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## ASSOCIATION OF Q ANGLE ALTERATIONS AND KNEE PAIN IN HOUSEMAID WORKERS

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### Abstract

**Background:** Work related musculoskeletal disorders were previously known as repetitive strain injuries or cumulative trauma disorders <sup>(2)</sup>. These disorders mainly affect the back, lower limb, upper limb and cervical regions. The musculoskeletal disorders are a result of various factors such as repetition, force and awkward postures. The knee joint is a complex synovial joint and is known to be the longest bony lever arm <sup>(12)</sup>. It is capable of transmitting big amounts of load throughout the body <sup>(11)</sup>. The extensor mechanism which consists of patellofemoral joint, quadriceps tendon and the muscle group reinforces the anterior knee joint. The normal range of Q angle in females is 15 degrees to 20 degree and is greater than males as females have a broad pelvic width <sup>(7)</sup>. According to previous studies a Q angle of 20 degree to 22 degree is supposed to be the predisposing factor to anterior knee pain <sup>(7)</sup>. If the Q angle is greater than it increases the lateralization of force on patella which increases the retro patellar pressure between the lateral femoral condyle and lateral facet of the patella.

**Methodology:** 64 housemaid workers were participated in this study. They were given consent form and their knee pain was taken using NPRS and Q angle was measured.

**Result:** The knee pain and Q angle are significantly correlated with each other. Correlation coefficient R-value for NPRS Right and Q angle right has been recorded as 0.511 which is statistically significant at 5% level with linear association.

**Conclusion:** The study concluded that there is association between altered Q angle and knee pain in housemaid workers.

**Keywords:** NPRS, Q angle, Housemaid workers, Knee pain, Patella, Quadriceps muscle, Musculoskeletal disorders.



## 1.INTRODUCTION

Working condition of the people lead to problems work related physical disorders which in turn lead to reduced working efficiency<sup>(1)</sup>. Work related musculoskeletal disorders were previously known as repetitive strain injuries or cumulative trauma disorders<sup>(2)</sup>. These disorders mainly affect the back, lower limb, upper limb and cervical regions. The musculoskeletal disorders are a result of various factors such as repetition, force and awkward postures. Risk factors for the injuries include kneeling/squatting, climbing stairs frequently, heavy lifting, sitting in an uncomfortable position for long periods of time<sup>(2)</sup>. An increase in Q angle is a risk factor for many musculoskeletal injuries and disorders such as patellofemoral pain, patellar dislocation, osteoarthritis of knee, injuries due to overuse, ligament injury, patellar instability<sup>(2)</sup>.

Other factors which contribute to the work-related musculoskeletal disorders are workplace or environmental factor, excessive working duration, taking inadequate breaks and other psychosocial workplace factors<sup>(3)</sup>.

A large number of women populations in India work as housemaids mainly due to their low socioeconomic status<sup>(4)</sup>. They often work 12-14 hours daily and are required to carry out extensive household work<sup>(4)</sup>. One of the most important health related problems are work related musculoskeletal disorders causing disability.

Studies have showed that the workers during the day do not take sufficient number of breaks which further aggravate their pain<sup>(4)</sup>. Housemaid workers carry out different activities that range from cutting vegetables to washing clothes, cleaning the floor or carpet in the kneeling position<sup>(4)</sup>.

The knee joint is a complex synovial joint. The knee joint is known to the longest bony lever arm<sup>(5)</sup>. It is capable of transmitting big amounts of load throughout the body<sup>(5)</sup>. The extensor mechanism which consists of patellofemoral joint, quadriceps tendon and the muscle group reinforces the anterior knee joint<sup>(5)</sup>. All these structures work together to support and stabilize the knee and the power knee extension which are important for the daily activities<sup>(5)</sup>. It is involved 50% in musculoskeletal injuries and dysfunction. Q angle is the index of vector of two component I.e., the extensor mechanism and the patellar tendon<sup>(5)</sup>. Previous studies have shown that pelvic position, hip rotation, tibial torsion, patella position and foot position are a composite measure of the Q angle. The Q angle may be altered with increase in anterior pelvic tilt, femoral anteversion, knee valgus, external tibia rotation<sup>(5)</sup>. The most reliable and necessary factor the knee joint and knee pain is Q angle<sup>(6)</sup>. It is mostly used for the evaluation of knee pain and more frequently the patellofemoral pain<sup>(6)</sup>. The Q angle is the angle formed by intersecting lines i.e., from anterior superior iliac spine to centre of patella and the other from tibial tuberosity to the centre of patella.<sup>(6)</sup>



