

Research Article

Prevalence of patellofemoral pain syndrome and its effect on lower extremity function in young females

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ABSTRACT

Background: Patellofemoral Pain Syndrome (PFPS) causes anterior knee pains in young females, which can be experienced when performing daily activities. The measurement of its prevalence and functional impact provides the assistance in prevention and rehabilitation in its early stages.

Objective: To determine the prevalence of PFPS and its effects on lower extremity function in young female adults.

Materials and Methods: The observational cross-sectional study was carried out in the University of Sialkot. The n=357 females between the ages of 20-26 years were recruited through non-probability convenient sampling. The inclusion criteria were females experiencing anterior knee pain during functional activities; recently injured knee, prior knee surgery or systemic joint disease, neurological or instant analgesics/anti-inflammatories. PFPS was evaluated using Clarke test, quadriceps tightness using Ely test, knee symptoms using Kujala Score and lower limb performance using LEFS. The SPSS v27 was used to analyze data.

Results: Clarke's test was positive in 16% of the right knees and 12% of the left knees. Tightness of the quadriceps was observed on 27-33% of the subjects. The participants that were PFPS-positive had significantly lower LEFS scores compared to those participants that were PFPS-negative ($p < 0.001$). The regression analysis showed that both AKPQ and LEFS scores have a significant correlation ($R^2 = 0.311$, $p < 0.001$) meaning that lower extremity functional limitation is predicted by knee-specific symptoms.

Conclusion: PFPS is prevalent among young females and is associated with quadriceps tightness and mild-to-moderate functional limitations.

Keywords: *kujala score, lower extremity functional scale, patellofemoral pain syndrome, quadriceps tightness, young females*

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INTRODUCTION

Patellofemoral pain syndrome (PFPS) is distinguished by the excessive pain condition in the patellar area, among the most frequent causes of anterior knee pain in teenagers and young adults. The symptoms also comprised of the presence of catching or giving way sensations, short-term stiffness (mostly following sitting) and swelling and crepitus[1]. The symptoms may also prevent sports, working, and physical activities and they may last many year[2]. the prevalence rate of PFPS among adolescents and the general population is 28.9% and 22.7%, respectively[3, 4]. Besides, PFPS is more common in females approximately two times more than it is in males[4, 5].

PFPS etiology is multifactorial, and it includes excessive extensor mechanism use, patella instability, chondral damage, and quadriceps weakness[6]. It is worth mentioning that PFPS could be one of the risk factors in osteoarthritis of the patellofemoral joint, and the instability of the patients[7]. PFPS influences lower extremity functioning, may cause severe pain and progressive functional impairments, and daily tasks such as squatting and climbing stairs will become challenging[8]. Kinematic pattern changes in patients with PFPS have been shown to increase pain and dysfunction during an activity like the stair descent[9]. Further, a variation in lower extremity kinematics and muscle patterns of activity associated with PFPS can result in compensatory movement responses, notably dynamic knee valgus which is one of the biomechanical dysfunctions[10]. The affected balance has also been reported in females with PFPS and both the functional and laboratory dynamic balance tests have significant differences between the affected and the unaffected ones[11]. These functional impairments are able to diminish the participation in physical activities, sports, and work role[12].

The management of the PFPS requires specific care and delayed treatment may lead to develop osteoarthritis, which has a severe effect on their daily lives and the quality of life[13]. Notably, no extensive information is available on the prevalence and functional effect of PFPS in South Asian people and specifically in Pakistan[14]

The patellofemoral pain syndrome has been increasing as a disease among young females, which is mostly linked to sedentary lives, extended sitting and muscle imbalances. Students of the universities are exceptionally susceptible because they lack physical activity and have poor posture when doing their studies too long[3]. Besides, obesity and high body mass index correlates with an increase in musculoskeletal discomfort and functional mobility loss among women[15,16]. The

issues can be especially relevant to the South Asian populations with the increasing tendencies of obesity. It is observed that prevalence rates of PFPS are approximately 23% among obese people and prevalence rates of 35% were reported in athletes[5].

