



Original Research Article

## Q Angle in Children Population Aged Between 7 To 12 Years

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### ABSTRACT

**Introduction:** Q angle provides useful information about the alignment or the knee joint, which if outside of normal ranges can be precursor for overuse injuries. Though numerous studies on the Q angle have been conducted worldwide, relatively few of them have focused on Q angle in children population.

**Aim of Study:** To find out Q angle in children aged 7 to 12 years, and to find out difference in Q angle between girls and boys.

**Methodology:** Study designed – Observational study, Sample size – 200 legs; 100 subjects; M: 50, F:50, Sample Selection- A random sample of 100 children (200 legs) was taken after giving due consideration to inclusive & exclusive criteria. Data was collected by measuring Q angle with the use of standard goniometer. Inclusion criteria – children age between 7 to 12 years, Exclusion criteria – cases of children with a history of previous fractures on lower limbs or major orthopedic or neurological disorders have been excluded.

**Results:** The average Q angle value of all the 200 limbs was 15.7 degrees; and SD was 4.0 degrees. Mean Q angle for boys was 15.7 degrees and SD was 4.6 degrees. The mean Q angle for girls was 15.6 degrees and SD was 4.1 degrees. For the children aged 7–8, the values of Q angle have been measured was  $10.1 \pm 0.9$  degrees in boys, while in girls it was  $12.5 \pm 2.6$  degrees. For the ages 9–10, the values were  $15.6 \pm 4.5$  degrees in boys, while in girls it was  $15.7 \pm 3.4$ . For the ages 11–12, the values of Q angle was  $18.3 \pm 3.3$  degrees in boys, while in girls it was  $16.8 \pm 3$ .

**Conclusion:** Normative value of Q angle in children aged between 7-12 years in Jamnagar was, for boys:  $15.7 \pm 4$  degrees, and for girls:  $15.8 \pm 3.4$  degrees. With increase in the age there was significant increase in values of Q angle in children of both the sexes and there was no significant difference between the boys and girls in Q angle in all ages.

**Key words:** Q angle, Children, 7-12 years

### INTRODUCTION

The Q angle was first defined by Brattstrom. He described the Q angle as an angle with its apex at the patella, and formed

between the ligamentum patellae and the extension of the line formed by the quadriceps femoris muscle resultant force. It was later measured using the anterior

superior iliac spine (ASIS) as the proximal landmark. The Q angle provides an estimate of the vector force between the quadriceps femoris muscle and the patellar tendon. It is formed by the crossing of two imaginary lines. The first line extends from the ASIS to the centre of the patella (CP). The second line is drawn from the tibial tuberosity (TT) to the CP. The angle formed between these two lines represents the Q angle. [1]

The Q angle has come to be accepted as an important factor in assessing knee joint function. An increase in Q angle beyond the normal range is considered as indicative of extensor mechanism misalignment, and has been associated with knee joint hypermobility and patellar instability. Moreover, its role in assessing other lower extremity injuries in sports has been documented. [1] Q angle as a potential risk factor for non contact anterior cruciate ligament injuries in female athletes. [2]

The values of Q angle in a child's knee cover a wide range. Frequently its extreme values are responsible for complaints or the appearance of some pathological conditions (e.g. chondromalacia, recurrent dislocation of patella etc) Though numerous studies on the Q angle have been conducted worldwide, relatively few of them have focused on Q angle in children population. [3]

The position of the knee as an intermediate joint between the hip and the foot also makes it vulnerable to problems in these two areas. A problem in the foot, pes planus deformity (PPD) or pronated foot is a common source of parental concern. Although the child is usually asymptomatic, some children complain of leg pain and easy fatigability. This is more frequently seen in obese children. Many children with PPD dislike physical activity and whether this is related to weakness in the foot is uncertain but studies have shown that some children

do increase their walking and running limits after successful treatment. [2]

The values of Q angle documented by various researchers in literature vary. Normal values of Q angle for adults, When measured standing, should fall between 18 degrees and 22 degrees. Males are usually at the low end of this range, while females (because of a wider pelvis) tend to have higher measurements. One author considers standing Q angles greater than 25 degrees in females and 20 degrees in males to be abnormal, when measured in the supine position, the values will be lower, and the normal range ends at 15 degrees in males and 20 degrees in females. [4] These data were mainly obtained from young adult and adult populations.