Prevalence of knee pain in work related disorder in females was seen 80.36% with right knee the percentage was 68.9% and left knee pain 75.6% <sup>(8)</sup>. The normal range of Q angle in females is 15 degrees to 20 degree and is greater than males as females have a broad pelvic width <sup>(9)</sup>. According to previous studies a Q angle of 20 degree to 22 degree is supposed to be the predisposing factor to anterior knee pain <sup>(9)</sup>. If the Q angle is greater than it increases the lateralization of force on patella which increases the retro patellar pressure between the lateral femoral condyle and lateral facet of the patella. The Q angle affects the static alignment of the lower extremity.

The knee joint has higher concurrence of injury as it is designed in a way for rapid action<sup>(11)</sup>. The knee joint not only works in simple motions like going in flexion from full extension but it also works in small movements of rotation, tilt and glide <sup>(11)</sup>. An increase in the Q angle is said to be an indication of the misalignment of the extensor mechanism, patellar instability and patellofemoral pain syndrome <sup>(12)</sup>.

Another common musculoskeletal complaint is anterior knee pain which contributes to functional limitation in all age group <sup>(13)</sup>. This anterior knee pain has symptoms that can affect on a persons function, quality of life and overall health <sup>(13)</sup>. Further clinical findings that are associated with anterior knee pain are hyper or hypo mobility, foot over pronation, impaired quadriceps or hip muscle activity, dynamic knee valgus, chondral lesions, impaired activity of anterior-lateral thigh soft tissues, tendon reactivity, synovial bursae and other fear- avoidance beliefs <sup>(13)</sup>.



## 2.METHDOLOGY:

2.1 Study design – correlation study

2.2 Sample size – 64

2.3 Study set up – Agencies who provide housemaids.

2.4 Sampling method – simple random sampling.

2.5 Study duration - 6 months

Ethical committee clearance was approved by the institutional ethical committee. 64 Participants were selected based on the inclusion and exclusion criteria. The subjects were given the consent form. All the procedure was explained to them. Their pain intensity was taken from numerical pain rating scale. Their demographic data and the history of their work and pain was taken. The Q angle was then taken by the goniometer. The Q angle measurement will be then noted down for the result purpose.

Patient position: supine lying

Therapist position: besides the knee to be tested.

Placement: Proximal arm along the line taken from ASIS to centre of patella. Distal arm along the line taken from centre of patella to tibial tubercule.

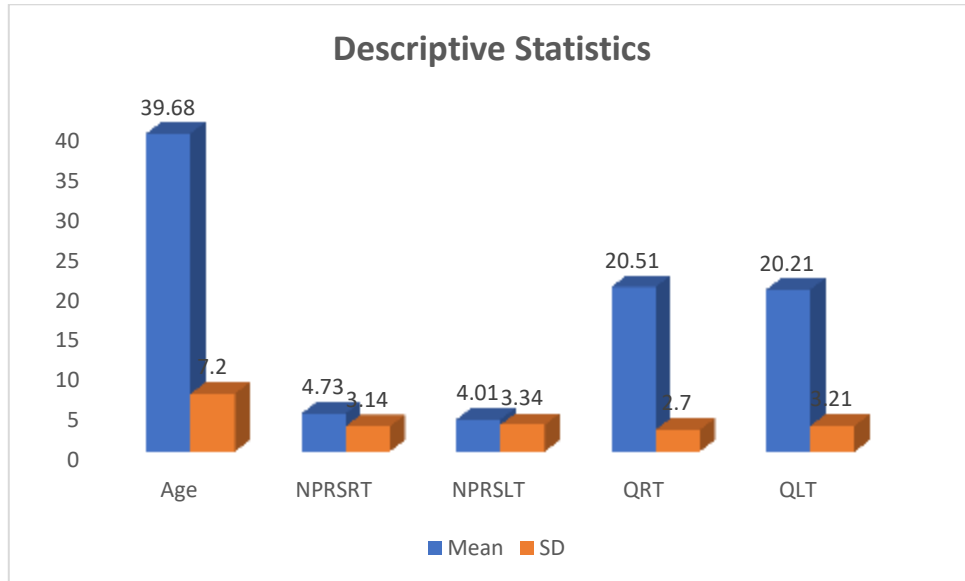
The angle formed by the intersection of two lines is taken as measurement for the Q angle and noted down.



