

Influence of High-Heels Usage on Q-Angle among College Going Females: An Observational Study

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Abstract: ***Background:** The knee joint is a complex synovial joint of the condylar variety, stabilized by ligaments and muscles, and is involved in approximately 50% of musculoskeletal injuries. The Q-angle or quadriceps angle is defined as the angle formed by the intersection of a line drawn from the anterior superior iliac spine (ASIS) to the center of the patella (CP) and another line connecting the center of the patella to the center of the tibial tuberosity (TT) (Greaser et al., 2005). This angle has been utilized for diagnosing various conditions and comparing normal and injured knees. The Q angle changes at various positions of knee joint and in different conditions around the knee joint. **Aim:** 1) To assess the effectiveness of high heels usage on Q-angle among college-going females. **Objective:** To evaluate the impact of high heels on the Q-angle among college going females. **Methodology:** The Subjects were recruited from the students pursuing Physiotherapy, Nursing and MBBS in SVIMS University. An informed Consent was taken from all the subjects who are willing to participate in the study who met inclusion Criteria. All the students underwent measurement of Q angle of both the lower limbs with the universal goniometer in supine lying and standing positions. **Conclusion:** The study concluded that the women who use high heels markedly have higher Q angle in standing position than the supine lying position compared to the subjects using normal footwear.*

Keywords: Q angle, Tibial Tuberosity (TT), Anterior iliac spine (ASIS), Center of patella (CC)

1. Introduction

The knee joint comprises two main articulations: the tibiofemoral (TF) joint, where the femur articulates with the tibia, and the patellofemoral (PF) joint, where the patella articulates with the femur. The knee joint's primary role is to facilitate locomotion with minimal muscle energy expenditure and stability, accommodating various terrains, to transmit, absorb, redistribute forces generated during activities.

Loading and Articular Mechanics:

The forces experienced by the joint surfaces result from external forces (e. g., ground reaction forces) and the muscle forces needed to maintain posture and facilitate movement. Ligament forces, as passive internal forces, develop in response to joint motion or external loading, providing alternative pathways for load transmission through the joint. The knee joint's anatomical and structural complexity means that forces within its different structures are varied.

Q-angle and High Heels:

In recent times, young women have increasingly opted for high heels over lower heels to appear taller, thinner, and more fashionable. From a motor control perspective, walking, as the most typical mode of human movement, is particularly challenging due to human bipedalism. Prolonged use of high heels has been found to cause a forward shift in the body's center of mass, affecting muscle recruitment, including that of the knee extensors. This shift contributes to increased activation of the quadriceps muscles and potential alterations in the Q-angle, which impacts knee joint mechanics. Additionally, extended high heel use is associated with musculoskeletal issues such as shortened calf muscles and changes in joint alignment.

A study investigated how different types of heels affect the Q-angle. It is found that flat heels typically maintain a normal Q-angle, while high and pointed heels are associated with a significant increase in the Q-angle. In a normal adult population, increased heel height resulted in notable changes. Specifically, knee flexion and extension during the swing phase differed significantly and decreased with high heels, making the knee more prone to injury. Additionally, a 25% increase in knee varus moments was observed with high-heeled gait. Esen-Yel et al. (year) demonstrated that the hip abductor muscles showed an 11% increase in work during the stance phase to counteract the hip varus moment created by high-heeled walking. The study also found that the peak torque of the knee extensor muscles is elevated when walking in high heels.

2. Materials and Methodology

Materials

- 1) Inch tape
- 2) Goniometer
- 3) Couch

Methodology:

- Study design-observational study
- Study duration-4 months

The Sample Size is 137 students of SVIMS University

The subjects were divided into two groups:
i. e., females using High Heels

Female using normal footwear.

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Inclusion Criteria-

- college going female students
- Age between 18-26 years.

Exclusion Criteria-

- Individuals aged <18 and > 26 years
- Previous history of knee injury, knee surgery
- Gait abnormalities
- Males
- History of Hip, Spine, ankle pathology.

All the students who included in the study were divided into two groups:

- Those who use high heels & those who use normal foot wear
- The Q-angle is measured using a universal goniometer in both Supine & Standing positions.

3. Procedure

A Goniometric method as described by Jha and Raza (2000) was adopted. The measurement of the Q angle was performed with the Subject Supine & Keeping the pelvis square. The legs were Extended at the knee Joint with the quadriceps muscle relaxed. The feet were placed in a position of neutral rotation, such that the toes were pointing directly upwards, and the feet were perpendicular to the resting surface. The following body

landmarks were marked with a marker pen ASIS, CP and Centre of the TT-the outline of the patella was marked & drawn with a marker pen, after palpating the borders and making Sure that the Skin was not Stretched in doing So. The Cp was defined as the point of intersection of the maximum Vertical and transvers diameter of the patella.

The point of maximum prominence was defined as the center of the TT & A line was drawn from the Cp towards the ASIS using the straight

Edge of a measuring tape. Another line joined the Centre of the TT & the CP. The Second line was Extended upward. The angle formed between the above two lines is defined as the Q-ANGLE and measured with a goniometer.

