



An Analytical Study of Quadriceps Angle in the Young adult Population.

Mukesh Chand^{1*}, Latika Arora², Swati Yadav³, Soniya Arunkumar Gupta⁴, Suraj Pal Singh⁵

¹M.Sc. Medical Anatomy student, Department of Anatomy, Faculty of Medicine, Santosh Deemed to be University, Ghaziabad, Uttar Pradesh, India (*Corresponding Author)

²Professor, Department of Anatomy, Faculty of Medicine, Santosh Deemed to be University, Ghaziabad, Uttar Pradesh, India

³Associate Professor Department of Anatomy, Faculty of Medicine, Santosh Deemed to be University, Ghaziabad, Uttar Pradesh, India

⁴Professor Department of Anatomy, Faculty of Medicine, Santosh Deemed to be University, Ghaziabad, Uttar Pradesh, India

⁵Ph.D. Research Scholar, Department of Biochemistry, Faculty of Medicine, Pacific Medical College and Hospital, Pacific Medical University (PMU) Udaipur, Rajasthan, India

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KEYWORDS

Quadriceps angle (Q angle), Center of patella (CP), Tibial tuberosity (TT), anterosuperior iliac spine (ASIS), RQA (right quadriceps angle), LQA (left quadriceps angle)

ABSTRACT:

Introduction: The Q angle which is also known as quadriceps angle is defined as the angle formed between the quadriceps muscles and the patella tendon. The Q angle is an important reflection of biomechanical effect of quadriceps femoris on the movements of knee articulation & maintenance of proper posture. So, its evaluation is an important diagnostic method for evaluation of alignment of knee with that of hip, femur and tibia. Assessment of Q angle is very important and mandatory for picking early patella femoral problems particularly in young adult athletically and physically active sports person. It can change with increasing age. Normal values of the Q angle cited were 10 - 14° for men and 14 -17° for women.

Objectives: To evaluate Quadriceps angle in a young adult population.

Material and Methods: The subjects for our study were healthy young adult students of the Santosh University Ghaziabad, aged 17-25 years, The Quadriceps angle was measured using a electronic universal goniometric method with the subjects supine, the quadriceps relaxed and the lower limbs in neutral rotation. Lateral placement of the tibial tuberosity with respect to the centre of the patella was measured.

Results: A total of 78 participants were assessed in which 39 (50 %) were males and 39 (50 %) were females, average age of the all participants was 21.17 years ranging from 17 to 25 years. The Q angle was obtained in a group of 78 young adult participants and divided equally into two groups based on gender types males and females. The mean age was 21.25± 2.41 and 20.97 ± 2.31 years in male and female participants respectively. The mean of Right Q angle in the female group is greater (13.45 ± 1.25°) than the male group (12.39 ± 0.98°). The average Q angle of both the limbs was 12.15 ± 0.97 and 13.23±1.27 in male and female participants respectively.

Conclusion: Our findings concluded that the present study documented bilateral variations in the Q angle in young adults population. All measurements were made with the subjects in a supine position, the quadriceps relaxed and the feet in neutral rotation. A positive statistically significant differences was appreciated in the Q angle among males and females participants.

Introduction: The Q angle which is also known as Quadriceps angle is defined as the angle formed between the quadriceps muscles and the patella tendon [1]. The Q

angle is an important reflection of biomechanical effect of quadriceps femoris on the movements of knee articulation & maintenance of proper posture [2]. So, its