Fig 1. While taking Q angle using Goniometer

### 3.Result

The study showed that there was significant change in Q angle in housemaid workers with their knee pain. The correlation between age and NPRS for right knee was significant with r-value 0.282 and p-value 0.024. The remaining correlation between age and NPRS for left knee and Q angle of right knee and left knee was found to be non significant. There was significant correlation between the NPRS of right knee and NPRS of left knee. Similarly, there was a significant correlation between Q angle of right knee to Q angle of left knee. The study showed that there was significant correlation between the Q angle of right knee to NPRS of right knee with r-value of 0.511 and p-value of 0.001 and also between the Q angle of left knee to NPRS of left knee with r-value of 0.492 and p-value of 0.001. it showed that they are highly significant with each other.



Graph 1: Mean and SD values for Age, NPRS and Q angle in Right and Left knee

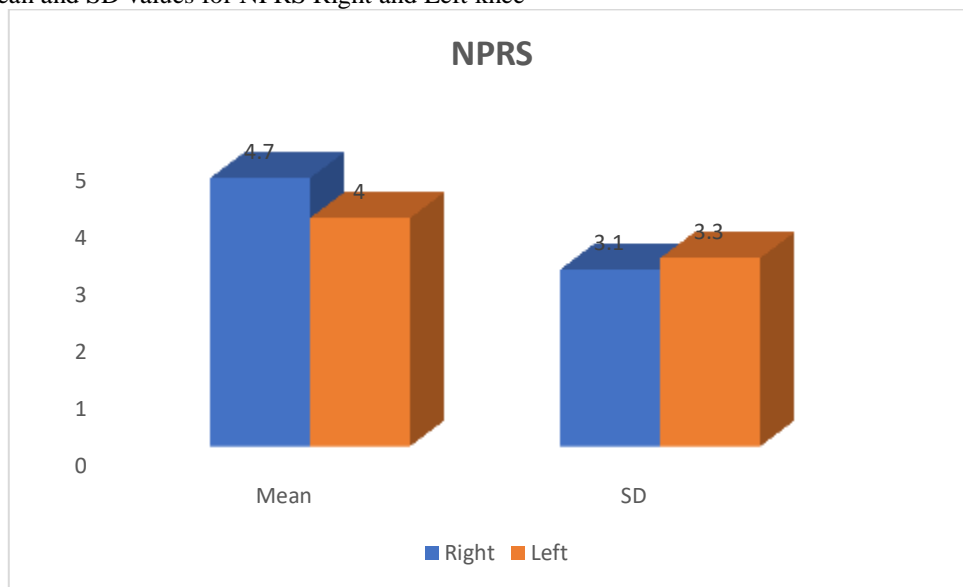
Interpretation: The above graph concludes the mean and SD values for the age, NPRS of their knee pain and the Q angle of the respective knee. The mean value for age is 39.68 and the SD for the same is 7.2. The mean value for NPRS right knee is 4.73 and SD is 3.14 and for left knee the mean value is 4.01 and SD is 3.34. The mean value for Q angle of right knee is 20.51 and SD is 2.7 and for left knee the mean value is 20.21 and SD is 3.21.



Side	Mean	SD	t-value	p-value
Right	4.7	3.1	1.219	0.225
Left	4.0	3.3		

Independent sample test for NPRS

Table 2: Mean and SD values for NPRS Right and Left knee



Graph 2: Mean values and SD values for Right and Left NPRS

Interpretation: The above graph shows the values of mean and SD for NPRS of right and left knee. The mean value for right knee is 4.7 and SD is 3.1 and for left knee the mean value is 4 and SD is 3.3