Statistics and results:

Table 1

S. No	Age	No. of Patients	%
1	18-20 Years	27	36.5
2	21-23 Years	43	58.1
3	Above 23 Years	4	5.4
4	Total	74	100.0
	Mean Age	20.97 ± 1.50	

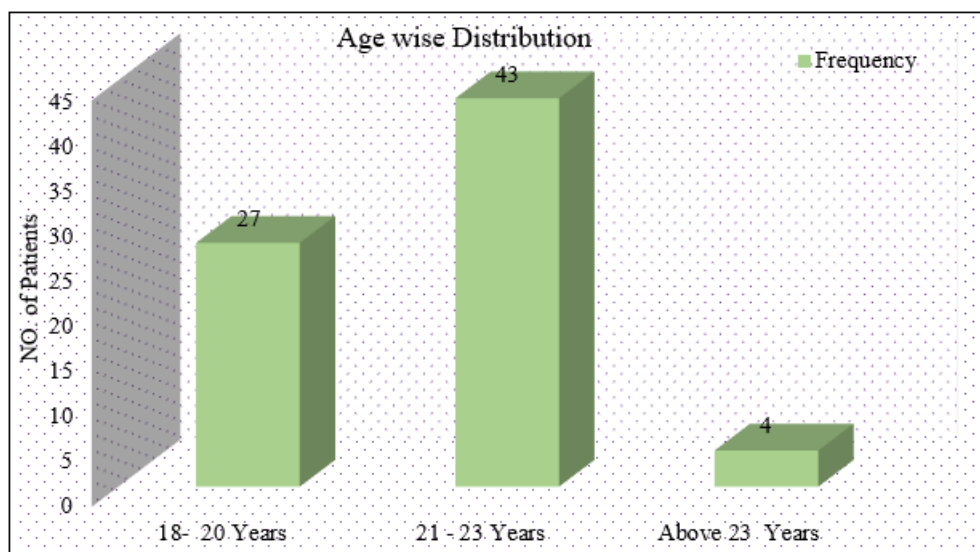


Table 1: The above table shows categorization of subjects according to the age.

Inference: Among all the subjects 27 members were between 18-20 years, 43 members were between 21-23 years and 4 members were above 23 years.

Table 2

BMI	Frequency	
	No. of Patient	%
Severe underweight (<16.5)	4	5.4
Under Weight (<18.5)	4	5.4
Normal weight (18.5-24.9)	58	78.4
Over weight (25 – 29.9)	8	10.8
Total	74	100.0
Mean BMI	21.62 ± 3.53	

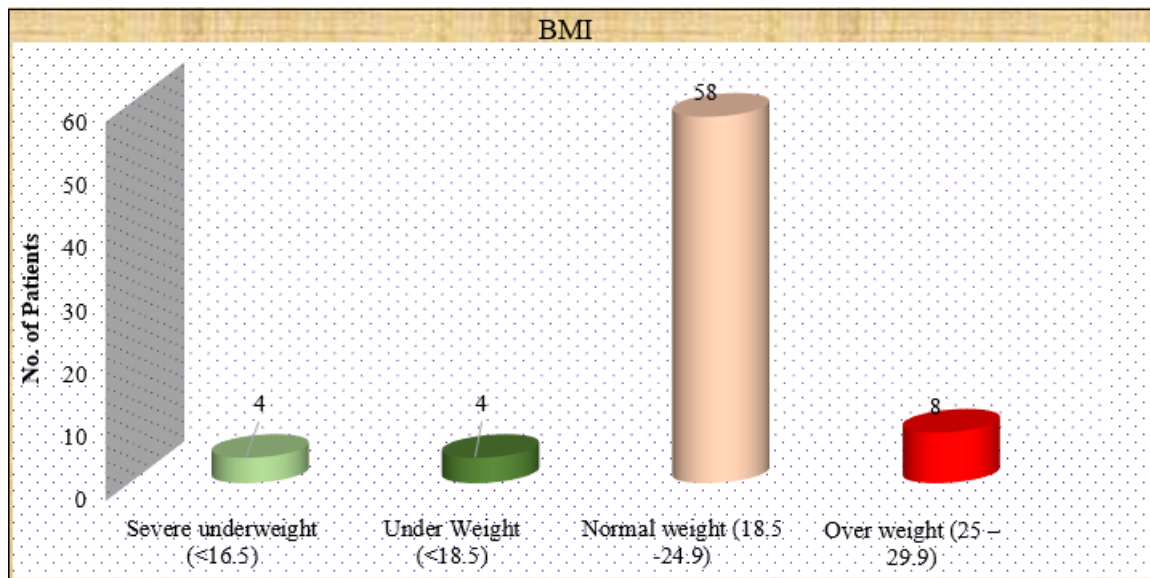


Table 2: The above table 2 shows categorization of subjects according to the respective BMI.

