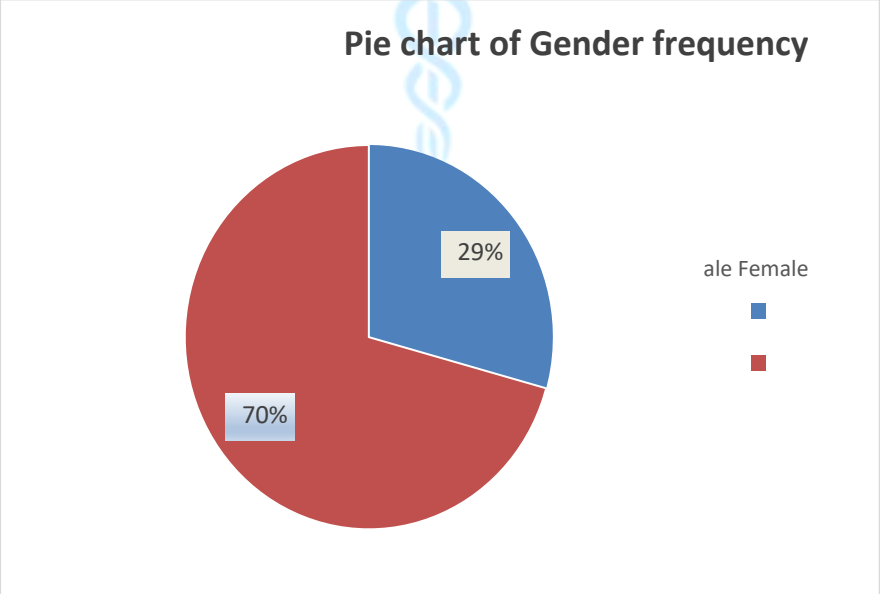

Figure 3 ie chart of gender frequency

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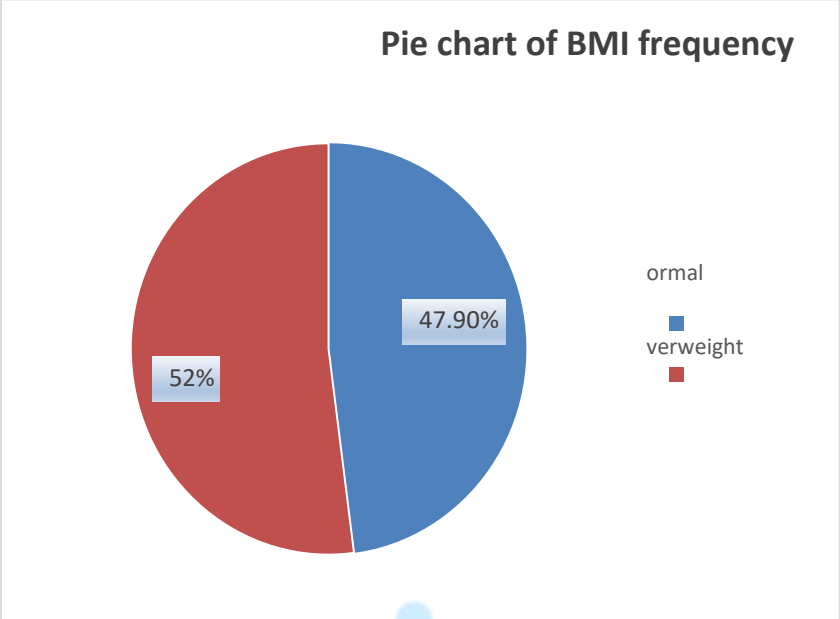