evaluation is an important diagnostic method for evaluation of alignment of knee with that of hip, femur and tibia [3]. Assessment of Q angle is very important and mandatory for picking early patella femoral problems particularly in young adult athletically and physically active sports person [4]. It can change with increasing age [5]. Normal values of the Q angle cited were 10 - 14° for male and 14-17° for female [6]. Strenuous physical activity has also been shown to have significant effects on the normal values of Q angle in an individual [7]. Clinically Quadriceps angle is used by physicians and physiotherapists during any identification, evaluation and surgical treatment of knee joint function [8]. Q-angle greater than 15° in men and 20° in women are considered abnormal [9]. It is well known that the normal Q angle should fall between 12 and 20 degrees, the males are usually at the low of this range while females have higher measurements [10]. It is an evident medical fact that the measurement of the Q-angle is a very decisive indicator of the biomechanical function in the lower extremity since this measurement reflects the effect of the quadriceps mechanism on the knee, it also gives an idea how the thigh muscles function to make the knee moves as well as how the knee patella tracks in the groove of the knee joint [11]. Moreover Q angle has become accepted as an important factor in assessing knee joint function and determining knee health in individuals suffering from knee pain [12]. When it is assessed correctly it will supply very useful information concerning the alignment of the pelvis, leg and foot [13]. Therefore, the determination of the Q angle is particularly momentous for patients who are athletically and physically active [14]. Furthermore it is essential to measure the angle of female patients who walk for health purposes, climb stairs frequently and participate in a regular form of sports [15]. The knee joint is a complex synovial joint of the condylar variety that is stabilized by ligaments and muscles [16]. It is involved in around 50% of musculoskeletal injuries [17]. The quadriceps angle is an important parameter to assess patella femoral mechanics and is thus of great interest to clinicians [18]. It is a clinical measure of the alignment of the quadriceps femoris musculature relative to the alignment of the underlying skeletal structures of the pelvis, femur and tibia [19]. The Q angle which is also

known as quadriceps angle is defined as the angle formed between the quadriceps muscles and the patella tendon [20].

Materials and Methods: The subjects for our study were healthy young adult students of the Santosh University Ghaziabad, aged 17-25 years who were sought to participate in the study after due explanations. The total no of subject's chosen was 78 (as per statistical calculation). All ethical guidelines were duly followed. This study was performed upon approval of the Ethics Committee of Santosh Deemed to be University Ghaziabad. The clinical importance of conducting this study was explained to all participants. A consent form was duly signed by every participant. All the subjects showed their willingness to undertake their participation in this study without any force.

1. Electronic universal Goniometer.
2. Electronic scale.
3. Marker Pen.

Inclusion Criteria:

1. According to the sample size 39 male and 39 female were assessed.
2. Young adult (an age between 17 to 25 years).

Exclusion criteria:

1. Subjects with neurological disorders.
2. Any known bony pathology.
3. Congenital anomalies of lower extremity.
4. Age less than 17 and more 25 was excluded.
5. Third gender was excluded.

Methodology: The measurement of the Q angle was performed with the subject supine position and keeping the pelvis square. The following bony landmarks were marked with a marker pen:

1. ASIS (Anterior Superior Iliac spine).
2. CP (Center of patella).
3. TT (Tibial tuberosity)

One line was drawn from the center of patella (CP) towards the anterior superior iliac spine (ASIS) using the straight measuring tape and represented the longitudinal axis of the femur another line joined the center of patella (CP) to the tibial tuberosity (TT) the second line was extended upwards. The angle formed between the above two lines was defined as the Q angle and measured with a electronic universal goniometer (Figure No. 1).