Inference: Among all the subjects 8 subjects were underweight, 58 subjects were normal in weight and 8 subjects were over- weight.

Table 3: Supine Q Angle

	Age	Supine Right		Supine Left	
		Mean	SD	Mean	S D
	18-20 Years	18.74	.71	18.56	.51
	21-23 Years	18.95	.75	18.65	.72
	Above 23 Years	19.75	.50	19.75	.50
	Total	18.92	.75	18.68	.68
	F-value	3.444* (0.037)		6.121** (0.004)	

*Significant at 0.05 level; *Significant at 0.01level

Paired Samples Statistics

	Group	N	Mean	S. D	S. E	t- value	p- value
Supine score	Supine Right	74	18.92	0.754	0.088	2.771**	0.007
	Supine Left	74	18.68	0.685	0.080		

**significant at 0.01 level;

Inference: Supine Right P=0.037, Supine Left side P= 0.004 P<0.05

So, there is a significant effect on Q angle among college going females based on increasing age.

Table 4: Standing Q Angle:

	Age	Standard Right		Standard Left	
		Mean	SD	Mean	SD
	18-20 Years	19.78	.70	19.56	.51
	21-23 Years	20.00	.87	19.93	.96
	Above 23 Years	20.75	.50	20.75	.50
	Total	19.96	.82	19.84	.84
	F-value (P- value)	2.706 ^[at] (0.074)		4.492* (0.015)	

Paired Samples Statistics

	Group	N	Mean	S. D	S. E	t- value	p- value
Standing score	Standing Right	74	19.96	0.818	0.095	1.692 ^[at]	0.095
	Standing Left	74	19.84	0.844	0.098		

[at]- Not significant;

Inference: In Standing right =0.074, P>0.05 (not significant)

Standing Left = 0.015, p<0.05 (significant)

Table 5: Paired Sample t-test

Group	N	Mean	S. D	S. E	t-value	p-value
Supine Right	74	18.92	0.754	0.088	12.594**	0.000
Standing Right	74	19.96	0.818	0.095	(0.000)	
Supine Left	74	18.68	0.685	0.080	14.637**	0.000
Standing Left	74	19.84	0.844	0.098	(0.000)	

Result: Right supine and standing position, P=0.000

Left supine and standing position, P=0.000

P<0.05

Significant at 0.01 level

The mean Q angle value for all subjects in both positions was 62.52 with a standard deviation of 24.68. The paired sample t-test revealed that there is a significant effect of High heels on Q angle among college going females.

4. Discussions

The mean values derived from the present study of Q angle in a college-aged population vary from a minor to a major amount from those reported by other investigators and authors. Differences in population, sampling, and precision of method and measuring equipment may account for these differences. Although the subjects in this study were not a true randomized sample from the student population, they tend to reflect the same Q-angle characteristics, because all students are required to take physical education classes. Most other studies have not described these parameters completely.

The increase in Q-Angle observed in the standing position as compared to the supine position is worthy of comment, and has not been previously studied.

This may indeed be clinically relevant and affect patellar mechanics.

A plausible explanation for increases in standing versus supine Q angle is that knee valgus angulation forces increase when standing because of weightbearing. Other authors feel that excessive foot pronation or supination may effect patellar mechanics and Q angle.

The question of whether Q angle should be measured in the supine or standing position is debatable. Measuring the angle in both positions is the most complete way to assess this parameter. If clinician choose to measure only in the supine position, they need to remember that weightbearing or other factors may cause a significant change on standing measurements. The incidence of abnormally high Q angles among the subjects in this study is also of note. Defining what constitutes an abnormally high Q angle is somewhat subjective and is only one of several components in the clinical picture of the knee.

In this study also noted that visual estimation of Q angle did not necessarily correlate well with the measured values. Some subjects with extreme genuvalgum had a relatively low measured Q angle, and vice versa. Visual estimation of Q angle should not take the place of actual measurement. Accurate measurement also requires a precise instrument. The modified goniometer used in this study provided better accuracy than a standard goniometer, which many clinicians use.

Certainly, Q angle assessment is only one component of a thorough knee examination and should not be overemphasized. It is however, a useful clinical measure of an anatomic relationship that has bearing on patellar tracking and knee mechanics. Q angle and patellar tracking can be affected by a number of factors, including quadriceps mechanism, muscle balance, internal tibial torsion, femoral neck anteversion, patella Alta, patella Baja, and other structural and soft tissue variations. Clinicians should consider all of these principles when assessing and determining proper treatment.

5. Conclusion

The study concluded that the women who use high heels markedly have higher Q angle in standing position than the supine lying position compared to the subjects using normal foot wear.

6. Limitations

- The sample size is smaller.
- Observer bias and limited generalizability.

7. Future Recommendations

- The future study is recommended with a large sample size and used interventional study to evaluate the therapeutic

measures on outcomes by assigning participants to compare the Q angle between males and females.

- The study can be done in geriatric population.
- The study can also be done in various positions (sitting, standing)

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