

# The Variability In Mean Q Angle Of Indian Men And Women – A Review

Dr. Eshita Sharma (PT)<sup>1\*</sup>, Dr. Navjyot S Trivedi<sup>2</sup>

<sup>1\*</sup>Postgraduate student, Department of Physiotherapy, Chandigarh University

<sup>2</sup>Professor, Department of Physiotherapy, Chandigarh University

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## ARTICLE INFO

## ABSTRACT

**Background-** Q angle or Quadriceps angle is an indicator of the vector for the combined pull of the patellar tendon and extensor processes and serves as the most important marker of stability of knee joint. Looking at the Indian way of life which encourages sitting and crouching with the legs crossed with a greater likelihood to impose compressive force on the patellofemoral joint. Q angle is found to show variation with gender, and as such due to the numerous alterations observed in this stance across the literature, further research on the Indian populace is recommended.

**Method-** Pub Med, Web of Science, Cochrane Central Register of Controlled Trials, PEDRO, and Google Scholar are used to do an automated search for English language articles of Indian origin from the last fifteen years that is 2009-2023. Ten articles were then shortlisted for this review.

**Results-** The findings suggest that there is a significant difference present in the values of Q angle among Indian males and females, such that Indian females have considerably higher Q angles than their male counterparts.

**Conclusion-** Females are having statistically significant higher Q angles than the males and as such they can be more susceptible to injuries or abnormal knee biomechanics. And hence, taking into account such characteristics like gender, height, posture, etc when comparing and measuring the Q angle to understand the function of the quadriceps muscle and its impact on the knee are significant factors to consider.

**Keywords-** Gender, Indian population, knee, quadriceps, Q angle

## 1. INTRODUCTION

Knee joint is a complex or multifaceted joint, and being categorised as a condylar joint of synovial variety, supported by many muscles and ligaments, it contributes in the crucial biomechanics of normal human musculoskeletal functioning. (Baker & Juhn, 2000) If we look at literatures, Brattström was the first to describe about Q angle. (Brattström, 1970) Quadriceps angle or the q angle is formed by the intersection of the lines connecting the tibial tubercle to the midpoint of the patella and the anterior superior iliac spine (ASIS) (Grelsamer, 2000) Further it is also seen that the value of Q angle is significantly influenced by various variables like whether the patient is a woman or a male, whether the patient is in a supine or standing posture, whether the patient's knee is extended or flexed etc. (Biedert & Warnke, 2001) It is indeed a parameter of interest for clinicians, as the alignment of the quadriceps femoris muscle with relation to the underlying skeletal components of the pelvis, femur, and tibia is measured with respect to it. (Livingston, 1998) The Q angle can be raised by clinical circumstances such as tight lateral retinaculum, genu valgum, greater femoral anteversion, external tibial torsion, laterally positioned tibial tuberosity etc, thus an additional component that may contribute to repeated patellar dislocation is this rise in quadriceps angle. (Nandi et al., 2013)

The effects of the quadriceps mechanism on the knee are reflected in the Q angle. It indicates the oblique location of the femur relative to the tibia and the angle of pull of the quadriceps muscle to the axis of the patella and tibia, and when evaluated correctly, it provides highly significant information regarding the alignment of the lower extremities. The Indian way of life increases the danger of compressive force on the patellofemoral joint when sitting and crouching with the legs crossed. (Nandi et al., 2013) The force of the

lateral pull will increase if the Q-angle is greater than normal. According to Insall et al., abnormal lateral stresses on the patella may be indicated by an elevated Q-angle. It is therefore regarded as a crucial indicator of patellofemoral dysfunction and function.(GR & T, 2021) According to earlier research, women are more likely to experience genu recurvatum, femoral anterior torsion, Q-angle, tibiofemoral malalignment, and aberrant anterior pelvic tilt. (Mohanty & Koley, 2018) As a consequence, the Q angle has gained widespread acceptance as a crucial factor for determining knee joint functionality. However, there is significant dispute regarding the underlying cause of the higher Q angles seen in females and the variances in Q angles in Indian communities. (Singh et al., 2019)

It is known that the Q angle indicates the obliquity of the patellar pull caused by the quadriceps femoris muscles. In men, the normal Q angle ranges from 8° to 10°, while in women, it varies from 10° to 20°. Patellar dislocation is more likely if the Q angle is greater than 20–22°.(Nandi et al., 2013) The causes of high angle in females can be attributed to a more laterally located tibial tuberosity, a shorter femur, or a higher width of pelvis.(Veeramani, 2010) It is believed that due to differential anatomical alignments, reduced pain thresholds, and reduced physical tolerance as opposed to men, women are typically more susceptible to lower extremity malalignment.(McKeon& Hertel, 2009)