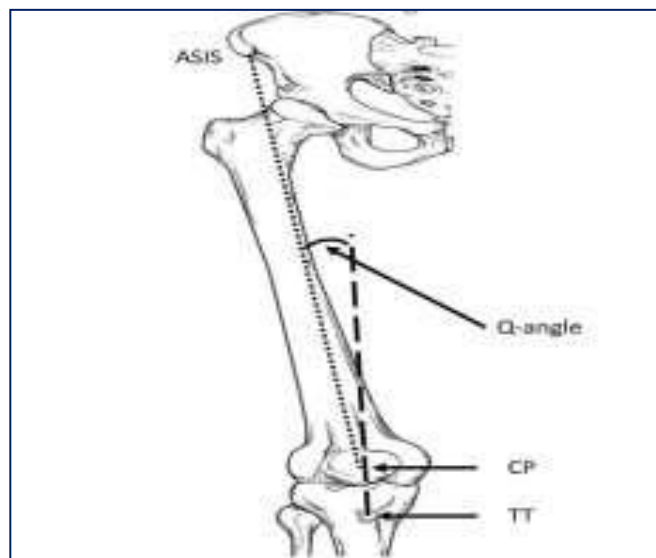
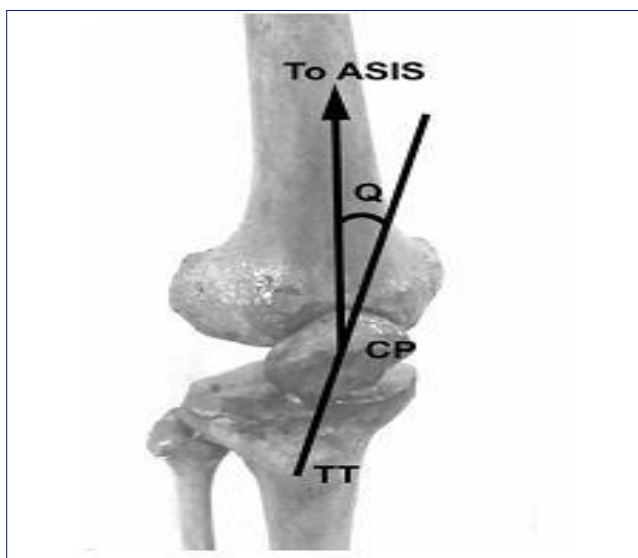


Figure No.1: Measurement of the Q-angle. ASIS (Anterior superior iliac spine) CP (Centre of patella) TT (Tibial tuberosity) Q Angle (Quadriceps angle).

Statistical Analysis: Means, standard deviations, and ranges were calculated. The Statistical Package for Social Sciences (SPSS) version 21.0 was the statistical program used to analyze the data. Appropriate statistical tests were used to analyze measures of central tendency, dispersion, and odds ratio following study of data distribution patterns. P-values less than 0.05 were considered statistically significant.

Results: A total of 78 participants were assessed in which 39 (50 %) were males and 39 (50 %) were females (Figure No. 2 and 3), average age of the all participants was 21.17 years ranging from 17 to 25 years. The Q angle was obtained in a group of 78 young adult participants and divided equally into two groups based on gender types (males and females participants). The mean age was 21.25 ± 2.41 and 20.97 ± 2.31 years in male and female participants respectively.