Figure 4 Pie chart of BMI frequency

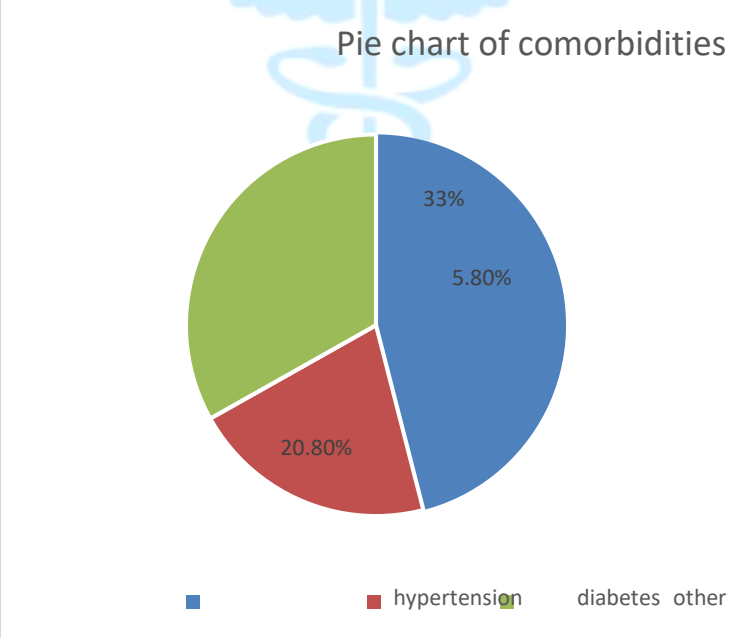

Figure 5 Pie chart of comorbidities

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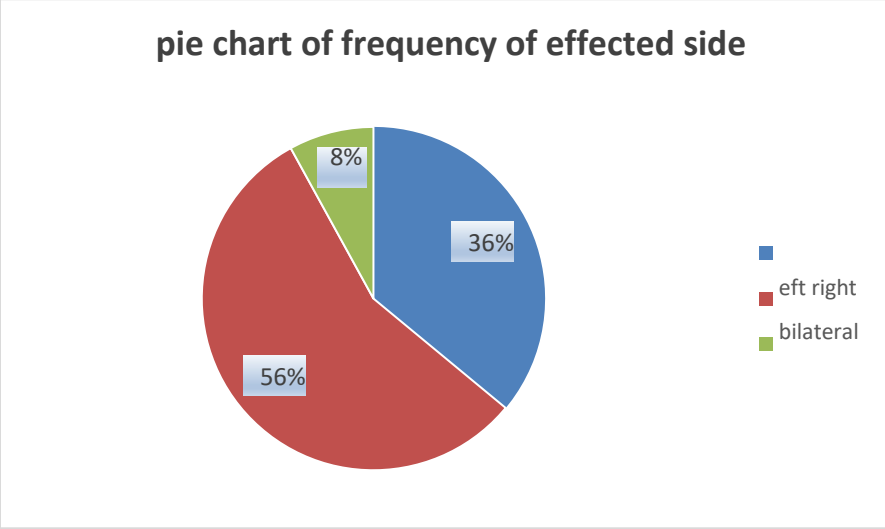