Determining the prevalence of PFPS and its functional effects in young female adults in the Pakistani setting are crucial to preventive actions and decrease disability in the long perspective. A better understanding of the epidemiology and functional consequences of PFPS among this population will contribute to the development of evidence-based rehabilitation interventions and efficient healthcare resources distribution. The objective of the study is to identify the prevalence of PFPS and determine its impact on lower extremity functioning among young female adults in Pakistan, and it will fill an important knowledge gap in the South Asian musculoskeletal epidemiology.

METHODOLOGY

Study Design

This observational cross-sectional study was done at the University of Sialkot from November 2024 to April 2025 after ethical approval from research ethical committee of University of Sialkot (Ref: USKT/FAHS/RECLetter-00063) and the informed consent of all the participants participating in the study

Participants

Female participants aged 20-26 years who reported experiencing pain in the anterior part of the knee during functional tasks like taking stairs, squatting or sitting were eligible to join the study. Students who had suffered knee injury within a recent period, had knee surgery in the past, suffered systemic joint diseases or neurological disorders were excluded. Also, those that had been taking analgesic or anti-inflammatory drugs regularly in the past month were excluded.

Sample Size

A total sample of n=357 participants was recruited using a non-probability convenience sampling technique. The Raosoft sample size calculator was used in calculating the sample size, with a confidence level of 95%, the margin of error of 5%, and response distribution of 50%. This was the sample size that was deemed to give statistically reliable and valid results.

Variables

Patellofemoral Pain Syndrome (PFPS): Clarke test (patellar grind test) was used in assessing PFPS in order to determine the dysfunction of the

patellofemoral joint. The examiner was pressing the superior border of the patella and the participant had to contract the quadriceps. A positive test result was as a result of the presence of pain or resistance during contraction. Though Clarke test has reported sensitivity of 39% and specificity of 67% and reported inter-rater variability, it was used as a screening test in a multifaceted clinical evaluation[17].

Anterior Knee Pain and Functional Limitation: Functional limitation and severity of pain were determined using the pain scale that included the Kujala Anterior Knee Pain Scale (AKPS). The current self-administered questionnaire is composed of 13 questions on the symptoms and functional activities of the knee, where the overall scores can be as low as zero to as high as one hundred. An increase in scores is a sign of increased knee functioning: 90-100 (excellent), 70-89 (good), 50-69 (fair), and less than 50 (poor). The sensitivity of the tool has been cited to be 80% and specificity is 90%[18].

Rectus Femoris Tightness: The Ely test was used to determine the tightness of rectus femoris muscle. The test subject was in the prone position with an examiner flexing the knee in a passive manner. Quadriceps tightness present as the existence of pain or tightness on the anterior thigh or knee. Knee flexion $<90^\circ$ was classified as severe tightness, $90-120^\circ$ as moderate tightness, and $>120^\circ$ as normal flexibility. The test has been proven to have an acceptable intra-rater reliability and construct validity in measuring the rectus femoris flexibility in case of using standardized procedures[19].

Lower Extremity Function: The assessment of lower limb functional status was on the Lower Extremity Functional Scale (LEFS). This questionnaire is a 20-item questionnaire wherein there is a 0-4 Likert scale which runs on extreme difficulty to no difficulty. A total of 80 is the highest score, and the higher the score, the higher is the level of functioning. Functional categories were categorized as 0-19 (severe limitation), 20-39 (moderate to severe), 40-59 (moderate), 60-79 (mild) and 80 (no limitation). It has shown great reliability (ICC = 0.98) and excellent construct validity to functional limitation in PFPS[20, 21].

Data Collection Procedure

The initial data gathered was demographic information and history of symptoms. All subjects were then subjected to a standardized body examination by a trained physiotherapist. The number of assessments was done during one session of about 20-30 minutes. Data were coded so as to ensure confidentiality and only the research team could access them.

Data Analysis

The SPSS version 27 was used to analyze the data. The characteristics of the participants, their functional scores, and the frequency of patellofemoral pain syndrome (PFPS) prevalence were summarized with the help of descriptive statistics in the form of means, standard deviations, ranges, frequencies, and percentages. PFPS positive and PFPS-negative groups were compared using independent samples t-tests to indicate the difference in Lower Extremity Functional Scale (LEFS) scores between the two groups, as indicated by Clarke test. Linear regression analysis was performed to predict LEFS scores based on Anterior Knee Pain Questionnaire (AKPQ) scores. Statistical significance was set at $p < 0.05$.