There were very few researches done to establish a normality range for Q angle in children population, so the purpose of the study was to find out Q angle in children population in Jamnagar.

## **MATERIALS AND METHODOLOGY**

**Study Design:** Observational study

**Sample size:** 200 legs; 100 subjects; M:50, F:50,

**Study Setting:** Shree Swaminarayan Gurukul School, Jamnagar and Shree Satya Sai Vidhyalay Jamnagar.

**Duration of study:** It was a one go study

**Materials used in the study:**

- Plinth
- Stool
- Standard Goniometer
- Metal measure tape

**Inclusion Criteria:**

Children age between 7 to 12 years

**Exclusion Criteria:**

- Children who had undergone prior orthopedic surgery at lower extremities,

- Children who had severe limitations in passive range of motion at lower extremities
- Children who were having systemic or localized infections
- Children who were having surgical incisions and open wounds
- Children who were having healing fractures
- Children who were having acute inflammation-Rheumatoid conditions
- Children who had cancer or tumors conditions
- Children with major orthopedic or neurological disorders
- Children with history of lower limb, spinal or neurological injury

**Procedure:**

Two schools were randomly selected from Jamnagar city by lottery method. children between 7 to 12 years were randomly taken for the study (odd roll no.). A total of 200 lower limbs (100 children consisting of 50 males and 50 females) were studied.

Consent was taken from the principals of both the schools.

*Measurement of Q angle:*

A goniometric method described by Jha and Raza was used. [5] The measurement of the Q angle was performed with the subject in supine and keeping the pelvis square, quadriceps relaxed and lower limbs in neutral rotation. For marking CP, borders of patella were palpated and outline of patella was drawn using a marker pen. Intersecting point of maximum vertical and transverse diameters of patella was marked as CP. The point of maximum prominence was marked as the center of the TT.

The first line was drawn extending from the anterior superior iliac spine (ASIS) to the center of the patella (CP) using the

straight edge of measuring tape. The second line was drawn from the tibial tuberosity (TT) to the CP. Then extending the second line upwards, the angle formed between these upper two lines were measured using a standard goniometer as the Q angle. Measurements were taken once by a single investigator. Data was analysed using appropriate statistical tests.



Fig. 1. Q Angle Measurement

**RESULTS**

Normal Q-angle values and ranges were established by calculating the mean and standard deviation for each group: boys, girls and the entire sample.

The Descriptive Statistics of Groups for Age were shown in Table 1.

All statistical analysis was done with the help of SPSS software. Significance level was 0.05(5%).

The average Q angle value of all the 200 limbs was 15.7 degrees and SD was 4.0 degrees. The mean Q angle for boys was 15.7 degrees and SD was 4.6 degrees. The mean Q angle for girls was 15.8 degrees and SD was 3.4 degrees.

The mean, standard deviation, minimum, maximum and median values of Q angles for each group: boys, girls and the entire sample, T value and P value were shown in Table 2. According to the P value obtained there was no statistically

significant difference in Q angle values of Boys and Girls.

Table 1: Descriptive Statistics of Groups for Age (in years)

GROUP	NO. OF CHILDREN	NO. OF LEGS	AGE (years)	MEDIAN	RANGE
			(MEAN ± SD)		
BOYS	50	100	10.0 ± 1.4	10	7-12
GIRLS	50	100	10.2 ± 1.1	10	7-12
ALL CHILDREN	100	200	10.1 ± 1.3	10	7-12

Table 2: Descriptive Statistics (in Degrees) of Q Angles for boys, girls and entire sample

GROUPS	Q ANGLE (Degrees)					t value	P value
	MEAN	SD	MEDIAN	RANGE			
BOYS	15.7	4.3	15	10-25		-.259	0.796
GIRLS	15.8	3.4	15	10-25			
ALL CHILDREN	15.7	4.0	15	10-25			

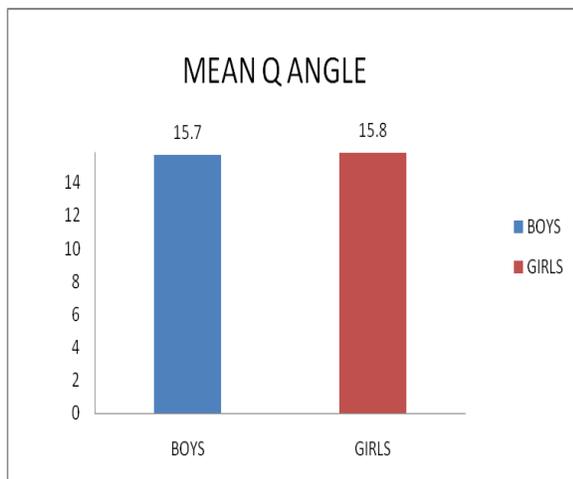
Table 3: Descriptive Statistics (in Degrees) of Q Angles for each Age Group (Boys)

