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*Research Article*

# Prevalence of Anterior Knee Pain in Long Standing Professionals

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**ABSTRACT:**
**INTRODUCTION:** Anterior knee pain is one of the most occurring issues in individuals, involving in physical activity. There are various factors that direct towards the anterior knee discomfort. In the view of its pathophysiology, a result of overuse should be considered when the structural unit of the tissue is impaired or its capacity to repair itself is surpassed.
**AIM:** To study the prevalence of anterior knee pain in long standing professionals
**METHODOLOGY:** Allocation of questionnaire was done to 206 participants in Karad city. An overview on the prevalence of anterior knee discomfort in long-tenured professionals was obtained.
**RESULT:** There were a total of 206 responses , collected from the questionnaire. The participants included, were in the age groups of 30 to 50 years . Both male and female participants were included.
**CONCLUSION:** Considering anterior knee pain in persons with long-standing professions may prevent other difficulties that might compound the condition and produce a significant misalignment. Individuals who work long hours typically report knee discomfort, and this study used the anterior knee pain scale as an initial screening tool to identify the key indication of multiple knee/patella disorders. Further problems can be prevented by properly treating the pain and preventing it from worsening.

**KEYWORDS:** Anterior knee pain , long-standing professionals , prevalence.

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## INTRODUCTION

Of the most prevalent knee issues among those who engage in physical activity is anterior knee pain. Patellar malalignment during knee joint flexion and extension has been proposed as a multifactorial cause of anterior knee discomfort, together with extensor mechanism disorders and patella abnormalities. Due to the patients' diverse presentations of signs and clinical findings, an intensive clinical evaluation is essential for the best course of care. One of the most prevalent musculoskeletal issues affecting the knee is anterior knee discomfort. [1,13, 14, 15]

The odd syndrome is caused by the multitude of different diagnoses; the only commonality is an occurrence of retro or peripatellar pain that is exacerbated by a single activity which loads the joint in flexion. Patho-physiologically speaking, an overuse injury should be taken into consideration when the tissue's structural unit is compromised or its ability to reparative response is exceeded.[2]

Even though the illness is highly prevalent, the cause is still up for debate. Furthermore, there isn't a strong correlation between objective variables and subjective reports of discomfort and painful sensations.[3]
Thus, there are a number of subpopulations of patients with anterior knee discomfort. Our therapeutic goals for the interdisciplinary management of anterior knee pain must address the two components: pelvic-femoral dysfunction and psychological issues (such as anxiety and depression). Depression and anxiety are highly correlated with the intensity of anterior knee pain.[4,9]
The patellofemoral joint's anatomy and biomechanics are intricate, and the symptoms are frequently nonspecific. Overuse and recurrent minor trauma are the most common

causes of anterior knee pain; the patella and quadriceps muscles tendon have also been linked to this condition. The sudden onset traumatic and excessive use are the two main ways that anterior knee injuries occur, and most knee structures can be damaged by both. [5] According to a recent study, anterior knee discomfort affecting the patella and retinaculum which rules out other intra-articular and peripatellar pathologies is known as patellofemoral pain syndrome. [23]

The most substantial sesamoid bone within the human skeleton is the patella, which has the thickest joint cartilage on its underside.

Between the ages of 4 and 6 is when primary ossified of the patella often starts.

The patella serves three main purposes.

1. It lengthens the quadriceps mechanism's lever arm
2. It shields the front part of the knee
3. It improves the lower limb's cosmesis Stability and strength are necessary for normal joint dysfunction [12,10] incorporating the bone, periarticular tissues, and synovium [11]

Four layers can be used to systematically approach the anatomy and pathology of the anterior knee: (a) the superficial layer, which consists of fat, fascia, and bursae; (b) the functional layer, which is made up of the patellar stabilizers and extensor mechanism; (c) the intracapsular extra synovial layer, which contains the fat pads; and (d) the intra-articular layer. The delicate tissues that make up the superficial layer are prone to irritation, infection, and harsh and penetrating damage. The functional layer is made up of the extensor mechanism, which is involved in repetitive motions, knee extension, and patellar stabilization. Overuse problems are predominant in this layer. Together, the anterior knee fat pads are referred to as the extracapsular extra synovial layer, which serves to enhance congruence and shield the articular surfaces from damage while in motion. Fat pad diseases may be primary or subsequent to pathologic disorders in the joint as a whole. The fourth and last intra-articular layer contains the cartilage surface and synovial lining; internal derangement and arthritides are the main pathologic diseases. Conditions impacting any or all of these interconnected layers may be the cause of complaints in the anterior knee.[6]

Most patients with anterior knee pain typically have weakening of the quadriceps muscle, particularly when performing eccentric contractions.[1]

The reasons of anterior knee pain may be tracked to both internal and external factors, including limb malalignment, weakness in particular muscle groups, and ligamentous laxity. Anterior knee pain can have a negative impact on the patient's standard of life and, on a larger scale, significantly burden economies with high healthcare costs.[7]

Activities that strain the patellofemoral joint, such as stair climbing and descending, kneeling, squatting, and extended knee flexion, are typically the cause of pain. The patient typically characterizes the pain as localizing in the above-described patterns and dull, with acute episodes.

Rarely, the discomfort may be widespread and poorly localized, with the anterior side of the knee being more noticeable. When it comes to painful musculoskeletal diseases, pain intensity is sometimes highly subjective and varies.[8]

A literature has documented a number of questionnaires that are intended to assess function in people who have anterior knee discomfort and predicted that the anterior knee pain scale would be dependable and sensitive in patients having anterior knee discomfort since it had strong content validity and showed the ability to distinguish between controls and patients with pain in the anterior knee.[16,17,18,19,20,21]

This 13-item self-report questionnaire is tailored specifically for knees and tracks responses to six activities. The act of walking, running, jumping, utilizing stairs, squatting, and extended periods of sitting with the knees bent are all recorded on the anterior knee pain scale. Symptoms include limping, being unable to support weight via the limb that is affected, swells, abnormal patellar movement, loss of muscle mass, and limited knee flexion.[25] score was out of 100, and the scale's test reliability was 95%.[22]

● **MATERIALS**: -

a) Pain Assessment
b) Standardized Questionnaire
c) Consent Form

● **INCLUSION: -**

1. Both male and female genders
2. Age group between 30-50
3. Long standing professionals
4. Patients who are willing to participate

● **EXCLUSION: -**

1. History of fracture (lower limb)
2. Recent injuries
3. Neurological conditions

● **OUTCOME MEASURE: -**

1. Pain Assessment - NPRS ( Numerical Pain Rating Scale )
2. Standardized questionnaire ( Anterior Knee Pain Scale)

**METHODOLOGY:**

a. Type of study**:** - Survey study
b. Study design: - Observational study
c. Sampling method: Convenience sampling Method
d. Place of study: - Karad
e. Sample size: $n = z^2pq/L^2$

$= 1.96 \times 1.96 \times 16 \times 100\text{-}16/5^2$

$= 3.841 \times 16 \times 84/25$

$n = 206$

Where, n = sample size

Z = standard normal variant at 95% = 1.96

p = proportion of population in standing = 16%

q = 100 – 16

$L = 5^2 = 25$

$n = 206$

f. Study population: long standing professionals

**PROCEDURE**

This is an observational study of assessing the anterior knee pain in long standing professionals The study was conducted in Karad.

Certification was taken from protocol committee. Then permission was taken from authorities and ethical committee. Patients were selected according to inclusion and exclusion

criteria. Informed consent was taken and data collection was done. A structured questionnaire was circulated among the patients for data collection. Based on collected data the statistical analysis was done.