Figure 6 Pie chart of frequency of effected side

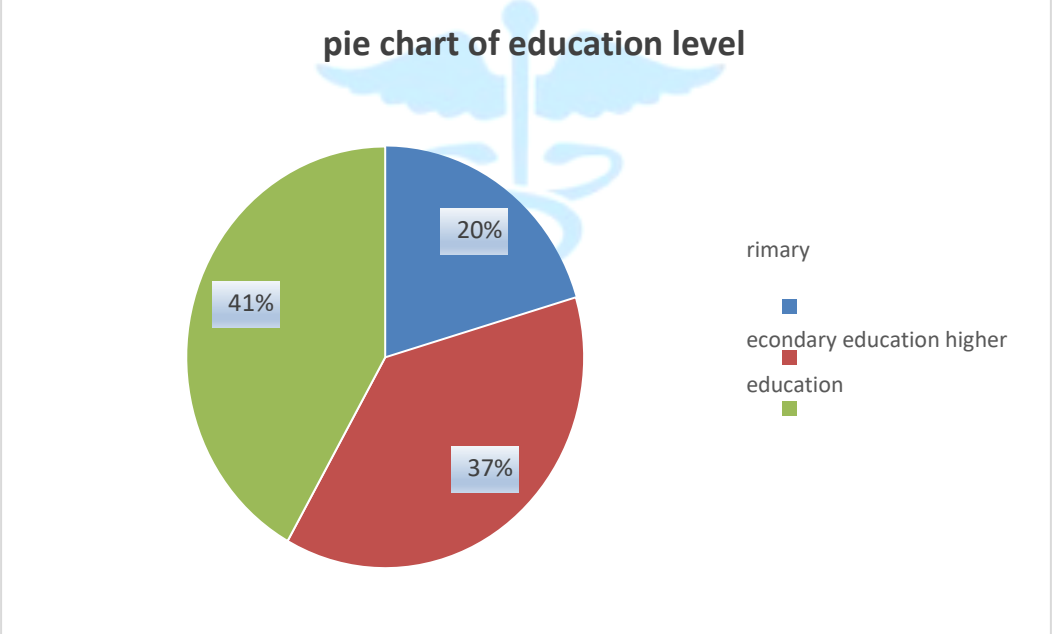

Figure 7 Pie chart of education level

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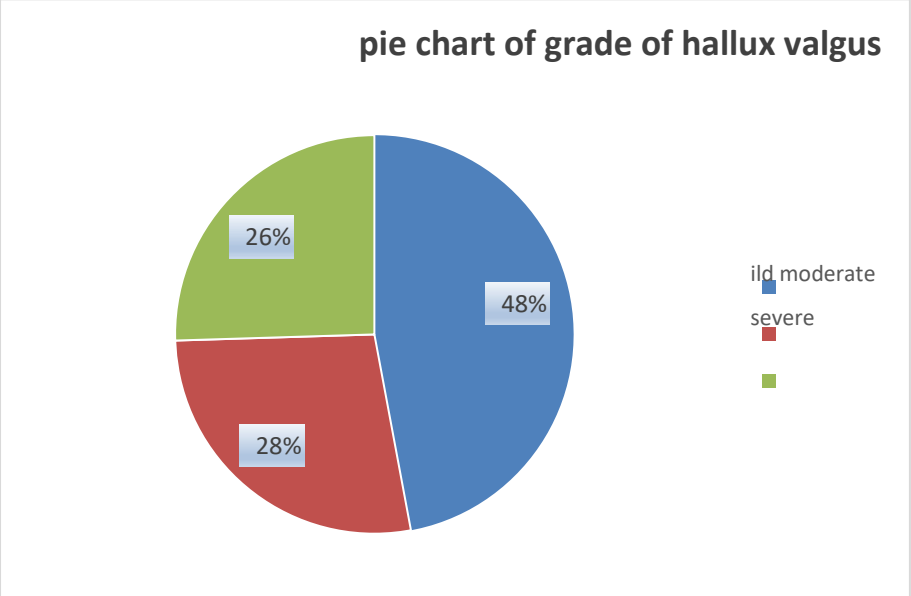

Figure 8 Pie chart of grade of hallux valgus

INFERENTIAL ANALYSIS

Shapiro-wilk Normality Test for FPI showed the test statistics 0.907 with p value 0.01 and for Q angle the test statistic was 0.939 with p value 0.013.

Since the p values of both variables are less than 0.05, this indicated statistically significant deviation from normality. This means both variables are not normally distributed.

Table 4 Normality test statistics

TEST OF NORMALITY		
Shapiro-Wilk		
	Statistic	**Sig.**
Foot Posture Index	0.907	0.001
Q angle	0.939	0.013

