Journal of Advanced Zoology

*ISSN: 0253-7214*
*Volume **44** Issue **03 Year 2023** Page **1145:1150***

# Association of Quadriceps Angle (Q Angle) with Gender, Anthropometric Measurements and Quadriceps Muscle Strength in Healthy Young Adults

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***Article History***

Received: 06 June 2023
Revised: 05 Sept 2023
Accepted: 02 Nov 2023



***Abstract***

*Background: Quadriceps angle is the angle produced between the quadriceps muscle and the patellar tendon, which is also known as Q angle. It is also regarded as a key component for the correct knee posture and movement. Q angle is frequently employed as a diagnostic indicator for knee-related issues such as anterior knee pain, degenerative knee disorders, osteoarthritis etc. It has a great clinical and biomechanics significance and this angle gives useful information about alignment of lower limb. Present study shows association of Q angle with gender, various anthropometric measurements and Quadriceps muscle strength. Methods: Total 150 healthy young individuals (20 male and 130 female) between the age of 18 to 30 years from the different constituent institutes of Sumandeep Vidyapeeth University were included in the study. Q angle was measured in degrees by using universal goniometer on both sides. Anthropometric measurements - Height, weight. Body mass index, Waist and Hip circumference, Intercondylar distance between femur and Quadriceps muscle strength were measured. Results: In this study, the correlation between Q angle and Anthropometric measurements were analyzed. The mean Q angle on right side was 18.87 and on left side was 18.87. Bilaterally, no significant differences were found in Q angle. The angle of right and left side was significantly correlated with weight, height, BMI, intercondylar distance and quadriceps muscle strength. However, these angles are not correlated with WHR. Conclusion: This study supported positive correlation of weight and BMI with Q angle; negative correlation of height, intercondylar distance of femur and quadriceps muscle strength with Q angle. Although, no significant correlation was found between Q angle and WHR.*

**Keywords:** *Q angle, Anthropometric measurements, Quadriceps muscle strength*

## 1. Introduction

Quadriceps angle is the angle produced between the quadriceps muscle and the patellar tendon, which is also known as Q angle.[1] It is measured between a line connecting the anterior superior iliac spine to the mid-point of patella and the tibial tuberosity to the mid-point of patella.[2] This angle is regarded clinically as a very significant anatomical vector that shows the biomechanical effect of the quadriceps muscle on the knee. It is also regarded as a key component for the correct knee posture and movement.[1] In the frontal plane, the patellar tendon works as information relay center about the net force generated by quadriceps muscles. The net effect of the pull of the quadriceps and the patellar alignment can be assessed clinically using a measurement called the Q angle.[3] The Q angle is frequently employed as a diagnostic indicator for knee related issues such as anterior knee pain, degenerative knee disorders, osteoarthritis etc.[1,3] Normal value of Q angle is between 130 to 180. In male it is 130 and in female it is 180.[2,3] A higher Q angle is indicative of pathological lateral forces on the patella. Although a very large Q angle is usually an indicator of some structural malalignment.[3,4] Large Q angle create excessive lateral forces on the patella that make the patella susceptible to pathologic changes. The patella may actually subluxate or dislocate over the femoral sulcus in the result of an excessive lateral strain. The patella may really subluxate or dislocate over the femoral sulcus in the event of a strong lateral strain. As a result, the lateral portion of the femoral sulcus may experience additional lateral patellar compression, which can be detrimental. The Q angle may result in an incorrect estimate of the lateral force on the patella if there is a significant imbalance between

the vastus medialis and vastus lateralis muscles in a patient because the quadriceps muscle's actual pull is no longer along the estimated line. Smaller Q angles are produced by patella that sit improperly lateral in the femoral sulcus as an outcome of uneven stresses, because they are better aligned with the ASIS and tibial tuberosity. There are some abnormalities that may produce more lateral forces. There is a possibility of imbalance between the vastus lateralis and vastus medialis muscles. Although, as identified earlier, this imbalance cannot be measured inside. The patellar movement may restrict and undergo stress when mobility of inter trochanteric band is compromised. This causes medial shift while knee flexion and facets of patella are remained under stress. When the IT band moves posteriorly with knee flexion, it applies greater lateral pull on the patella which results in a higher lateral tilting as knee flexion increases. The increased lateral tilt could, increasing joint stress.[4] Thus, it is considered as an important factor of patellofemoral function and dysfunction. It is a risk factor for patellofemoral pain, patellar subluxation and dislocation.[5,6,7] Since the quadriceps angle reflects the effect of the quadriceps mechanism on the knee, it is an accepted medical fact that this measurement is a very significant indicator of the biomechanical function in the lower extremity.[1,15,16] The importance of Q angle in assessing knee joint function and determining an individual's knee health has come to be accepted.[17] Q angle measurement gives useful information about how the pelvis, leg and foot may be aligned. Uneven alignment may have an impact on the knee's efficacy.[1,18,19] Therefore the aim of the study was To study the association of quadriceps angle with gender, anthropometric measurements and quadriceps muscle strength in healthy young adults.

