HALLUX VALGUS DEFORMITY AND QUADRICEPS ANGLE AMONG FEMALE MEDICAL STUDENTS: A CROSS-SECTIONAL STUDY

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خلاصہ

ہالکس ویلگس اور کواڈر سیپس زاویہ مختلف محققین کے لئے تحقیق کا انتخاب رہتا ہے۔ہالکس والگس کے پھیلاؤ کا مطالعہ خواتین اور ریمیٹائڈ اور ذیابیطس کے مریضوں میں کیا گیا ہے، لیکن اس کے دیگر بائیو مکینیکل عوامل کے ساتھ اس کی وابستگی کو اڈریسیپ پٹھوں کے زاویہ اور جوتا پہننے کی خصوصیات کی طرح کم ہے۔خواتین انڈر گریجویٹ طلباء میں ہالکس والگس کی تعدد اور اس کی وابستگی کو اڈریسیپ زاویہ کے ساتھ طے کرنا۔ڈاؤ یونیورسٹی آف ہیلتھ سائنسز کے مختلف شعبہ کی 226 انڈر گریجویٹ خواتین طلباء کے مابین کراس سیکشنل اسٹڈی کی گئی۔ تحریری باخبر رضامندی لی گئی۔شرکاء میں خود ساختہ سوالنامہ تقسیم کیا گیا۔اونچائی اور وزن کی پیمائش کی گئی تھی۔ہالکس ویلگس زاویہ اور کواڈریسیپ زاویہ کو یونیورسل گونیومیٹر سے ماپا گیا۔ اعداد و شمار کو معاشرتی علوم کے 21.0 ورژن کے لئے شماریاتی پیکیج میں داخل کیا گیا تھ. ہائی ہیلس اور تنگ پیر کے خانے کے ساتھ ہالکس والگس کے تعلق کو چیک کرنے کے لئے کائی اسکوائر ٹیسٹ لاگو کیا گیا تھا اور مسلسل متغیر کے لئے بائیواریٹ ارتباط ٹیسٹ کا اطلاق کیا گیا تھا۔مان- ویلیو 0.05 سے کم تھی وٹنی یو ٹیسٹ میں ملازمت کی اہمیت. نتائج میں عمر (وزن) اور اونچائی کا اوسط (ایس ڈی) دکھایا گیا جس نے بالترتیب 21.79 (1.33) سال، 52.8 (9.55) کلو گرام اور 156.17 (7.14) انچ کا انکشاف کیا۔دائیں اور بائیں ہالکس ویلگس زاویوں کا مین (ایس ڈی) 8.22 (3.79) اور 8.47 (4.17) ڈگری اور دائیں اور بائیں کو اڈریسیپ کا زاویہ 21.79 (1.33) اور 52.8 (9.55) ڈگری تھا۔ ہالکس والگس کی فریکوئنسی 14 (4.7٪) تھی۔دائیں ہالکس والگس اور کواڈریسیپ زاویہ نے مثبت کمزور باہمی تعلق دکھایا۔بائیں ہالکس والگس اور کواڈریسیپس اینگل کے درمیان غیر اہم ارتباط پایا گیا۔نتائج سے پتہ چلتا ہے کہ انڈر گریجویٹ طلباء میں ہالکس والگس کی کثرت کم ہوتی ہے۔تاہم، ہولکس ویلگس زاویہ پر کواڈریسیپس زاویہ کا کوئی اثر نہیں ہے۔ان زاویوں کو دوسرے بائیو مکینیکل عوامل کے ساتھ وابستہ کرنے کے لئے مزید مطالعہ کرنے کی تجویز کی گئی ہے۔

Abstract

Hallux valgus and quadriceps angle remain choice of study for various researchers. Hallux valgus prevalence has been studied among females and patients with rheumatoid arthritis and diabetes, but its association with other biomechanical factors is still questionable like quadriceps angle and shoe wear characteristics. The objective as to determine the frequency of hallux valgus deformity and its association with quadriceps angle among female undergraduate students. This cross sectional study was conducted among 300 undergraduate female students of different department of Dow University of Health Sciences. The written informed consent was taken. A self-designed questionnaire was distributed to the participants and anthropometric variables i.e. height and weight was measured Universal goniometer was used to measure the hallux valgus angle and quadriceps angle. Data was entered into Statistical package for social sciences version 21.0. Chi square test was applied to check the association of hallux valgus with high heel and narrow toe box . The normality data was not normally distributed so spearmen test was used. The Mann Whitney U test employed, the significance p- value is less than 0.05.