GROUPS	BOYS				
	MEAN±SD	MEDIAN	RANGE	F	Sig.
7-8 YEARS	10.1±0.9	10	10-12	37.484	.000
9-10 YEARS	15.6±4.5	15	10-25		
11-12 YEARS	18.3±3.3	20	10-25		
F - analysis of variance test value					

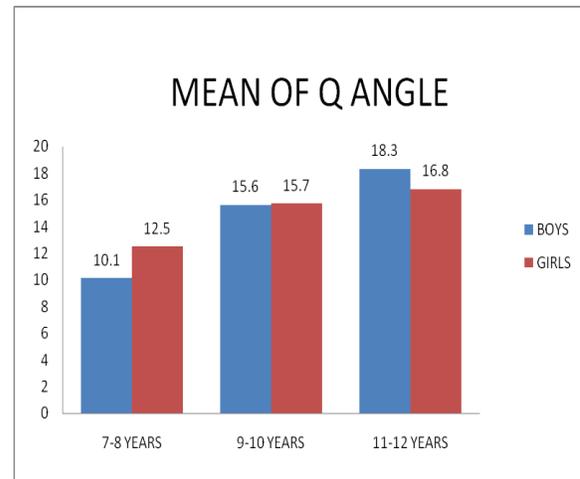
Table 4: Descriptive Statistics (in Degrees) of Q Angles for each Age Group (Girls)

GROUPS	GIRLS				
	MEAN±SD	MEDIAN	RANGE	F	Sig.
7-8 YEARS	12.5±2.6	12.5	10-15	37.484	.000
9-10 YEARS	15.7±3.4	15	10-20		
11-12 YEARS	16.8±3.0	15	10-25		
F - analysis of variance test value					

Figures/Photographs:



Graph 1: Mean Q angle of boys and girls



Graph 2: Mean Q angle of boys and girls in each age group

For the children aged 7–8, the values of Q angle have been measured was  $10.1 \pm 0.9$  degrees in boys, while in girls it was  $12.5 \pm 2.6$  degrees. For the ages 9–10, the values were  $15.6 \pm 4.5$  degrees in boys, while in girls it was  $15.7 \pm 3.4$ . For the ages 11–12, the values of Q angle was  $18.3 \pm 3.3$  degrees in boys, while in girls it was  $16.8 \pm 3$ .

The 3 way ANOVA was used to evaluate correlation between Q angle values and age. The test values shows there was significant correlation between the two, i.e. as age increases there was increase in Q angle in both groups: boys and girls. Descriptive Statistics of Q Angles for each Age Group are shown for Boys in Table 3, and for Girls in Table 4.

There has been no significant difference in Q angle between boys and girls. As children were growing up Q angle was increasing in both the sexes.

## DISCUSSION

The result of this study showed that there was no significant difference in q angle value between boys and girls and there was positive correlation between age and Q angle values in both sexes.

The Q angle has been related to knee problems such as patellofemoral pain syndrome, patellar dislocation and so forth and may contribute to the indication of a need for knee surgery. [6-10,11,11] Twenty-five to thirty percent of all knee injuries during running, occurring at the patellofemoral joint, [12] has led some authors to suggest that the alignment/orientation of the thigh, leg and foot may predispose individuals to patella femoral pain. [9, 13-15] Dislocation of the patella is a common disorder leading to considerable morbidity in young individuals. [6,16] Representing 0.4% of pediatric emergency admissions to surgical wards, annual incidence rates of 43/100,000 in

children under 16 years and 107/100,000 in the age group 9-15 have been reported. [16] Smaller Q angles have been found in both habitual and traumatic dislocating knees in comparison with healthy knees. [6] The increase of Q angle values has been shown to shift the patella laterally and rotate it medially, increasing lateral patellofemoral contact pressures. [17] A significant association between Q angle and quadriceps strength has been stated. [18] Though numerous studies on the Q angle have been conducted worldwide, relatively few of them have focused on Q angle in children population.