**RESULT:**

**AGE GROUP:**

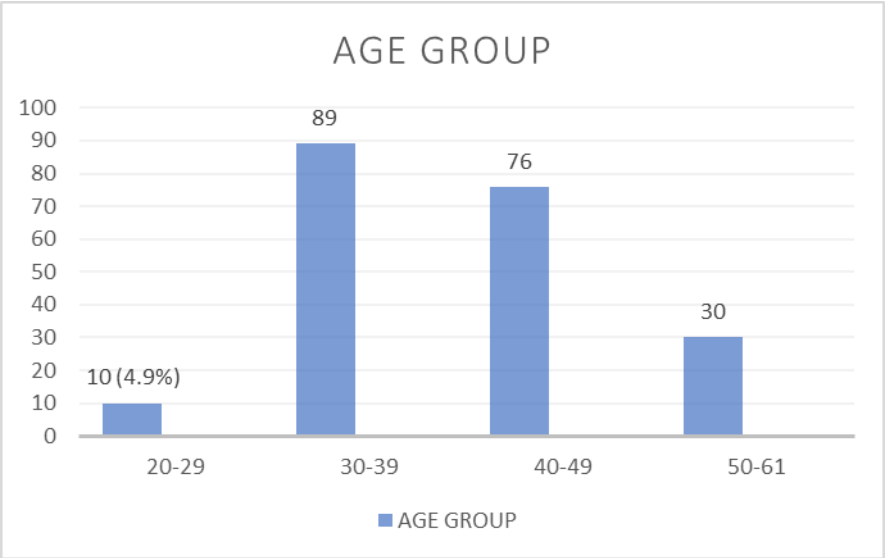



**Table no. 1**

| SR NO. | AGE (years) | PERCENTAGE | COUNT |
|---|---|---|---|
| 1. | 20-29 | 4.9% | 10 |
| 2. | 30-39 | 43.7% | 90 |
| 3. | 40-49 | 36.8% | 76 |
| 4. | 50-61 | 14.6% | 30 |

In the age group 20-29 years, there are 10 participants (4.9%); 30-39 years has 90 (43.7%); 40-49 years has 76 (36.8%); and 50-61 years has 30 (14.6%)

**2. GENDER:**

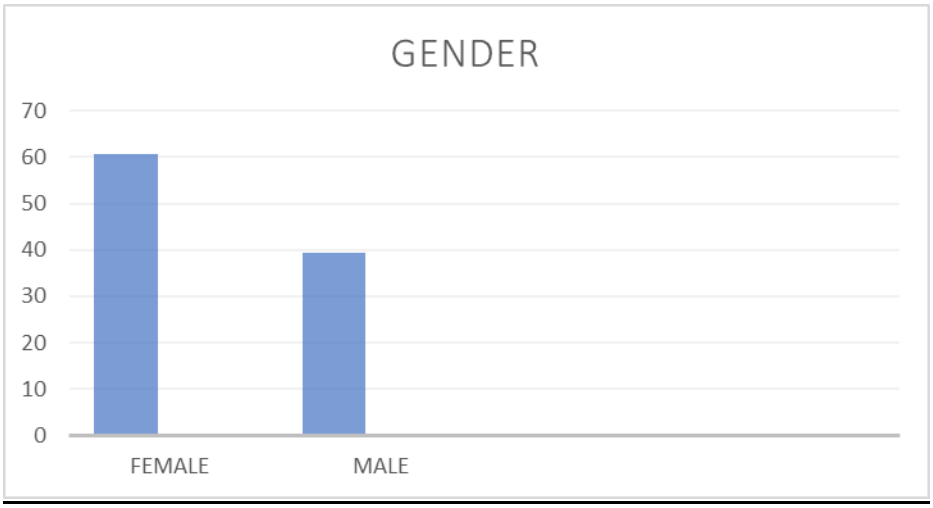


**Table no. 2**

| SR NO. | GENDER | PERCENTAGE | COUNT |
|---|---|---|---|
| 1. | FEMALE | 60.7% | 125 |
| 2. | MALE | 39.3% | 81 |

Participants: 125 (60.7%) females and 81(39.3%) males, who participated in this study.

**3. OCCUPATION:**

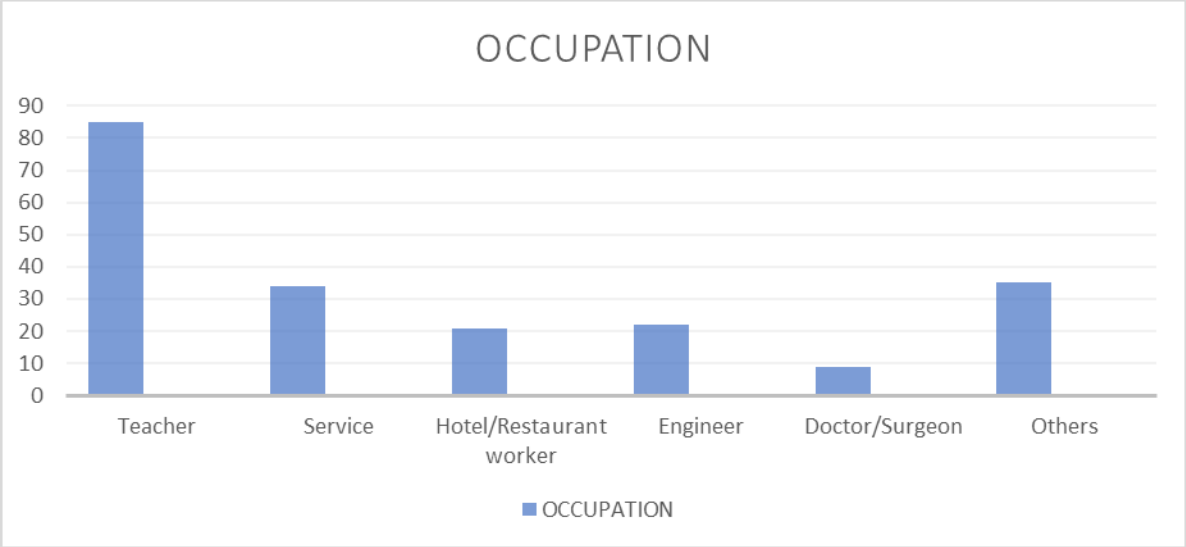



**Table no. 3**

| SR NO. | OCCUPATION | PERCENTAGE | COUNT |
|---|---|---|---|
| 1. | TEACHER | 41.2 | 85 |
| 2. | SERVICE | 16.5 | 34 |
| 3. | HOTEL/RESTAURANT WORKER | 10.3 | 21 |
| 4. | ENGINEER | 10.7 | 22 |
| 5. | DOCTOR/SURGEON | 4.4 | 9 |
| 6. | OTHERS | 16.9 | 35 |

The study involved 206 participants from diverse professions: Teachers (85, 41.2%), Service (34, 16.5%), Hotel staff (21, 10.3%), Engineers (22, 10.7%), Doctors (9, 4.4%), Others (35, 16.9%).

**4. BMI { BODY MASS INDEX}:**

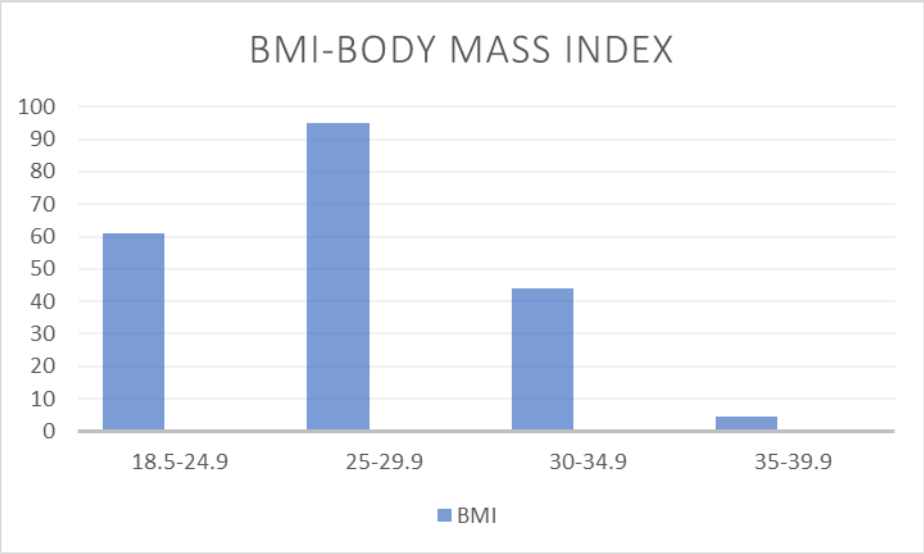



**Table no. 4**

| SR.NO | BMI | PERCENTAGE | COUNT |
|---|---|---|---|
| 1 | 18.5-24.9 | 29.6 | 61 |
| 2 | 25-29.9 | 46.1 | 95 |
| 3 | 30-34.9 | 21.4 | 44 |
| 4 | 35-39.9 | 3.0 | 6 |

The height and weight of 206 participants were measured to calculate BMI, revealing the following distribution: 18.5-24.9 (29.6%, 61), 25-29.9 (46.1%, 95), 30-34.9 (21.4%, 44), and 35-39.9 (3.0%, 6).