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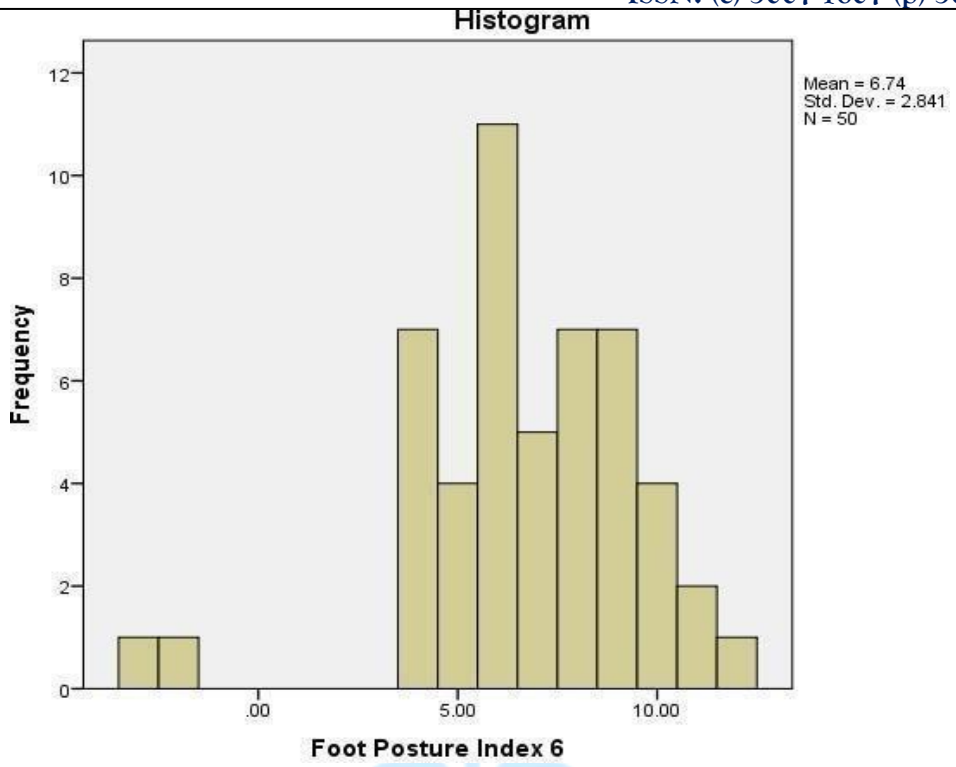

Figure 9 Histogram of foot posture index

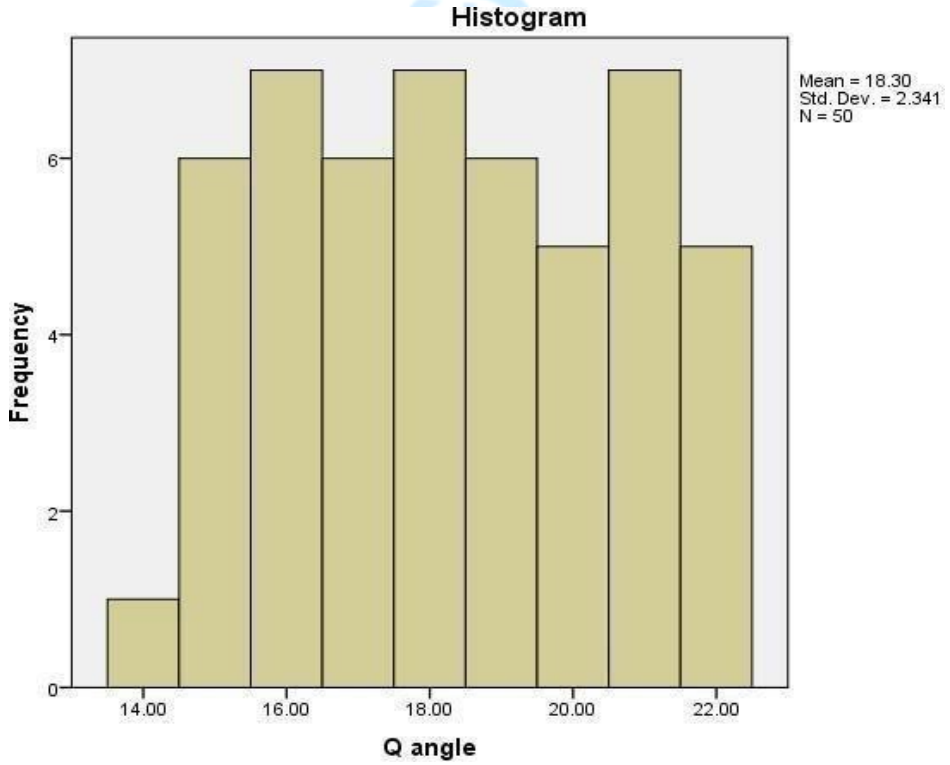

Figure 10 Histogram of Q angle

The result of spearman's correlation showed moderate positive and statistically significant

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relationship between the Foot posture and Q angle in patients with Hallux valgus (r=0.613, p=0.000).

