ORIGINAL ARTICLE

Comparison of Hallux Valgus and Quadriceps Angle in High Heel Wearers and Non-Heel Wearers

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ABSTRACT

Background: "Hallux Valgus is a structural deformity of first metatarsophalangeal joint, lateral deviation of the great toe," often caused by wearing ill-fitting or high-heeled shoes. Lower extremity deformities may be predisposed by the lower extremity's anatomical alignment, particularly the Q angle.

Objective: The objective of this study was to determine the comparison of hallux valgus and quadriceps angle in heel wearers and non-heel wearers.

Methods: This was a comparative cross-sectional survey that was collected through non-probability convenient sampling. The participants were divided into two groups. One group included 50 females who wore high heels for approximately 3-6 months and 4-6 hours a day and the other group included 50 females who did not wear high heels. The written informed consent was acquired. All of the participants were given a self-designed questionnaire, and measurements of their weight and height were taken. The Q angle and HV angle were measured with a universal goniometer. The data was analysed in SPSS for Windows software version 25. The normality of the data was assessed by Levene's Test for equality of variances. Independent-T test was selected to apply for measuring difference of the two groups.

Results: An Independent sample test was used. Age of the participants was 18-25. Mean HV angle of non-high heel wearers was 12.11±1.855 and heel wearers was 22.30±5.932. There is significant difference between HV angle of non-high heel wearers. Mean Q angle of non-high heel wearers observed was 13.98±2.951 and high heel wearers was observed to be14.38±2.633. There was no significant difference between Q angle of non-high heel wearers.

Conclusion: The current study's findings indicated a considerable variation in the HV angle between those who wear high heels and those who do not. But there is no remarkable difference between the Q angle of these two groups.

Keywords: *Hallux Valgus, Quadriceps Angle, High Heel, Wearers*

INTRODUCTION

The feet are a vital static and dynamic part of the human motor system.[1] Forefoot disorders are exceedingly prevalent in the general population and can impede patients' activities of daily living. In many cases, forefoot disorders are usually the result of wearing ill-fitting or high-heeled shoes.[2] Wearing high-heeled shoes is correlated with a higher incidence of hallux valgus and musculoskeletal pain.[3]

In adults, the most common forefoot problem is Hallux valgus.[4] Hallux Valgus is defined as "a structural deformity of the first metatarsophalangeal joint in which the angular deviation of the hallux is greater than 15° toward the lesser toes with respect to the first metatarsal bone",[5] which means medial deviation of the first metatarsal and lateral deviation of the great toe, either with or without valgus rotation, which results in subluxation of the corresponding joint.[6] Due to the big toe deformity in Hallux Valgus, the first metatarsophalangeal joint protrudes, and friction from shoes may cause swelling, reddening, and inflammation. Compression of nearby nerves may be the cause of big toe pain and numbness. In the advanced stage, the second toe may develop a callus or become dislocated since the big toe slides under it. The risk of falls increases due to marked deformity, impairing physical performance and daily living quality. High-heeled shoes, in particular, are likely to have contributed significantly to the recent rise in HV prevalence.[7] High heels are a common footwear choice for women. Hence, many orthopedic disorders are also brought on by walking in heels. (e.g., blisters, bunions, hallux valgus, lesser toe deformities). These disorders are a significant public health concern as they pertain to women, they have a significant economic influence on the patient's work and personal activities, which can negatively affect autonomy, welfare, and quality of life.[8] Increased heel height and its prolonged use progressively increases the severity of the deformity[9] which may impair body balance[10] as high heels places the foot in more plantarflexed position affecting the stability.[11] Lorkowski et al reported that professionally

active women were frequently obliged to wear unpleasant and constricting footwear to adhere to the "business dress code". They emphasized that many firms have strict rules regarding the business attire of their female employees, and they believe that women's work attire is complemented by high-heeled shoes.[7] Around 80% of women prefer wearing high heel footwear, 30% of whom use it for professional reasons.[12] Pain caused by pressure between the first and second toes or between the bunion and the shoe is the most common complaint of people with hallux valgus. The hallux valgus angle measured with a goniometer is the most recognized indication for hallux valgus deformity.[13]