The results showed mean (SD)of age, weight and height showed 21.79(1.33) years, 52.8(9.55) kg and 156.17(7.14) inches respectively. Mean (SD) of right and left hallux valgus angles were 8.22(3.79) and 8.47(4.17) degree and right and left quadriceps angle were 21.79(1.33) and 52.8(9.55) degree. Frequency of hallux valgus was 14(4.7%). Right hallux valgus and quadriceps angle showed positive weak correlation. Non significant correlation was found between left hallux valgus and quadriceps angle.

Findings suggest hallux valgux deformity is less frequent among undergraduate university students. However, quadriceps angle has no effects on hallux valgus angle. It is suggested to evaluate further studies for these angles association with other biomechanical factors.

Keywords: forefoot, knee, feminine, big toe pain, q angle

Introduction

The Hallux valgus (HV) is extremely prevalent condition among females(Okuda *et al*., 2014). It is a deformity of first Mertatarsophalangeal joint. It is characterized as sideways deviation of great toe and medial deviation of first metatarsal bone (Deveci, *et al.,* 2016).The Mertatarsophalangeal joint is a movable joint which depends on static stabilizers like ligaments and dynamic stabilizers like muscles (Montgomery HC & Davies MB ,. 2016).When the deformity advances, the lateral shifting of Hallux interferes with these stabilizers and causes disturbed normal alignment. The disturbed normal alignment can affect the balance and gait pattern and eventually become a risk factor for falls (López-López *et al*., 2018). The individuals with HV do not walk because of pain which can lead to further poor physical function (Wu D & Louie L., 2010).
In a study in Turkey the prevalence estimations of Hallux valgus was calculated as 54.3% and positive family history rates were 53.2% (Crevoisier X,. 2016). In Saudi Arabia, estimated
prevalence of Hallux valgus ranges from 21% to 70% (Saç A., 2019). In Australia Hallux valgus is a common condition with an estimated prevalence of 23% in adults 18-65 years of age and 35.7% in those older than 65 years (Daneshmandi, 2011; Mohanty NR,. 2019; Elvan *et al*., 2019). In Spain Hallux valgus effect approximately 12–70% of general population and out of which 30–58% were women (Khasawneh *et al*., 2019). In Ankara out of 203 patients with Hallux valgus 7.4 % had bunionette (Mickle, and Nester, 2018). Multiple risk factor have been associated with the deformity including age, gender, genetic factor, foot wear and are also manifestation of degenerative disease, inflammatory arthropathies, neuromuscular imbalance and congenital anomalies (Rauh *et al.,* 2007). The etiology of Hallux valgus is believed to be multi factorial but studies showed association with female gender and old age (Pathak *et al*., 2018). According to the researcher females were more prevalent to the condition and wearing high heels was not contributing factor instead family history appeared to be a major concern for progression of Hallux valgus (Janssen *et al* ,. 2014).The ratio of Hallux valgus in female and male is 8:1 (Puszczłowska-Lizis *et al*., 2019).

The quadriceps (Q) angle is another important structural and biomechanical variable that affect performance of lower limb (Padasala, 2019). The changes in Q angle results effect on lower limb joint reaction forces and mechanical order of muscles. All these changes cause disturbed neuromuscular function and control of the lower extremities (Daneshmandi *et al*., 2011).The suggested normal range of Q angle is 12 to 20 degrees. The males are usually prone to low end of this range. Females are suggested to be near higher measurements (Mohanty and Tiwari, 2019).The higher range of Q angle increases the resultant force acting on the patella laterally. Hence this increases the risk of anterior or anterio-lateral knee pain (Elvan A., 2019). Furthermore, this uneven pressure may cause disturbed foot biomechanics, as all joints and muscles of lower extremity work in a unit. This raises an issue of association between knee and foot deformity like Hallux valgus (Elvan A., 2019).
The high heel size increases the load toward metatarsal heads. This reduces movement of the first Metatarsophalangeal joint and flexibility of Achilles tendon. However, the person who used to wear shoes with a narrow toe box may have increased pressures on medial side of the foot and between the toes. This sustained load may be responsible of forefoot deformity along with pain (Khasawneh *et al*., 2019). Previous research has been conducted on association between factors related knee and foot musculoskeletal conditions (Mickle KJ and Nester CJ,. 2018). According to author, there was still requirement to investigate specific conditions like Hallux valgus and Q-angle along with their associations. Hence, the purpose of this study was to evaluate the frequency of Hallux valgus deformity and its association with quadriceps angle among female. Hallux valgus is a general issue among females and could lead to physical disabilities and surgery. As far as author's knowledge there was limited evidence regarding prevalence of HV deformity and its associated factors among females especially among current population. Objectives of this study were to find out the frequency of HV and to determine the significant association between HV angle and Q angle.