Table 5 Spearman's correlation statistics

Spearman's Correlation Statistics		
Variable	**P- value**	**Correlation Coefficient**
Foot posture Index	<0.001	r= 0.613
Q angle	<0.001	r= 0.613

DISCUSSION

Our study investigated the relationship between foot posture and Q angle in young to middle-aged patients presenting with hallux valgus. Our findings indicate a significant association between pronated foot posture and increased Q angle in this population. The pronated foot posture observed in many hallux valgus patients likely contributes to altered biomechanics at the foot and lower limb, increasing medial stress on the first metatarsophalangeal joint, which is a critical factor in hallux valgus development and progression. An increased Q angle, reflecting greater lateral deviation of the quadriceps pull relative to the patellar tendon, may exacerbate abnormal lower limb alignment, leading to compensatory foot pronation. This altered alignment can further increase the mechanical load on the medial side of the foot, reinforcing the deformity. These findings align with previous literature suggesting that increased Q angle and pronated foot posture together contribute to abnormal loading patterns in the lower extremity, thereby facilitating hallux valgus deformity. Clinically, this highlights the importance of comprehensive lower limb assessment—including both foot posture and Q angle evaluation—in managing patients with hallux valgus.

In 2019, a study carried out in Pakistan examined the relationship among the flexible flat foot and Q angle in secondary school students using the Dennis method (29), This study reveals fair to strong correlation of foot deformity with Q-angle, mean value of Q-angle is (18.60). The result of our study shows consistency with the result of this study, as it suggests positive correlation of foot deformity with Q-Angle. Our research findings are in alignment with those reported in the referenced study, as both indicate a significant positive association between foot deformities and the Q-Angle.

A study was conducted on The Relationship between the Range of Hip Rotation andthe Quadriceps Angle in Subjects With and Without Flat Foot in 2018 in South Korea (30), which have moderate correlation with Q-angle. The result of our study shows consistency with the result of this study, as it suggests positive correlation of foot deformity with Q-Angle. The results we obtained in our study are consistent with the outcomes observed in this particular study, both suggesting that there is a positive correlation between the presence of foot deformities and the Q-Angle measurement.

A study was conducted on the relationship between flat foot and q-angle in elementary school students in 2023 in Indonesia (31) The study reveals a moderate and meaningful correlation between foot deformity and Q-Angle. The result of our study shows consistency with the result of this study, as it suggests positive correlation of foot deformity with Q-Angle. In examining the data from our study, we found results that tells the findings of the comparative research, particularly in demonstrating a positive correlation between deformities in the foot structure and the angle of the quadriceps (Q-Angle).

Correlation between Foot Arch Index and Quadriceps Angle among Patients with Knee Osteoarthritis in National Orthopedics Hospital Enugu in Nigeria in 2021 (32). This study aimed to determine whether a relationship exists foot

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arch index and quadriceps angle in adults. The findings showed statistically significant association between with mean value of Q-angle (21.2) on both sides. The result of our study show no consistency with the result of this study, as it suggests positive correlation of foot deformity with Q-Angle.

A study was conducted on the effect of heel type on Q-angle in 2020 in India (33).Variable heel type has an effect on Q angle with mean value of (14.18). This study reveals a strong correlation with Q-angle. The result of our study shows consistency with the result of this study, as it suggests positive correlation of foot deformity with Q-Angle. Based on the analysis conducted in our research, we observed results that closely mirror those of the cited study, particularly insuggesting a noteworthy positive relationship between foot deformity and Q-Angle values.

A study was conducted in Turkey in 2024 to investigate the relationship between hallux valgus, quadriceps angle, and body image perception in young adults (16). This study reveals significant relationship between hallux valgus and Q-angle.Therefore, deviations from the normal values of HV and the Q angle, affecting the musculoskeletal system, may lead to health problems. Such conditions can negatively affect an individual's daily life activities and normal functionality. The result of our study shows consistency with the result of this study, as it suggests positive correlation of foot deformity with Q-Angle. Through our analysis, we discovered a trend similar to that reported in the selected study, indicating that individuals with greater Q-Angles are more likely to exhibit signs of foot deformity, thereby suggesting a positive correlation.