Regarding the Q-angle's clinical significance, it has been noted that variations in this angle are linked to a number of conditions, including femoral internal rotation, foot pronation, internal tibial torsion, chondromalacia patella, lateral dislocation of the patella, and erosion of the patellar cartilage and lateral condyle.(Biedert & Warnke, 2001) Due to the external rotation of the tibia during the screw-home mechanism, which permits complete extension, the q-angle varies dynamically, reducing with knee flexion and increasing with knee extension. The q-angle can rise as a result of increased femoral anteversion, external tibial torsion, or lateral tibial tubercle displacement. (Malek & Mangine, 1981) This eventually causes an accelerated course that starts with patellofemoral arthralgia and ends with degenerative joint disease, which is caused by knee dysfunction. The negative effects of an improper Q-angle are frequently lessened by correcting foot pronation.(Piva et al., 2009)

To prevent problems with knee alignment, it is imperative to evaluate the quadriceps angle (Q angle) of the knee joint. With the recent progress in sports medicine, measuring the Q-angle of young athletes has become a standard practice in Western nations.(Nandi et al., 2013) A lot of research on biomechanics, clinics, and knee surgery concerning athletes mentions measuring the Q angle as this angle is useful for displaying the force vector applied to the patella and patellofemoral joint, furthermore, it is employed as a standard to determine potential candidates for surgery or as an indicator of impact risk after many sports-related injuries.(GR & T, 2021)

Sports or Orthopaedic therapists might use such statistical information to better understand how Qangles of patients when gender is taken into consideration, are evaluated as potential predictors of future knee conditions and physicians who specialize in physical therapy and orthopedic surgery will find the observations helpful in comprehending and managing replacement arthroplasty and patellofemoral pain.

## 2. METHODOLOGY

### 2.1 Study design – Literature review

### 2.2 Inclusion criteria –

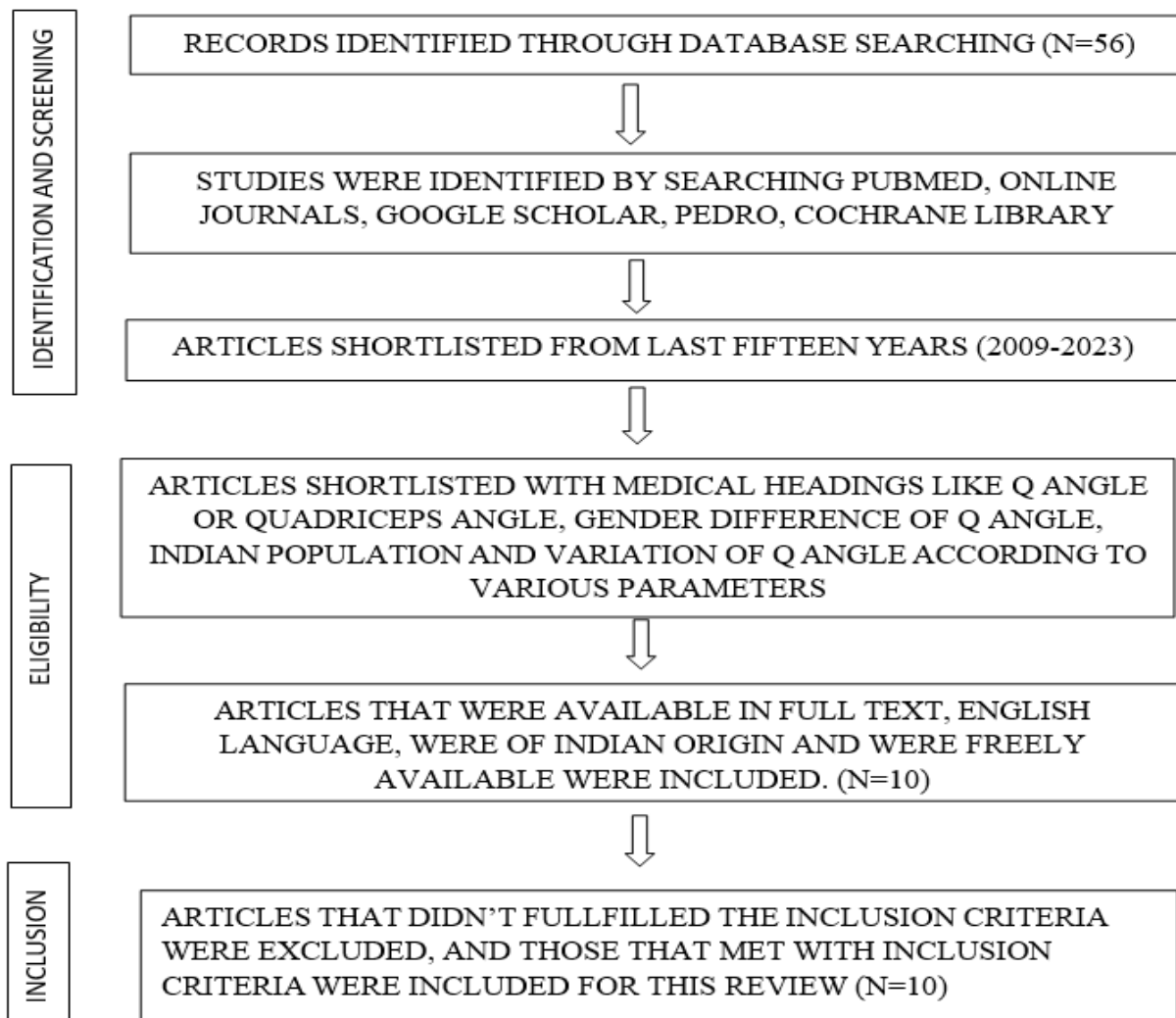
- Literature reviews, systematic reviews, meta-analyses, randomized controlled trials, observational studies, pilot studies, and cross-sectional studies were searched.
- Articles that were available in full text and English language were included.
- Articles of Indian origin and also that were freely available were included.