Side	Mean	SD	t-value	p-value
Right	20.51	2.70	0.572	0.568
Left	20.21	3.21		

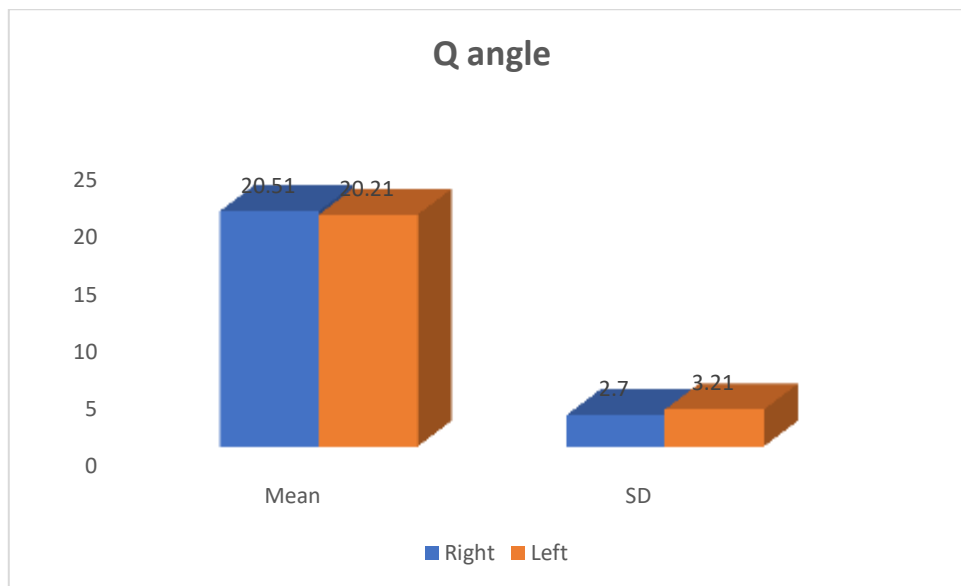
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Independent sample test for Q angle

Table 3: Mean and SD values for Right and Left Q angle



Graph 3: Mean and SD values for Right and Left Q angles

Interpretation: The above graph shows the individual mean and SD values for Q angle of right and left knee. The mean value for right knee is 20.51 and SD is 2.7 and for left knee the mean value is 20.21 and SD is 3.21

Karl Pearson Correlation Analysis

Variable X	Variable Y	r-value	p-value	Result
NPRS Right	NPRS Left	-0.376	0.002*	Significant at 5% Non-Linear association

Table 5: Correlation between NPRS of right and left knee

Correlation coefficient r-value for NPRS Right and NPRS Left has been recorded as -0.376 which is statistically significant at 5% level with non-linear association.

Karl Pearson Correlation Analysis

Variable X	Variable Y	r-value	p-value	Result
Q angle right	Q angle Left	0.654	0.001*	Significant at 5% Linear association





**Table 6: Correlation between Q angle of right and left knee**

Correlation coefficient r-value for NPRS Right and NPRS Left has been recorded as 0.654 which is statistically significant at 5% level with linear association.