**5. How many hours do you work in a day.**

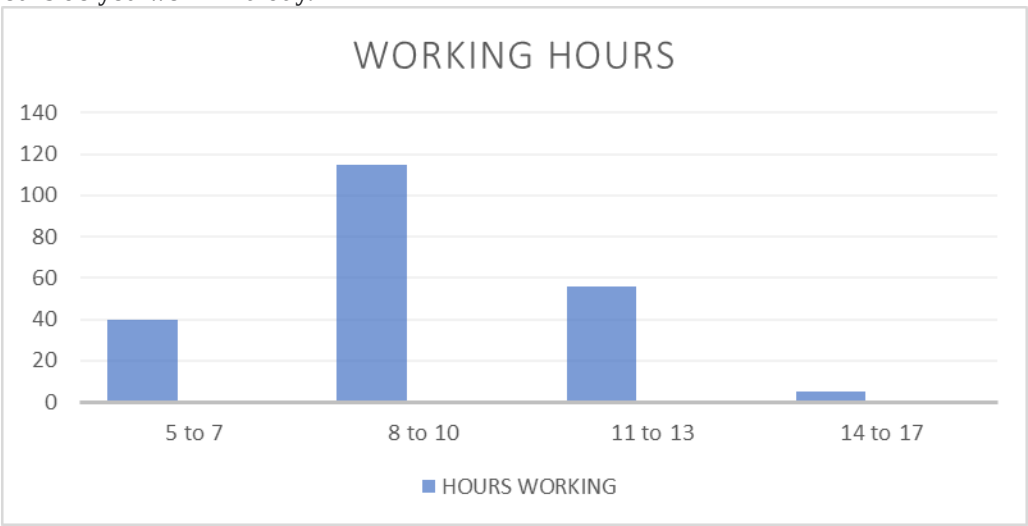



**Table no. 5**

| SR NO. | HOURS WORKING | PERCENTAGE | COUNT |
|---|---|---|---|
| 1. | 5-7 | 19.4 | 40 |
| 2. | 8-10 | 55.9 | 115 |
| 3. | 11-13 | 22.3 | 46 |
| 4. | 14-17 | 2.4 | 5 |

Participants' working hours were recorded: 5-7 hours (19.4%, 40), 8-10 hours (55.9%, 115), 11-13 hours (22.3%, 46), and 14-17 hours (2.4%, 5)

**6. How many hours do you work by standing.**

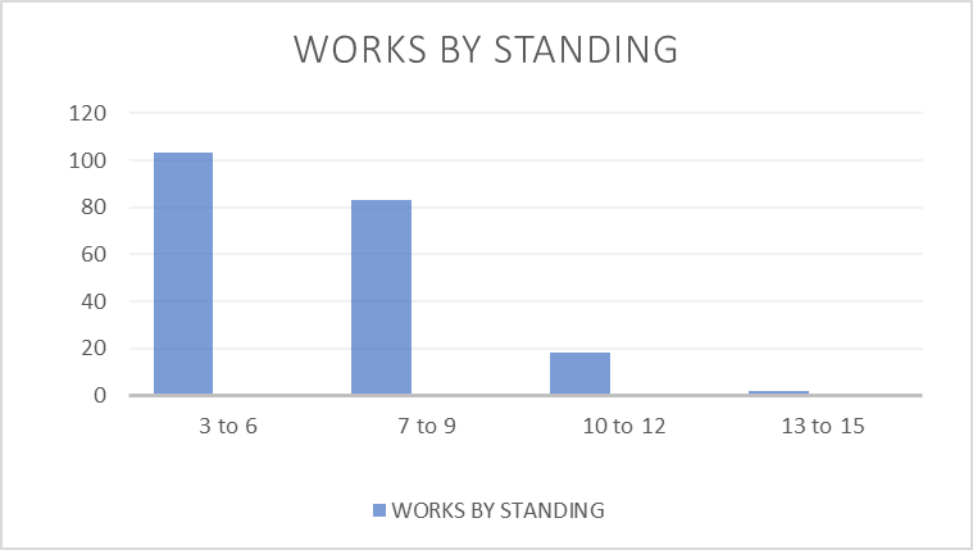
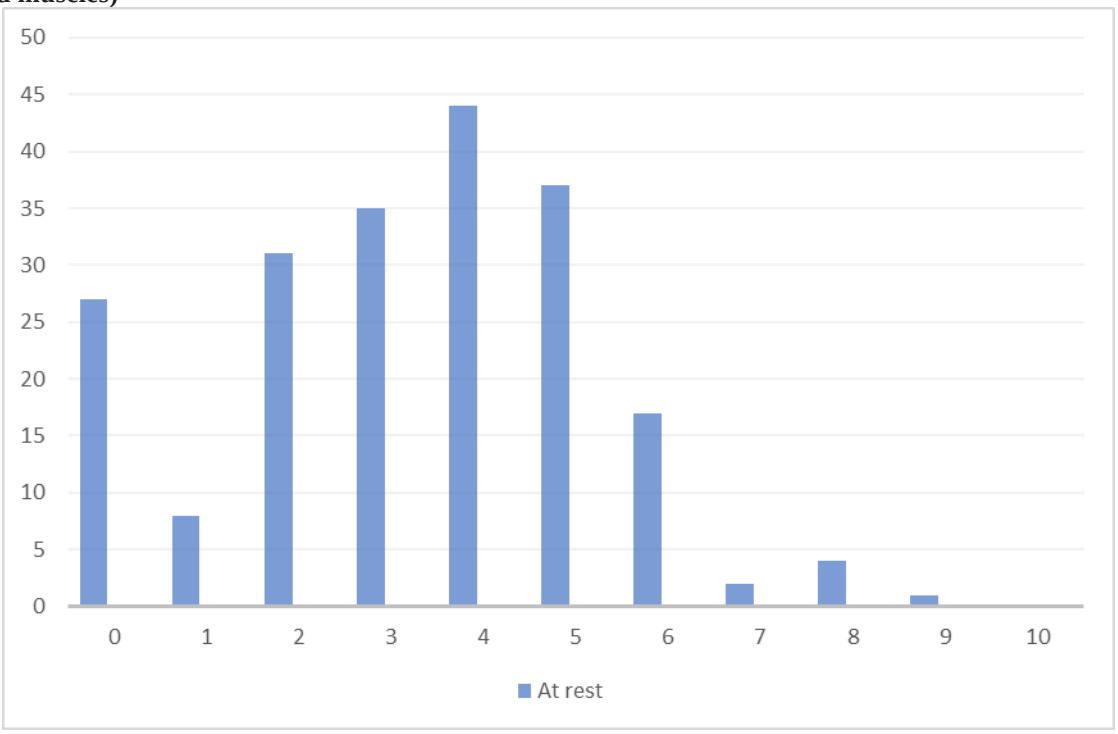



**Table no. 6**

| SR NO. | WORKS BY STANDING | PERCENTAGE | COUNT |
|---|---|---|---|
| 1. | 3-6 | 50 | 103 |
| 2. | 7-9 | 40.3 | 83 |
| 3. | 10-12 | 8.7 | 18 |
| 4. | 13-15 | 1 | 2 |

Standing work hours recorded: 3-6 hours (50%, 103), 7-9 hours (40.3%, 83), 10-12 hours (8.7%, 18), and 13-15 hours (2%, 1).

**7. Out of (0-10), how much would you like to rate your severity of pain (0 = null 10 = very severe) (pain in and around the joint and muscles)**



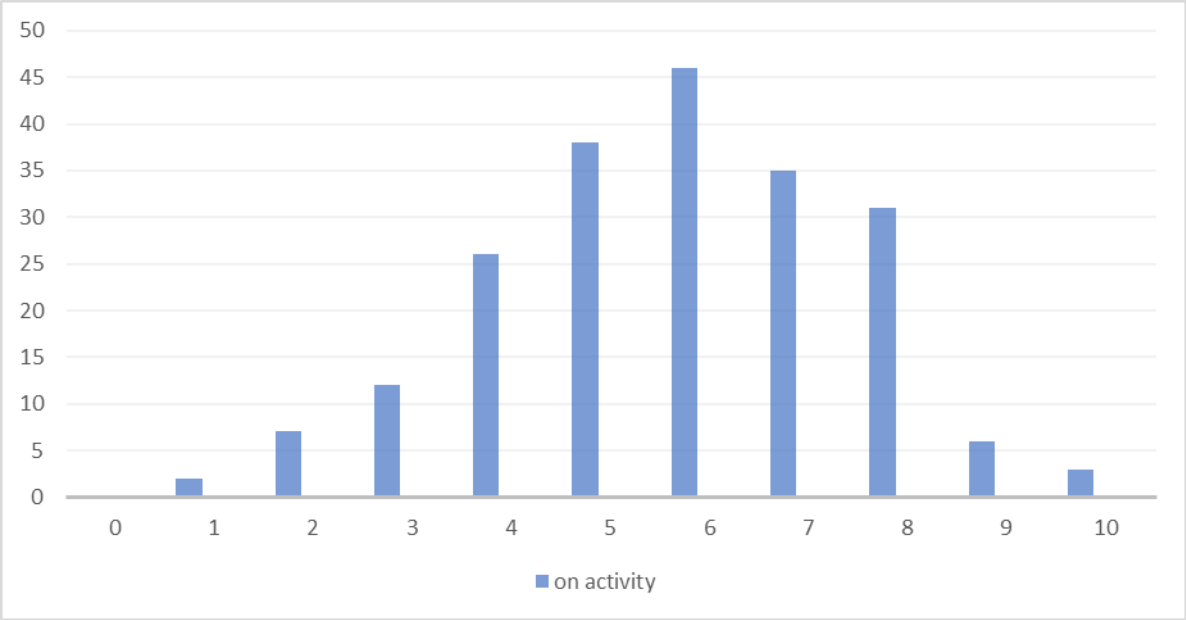



**Table no. 7**

| SR NO. | ON ACTIVITY | PERCENTAGE | COUNT |
|---|---|---|---|
| 1. | 0 | 0 | 0 |
| 2. | 1 | 1 | 2 |
| 3. | 2 | 3.4 | 7 |
| 4. | 3 | 5.8 | 12 |
| 5. | 4 | 12.6 | 26 |
| 6. | 5 | 18.4 | 38 |
| 7. | 6 | 22.3 | 46 |
| 8. | 7 | 17 | 35 |
| 9. | 8 | 15 | 31 |
| 10. | 9 | 2.9 | 6 |
| 11. | 10 | 1.5 | 3 |