It must be noted that measurement of Q angle was made having the children in supine position, the feet in neutral rotation and the quadriceps relaxed. It is important that the position of the children and their lower limb, and the degree of contraction of the quadriceps are taken into account when comparisons were made. Q angle should be measured in the standing position, as it depicts the functional position of the lower limb. [19] (The present study was done with the subjects in a supine position to enable accurate comparison with the previous similar study). [5]

The degree of contraction of the quadriceps is especially important in determining the location of the CP, which in turn could influence the value of the Q angle. Contraction of the quadriceps causes a decrease in the Q angle in the supine or standing position by causing an upward and lateral movement of the patella. [19] A disadvantage of measuring the Q angle with the quadriceps contracted is that the varying strength of the quadriceps in the subjects would cause variable positioning of the CP. Thus, it would be difficult to make precise comparisons between the subjects. [20]

The results of present study establish  $15.7 \pm 4.0$  degrees as the mean Q angle for the population sample. This mean value

differs by 4.2 degrees from the value attributed by N.Markeas et al. [3] and by 2.3 degrees from the value found for sedentary subjects between 9-19 years of age group by Bulent Bayraktar et al. [21] These difference may be attributed to the difference in the sample size, and for the later study may be due to change in age group criterion of sample selected.

In addition to establishing this value for normal Q angles, the results of this study establish an average of  $15.7 \pm 4.6$  degrees for boys and  $15.8 \pm 3.4$  degrees for girls. From statistical analysis it was found that there was no statistically significant difference in Q angle values between boys and girls. These findings were in accordance with the study done by N.Markeas et al, [3] in which they have stated that there has been no difference in value of Q angle between boys and girls in both lower limbs in all ages. Findings of another study done on, Quadriceps Angle in Children with and without Pes Planus, [2] was also in accordance with present study.

In the present study, according to the analysis done on different age groups, For the children aged 7–8, the values of Q angle have been measured was  $10.1 \pm 0.9$  degrees in boys, while in girls it was  $12.5 \pm 2.6$  degrees. For the ages 9–10, the values were  $15.6 \pm 4.5$  degrees in boys, while in girls they were  $15.7 \pm 3.4$ . For the ages 11–12, the values of Q angle was  $18.3 \pm 3.3$  degrees in boys, while in girls they were  $16.8 \pm 3$ . According to these findings in the children aged between 7-12 years, as children were growing up Q angle was increasing in both the sexes. This finding of present study is partially in accordance with N.Markeas et al, [3] as in their study there was increase in Q angle with increasing age only in girls, not in boys. Another study done by Bulent Bayraktar et al [21] on Change of quadriceps angle values with age and activity, found out that the Q angle values of both subgroups

(active and sedentary) for both knees showed a negative association with age, and they have justified their finding on the fact that high strength and tonus of the quadriceps muscle tend to straighten the angle, with increase in age, Quadriceps strength increases. A study done by Shultz et al [22] also have findings for Q angle in variance to the present study. The reason for the variance may be because of difference in age group criteria in sample selected in the studies.

The Quadriceps angle (Q angle) is an important determinant of knee health. [2] The values of Q angle documented by various researchers in literature vary, Normal values of the Q angle have been reported and accepted by clinicians, but there was no consensus on the reference values, and most of the study subjects were adults. The Q angles exceeding 15 degree in men and 20 degree in women are considered abnormal for adults, [21] others have suggested that values as low as 10 degrees are problematic. These data were mainly obtained from young adult and adult populations, [2] which will be helpful to diagnose abnormality in adult population. As equally there is a need for establishing normal values of Q angle for children population. And present study contributes to this by establishing normative values for Q angle in children population so, by knowing normal values and ranges, clinicians can legitimately define and recognize abnormal values.

The major limiting factor in present study was smaller sample size, so future study can be done by taking a larger sample.

In present study gender variation for Q angle was studied but bilateral variation was not, so further study can be done to study bilateral variability for Q angle.

## CONCLUSION

In Conclusion of the present study, normative value of Q angle in children aged

between 7-12 years in Jamnagar was, for boys:  $15.7 \pm 4$  degrees, and for girls:  $15.8 \pm 3.4$  degrees. There was no significant difference in Q angle value between boys and girls. And with increase in the age there is significant increase in values of Q angle in children of both the sexes.

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