Another significant anatomical and biomechanical factor influencing lower limb performance is the quadriceps (Q) angle.[14] Lower extremity injuries and deformities have both been linked to the anatomical alignment of the lower limb. The Quadriceps angle, which is "the angle formed by two lines connecting the anterior superior iliac spine to the center of patella and the center of patella to the tibial tuberosity," [15] The Q angle measurement, which reflects the impact of the quadriceps mechanism on the knee, is a an important sign of the biomechanical function in the lower extremity[16] It has been proposed that the Q angle is a composite measurement of foot position, patella position, hip rotation and tibial rotation. The location of a landmark or landmarks utilized in the Q angle measurement may hypothetically vary if any one of these alignment parameters changed.[15]

METHODS

It was a comparative cross-sectional study. The study was conducted for the period of six months from July – December in Pakistan Institute of Fashion Designing. Non-probability convenient sampling technique was used. WHO calculator was used to calculate sample size.

$n= \sigma^2(Z_{1-\alpha/2} + Z_{1-\beta})^2/ (\mu_o - \mu_a)^2$
Population standard deviation (σ)= 0.34
Population variance (σ^2) = 0.1156
Level of significance (%)= (α) = 5
Test value of population mean (μ_o)= 8.03
Power (1-β)= 90
Anticipated population mean (μ_a)= 7.92
Sample size group 1 = 50
Sample size group 2 = 50
Sample size (n)= 100
The sample size of this study was 50 for each group. (17)Subjects inducted into the studyas per eligibility criteria consented to participate in the study. Informed consent in English or Urdu was signed by each participant. Hundred participants were selected and allocated into two groups i.e 50 in each group. Group A includes High heel wearers, while Group B includes non-heel wearers.
Female students with the age group of 18-25 that wear high heels or pointed shoes for approximately 3-6 months and 4-6 hours a day were included in one group. For the other group, female students that do not wear high heels or pointed shoes more often were included. Females with history of severe foot trauma, foot ulceration, foot surgery, foot deformity, any chronic disease and congenital deformity of foot were not considered.
After the group allocation Baseline measurements were obtained from each person. The hallux valgus angle and Q angle were measured using a goniometer.

The Q angle is measured by drawing a line from the anterior superior iliac spine (ASIS) to the center of the patella, and another line from the center of the patella to the tibial tubercle. And the Hallux Valgus angle is measured by drawing a line along the longitudinal axis of the first metatarsal bone and another line along the longitudinal axis of the proximal phalanx of the hallux. Intra-observer variation can be avoided by ensuring that the measurement technique is standardized and consistent and by taking multiple measurements of the angles.

RESULTS

The data collected was analysed in SPSS for Windows software version 25. The normality of the data was assessed by Levene's Test for equality of variances. Parametric test (Independent-T test), was selected to apply for measuring difference of the two group**s.** Body mass index was converted to categories using Asia-Pacific body mass index classification. (Okawa, 2024 #35)

Mean HV angle of non-high heel wearers was 12.1±1.8 and heel wearers was 22.3±5.9. There is significant difference between hv angle of non-high heel wearers. Mean Q angle of non-high heel wearers was observed to be 13.9±2.9 and high heel wearers showed14.3±2.6 degrees. There is no significant difference between Q angle of non-high heel wearers.