### 2.3 Exclusion –

- Animal and cadaver studies.
- Paid articles and in other languages except English.
- Articles with only abstracts.
- Articles not of Indian origin.

2.4 Search strategy – Pub Med, Web of Science, Cochrane Central Register of controlled trials, PEDRO, and Google Scholar are used to do an automated search for English language articles of Indian origin from the last fifteen years that is 2009-2023, with headings of Q angle or Quadriceps angle, gender difference of Q angle, Indian population and variation of Q angle according to various parameters like medical headings. Human subject research and trials written in any language other than English were filtered out of the studies. The selected ten articles were then considered for literature review. The studies with language other than English, duplicate articles, and articles with ambiguous conclusions were excluded.

**3. PROCEDURE-**



**Flow chart 3.1**

**4. REVIEW OF LITERATURE-Table 4.1 Tabular review of literature**

AUTHOR'S NAME	REGION OF STUDY	TITLE OF STUDY	JOURNAL NAME AND YEAR OF PUBLICATION	RESULTS
Raveendranath Veeramani et al	Karnataka, India	The Quadriceps angle (Q angle) in Indian men and women	European Journal of Anatomy, 2009	Study was done across 200 limbs, such that the average Q angle value was $12.73^{\circ} \pm 2.58$ . It was discovered that the mean values for females ( $14.48^{\circ}$ ) were greater than those for males ( $10.98^{\circ}$ ).
Raveendranath Veeramani, Nachiket Shankar, et al	India	Gender differences in the mediolateral placement of the patella and tibial tuberosity: a geometric analysis	Anatomy: international journal of experimental and clinical anatomy, 2010	One hundred paired limbs of fifty male and fifty female healthy adult Indian volunteers were examined. With reference to the medial and lateral joint lines, the precise locations of the tibial tuberosity and the patella centre

				were ascertained using trigonometric analysis. The centre of patella and tibial tuberosity were positioned mediolaterally based on two ratios, R1 and R2. It was seen that in comparison to males ( $1.29 \pm 0.67$ ), females had considerably higher mean values of tibial tuberosity ( $2.09 \pm 0.90$ ), possibly causing females to have a larger Q angle.
Maitreyee Nandi et al	Darjeeling, Bengal, India	The 'quadriceps angle': correlation between clinical and radiographic measurements from a study in North Bengal	Journal of the Anatomical Society of India, 2013	In this study, out of total 93 participants, of which 42 were males and 51 were females, the mean Q-angle values in males were recorded as $10.5 \pm 2.06$ radiologically and $11.8 \pm 2.86$ clinically. For females, the figures were $17.4 \pm 4.27$ and $15.8 \pm 3.82$ , respectively.
Nihar Ranjan Mohanty, Shyamal Koley	Cuttack and Bhubaneswar, Odisha, India	A Study on Lower Extremity Malalignment and its Correlation to Q-Angle in State Level Athletes of Odisha	International Journal of Health Sciences & Research, 2018	One hundred athletes representing the state, fifty men and fifty women, in the 18–27 age range were chosen for this study, the results show value of Q-angle (degree) for right side in females as $21.56 \pm 1.72$ and for males as $16.28 \pm 2.36$ and for left side in females as $20.62 \pm 1.83$ and in males as $15.62 \pm 2.04$ which is statistically significant.
Aprajita Raizada, Shruthy K.M, et al	Chennai, India	Changes in quadriceps angle (q-angle) with regard to gender and different anthropometric parameters	International Journal of Anatomy and Research, 2019	148 subjects comprising of 80 females and 68 males were studied, such that the results concluded that the males have mean Q-angles of $8.6 + 2.20$ on the right side and $8.1 + 1.83$ on the left.
				The average Q-angle for females was found slightly higher as $8.8 + 2.33$ on the left side and