Figure No.2: Showing total number of assessed participants data

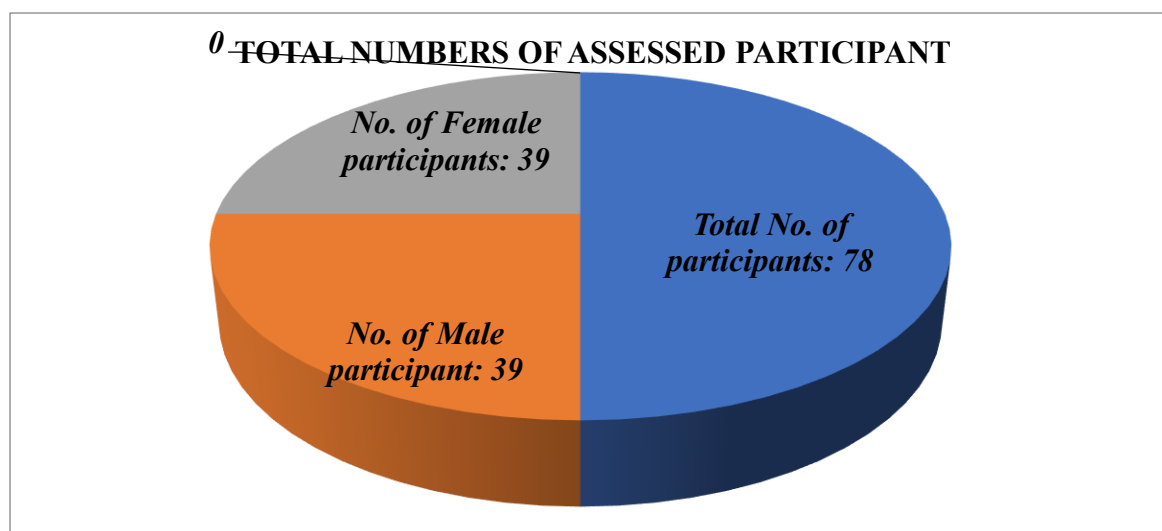
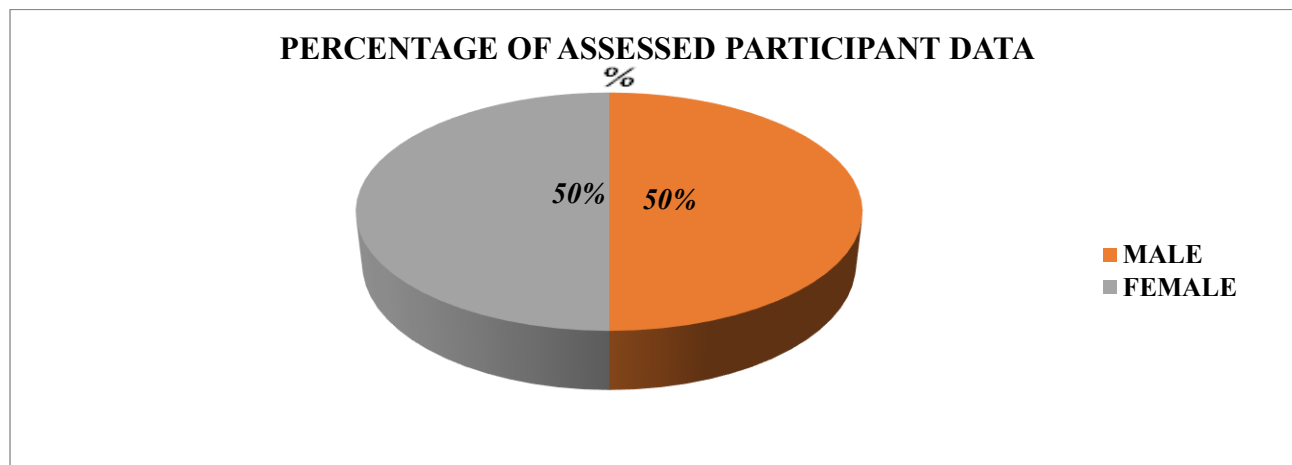




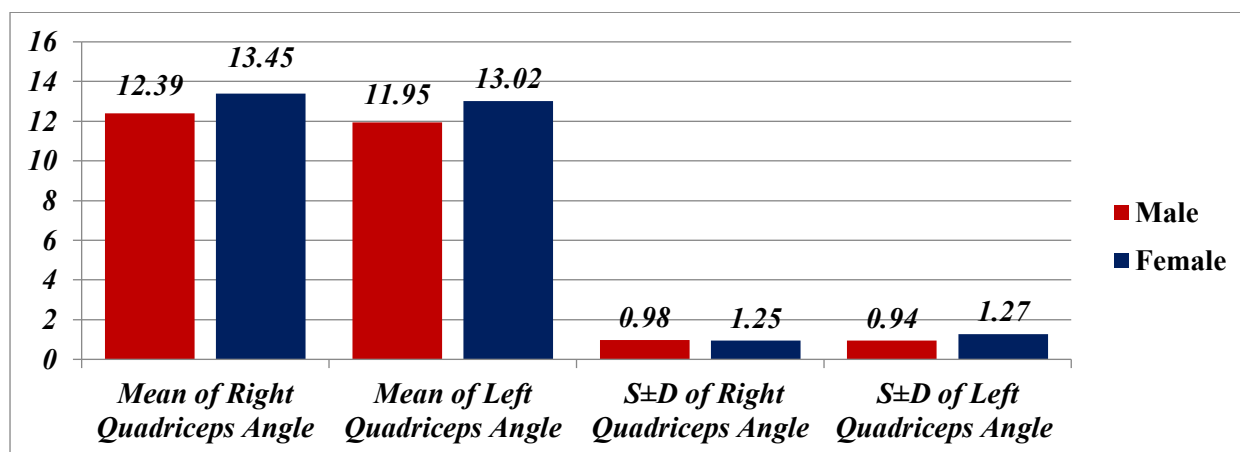
Figure No.3: Showing percentage of assessed participants data