A study to investigate the association of foot posture and quadriceps (q) angle with knee pain in traffic police officers in 2012 in India(34). Independent t test for Q angle and FPI showed statistically significant difference ($p<0.05$) between case and control group. The results showed that the KPQ score is moderately correlated with Q angle (-0.462 {P><0.0001} and 0.440 (P><0.0001) for the right and left lower limbs respectively). Also that the KPQ score is highly correlated with Foot posture (-0.645 {P><0.0001} and 0.614 (P><0.0001) for the right and left lower limbs respectively)><0.05. The result of our study shows consistency with the result of this study, as it suggests positive correlation of foot deformity with Q-Angle. The outcome of our research is in agreement with the findings presented in the other study, both pointing toward a direct and positive correlation between abnormal Q-Angle measurements and the incidence of foot deformities.

A study was conducted in 2024 in Pakistan (Lahore) to investigate the Comparison of hallux valgus and quadriceps angle in high heel wearers and non-heel wearers(35). This study reveals considerable variation in the HV angle between those who wearhigh heels and those who do not. However, there is no remarkable difference between the Q-angle of these two groups. This study shows no significant relationship between Q-angle and Hallux valgus. The result of our study shows no consistency with the result of our study, as it suggests no positive correlation of hallux valgus with Q-Angle. Upon reviewing the results of our own investigation, we observed a similar pattern to that described in the referenced study, specifically highlighting a positive link between the presence of foot deformities and the angle formed by the quadriceps (Q-Angle).

In 2021 a study was conducted in Pakistan to examine the relationship between Hallux Valgus Deformity and Quadriceps Angle among Female Medical Students

(22). The results suggested that hallux Valgus HV deformity is less common in this population. A correlation was observed between the Hallux valgus angle and Q-angle, however, the overall study suggests no effect of Q-angle on Hallux valgus angle. This study recommended further research to evaluate other biomechanical factors affecting Hallux valgus angle on larger sample size and on males too. The result of our study shows consistency with the result of this study, as it suggests positive correlation of foot deformity with Q-Angle. The conclusion drawn from our study aligns with the findings of this study, reinforcing the idea that an increase in Q-Angle is positively

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correlated with the occurrence of various foot deformities.

A study to investigate the Comparison of Q Angle in Hallux Valgus and Healthy Individuals was conducted in Turkey In 2024 (15) A weak positive correlation was found between the right-sided HV and right-sided Q angles of the study participants (r=0.446, p=0.013). When the relationship was analyzed according to the groups, a moderate positive correlation was found between right-sided HV and right-sided Q angles in the control group (r=0.533, p=0.041). There is a relationship, albeit weak, between HVA and Q angle in individuals with HV and healthy individuals. The result of our study shows consistency with the result of this study, as it suggests positive correlation of foot deformity with Q-Angle.

LIMITATIONS

The study's statistical strength and generalizability to a larger population may be constrained by its brief duration and small sample size.

Due to a lack of male participants, a significant statistical analysis could not be performed, making a comparison between male and female participants impossible.

Due to the cross-sectional nature of the study, a cause-and-effect relationship between Q-Angle and foot deformities such as hallux valgus cannot be established.

The Q-Angle was measured only on the side where the deformity was present, which may limit the interpretation of results and prevent bilateral or unaffected side comparisons (right and left).

RECOMMENDATIONS

Further studies should include a large sample size to increase the reliability and generalizability of the results.

Researchers should consider gender differences to explore the effects on foot biomechanics.

Researches should explore that how the relationship differs in different age groups.

Future studies should consider this relationship on the basis of Hallux valgus severity.

CONCLUSION

The study concludes a moderate positive correlation was identified between foot posture and Q angle in middle to young and middle-aged adults with hallux valgus, which indicates a significant relationship. According to the study's outcomes, a relationship exists between the presence of hallux valgus deformity and the Q-Angle and Foot Posture. This suggests that individuals with more pronated foot postures tend to exhibit a greater Q angle, which may contribute to or exacerbate the progression of hallux valgus deformity. These findings underscore the importance of considering both foot posture and Q-Angle when assessing and managing hallux valgus, particularly in younger-middle age populations where early intervention may prevent further structural changes.

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