Material and Methods

A cross sectional study with convenient sampling technique was conducted in Dow university of Health Sciences, Karachi. The inclusion criteria of the study were undergraduate female students of health care sciences with age group from 18 to 25. However, the exclusion criteria was females with history of severe foot trauma, foot ulceration, foot surgery or any other foot deformity, any chronic disease and congenital deformity of foot. Sample of 300 participants was calculated through open epi, version 3.The hypothesized percentage of HV among female student (26.5%) is considered from previous research. Confidence level 95% with 5% margin error is taken. Investigators approached the undergraduate medical students of different departments of DUHS in break time during classes with permission from class coordinators. The questionnaire contained demographics i.e age, height and weight, questions regarding presence of big toe and knee along with numerical pain rating scale (0-10) for pain intensity (Rauh MJ., 2007). Time of pain like during rest, night, walking exercise and standing. The questions regarding foot fatigue and any family history of HV deformity were asked. Foot wear was assessed by asking information regarding high heels and shoes with narrow toe boxes and duration of use of

high heels. The universal gonio meter (UG) was used to measure the HV angle and Q angle (Pathak *et al*., 2018). All data was collected and recorded.

Data was analyzed using statistical package of social sciences version 21 frequencies and percentage were reported of all descriptive variables. Mean and SD of all continuous variable were recorded. Chi square test was applied to check the association of hallux valgus with high heel and narrow toe box and correlation test for continuous variable was applied for the accomplishment of the assumption i.e to check the normality, we used Shapiro wilk test the value of Shapiro wilk test of right and left HV was 0.000 and of right Q angle was 0.000 and left Q angle was 0.001 data was not normally distributed so spearmen test was used. The Mann Whitney U test employed for difference between Q- angles of with and without HV deformity. The significance p- value is less than 0.05.

Measurement of Hallux valgus angle: Participants were asked to stand barefoot in weight bearing position. Fulcrum of UG was placed on space of first metatarsophalangeal joint with one arm of the UG parallel to the first metatarsal and other parallel to the proximal phalanx of the hallux (Pathak *et al*., 2018). Measurement was repeated for two times and average value was considered.

Measurement of Quadriceps angle: Investigator asked participant to stand in a comfortable position with knee extended, feet facing interiorly and with body weight evenly distributed on both lower extremities. Anterior superior iliac spine, center of patella and tibial tubercle were palpated and two straight lines were drawn and intersection of these two lines one from the anterior superior iliac spine to the center of the patella and the second one is from the center of the patella to the tibial tubercle. Fulcrum of UG was placed on the center of patella one arm was placed parallel to the tibial tubercle and the other arm parallel with the anterior superior iliac spine (Mickle KJ and Nester CJ., 2018).Measurement was repeated for two times and average value was considered (Mickle KJ and Nester CJ.,2018).

Fig.1 Hallux Valgus Angle Measure

Fig.2. Q- angle measurement

Results and Discussion

All the 300 female university students showed mean and SD of age, weight and height showed 21.79(1.33) years, 52.8(9.55) kg and 156.17(7.14) inches respectively. Mean (SD) of right and left hallux valgus angles were 8.22(3.79) and 8.47(4.17) degree and right and left quadriceps angles were 21.79(1.33) and 52.8(9.55) degree. The frequency of big toe and knee pain was 7(2.3%) and 62(20.7%), respectively. Responses of feet fatigue were 174(58%), and preference of high heel was 130(43.3%).The preference of shoes with narrow toe box was 75(25%). About 7(2.3%), 21(7%) and 123(41%) participants prefer high heels every day, several days a week and rare, respectively. The narrow toe boxes for every day, several days a week and rare were preferred by 15(5%), 33(11%) and 37(12%) participants. The frequency of family history of forefoot deformity was 10(3.3%) in mother and 3(1%) in grandmother. Most of the participants do not have hallux valgus deformity (figure 1).

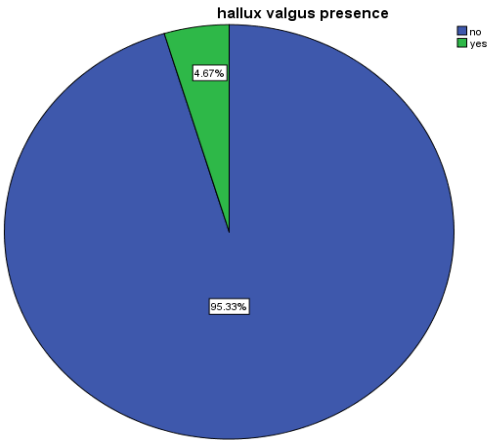

Fig.3. Frequency distribution of Hallux Valgus

Association between two categorical variable hallux valgus presence and high heels preference, and shoes with narrow toe boxes preference with hallux valgus shows significant association btw both of the groups Since the P value is less than α (α=0.05) which is 0.000. The table 1 shows correlation between Hallux valgus (right) with quadriceps angle (right) and hallux valgus (left) with quadriceps angle (left)