The mean Q angle of both gender (males and females) were assessed which is depicted individually in (Table No.1 and Figure no. 4).

Table No.1: Mean of Right and Left Q angle (among male and females participants group).

Variables	Number	Mean (Degree)	Std. Deviation (Degree)	Std. Error Mean
Male students group (Right Q-Angle)	39	12.39	0.98	0.15
Male students group (Left Q-Angle)	39	11.95	0.94	0.15
Female students group (Right Q-Angle)	39	13.45	1.25	0.20
Female students group (Left Q-Angle)	39	13.02	1.27	0.20

Figure No. 4: Showing the Mean \pm SD Differences in RQA & LQA between Males & Females



The mean of Right Q angle in the female is greater (13.45 ± 1.25^0) than the male (12.39 ± 0.98^0) shown in the figure no.5. In our study the mean Q angle including both males and females are greater on the

right side. The mean of Right Q angle of females is greater (13.45 ± 1.25^0) than the Left Q angle (13.02 ± 1.27^0) shown in the figure no.6.

Figure No. 5: Showing Mean and SD differences in right Q angle between Males and Females participants groups.

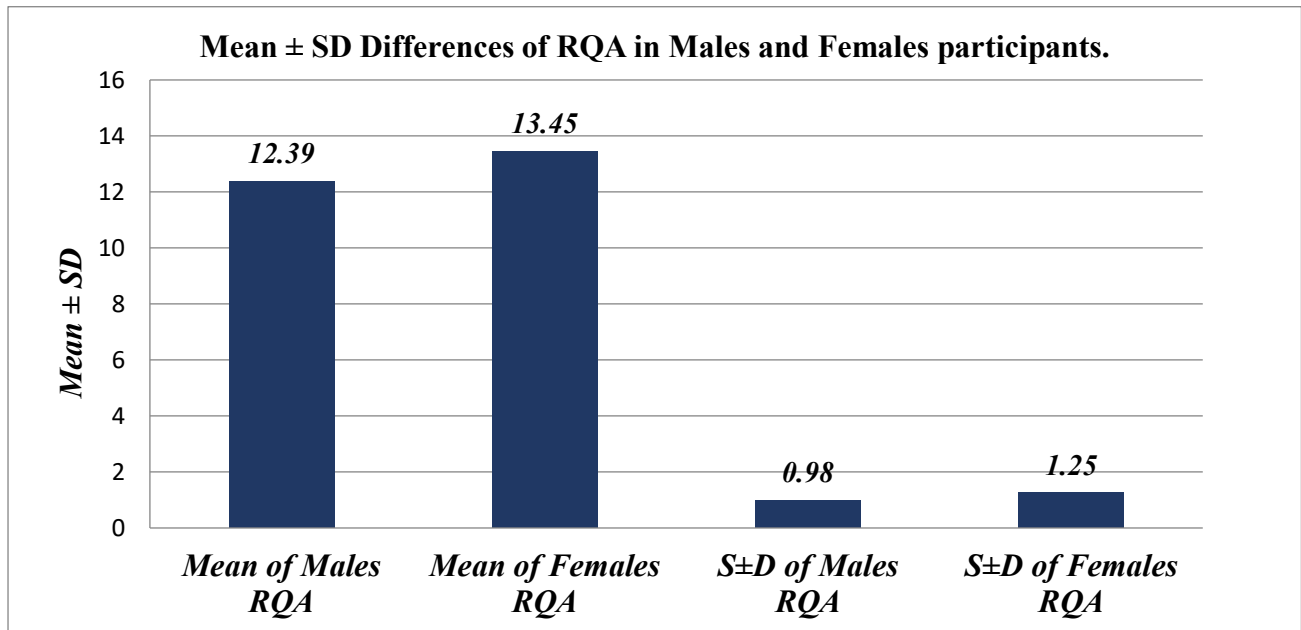
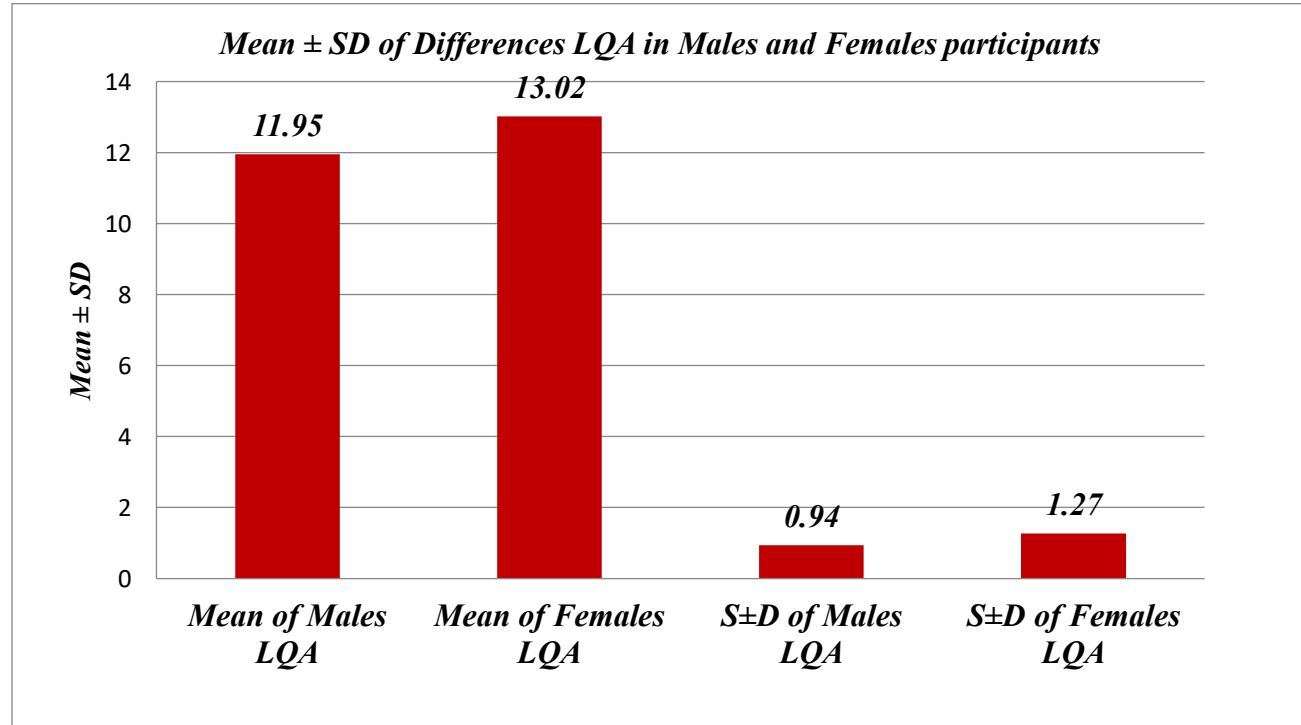


Figure No. 6: Showing Mean ± SD. differences in Left Q angle between Males and Females participants groups.





The mean Q angle (right and left) side was greater in females group as compare to males group. A statistically significant difference was appreciated among males and females, significant difference in mean at $P = 0.0001$.