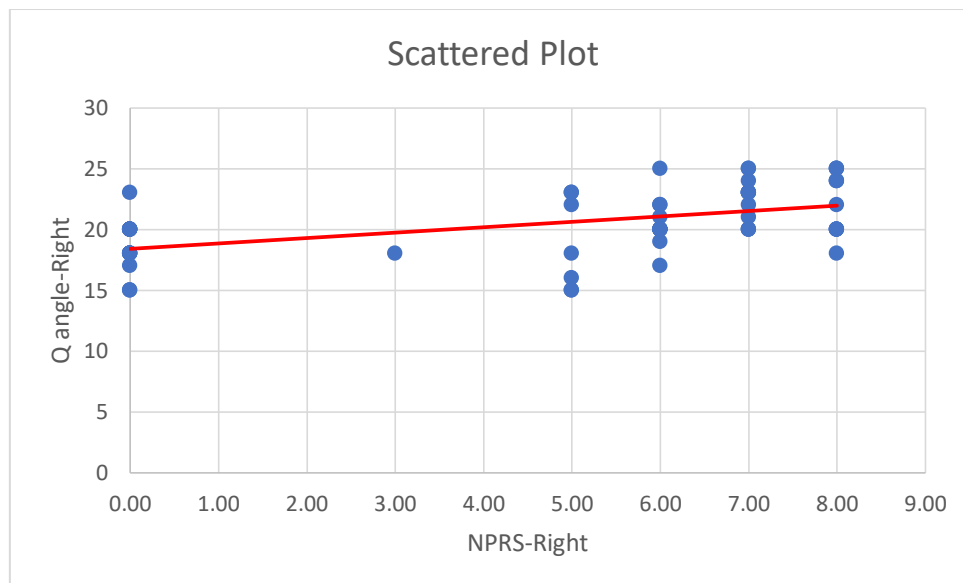
Karl Pearson Correlation Analysis

Variable X	Variable Y	r-value	p-value	Result
NPRS Right	Q angle right	0.511	0.001	Significant at 5% Linear association
NPRS Left	Q angle Left	0.492	0.001	Significant at 5% Linear association

Table 7: Correlation between NPRS and Q angle of Right and left knee

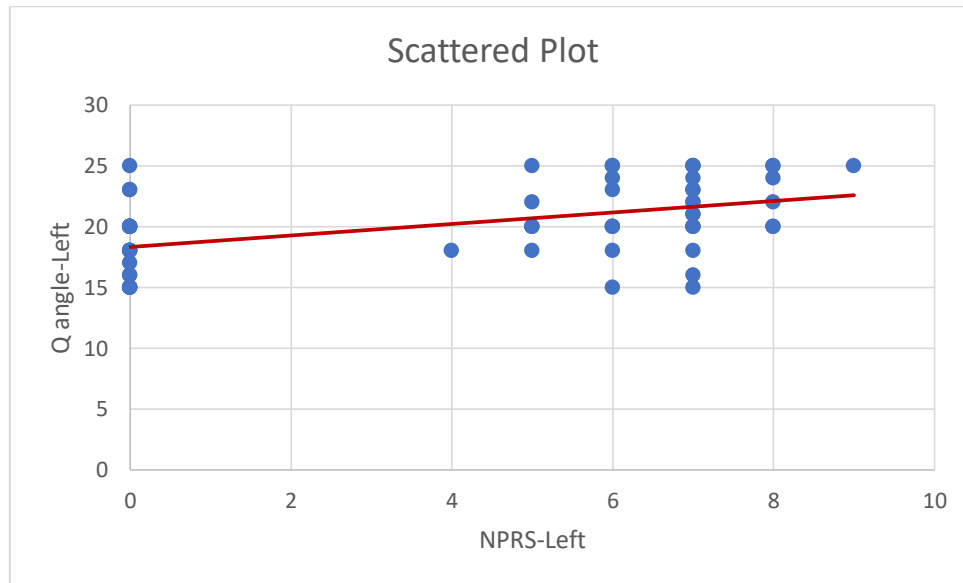
Correlation coefficient r-value for NPRS Right and Q angle right has been recorded as 0.511 which is statistically significant at 5% level with linear association.

Correlation coefficient r-value for NPRS left and Q angle left has been recorded as 0.492 which is statistically significant at 5% level with linear association.



Graph 5: Correlation between NPRS of Right knee and Q angle of Right knee

Interpretation:



Graph 6: Correlation of between NPRS of Right knee and angle of Left knee  
Interpretation:

#### 4. Discussion

The Q angle is the measurement between the line taken from ASIS to the tibial tubercle. Normal value of Q angle is supine position is 15-20 degrees. The position of the body and foot along with the degree of the contraction of the quadriceps muscle plays an important role in determining the Q angle. The main aim of this study was to find the association between the knee pain and Q angle in housemaid workers. In this study, the subject's position was supine lying position with feet in neutral position with quadriceps muscle in relaxed position. The subjects were asked their knee pain, type of work, no of working hours and no of breaks the taken during their working hours. Then their Q angle measurement was taken by the use of goniometer.

In previous studies, by veermani ravendranath, Shankar nachiket, et.al there was an association of knee pain and alteration in Q angle in healthy adults<sup>(12)</sup>. The study concluded that the knee pain is higher in right knee compared to the left knee and the change in the Q angle between both the knee<sup>(12)</sup>. In this study we have researched for the association of the Q angle in housemaids' workers with their knee pain. The housemaids' workers have higher



chances of having the knee pain due to their type of work, no. of working hours. The housemaids' workers sometimes work in the position which are usually not comfortable leading to more musculoskeletal discomfort.