| SR NO. | AT REST | PERCENTAGE | COUNT |
|---|---|---|---|
| 1. | 0 | 13.1 | 27 |
| 2. | 1 | 3.9 | 8 |
| 3. | 2 | 15 | 31 |
| 4. | 3 | 17 | 35 |
| 5. | 4 | 21.4 | 44 |
| 6. | 5 | 18 | 37 |
| 7. | 6 | 8.3 | 17 |
| 8. | 7 | 1 | 2 |
| 9. | 8 | 1.9 | 4 |
| 10. | 9 | 0.5 | 1 |
| 11. | 10 | 0 | 0 |

Pain assessment for Anterior Knee Pain was conducted using the Numerical Pain Rating Scale (NPRS), ranging from 0 (no pain) to 10 (extreme/severe pain), evaluating pain during activity and at rest.

**8. KNEE:**

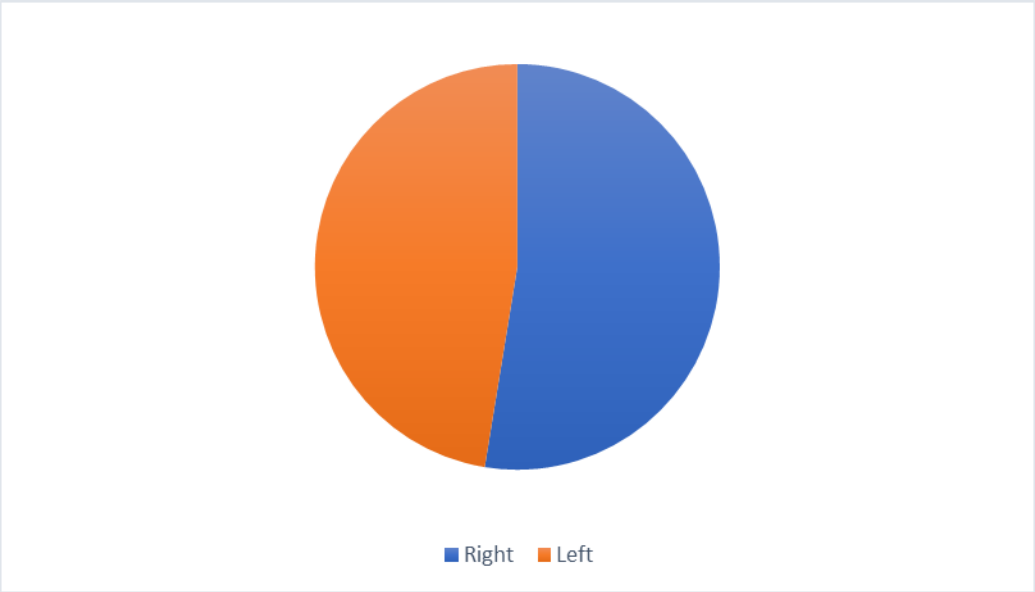



**Table no. 8**

| SR NO. | KNEE AFFECTED | PERCENTAGE | COUNT |
|---|---|---|---|
| 1. | LEFT | 67 | 138 |
| 2. | RIGHT | 74.3 | 153 |

Among 206 participants, 138 (67%) experienced left knee pain, 153 (74.3%) had right knee pain, and 85 (41.2%) reported pain in both knees.

**ANTERIOR KNEE PAIN SCALE**

**LIMP**

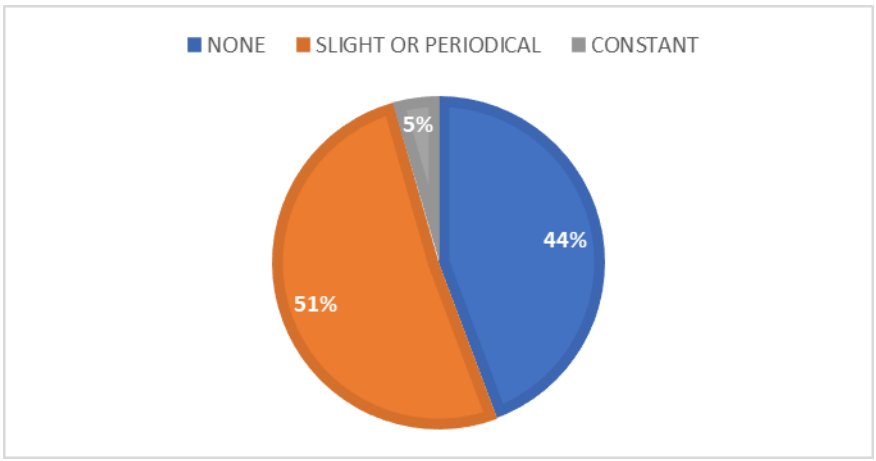



**Table no. 9**

| SR NO. | LIMP | PERCENTAGE | COUNT |
|---|---|---|---|
| 1 | NONE | 44.2 | 91 |
| 2 | SLIGHT OR PERIODICAL | 51.2 | 106 |
| 3 | CONSTANT | 4.4 | 9 |

Among 206 participants 44.2 % (91) have no limp. 51.2 % (106) participants have slight limping while walking. And 4.4% (9) had constant limp.

**SUPPORT**

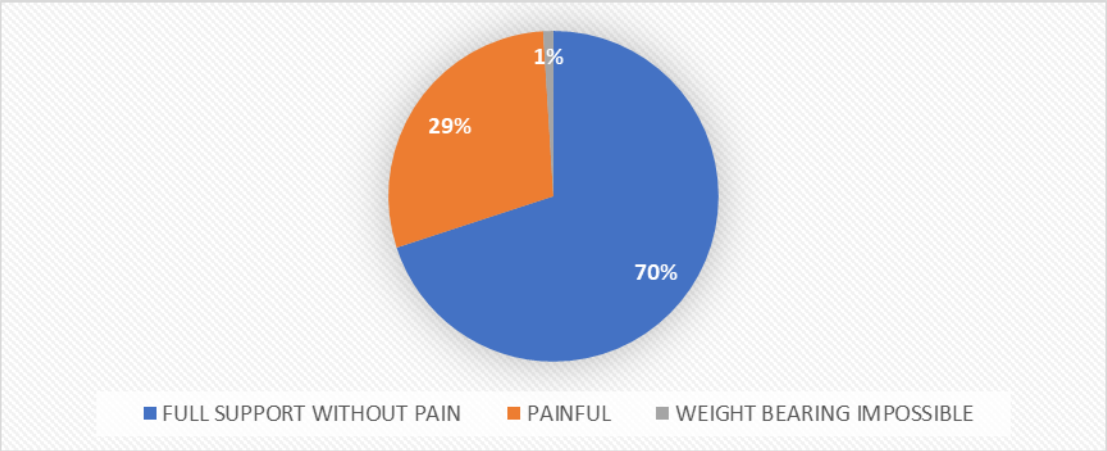



**Table no. 10**

| SR NO. | SUPPORT | PERCENTAGE | COUNT |
|---|---|---|---|
| 1. | FULL SUPPORT WITHOUT PAIN | 69.9 | 144 |
| 2. | PAINFUL | 29 | 60 |
| 3. | WEIGHT BEARING IMPOSSIBLE | 1 | 2 |

Out of 206 participants 69.9 % (144) have full support without pain. 29 % (60) have painful support and 1 % (2) have weight bearing impossible.