Table 1: Comparison of Different Demographics and Anthropometric Measures

	High	Non high
Age in years	21.14±2.40	21.48±2.25
Weight (kgs or Lbs?)	57.46±8.53	57.62±10.51
Height?	5.30±0.48	5.16±0.51
BMI ?	21.42±3.35	22.17±3.80
HV angle	22.30±5.93	12.11±1.86
Q angle	14.38±2.63	13.99±2.95
Pain Intensity	4.34±2.90	0.00±0.00

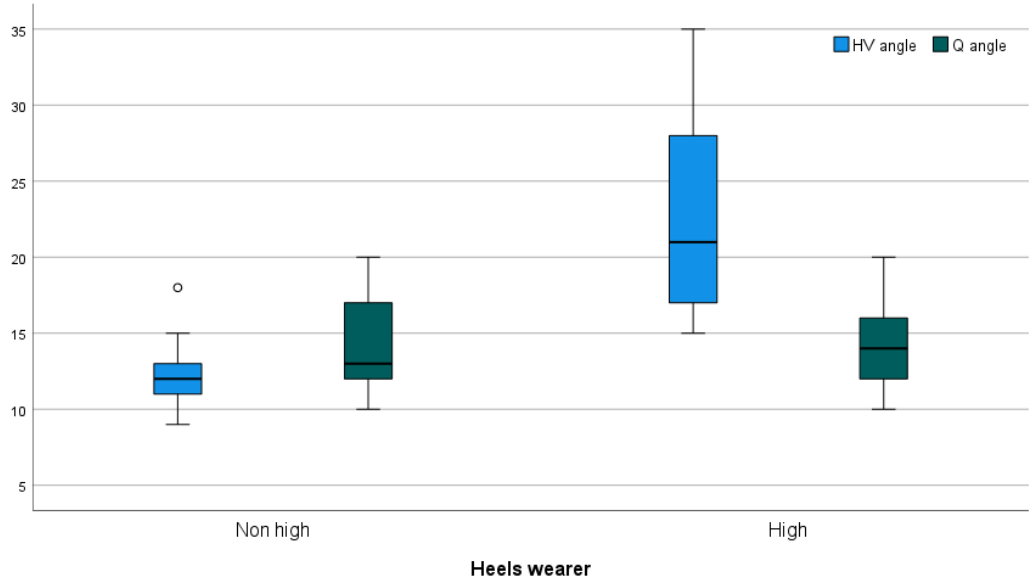

Figure. 1: Box & Whisker Plot of HV Angle and Q Angle in Non-High Heel Wearers and High Heel Wearers

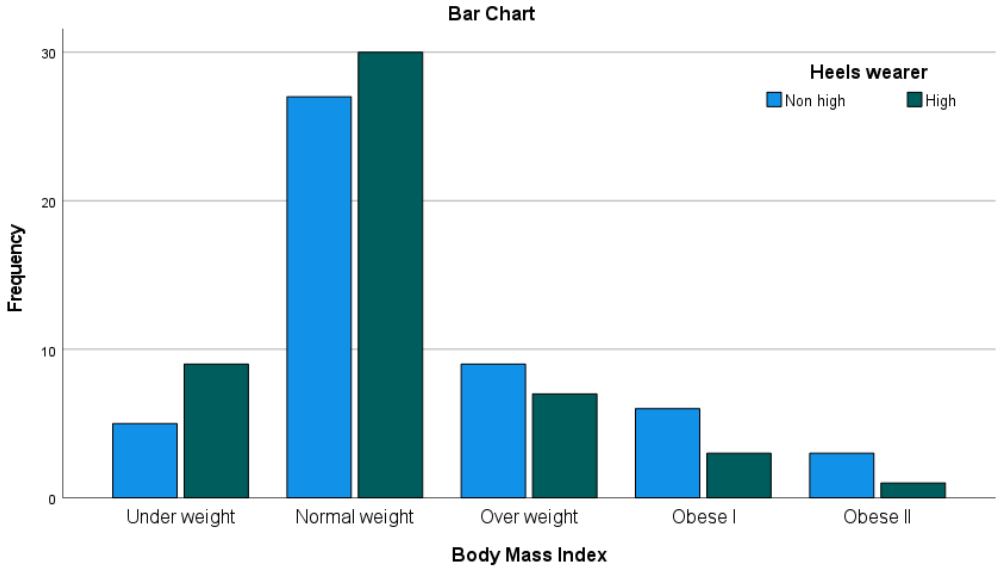

Figure 2: Comparison of Heel Wearers According to Obesity

DISCUSSION:

The present cross-sectional study was conducted study any association between high HV angles and use of narrow toe shows especially those with wider pelvises (high Q angle) All of the participants were given a self-designed questionnaire, and the hv and Q angles were measured with a universal goniometer. There is significant difference between hv angle of women who wear high heels and women who do not. However, there is no discernible difference between Q angle of high heel wearers and non-high heel wearers. Wu D, Louie L in 2010 madea study was of Chinese women to find out how prevalent hallux valgus is and how wearing high-heeled shoes affects the condition. It was concluded that Chinese women are prone to hallux valgus, and wearing high heels was not really a risk factor for the condition in them; family history, though, was a major concern (18). However, in the current study hallux valgus as well as quadriceps angle were measured in girls wearing high heels versus girls that do not wear high heel. There is remarkable distinction between HV angle of girls wearing high heels and girls that do not wear high heels. But there is no notable difference between Q angle of either of the groups.

Another previous study was carried out on a sample of adult women that had diverse HV scores to examine and

contrast the effects of hallux valgus (HV) on their foot health and the health in general. This study has identified measurable variations in the relationship between different levels of hv and a lower quality of life for women's feet (19). Whereas, this study is basically a comparison of hallux valgus and Q angle in women wearing high heels and women not wearing high heels rather than an impact. There is notable difference between HV angle of high heel wearers and non-high heel wearers. But there is no remarkable difference between Q angle of high heel wearers and non-high heel wearers.

Previously, a study was published to determine the influence of heel height related to the quality of life. According to results, the quality of life in relation to foot health is negatively impacted by women wearing high heels (8). This study on the other hand shows the comparison of hallux valgus and Q angle in women wearing high heels and women not wearing high heels. There is notable difference between hv angle of either of the groups. But there is no remarkable difference between their Q angles.

A previous study aims to determine the degree to which the hip, knee, ankle, and foot alignment characteristics of the lower extremities were associated with the development of hallux valgus. Consequently, there was a correlation found between hallux valgus, joint range of motion and lower extremity alignment (20). But this study is basically a comparison of hallux valgus and Q angle in women wearing high heels and women not wearing high heels. There is remarkable difference between HV angle of the two groups. But there is no considerable difference between Q angle of the two groups.

This study has few limitations that it was conducted in only one setting and the sample size was limited. Protocol was standardised and the sample size population was of a certain age. Hence, it is recommended that further studies focus on other complications and effects in high heel wearers and non-high heel wearers other than hallux valgus and Q angle. Moreover, further researchers should take large sample for the study from other cities other than Lahore.

CONCLUSION

Findings of this current study showed that HV angle of high heel wearers was increased as compared to non-high heel wearers. But there is no notable difference between Q angle of high heel wearers and non-high heel wearers.

CONFLICT OF INTEREST / DISCLOSURE: Nil.

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AUTHORS' CONTRIBUTION:

IA: Conceived, designed and manuscript writing, Statistical analysis and data interpretation final approval of manuscript.

MAJ: Data analysis and interpretation, manuscript writing, critically review of important intellectual content

RN: Analysis & interpretation,

IZA: Helped in data collection and manuscript writing.

ZA: Helped in data collection and manuscript writing.