## 2. Materials And Methods

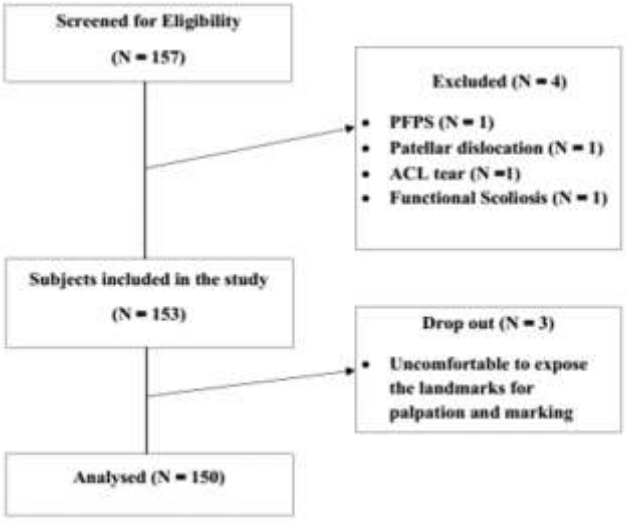
### Inclusion Criteria

Age between 18 to 30 years 2. Both male and female, 3. Those who are willing to participate.

### Exclusion Criteria

Subjects with traumatic history and injuries in lower limb in last 1 year . Subjects with surgical history in lower limb in last 1 year 3. Subjects with any pathological condition of knees like degenerative changes, arthritis, limb length discrepancy 4. Other pathology which can impact muscle strength5. Subjects with any neurological disorders affected lower limbs. The above study was forwarded and approved by Institutional Ethical Committee. After that, it was registered with the Clinical Trial Registry - India. After obtaining the ethical approval, healthy individuals were approached and explained the study. All those who were willing to participate in study were requested to fill out Informed Consent Form.

A Participant Information Sheet was given to each participant and they were explained regarding the assessment involved in the study. All the participant were screened as per the assessment sheet. Participants who were falling under the exclusion criteria were excluded from the study. All those participants who fulfill inclusion criteria were explained detail about the entire study procedure in their language and they were recruited in the study. Those subjects who were recruited for the study, their anthropometric measurement (Height, weight, west and hip circumference and intercondylar distance) were taken. After that quadriceps angle and quadriceps muscles strength were assessed. Flow chart of recruitment of patient is as below.



## 3. Results and Discussion

150 participants were recruited in the present study with a mean age of 23 years. The descriptive characteristics of all variables are as follows:

| Characteristics | Mean | StandardDeviation |
|---|---|---|
| Quadriceps Angle - Right | 18.87 | 2.92 |
| Quadriceps Angle - Left | 18.87 | 2.92 |
| Height | 159.18 | 7.71 |
| Weight | 58.08 | 11.94 |
| Body Mass Index | 22.99 | 4.74 |
| Waist Hip Ratio | 0.8 | 0.06 |
| Intercondylar Distance of Femur | 16.58 | 19.9 |
| Quadriceps Muscle Strength Right | 4.6 | 1.19 |
| Quadriceps Muscle Strength Left | 4.57 | 1.2 |
| Gender | Male: 20<br>Female: 130 | |

| Test Variable | Point Biserial | P Value |
|---|---|---|
| Q Angle - Gender | 0.51 | 0.001 |

| Test Variable | Pearson's R | P Value |
|---|---|---|
| Q Angle- BMI | 0.61 | 0.001 |

There is a significant correlation between Q angle and BMI, where the p value is <0.05

| Test Variable | Pearson's R | P Value |
|---|---|---|
| Q Angle- Height | -0.31 | 0.001 |

There is a significant correlation between Q angle and Height, where the p value is <0.05

| Test Variable | Pearson's R | P Value |
|---|---|---|
| Q Angle- Weight | 0.48 | 0.001 |

There is a significant correlation between Q angle and Weight, where the p value is <0.05

| Test Variable | Pearson's R | P Value |
|---|---|---|
| Q Angle- Weight | -0.39 | 0.001 |

There is a significant correlation between Q angle and Intercondylar distance of femur, where the p value is <0.05

| Test Variable | Pearson's R | P Value |
|---|---|---|
| Q Angle- Weight | -0.15 | 0.0609 |

There is no significant correlation between Q angle and waist hip ratio, where the p value is >0.05

| Test Variable | Pearson's R | P Value |
|---|---|---|
| Q Angle Right - Q Muscle Strength Right | -0.29 | 0.0527 |

There is significant correlation between Q angle and quadriceps muscle strength of right lower limb, where the p value is <0.05

| Test Variable | Pearson's R | P Value |
|---|---|---|
| Q Angle Right - Q Muscle Strength Left | -0.36 | 0.0514 |

The study aimed to observe the association of Q angle with gender, anthropometric measurements and quadriceps muscle strength in healthy young adults. In this study, out of 157 subjects, 150 were recruited and 7 were excluded due to not matching the inclusion criteria and denied to complete full procedure.