**WALKING**

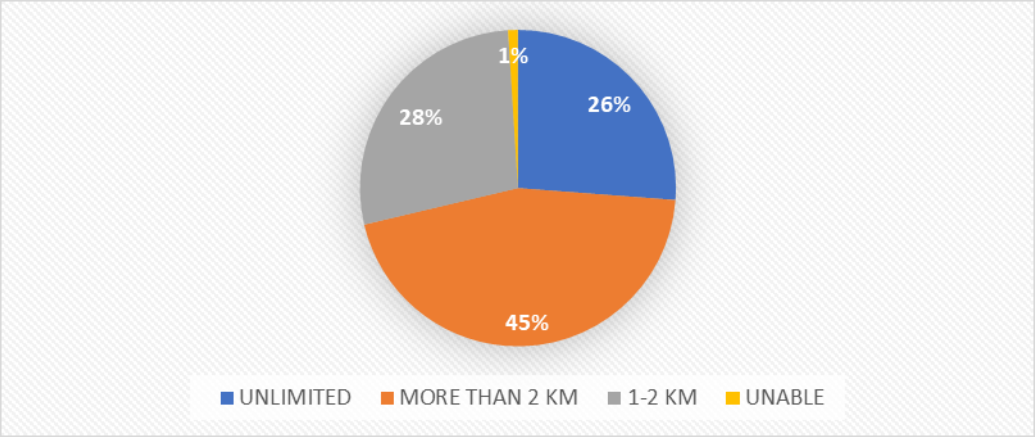



**Table no. 11**

| SR NO. | WALKING | PERCENTAGE | COUNT |
|---|---|---|---|
| 1. | UNLIMITED | 26.2 | 54 |
| 2. | MORE THAN 2KM | 45.1 | 93 |
| 3. | 1-2KM | 27.7 | 57 |
| 4. | UNABLE | 1 | 2 |

Of the 206 participants, 26.2% could walk unlimited distances, while 45.1% experienced pain walking over 2 km, and 1% were unable to walk.

**STAIRS**

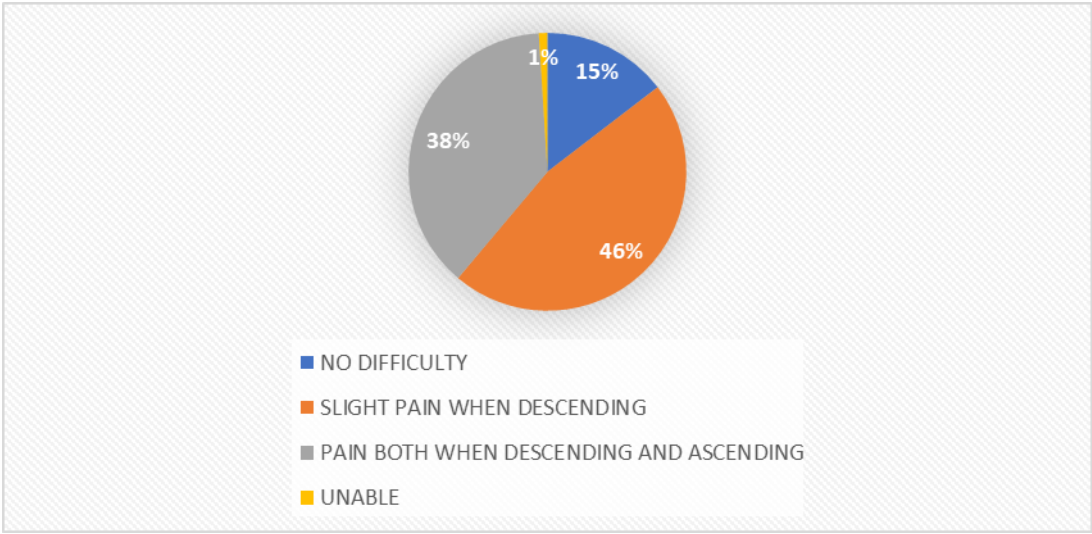



**Table no. 12**

| SR NO. | STAIRS | PERCENTAGE | COUNT |
|---|---|---|---|
| 1. | NO DIFFICULTY | 14.6 | 30 |
| 2. | SLIGHT PAIN WHEN DESCENDING | 46.6 | 96 |
| 3. | PAIN BOTH WHEN DESCENDING AND ASCENDING | 37.9 | 78 |
| 4. | UNABLE | 1 | 2 |

Among 206 participants, 14.6% had no stair difficulties, 46.6% experienced slight pain descending, and 37.9% reported pain ascending and descending. Only 1% were unable to climb stairs.

**RUNNING**

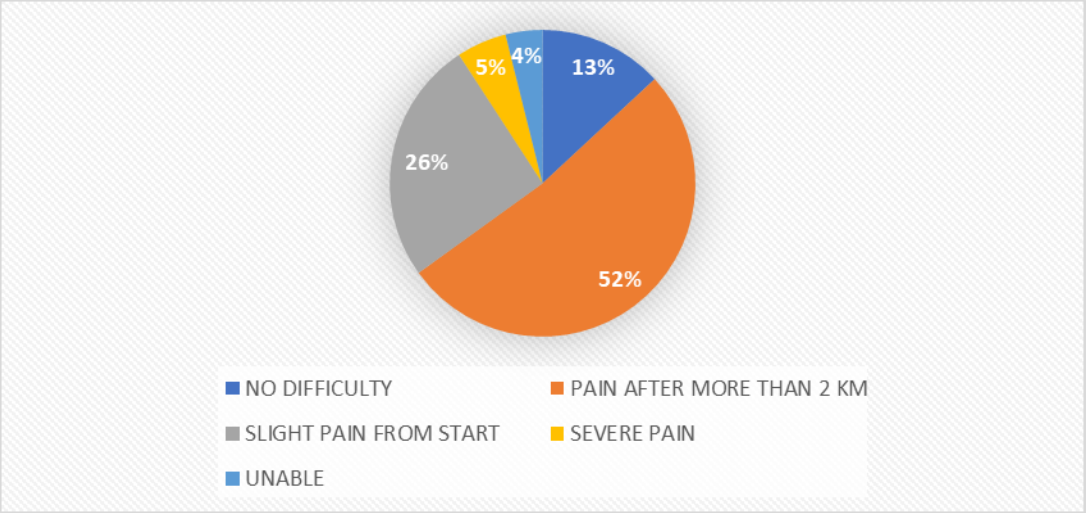



**Table no. 13**

| SR NO. | RUNNING | PERCENTAGE | COUNT |
|---|---|---|---|
| 1. | NO DIFFICULTY | 13.1 | 27 |
| 2. | PAIN AFTER MORE THAN 2KM | 51.9 | 107 |
| 3. | SLIGHT PAIN FROM START | 25.7 | 53 |
| 4. | SEVERE PAIN | 5.3 | 11 |
| 5. | UNABLE | 3.9 | 8 |

Among 206 participants, 13.1% experienced no running difficulties, while 51.9% felt pain after running over 2 km, 25.7% had slight pain from the start, and 3.9% were unable to run.

**JUMPING**

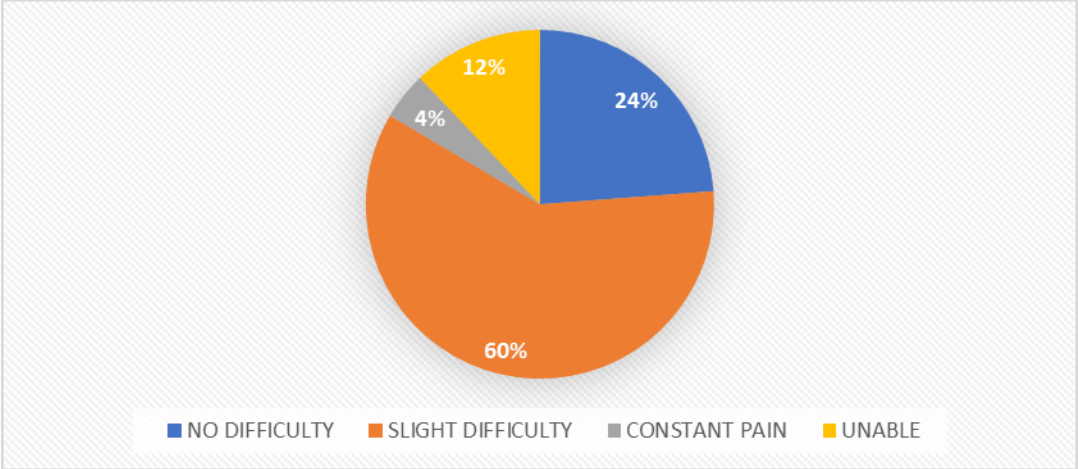



**Table no. 14**

| SR NO. | JUMPING | PERCENTAGE | COUNT |
|---|---|---|---|
| 1. | NO DIFFICULTY | 23.8 | 49 |
| 2. | SLIGHT DIFFICULTY | 59.7 | 123 |
| 3. | CONSTANT PAIN | 4.4 | 9 |
| 4. | UNABLE | 12.1 | 25 |

Of the 206 participants, 23.8% reported no jumping difficulties, 59.7% experienced slight difficulty, 4.4% had constant pain, and 12.1% were unable to jump.