In the present study has showed that there is significant increase in Q angle in association with their knee pain. As the knee joint is the main weight bearing joint in the body the forces acting on it during the work done by the housemaids made a significant change in the Q angle. The position in which the housemaids' workers usually work is squatting, kneeling, or bending position. The Q angle changes with the increased lateralization forces on patella. When the Q angle is measured correctly it gives us the information about the alignment of pelvis, leg and foot<sup>(14)</sup>. Therefore, in healthy and active individuals' determination of Q angle is very important<sup>(14)</sup>.

In this study there was an increase in the Q angle with the knee pain as the Q angle is formed by the combined pull of Quadriceps femoris muscle and the patellar tendon and it exerts a lateral pull to the patella. An increased Q angle can be harmful as the increased lateral force on the patella can in turn lead to the compression of the lateral patella on the lateral lip of the femoral sulcus<sup>(14)</sup>. The patella sometimes may actually dislocate over the femoral sulcus in the presence of great enough lateral force when the quadriceps muscle is activated on the extended knee<sup>(14)</sup>. The Q angle effect describes a force by quadriceps vastus medialis oblique applies more force to narrow down the Q angle<sup>(15)</sup>. The increase in Q angle further leads to more lateral tracking of patella and to correct this situation the VMO also has to apply a greater force<sup>(15)</sup>.

It is seen that there is an increased incidence of knee joint disorders in the women who have the genu valgum deformity<sup>(16)</sup>. In women, there is an increased Q angle due to their wider pelvis due to which their ASIS is placed farther from the patellar midline<sup>(17)</sup>. The Q angle is also found to be greater in genu valgum postural diction, this is known as knock knees<sup>(17)</sup>. It's difficult to alter the angle with aloe soft tissue work while determining the Q angle as certain aspects of the bony structure such as wide pelvis<sup>(17)</sup>. Imbalance in between the muscles vastus lateralis and vastus medialis muscles leads to patellar tracking disorders<sup>(17)</sup>. When there is tightness in vastus lateralis muscle it pulls the patella farther into the lateral direction and this most commonly occurs in people with greater Q angle<sup>(17)</sup>.

In the present study, the housemaid workers are experiencing the knee pain as they work in squatting, kneeling or bending position which may cause to experience knee pain. Recent studies suggested that during the patellofemoral joint, kinematics can be different while performing the weight bearing joints<sup>(18)</sup>. Dynamic magnetic resonance imaging technique were used to compare the joint kinematics during the weight bearing and non weight bearing activities. It was seen that during the non weight bearing activities the patella was tilted and placed laterally to the fixed femur. While during the weight bearing activities the lateral patellar tilt along with the displacement occurred due to the internal rotation of femur which was placed under the stable patella. This suggested that as the femur moved with the patella it is attached to the tibia via the quadriceps tendon. During the weight bearing when



the quadriceps contracts causing the patella to comparatively stable tibia which allows the femur to move with the extensor mechanism<sup>(20)</sup>.

In the present study it was found that knee pain and Q angle are statistically significant and are associated with each other. In a study done by Jayeeta roy, et.al it was said that an increase in Q angle will put more lateral pull on quadriceps femoris muscle which leads to patellofemoral disorders which shows a better connection between Q angle and knee pain. The knee pain and Q angle is more significant in right knee than in left knee. It was found in the previous study that the more dominant side of the body works more accurately than the non-dominant side of the body<sup>(18)</sup>. As in this study the women participated had mostly their right side dominant, the right lower limb was more affected than the left lower limb. It shows that both the variables are in a direct relationship with each other for both the knees. This shows evidence that the Q angle changes are associated with their knee pain and higher their pain the more altered are their Q angle. In addition, it also showed the relationship between age and knee pain and it was slight significant for right knee (0.282-0.024) and for left knee it was poor correlation (0.151-0.232). It also showed poor correlation between age and Q angle for both right and left knee (0.0941-0.461) (0.002-0.986).

## 5. Conclusion

This study concluded that there is significant correlation between the Q angle and the knee pain in housemaid workers. The Q angle measured by the goniometer was altered in most of the housemaid workers. The deviation seen was more in right knee than in left knee. The more altered Q angle the higher was their knee pain. The study also concluded that there was high value of knee pain in right knee than in left knee.



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