Discussion: The goal of the current study was to analyzed 78 participants, of which 39 (50%) were male and 39 (50%) were female. The average age of all participants was 21.17 years, with the range being 17 to 25 years. A total of 78 young adult students were included in the Q angle study, and they were split evenly into two groups according to their gender types (male and female participants). The average age of the male and female participants was 20.97 ± 2.31 and 21.25 ± 2.41 years respectively, For both male and female individuals, the average Q angle of both limbs was 12.15 ± 0.97 and 13.23 ± 1.27 , respectively. According to Table No. 1, the female groups' mean Right Q angle is higher (13.45 ± 1.25^0) than the male groups' (12.39 ± 0.98^0). The mean Q-angle for both the male and female groups in our study is higher on the right side. Females had a higher mean Right Q angle (13.45 ± 1.25^0) than a Left Q angle (13.02 ± 1.27^0). The female group had a higher mean Q angle (right and left) than the male group. There was a statistically significant difference between the male and female groups, with a mean difference of $P = 0.0001$. The gender differences in the Q angle have been the subject of numerous research. Young adult females have larger mean Q angles than males, with differences ranging from 2.7° to 5.8° in many studies, according to a comprehensive review by Sharma et al. (2023). This discrepancy is explained by gender-specific anatomical and structural differences, including femoral anteversion and pelvic breadth. In a study on Q angle and its relationship to gender, Jaiyesimi et al. (2009) found that females had considerably larger values for both the Right and Left Q angles. In females, a larger Q angle was linked to a broader pelvis. Problems are reflected in other researchers' recommendations that the values should be as low as 10 degrees [21]. According to recent research, levels between 8° and 10° for men and up to 15° for women are considered normal; however, readings above that range may suggest an abnormality. Although they did not provide a range for typical values, Davies and Larson considered Q angles greater than 20° to be excessive [22]. When the Q angle measurement intensifies patellofemoral diseases

and increases the lateral tension of the quadriceps femoris muscle on the patella, it is typically considered excessive [23]. Because it prevents the patella from moving smoothly in the femoral groove, an excessive Q angle suggests a propensity for increased biomechanical stress during repetitive knee activities [24]. Over time, particularly during athletic activities, it will lead to muscular imbalance and ultimately the degeneration of the patella's underside cartilage, which can result in the loss of the knee's articular surface [25]. As a result, the damage caused is irreversible, making full recovery following treatment unattainable [26]. Furthermore, an excessive Q-angle causes the foot to pronate excessively, and an increase in pronation duration causes the tibia to internally rotate excessively, altering the quadriceps mechanism and the patella's lateral tracking [27]. Degenerative joint disease may eventually arise from the quicker progression of patellofemoral arthralgia to knee dysfunction [28]. The negative effects of an improper Q angle can frequently be lessened by controlling foot pronation. The purpose of the study is to further examine the mean Q angle in Arab nations, including some Gulf nations, in order to make the data useful for comparison with values from other regions of the world and to aid in the improvement of clinical diagnosis and evaluation of knee joint misalignments [29]. The most prevalent knee ailment among teenagers and young people is knee pain [30].

Conclusion: Our findings concluded that the present study documented bilateral variations in the Q angle in young adults population. all measurements were made with the subjects in a supine position, the quadriceps relaxed and the feet in neutral rotation. A positive statistically significant differences was appreciated in the Q- angle among males and females participants. Our findings homologate that there is a gender related differences in Q angle and also most individuals shows bilateral variations. though our study prove most other findings of a higher Q angle in females we strongly suggests that a further reliable result can be achieved by first adjusting the same height and age between subjects. The results of this study may be beneficial to surgeons and sports coaches to identify the individuals at risk of a knee injury. This study may have limitations including a relatively small sample size.



Additional Information:

Disclosures:

Human subjects: All study participants either gave their consent or waived it for evaluation and open access publication. Santosh Institutional Ethics Committee the University is located in Ghaziabad, Uttar Pradesh, India. Prior to inclusion in the study, each participant provided a signed informed permission form for evaluation and publishing in an open access journal.

Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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