### Quadriceps angle and Gender

In present study, a significant correlation was found between Q angle and gender. This was supported by previous studies which are as follows:

Ramada R. Khasawneh et al (2019) showed that in contrast to men, women had a larger Q angle. In that study, the absolute difference in Q angle between young men and young women was measured using a goniometer, and it was discovered that the difference was 3.25 higher in females than in boys. Additionally, both sexes had considerably larger Q angle values. As the outcome of having a wider pelvis than men, which can be extrapolated by having a greater distance between the pelvis and the patella than between the patella and the tibial tuberosity, women may have higher Qangle values. This may cause an alteration in the position of the anterior superior iliac spine, which has a significant effect on the Q angle values.1 Quadriceps angle and height: In present study, it was found that Q angle and height was significantly correlated. Along with this it was found that as the height of the subject is inversely proportional to Q angle. The above findings are supported by previous study which is as follows: Ramada R. Khasawneh et al (2019) showed significant correlation between height and Q angle. The same was also supported by other study which was done by Jaiyesimi et al (2009). The possible reason behind these findings is due to the fact that taller people often have a smaller Q angle due to the fact that men likely to be taller compared to women.4 Results of the investigation further supported the notion that taller people had significantly smaller Q angles on both genders.1,39

**Quadriceps angle and Body Mass Index**

In this study, it was found that Q angle and BMI have significant correlation, which was positively correlated with each other. This finding is supported by previous study which are as follows: Anand Heggannavar et al (2016) concluded that due to increased body mass, people have greater absolute knee adduction moments which was compensated by slow walking gait and increased toe outing gait. With this femoral anteversion occurs which may lead to medial rotation of femur and it displaced patella medially. So due to that, in toing of gait is compensated with external rotation of tibia and this increased tibial external rotation leads to greater Q angle.23 That the Q angle increased with increased tibial external rotation and so the load of weight bearing joint was increased. Quadriceps angle and Intercondylar distance of femur: In present study, significant correlation was found between Q angle and intercondylar distance of femur. The above findings are supported by previous studies which are as follows: An increase in the normal tibiofemoral angle results in genu valgum or knock knees. A decrease in the normal tibiofemoral angle results in genu varum or bow legs.4 According to Hassan Daneshmandi (2011), the Q angle's magnitude and the lower extremity's alignment are related. Along with the tibiofemoral angle had the strongest association with greater Q angle. These finding support that the peculiarities of lower extremity alignment may alter where the anatomical markers used to calculate the Q angle are located. The results indicated that Q angle and tibiofemoral angle were related. Increased the patella would be moved medially in relation to the anterior superior iliac spine by the tibiofemoral angle, which symbolizes the valgus angle created by the anatomical axes of the femur and tibia and tibial tuberosity laterally, thus increasing Q angle. In addition to aberrant transverse plane motions, the patellofemoral joint can also be affected by excessive frontal plane motions. Most significantly, valgus at the knee might widen the Q angle because the patella would move medially in relation to the ASIS. In contrast, a varus angle of the knee might reduce the Q angle since it would bring the patella closer to the ASIS.

**Quadriceps angle and Waist Hip Ratio (WHR)**

In present study, Q angle showed no significant correlation with WHR. Some previous studies showed significant correlation between these two, which are as follows: A study by Ved Prakash et al (2017) and Atif Maqsood (2022), stated that there is significant correlation between WHR and Q angle. It means that if there is increase in WHR, substantially there is reduction in Q angle.3,9Waist hip ratio shows the proportion of fat stored in body in the waist & hip areas. Most people have body fat distribution in two ways in which one is around the middle of the body known as apple shaped while another one is around the hip known as pear. According to the World Health Organization, abdominal obesity is indicated by a waist-hip ratio that is greater than 0.90 for men and 0.85 for women, or by a body mass index that is greater than 30.0. According to the National Institute of Diabetes, Digestive and Kidney Diseases, men and women who have a waist-to-hip ratio greater than 1.0 are at an elevated risk for health problems because of their fat distribution. The findings of this investigation indicated a negligible positive connection between WHR and BMI in OA knees. WHR and Q angle revealed a weakly negative correlation,3 which suggests that as WHR increases, Q angle will fall.3,9.

**Q-angle and Quadriceps muscle strength**

In our study, significant correlation was found between Q angle and quadriceps muscle strength. Some previous studies showed significant correlation Q angle and quadriceps muscle strength. Ramada R. Khasawneh et al studied demonstrated the patellar position was impacted by the

quadriceps contraction, which had a significant impact on the Q angle values. Conclusion of the study claimed that since men have greater quadriceps muscles than women, they are more physically active, which results in lower Q angle values 1. Ajlan Saç et al (2018) studied that due to inadequate muscular strength, the patella cannot be moved laterally or the quadriceps cannot dynamically stabilize the movement by putting the patella in the intercondylar sulcus of the femur. Consequently, similar to the patellar mal tracking, this could also be a decrease in the knee joint's range of motion. Thus, there was a significant correlation between this two.14.

## 4. Conclusion

The present study provided information of correlation between Q angle, gender, anthropometric measurements and quadriceps muscle strength. This study supported positive significant correlation of weight and BMI with Q angle, negative correlation of height, intercondylar distance of femur and quadriceps muscle strength with Q angle. Also, the study reported no significant correlation between Q angle and WHR.

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