**PROLONGED SITTING WITH KNEE FLEXED**

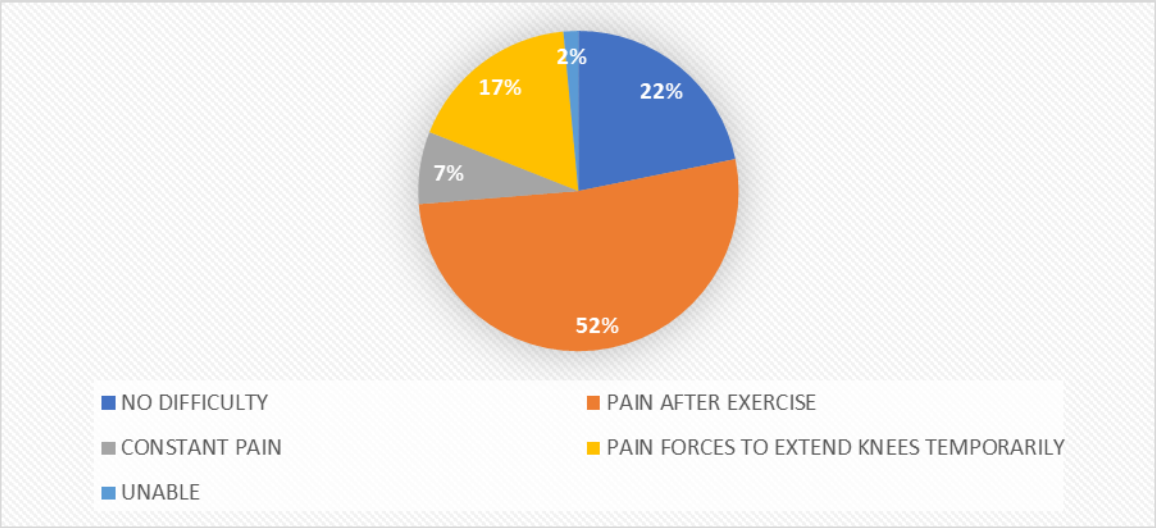



**Table no. 15**

| SR NO. | PROLONGED SITTING WITH KNEE FLEXED | PERCENTAGE | COUNT |
|---|---|---|---|
| 1. | NO DIFFICULTY | 21.8 | 45 |
| 2. | PAIN AFTER EXERCISE | 51.9 | 107 |
| 3. | CONSTANT PAIN | 7.3 | 15 |
| 4. | PAIN FORCES TO EXTEND KNEES TEMPORARILY | 17.5 | 36 |
| 5. | UNABLE | 1.5 | 3 |

Among the 206 participants, 21.8% reported no difficulty in prolonged sitting with knees flexed, while 51.9% experienced pain after exercise, and 1.5% were unable to flex and sit.

**PAIN**

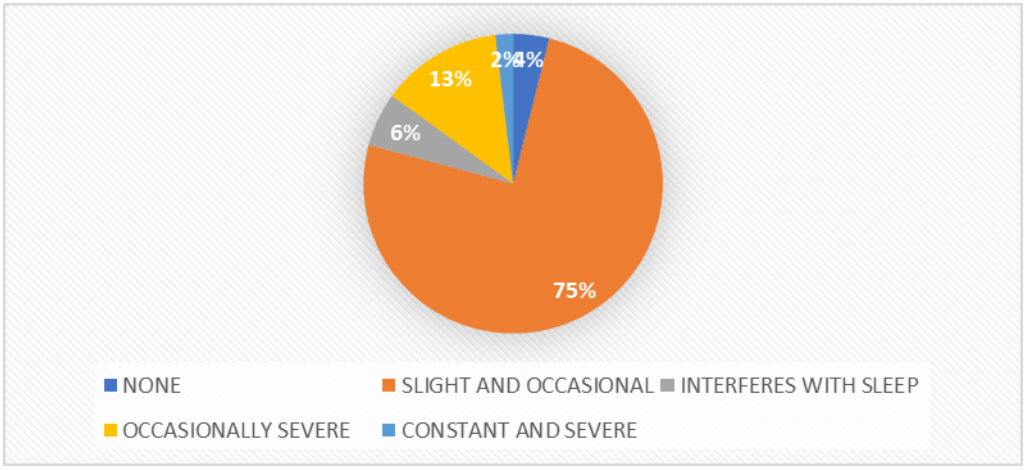



**Table no. 16**

| SR.NO | PAIN | PERCENTAGE | COUNT |
|---|---|---|---|
| 1. | NONE | 3.9 | 8 |
| 2. | SLIGHT AND OCCASIONAL | 75.2 | 155 |
| 3. | INTERFERES WITH SLEEP | 5.8 | 12 |
| 4. | OCCASIONALLY SEVERE | 13.1 | 27 |
| 5. | CONSTANT AND SEVERE | 1.9 | 4 |

Of the 206 participants, 3.9% reported no pain, while 75.2% experienced slight pain; 13.1% occasionally had severe pain, and 1.9% had constant severe pain.

**SWELLING**

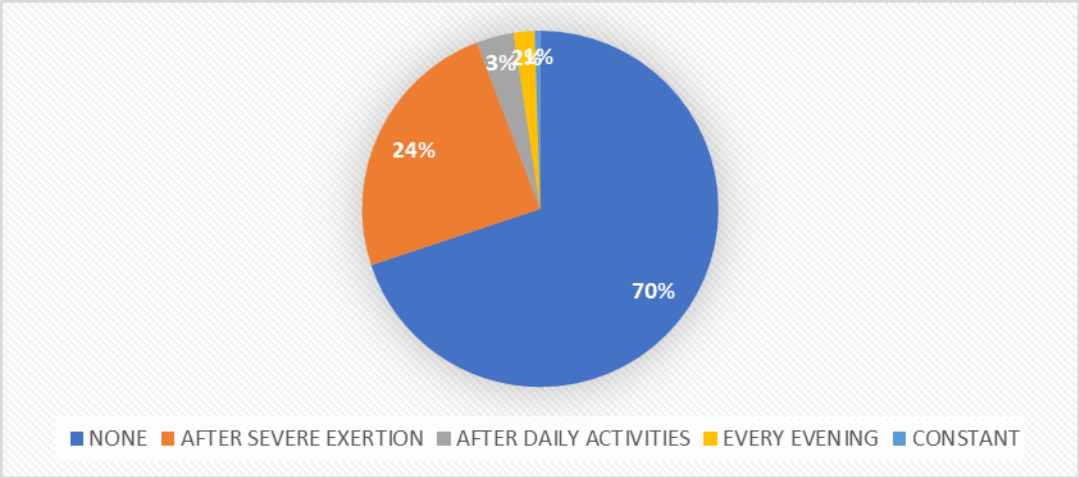



**Table no. 17**

| SR NO. | SWELLING | PERCENTAGE | COUNT |
|---|---|---|---|
| 1. | NONE | 69.9 | 144 |
| 2. | AFTER SEVERE EXERTION | 24.3 | 50 |
| 3. | AFTER DAILY ACTIVITES | 3.4 | 7 |
| 4. | EVERY EVENING | 1.9 | 4 |
| 5. | CONSTANT | 0.5 | 1 |

Of the 206 participants, 69.9% had no swelling, while 24.3% experienced swelling after exertion and 1.9% had constant swelling.