Table1. Correlation of hallux valgus and quadriceps angle

Correlation		Q-ANGLE RIGHT
HV RIGHT Spearman's	Coefficient correlation	0.119
	Sig. (2-tailed)	0.039
		Q-ANGLE LEFT
HV LEFT Spearman's	Coefficient correlation	-0.026
	Sig. (2-tailed)	0.658

Since p value is less than α (α= 0.05) and the ρ-value is 0.039, R-value 0.119 shows positive but weak significant association for right side. However, for left side since p value is greater than α (α= 0.05) and the ρ-value is 0.658, R-value -0.26 shows negative but weak non-significant association for left side.

The table 2 shows correlation between height (right) with quadriceps angle (right) and height (left) with quadriceps angle (left)

Table 2: Association of quadriceps angle with height

Correlation		Q-ANGLE RIGHT
Cm/ft Spearman's	Coefficient correlation	0.072
	Sig. (2-tailed)	0.215
		Q-ANGLE LEFT
Cm/ft Spearman's	Coefficient correlation	0.110
	Sig. (2-tailed)	0.057

Since p value is greater than α (α= 0.05) and the ρ-value is 0.215, R-value 0.072 shows positive but weak non-significant association for right side. Since p value is slightly more than α (α= 0.05) and the ρ-value is 0.057, R-value 0.110 shows positive but weak non-significant association for left side. Table3 shows relationship of Hallux valgus presence and quadriceps angle mean and SD .

Table 3. Compare mean of Hallux valgus presence and quadriceps angle with Mann Whitney U test.

HV PRESENCE	MEAN	SD		
NO	15.995	3.4543	Asymp. Sig. (2tailed)	0.058
YES	18.071	3.8772		
TOTAL	16.092	3.4957		

As the Table above shows that individuals with Hallux valgus had higher quadriceps angle as compare to individual without hallux valgus, since p value is 0.058 which is slight greater that α (α= 0.05) so it shows non-significant difference between Hallux valgus and quadriceps angle. The finding of current study showed that majority of the individuals had normal HV angle and Q angle only a few showed positive findings of HV deformity out of 300 females. There is no effect of Q-angle on hallux valgus angle among undergraduate females. A study on factors related to prevalence of Hallux valgus in female university students reported that frequency of HV was about 30% and out of 634 participants (Okuda *et al*., 2014). In current study there was less frequency seen for HV deformity and big toe pain among female university students. This can be due to consideration of less sample size as compare to that study.

Another study showed that alignment of lower extremity correlate with foot biomechanics and presented association between lower extremity and HV deformity (Steinberg *et al*., 2013). However, in current study the HV deformity was associated for Q-angle for right side and left side separately. Findings showed weak correlation between the Quadriceps angle and HV for right side only. Left side correlation for these two angles showed no significant results. This can be due to right side dominancy of the participated females. Moreover, there was non significant difference in Q- angle among females with and without HV deformity. The reason can be few participants with HV deformity were present for comparison of Q- angle.

The current study shows the non significant correlation between Q angle and height. This change in results may be because, in comparison to previous study by Elvan A *et al*., in 2019).in which they measure the quadriceps angle with respect to various body parameters i.e Gender, height and weight including age group 18-25, shows significant variation in Q angle with height The current study comprised only female participants. Another study on foot deformities in women suggest that wearing high heels causes supination of the feet and rise in the pressure on forefoot and reported 76% cases of deformed feet most commonly Hallux valgus (Janssen *et al*., 2014).This favors current study that concluded significant association between high heels and Hallux valgus. One such study on relationship among bilateral quadriceps angle and anterior knee and its association with knee injury in long distance runner (Puszczałowska-Lizis *et al*., 2019) and a study on comparison of Hallux valgus angle with computerized planter pressure measurement, clinical examination and radiography in patient with diabetes (Pathak *et al*., 2018). Both showed reliable results using gonio meter for measuring angles, hence we used universal goniometer for angle measurement.

Conclusion

Findings suggest HV deformity is less frequent among undergraduate university students. The right side Hallux valgus angle has relationship with right side Q-angle but overall study suggests no effect of Q-angle on Hallux valgus angle. It is suggested to evaluate other biomechanical factors affecting Hallux valgus angle on larger sample size and on males too.

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