				8.9 + 2.52 on the right.
Kundan Kumar Singh, Richa Hirendra Rai, et al	Delhi, India	Variation in quadriceps angle (Q angle) and its correlation with anthropometric parameters	Journal of Cardiovascular Disease Research, 2019	The study involved a total of one hundred individuals, out of which 58 were assessed, such that results showed adult males having the average Q-angle for the right and left lower limbs as $16.82 \pm 1.98^\circ$ and $15.64 \pm 1.74^\circ$ , respectively, whereas females having the average Q-angle as $18.87 \pm 2.98^\circ$ and $17.07 \pm 2.72^\circ$ , respectively. Concluding that right and left Q angles show inequity within the same person, with women exhibiting relatively higher Q angles.
Rajeev Choudhary, Mudasir Malik, et al	India	Effect of various parameters on Quadriceps angle in adult Indian population	Journal of Clinical Orthopaedics and Trauma, 2019	450 adult healthy volunteers participated in the study, such that they underwent bilateral measurements of their Q angle while standing and supine using the same goniometer, results showed that in comparison to men, women's Q angles were statistically significantly higher in both knees.
Madhu GR and Keshavamurthy T	Dakshina Kannada, Karnataka, India	An analysis of Q angle with respect to various body parameters in athletes	International Journal of Physiology, Nutrition and Physical Education, 2021	For this study, fifty male and fifty female athletes were chosen, and a full circle universal manual goniometer was used to measure the Q angle when the subject was standing and in the upright weight-bearing position. The results showed that compared to males,
				females have a larger Q angle based on body weight and on height, further the gender-specific Q angle is as follows, the mean and standard deviation for men and women are

				14.22 and 3.34, respectively and for females, these values are 17.58 and 3.36, respectively.
uhin Ghulyani, Sumit Babuta, et al	Rajasthan, India	A study of variability of quadriceps angle (q-angle) in a group of asymptomatic young adults	International Journal of Medical Science and Education, 2021	In this study twenty-one healthy adult volunteers were split into equal groups of males and females for the purpose of analysing the Qangle, The results showed that the females had greater mean Q angles, and this difference was statistically significant ( $p < 0.05$ ), further for both limbs the mean Q
				angle for males and females was $12.84^\circ$ and $14.48^\circ$ respectively.
Kumar Shantanu, Shailendra Singh, et al	Lucknow, India	Anatomical Variation in Quadriceps Angle with Regard to Different Anthropometric Parameters in a Tertiary Care Center in Northern India: A Descriptive Study	Cureus Journal of Medical Science, 2021	The study included 100 healthy persons, 50 males and 50 females such that their femur lengths, Q-angles, and bicondylar distances were measured, the results determined that the average Q- angle in males was $10.84^\circ \pm 1.86^\circ$ on the left side and $11.14^\circ \pm 1.9^\circ$ on the right. It was also discovered that in females, the right side measured $13.68^\circ \pm 1.87^\circ$ while the left side measured $13.61^\circ \pm 2.04^\circ$ , thus there is a difference in the measurements of Qangle with regards to gender.

## 5. DISCUSSION

The aim of this article was to do a literature review of English articles of Indian origin in order to determine whether the literature supports the variability in the values of Q angle in Indian males and females.