REFERENCES

1. Puszczałowska-Lizis E, Dąbrowiecki D, Jandziś S, Żak M. Foot deformities in women are associated with wearing high-heeled shoes. Medical science monitor: Int J Exp Clin Res. 2019;25:7746.
2. Park CH, Chang MC. Forefoot disorders and conservative treatment. Yeungnam Univ. J. Med.2019;36(2):92-8.
3. Barnish MS, Barnish J. High-heeled shoes and musculoskeletal injuries: a narrative systematic review. BMJ open. 2016;6(1):e010053
4. Hecht PJ, Lin TJ. Hallux valgus. Medical Clinics. 2014;98(2):227-32.
5. Nguyen U-S, Hillstrom HJ, Li W, Dufour AB, Kiel DP, Procter-Gray E, et al. Factors associated with hallux valgus in a population-based study of older women and men: the MOBILIZE Boston Study. Osteoarthritis and cartilage. 2010;18(1):41-6.
6. Deveci A, Yilmaz S, Firat A, Yildirim AO, Oken OF, Gulcek M, et al. An Overlooked Deformity in Patients with Hallux Valgus: Tailor's Bunion. Journal of the American Podiatric Medical Association. 2015;105(3):233-7.
7. Okuda H, Juman S, Ueda A, Miki T, Shima M. Factors related to prevalence of hallux valgus in female university students: a cross-sectional study. J. Epidemiol. 2014;24(3): 200-8.
8. López-López D, Marañon-Medina J, Losa-Iglesias ME, Calvo-Lobo C, Rodríguez-Sanz D, Palomo-López P, et al. The influence of heel height related on quality of life on the foot in a sample of women. Revista da Associação Médica Brasileira. 2018;64:324-9.
9. Carvalho KA, Mann TS, Talaski GM, Fayed AM, Ferrarezi S, Schmidt E, et al. Relationship between High Heels and Hallux Valgus Deformity. Fact or Fiction? A 3-Dimensional Weight-bearing CT Assessment. Foot & Ankle Orthopaedics. 2023;8(4):2473011423S00397.
10. Hasiuk AM, Jaszczur-Nowicki J, Granda T, Potocka-Mitan M, Perliński J, Guodong Z, et al. Effect of wearing high heels on the biomechanical parameters of the foot. J. Kinesiol. Exerc. Sci. 2023;33(103):8-17.
11. Wan FK, Yick K-L, Winnie W. Effects of heel height and high-heel experience on foot stability during quiet standing. Gait & Posture. 2019;68:252-7.
12. Patil P, Sidhaye-Bhadbhade M. The effect of heel type on Q angle. Int J Physiother Res. 2020;8(5):3628-33.
13. Janssen D, Sanders AP, Guldemond NA, Hermus J, Walenkamp GH, Van Rhijn LW. A comparison of hallux valgus angles assessed with computerised plantar pressure measurements, clinical examination and radiography in patients with diabetes. J. Foot Ankle Res. 2014;7(1):1-9.

14. Baig AA, Ishaque F, Ismail S, Chawla R, Rani S, Kumar J, et al. Hallux valgus deformity and quadriceps angle among female medical students: a cross-sectional study. FUUAST j. biol. 2021;11(2):139-44.
15. Nguyen AD, Boling MC, Levine B, Shultz SJ. Relationships between lower extremity alignment and the quadriceps angle. Clinical journal of sport medicine: Clin J Sport Med. 2009;19(3):201-6.
16. Khasawneh RR, Allouh MZ, Abu-El-Rub E. Measurement of the quadriceps (Q) angle with respect to various body parameters in young Arab population. PloS one. 2019;14(6):e0218387.
17. Soemarko DS, Rahmasari F, Kamal AF, Cahayadi SD, Herqutanto. Hallux valgus among sales promotion women wearing high heels in a department store. Journal of orthopaedic surgery (Hong Kong). 2019 Jan-Apr;27(1):2309499019828456. PubMed PMID: 30782102. Epub 2019/02/21. eng.
18. Wu D, Louie L. Does wearing high-heeled shoe cause hallux valgus? A survey of 1,056 Chinese Females. The Foot and Ankle Online Journal. 2010;3(5):3.
19. Palomo-López P, Becerro-de-Bengoa-Vallejo R, Losa-Iglesias ME, Rodríguez-Sanz D, Calvo-Lobo C, López-López D. Impact of Hallux Valgus related of quality of life in Women. Int Wound J. 2017;14(5):782-5.
20. Steinberg N, Finestone A, Noff M, Zeev A, Dar G. Relationship between lower extremity alignment and hallux valgus in women. Foot & ankle international. 2013;34(6):824-31.