**ABNORMAL PAINFUL KNEECAP (PATELLAR) MOVEMENTS (SUBLUXATION)**

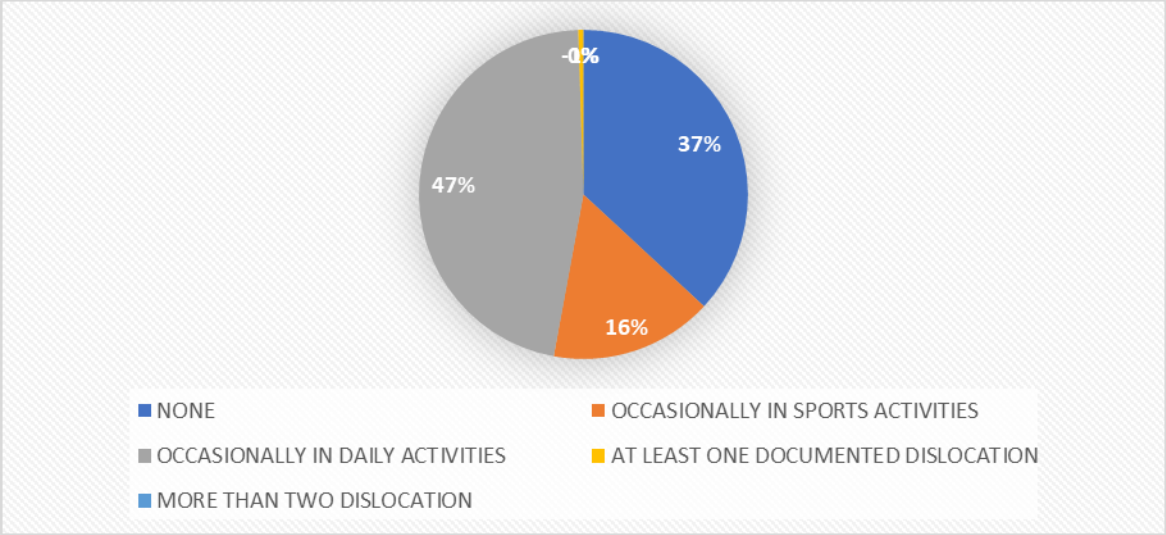



**Table no. 18**

| SR NO. | ABNORMAL PATELLAR MOVEMENTS | PERCENTAGE | COUNT |
|---|---|---|---|
| 1. | NONE | 36.9 | 76 |
| 2. | OCCASIONALLY IN SPORTS ACTIVITIES | 16 | 33 |
| 3. | OCCASIONALLY IN DAILY ACTIVITIES | 46.6 | 96 |
| 4. | AT LEAST ONE DOCUMENTED DISLOCATION | 0.5 | 1 |
| 5. | MORE THAN TWO DISLOCATIONS | 0 | 0 |

Out of 206 participants 36.9 % (76) have no abnormal patellar movements. 16 % (33) have occasionally in sports activities. 46.6 % (96 ) have occasionally in daily activities. 0.5 %(1) have at least one documented dislocation.

**ATROPHY OF THIGH**

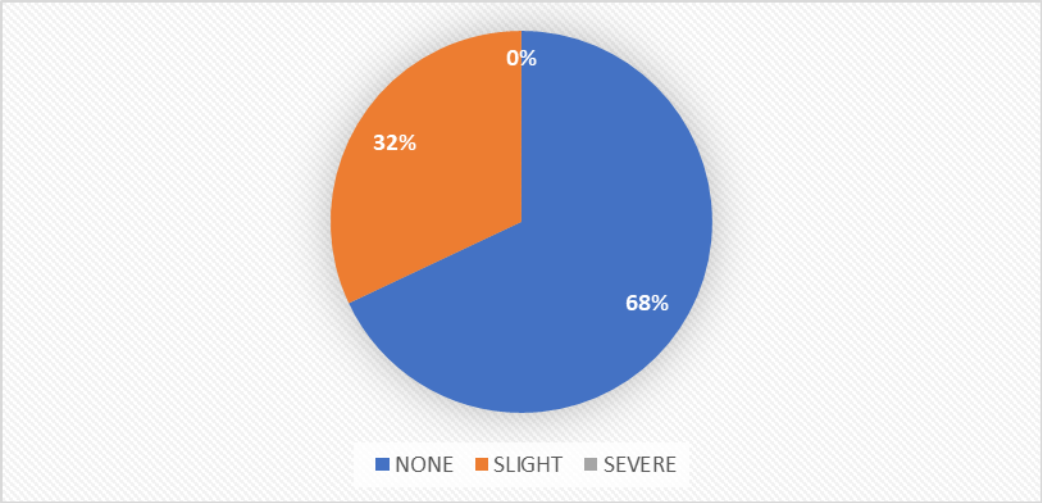



**Table no. 19**

| SR NO. | ATROPHY OF THIGH | PERCENTAGE | COUNT |
|---|---|---|---|
| 1. | NONE | 68 | 140 |
| 2. | SLIGHT | 32 | 66 |
| 3. | SEVERE | 0 | 0 |

Out of 206 participants 68 % (140) have no atrophy of thigh. 32 %(66) have slight atrophy of thigh.

**FLEXION DEFICIENCY**

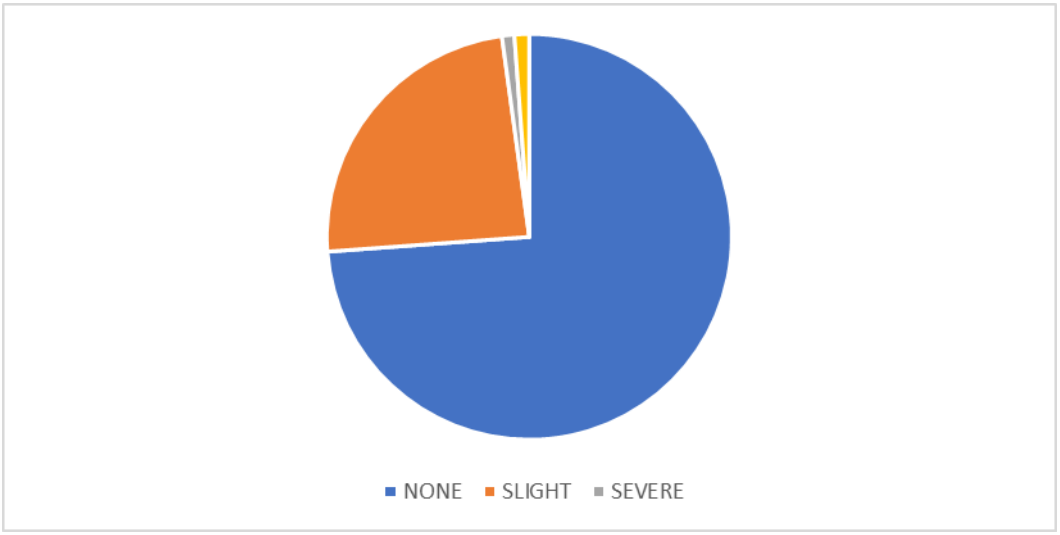



**Table no. 20**

| SR NO. | FLEXION DEFICIENCY | PERCENTAGE | COUNT |
|---|---|---|---|
| 1 | NONE | 74.8 | 154 |
| 2 | SLIGHT | 24.3 | 50 |
| 3 | SEVERE | 1 | 2 |

Out of 206 participants 74.8 % (154) have no flexion deficiency. 24.3 % (50) have slight flexion deficiency. 1 % (2) have severe flexion deficiency.

**DISSCUSSION**

A total of 206 participants were considered for the study survey of Prevalence of Anterior Knee Pain in Long-standing

Professionals. The categories to conduct the study were multifactorial with major two outcome sources being (1) Pain assessment : NPRS, (2) Anterior Knee Pain Scale, with them other factors considered were as follows : Age , Gender, BMI, hours of standing during work.

Professions were strictly considered those that had at-least 6 hours and more of standing work on an average.

Average age participation was 40 years (36.8% of 206 participants). age groups were : age group of 20-29 years (4.9%) ,30-39 years (43.7%), 40-49 years 76(36.8%),50-61 years (14.6%).

There were 125 (60.7%) females and 81(39.3%) males, who participated in this study, and are of different professions like, Teachers - 85(41.2%), Service – 34 (16.5), Hotel/Restaurant staff – 21(10.3), Engineer – 22(10.7), Doctor/Surgeon – 9 (4.4), Others- 35(16.9).

BMI of the 206 participants were taken with resulting the majority ranging from 25-29.9(46%)

Average hours of working of these participants were 9 hours, where work done by standing was 6 and more hours on an average. The hours of working for the given sample size were noted and are as follows : 5-7 hours (19.4%), 8-10 hours (55.9%), 11-13( 22.3%), 14-17 (2.4%). The hours of work by standing for the given sample size were noted and are as follows : 3-6 hours (50%), 7-9 hours (40.3%), 10-12 hours (8.7%), 13-15 hours (2%).

Pain assessment with the help of Numerical Pain Rating Scale had an average score of 5 for pain on activity and average score of 3 for pain at rest.

Anterior Knee Pain Scale was used for assessing the individual activities affecting and aggravating the knee pain. It is a questionnaire with 13 questions having scoring for each option.

Limp (51.2 %) have slight limping while walking, Support (69.9 %) have full support without pain, Walking (45.1% )have pain on walking more than 2 km, Stair climbing (46.6%) have slight pain while descending, Running (51.9 %) have pain after more than 2 km running, Jumping (59.7%) have slight difficulty while jumping. Prolonged flexion of knees (51.9%)have pain after exercise. Pain (75.2%)have slight and occasional pain. Abnormal Subluxations (46.6 %) have occasionally in daily activities.