There are literatures that suggest that during any athletic event, the most often used section of the body is the lower extremities. The most crucial topic to be regularly researched in order to identify incorrect lower extremity alignments and prevent future injuries that may arise during various sporting activities is the anatomical, anthropometric, and biomechanical relationship of the lower extremity alignment, and thus knowing about quadriceps angle also becomes significant. (Mohanty & Koley, 2018) There is evidence that the Q-angle affects the kinematics of the lower extremities. (Caldwell, 2000) A shift in the Q-angle alters the pattern of stress that the patella cartilage experiences, which is the first step toward a lot of knee ailments. (Puckree et al., 2009) Asymmetry in the quadriceps muscle's patella insertion points might cause the patella to shift, which will change the Q-angle. (Puckree et al., 2009)

When comparing the outcomes of various populations, it is important to keep in consideration that a number of variables, including subject height, age, gender, and measuring technique, could influence Q-angle magnitudes. (Ghulyani et al., 2021)

According to Hertel and McKeon, women exhibit higher genu recurvatum, anterior pelvic tilt, femoral

anteversion, and Q-angle than do men. (McKeon & Hertel, 2009)

In the study done by Ghulyani et al, the mean Q angle for the right side was determined as 12.62° and that of the left side was 13.07° for males and that for females was 14.37° and 14.58° for the right and left sides respectively. (Ghulyani et al., 2021) Further, the results of Livingston and Mandigo also support this such that women are more likely than men to have expanded Q angles and patellofemoral problems, which can manifest as increased skeletal measurements such as femoral neck anteversion, shorter femur length, or pelvic breadth. (Livingston & Mandigo, 1999)

In another study done by Kundan Kumar Singh the average Q angle was found for the right and left lower limbs as 16.82 ± 1.98° and 15.64 ± 1.74° respectively, whereas females having the average Q-angle as 18.87 ± 2.98° and 17.07 ± 2.72° respectively, and also many studies have stated that when muscles are used, a larger Q-angle (15 degrees for men and 20 degrees for women) may also place people at a mechanical disadvantage in terms of the alignment of the patellar ligament, putting additional vectorial strains that may exacerbate the Q angle. Therefore, when participating in sports that require jumping and landing, the activation and triggering of the quadriceps may indicate a person's risk of suffering a knee injury. (Singh et al., 2019) This can be further supported by study done by Lathinghouse and Trimble, in which they mentioned when women participate in activities that require high degrees of quadriceps activity, they may be at risk of having a lateral displacement of the patella. (Lathinghouse & Trimble, 2000)

In the investigation done by V Raveendranath et al, they discovered that the mean Q angle in females was substantially higher than that in males which was concluded as 14.48° for females and as 10.98° for males, and further, these findings resonated with previous studies of Woodland and Francis, 1992; Omololu et al., 2009. (Raveendranath et al., 2009) The study done in India by Jha and Raza also concurs with these findings, such that the individual's average Q angle for females (N = 140) and males (N = 110) was 13.968 and 12.364, respectively. (Choudhary et al., 2019)

According to several other research, women were shown to have higher Q-angle values. This is likely because women have broader pelvic diameters than men do, which influences the location of the anatomic sites. In females, a laterally located tibial tuberosity is one factor contributing to the Q-angle's rise. (Caylor et al., 1993) (Shantanu et al., 2023) Other studies have also stated that tibial torsion or an increase in the valgus angle may be the cause of a more laterally positioned tibial tuberosity in females, further resulting in a higher Q angle. (Choudhary et al., 2019)

There can be various other factors that can cause this difference in the values of Q angle amongst Indian males and females giving further scope for more researches to provide a fundamental reason for the differences in Q angles in Indian groups and the higher Q angles observed in females, also for more broader perspective number of review articles can be increased and further an elaborated analysis can be done.

## 6. CONCLUSION –

The goal of this review was to understand whether there is a significant difference present in the values of Q angle among Indian males and females, and we can conclude that there is a significant difference present in the values of Q angle of Indian males and females, it is also evident that the problems with the patellofemoral joint are associated with an increase in the quadriceps angle. Hence for Indian females having statistically significant higher Q angles than the males, makes them more susceptible to sports-related injuries or other abnormal knee biomechanics influenced conditions. For future research on the Indian population, we can suggest taking into account such characteristics like gender, height, posture, etc when comparing and measuring the Q angle to understand the function of the quadriceps muscle and its impact on the knee.

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## 9. DECLARATION OF INTEREST

The authors declare that there is no established conflict of interest, neither financial nor personal regarding this review paper that may have influenced the review presented here.

## 10. DATA AVAILABILITY STATEMENT

Data, if requested, can be made available by the authors of this review.

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### 12. AUTHOR CONTACT DETAILS

Eshita Sharma – [eshitasharma32e@gmail.com](mailto:eshitasharma32e@gmail.com)

Dr. Navjyot S Trivedi – [hod.physiotherapy@cumail.com](mailto:hod.physiotherapy@cumail.com)

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