In the reference article " Effect of Anterior Knee Pain on Lower Extremity Functions in Young Adults" The study found a high positive correlation among anterior knee pain and lower limb functions as the majority of functional activities in the Indian population require climbing stairs, squatting, standing, and sitting for longer than an hour primarily affected by anterior knee pain, meaning that anterior knee pain is the primary cause of these functional activities.[24 ] Fifty subjects with a mean age of 27 years old took part in the study; 42% of the subjects were male and 58% of the subjects were female, and 44% of the patients experienced anterior knee discomfort for a duration of one month to a year. Of those who had been involved for one to three years, 28% had experienced pain in both lower limbs in 50% of their cases. 20 percent of people reported discomfort in their left lower extremity and 30 percent reported pain in their right lower extremity. Additionally, 30% of participants stated that discomfort interferes with their everyday activities. Activities that were most severely impacted were squatting (55%), sitting with the knee flexed (47%), and utilizing stairs (65%). [24]

Previous studies have shown that the external structures are responsible for pulling the patella laterally; in the end, overly aggressive rubbing causes irritation, pain, edema, and malfunction (i.e., difficulty walking downhill hills and stairs). Previous studies have identified a variety of patterns of weakness as the cause of anterior knee pain, including particular weakness during active strength of muscles, inside the quadriceps muscles muscle, and during ultimate knee extension. The significance of muscle activity in an open vs closed kinetic chain was investigated, albeit not extensively. [26]

## CONCLUSION

This study investigates anterior knee pain in long-standing professionals using observations and data collected through a standardized questionnaire. The study, involving 206 participants, revealed moderate anterior knee pain in long-standing professionals based on pain assessment, age (mean 40 years), BMI (25-29.9), and hours worked by standing. The prevalence of several activities, including walking (45%), stair descent (46.6%), running (51.9%), jumping (59.7%), prolonged knee flexion (51.9%), abnormal subluxations (46.6%), and pain (75.2%), was calculated using the anterior knee pain scale.

Gaining insights into anterior knee pain among long-standing professionals may prevent complications and significant misalignment. This study utilized the anterior knee pain scale to evaluate key indicators of knee issues. Proper pain management, considering physical activity and workload, can help mitigate worsening symptoms and avoid additional problems.

## REFERENCES:

1. Werner, S. Anterior knee pain: an update of physical therapy. *Knee Surg Sports Traumatol Arthrosc* **22**, 2286–2294 (2014). https://doi.org/10.1007/s00167-014-3150-y
2. Díaz-Allende P, Osorio-Riquelme V, Colmenares-Sandoval O, Partarrieu-Stegmeier R, Guillén-Vicente I, Guillén-García P. Dolor anterior de rodilla: algoritmo simplificado de estudio y manejo [Anterior knee pain: a simplified assessment and management algorithm]. Acta Ortop Mex. 2023 May-Jun;37(3):126-136. Spanish. PMID: 38052432.
3. Sanchis-Alfonso V, Dye SF. How to Deal With Anterior Knee Pain in the Active Young Patient. Sports Health. 2017 Jul/Aug;9(4):346-351. doi: 10.1177/1941738116681269. Epub 2016 Nov 1. PMID: 27920260; PMCID: PMC5496698.
4. Sanchís-Alfonso, Vicente. (2014). Holistic approach to understanding anterior knee pain. Clinical implications. Knee surgery, sports traumatology, arthroscopy : official journal of the ESSKA. 22. 10.1007/s00167-014-3011-8.
5. LLopis E, Padrón M. Anterior knee pain. Eur J Radiol. 2007 Apr;62(1):27-43. doi: 10.1016/j.ejrad.2007.01.015. Epub 2007 Mar 12. PMID: 17350782.

6. Flores DV, Mejía Gómez C, Pathria MN. Layered Approach to the Anterior Knee: Normal Anatomy and Disorders Associated with Anterior Knee Pain. Radiographics. 2018 Nov-Dec;38(7):2069-2101. doi: 10.1148/rg.2018180048. PMID: 30422763.
7. D'Ambrosi, R., Meena, A., Raj, A. *et al*. Anterior Knee Pain: State of the Art. *Sports Med - Open* **8**, 98 (2022). https://doi.org/10.1186/s40798-022-00488-x
8. Reilly DT, Martens M. Experimental analysis of the quadriceps muscle force and patello-femoral joint reaction force for various activities. Acta Orthop Scand. 1972;43(2):126-37. doi: 10.3109/17453677208991251. PMID: 5079747.
9. Maclachlan LR, Matthews M, Hodges PW, Collins NJ, Vicenzino B. The psychological features of patellofemoral pain: a cross-sectional study. Scand J Pain. 2018 Apr 25;18(2):261-271. doi: 10.1515/sjpain-2018-0025. PMID: 29794307.
10. Reilly DT, Martens M. Experimental analysis of the quadriceps muscle force and patello-femoral joint reaction force for various activities. Acta Orthop Scand. 1972;43(2):126-37. doi: 10.3109/17453677208991251. PMID: 5079747.
11. Bourne, Michael H., William A. Hazel, Steven Scott and Franklin H. Sim. "Anterior knee pain." *Mayo Clinic proceedings* 63 5 (1988): 482-91 .
12. Kelly MA, Brittis DA. Patellectomy. Orthop Clin North Am. 1992 Oct;23(4):657-63. PMID: 1408048.
13. Arroll B, Ellis-Pegler E, Edwards A, Sutcliffe G. Patellofemoral pain syndrome. A critical review of the clinical trials on nonoperative therapy. Am J Sports Med. 1997 Mar-Apr;25(2):207-12. doi: 10.1177/036354659702500212. PMID: 9079175.
14. Powers CM. Rehabilitation of patellofemoral joint disorders: a critical review. The Journal of Orthopaedic and Sports Physical Therapy. 1998 Nov;28(5):345-354. DOI: 10.2519/jospt.1998.28.5.345. PMID: 9809282.
15. Wilk, Kevin & Davies, George & Mangine, Robert. (1998). Patellofemoral Disorders: A Classification System and Clinical Guidelines for Nonoperative Rehabilitation. The Journal of orthopaedic and sports physical therapy. 28. 307-22. 10.2519/jospt.1998.28.5.307.
16. Chesworth BM, Culham E, Tata GE, Peat M. Validation of outcome measures in patients with patellofemoral syndrome. The Journal of Orthopaedic and Sports Physical Therapy. 1989 ;10(8):302-308. DOI: 10.2519/jospt.1989.10.8.302. PMID: 18796951.
17. Harrison E, Magee D, Quinney H. Development of a clinical tool and patient questionnaire for evaluation of patellofemoral pain syndrome patients. Clin J Sport Med. 1996 Jul;6(3):163-70. doi: 10.1097/00042752-199607000-00005. PMID: 8792047.
18. Karlsson J, Thomeé R, Swärd L. Eleven year follow-up of patello-femoral pain syndrome. Clin J Sport Med. 1996 Jan;6(1):22-6. doi: 10.1097/00042752-199601000-00006. PMID: 8925361.
19. Kujala UM, Jaakkola LH, Koskinen SK, Taimela S, Hurme M, Nelimarkka O. Scoring of patellofemoral disorders. Arthroscopy. 1993;9(2):159-63. doi: 10.1016/s0749-8063(05)80366-4. PMID: 8461073.
20. Shea KP, Fulkerson JP. Preoperative computed tomography scanning and arthroscopy in predicting outcome after lateral retinacular release. Arthroscopy. 1992;8(3):327-34. doi: 10.1016/0749-8063(92)90063-h. PMID: 1418204.
21. Thomeé R, Renström P, Karlsson J, Grimby G. Patellofemoral pain syndrome in young women. I. A clinical analysis of alignment, pain parameters, common symptoms and functional activity level. Scand J Med Sci Sports. 1995 Aug;5(4):237-44. PMID: 7552769.
22. Watson CJ, Propps M, Ratner J, Zeigler DL, Horton P, Smith SS. Reliability and responsiveness of the lower extremity functional scale and the anterior knee pain scale in patients with anterior knee pain. J Orthop Sports Phys Ther. 2005 Mar;35(3):136-46. doi: 10.2519/jospt.2005.35.3.136. PMID: 15839307.
23. Duncan RC, Hay EM, Saklatvala J, Croft PR. Prevalence of radiographic osteoarthritis--it all depends on your point of view. Rheumatology (Oxford). 2006 Jun;45(6):757-60. doi: 10.1093/rheumatology/kei270. Epub 2006 Jan 17. PMID: 16418199.
24. Shroff, Riddhi and Vrushali Panhale. "Effect of Anterior Knee Pain on Lower Extremity Functions in Young Adults." *International Journal of Health Sciences and Research* 4 (2014): 223-229.
25. Singer B, Singer K. Anterior Knee Pain Scale. Aust J Physiother. 2009;55(2):140. doi: 10.1016/s0004-9514(09)70048-0. PMID: 19534016.
26. Thomeé R, Augustsson J, Karlsson J. Patellofemoral pain syndrome: a review of current issues. Sports Medicine (Auckland, N.Z.). 1999 Oct;28(4):245-262. DOI: 10.2165/00007256-199928040-00003. PMID: 10565551.