RESULTS

The $n=357$ participant's age ranged from 20 to 26 years (Mean \pm SD: 21.48 ± 1.31). AKPQ scores ranged from 32 to 100 (86.98 ± 14.16), and LEFS scores ranged from 7 to 80 (64.71 ± 14.30). For the Ely test, right-side knee flexion ROM ranged from 85° to 130° (mean 120.14 ± 8.83), while left-side ROM ranged from 87° to 130° (mean 120.89 ± 8.52).

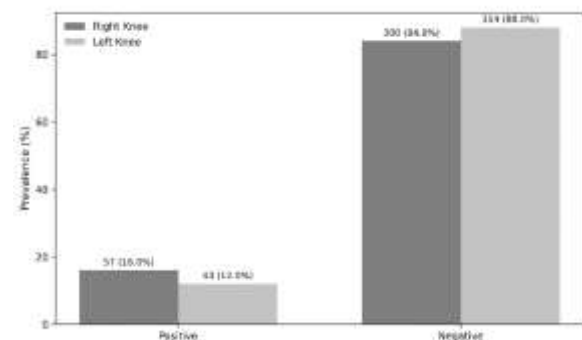


Figure 1: Prevalence of PFPS (Clark's Test)

The positive findings were observed in a minority of participants. Clarke's test was positive in $n=57(16.0\%)$ of participants on the right side and $n=43(12.0\%)$ on the left side. a total of 100 knees (14.0%) were identified as PFPS negative. Overall, these findings indicate that PFPS affected approximately one in seven knees in the PFPS positive based on Clarke's test, out of 714 assessed knees. The remaining 614 knees (86.0%) were classified study population.

Ely's test showed positive results in $n=118(33.1\%)$ on the right and $n=97(27.2\%)$ on the left. Among those with positive Ely's test, most had mild limitation in knee flexion, while moderate and severe limitations were uncommon. (table 1)

Participants with a positive Clarke's test demonstrated significantly ($p < 0.001$) lower extremity functional scores compared to those with negative test results in right knee (51.66 ± 16.04 vs. 67.00 ± 12.89 , $MD=-15.34$) with a large effect size

(Cohen's $d=-1.15$). These findings indicate that PFPS is associated with markedly reduced lower extremity function. (figure 2)

Table 1: Ely Test and Functional Scale Classifications

Test / Scale	Right n(%)	Left n(%)	Cut-off / Classification
Ely Test			
Positive	118(33.1)	97(27.2)	-
Negative	239(66.9)	260(72.8)	
Ely Test Scaling			
None	239(66.9)	260(72.8)	>120°
Mild	89(24.9)	71(19.8)	110-120°
Moderate	28(8.8)	25(7.0)	90-109°
Severe	1(0.3)	1(0.3)	<90°
AKPQ Classification		Score	
Poor	9(2.5)		0-25
Fair	41(11.5)		26-50
Good	111(31.1)		51-75
Excellent	196(54.9)		76-100
LEFS Classification		Score	
Severe	3(0.8)		0-19
Moderate-Severe	20(5.6)		20-39
Moderate	80(22.4)		40-59
Mild	254(71.2)		60-79
No Limitation	0(0)		80

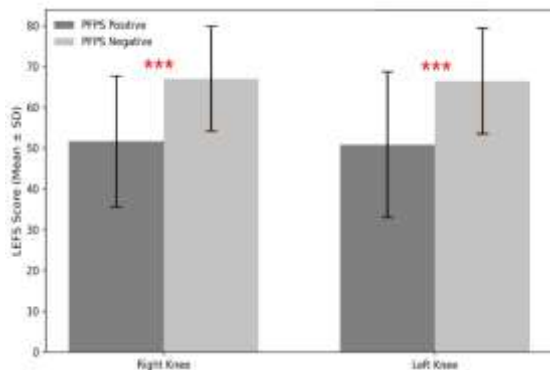


Figure 2: LEFS Scores by PFPS Status (Clarke's Test)

The results of linear regression analysis showed that the Anterior Knee Pain (AKPQ) could predict lower extremity function, as measured by the LEFS. The model was statistically significant ($F=160.40$, $p<0.001$), explaining 31.1% of the variance in LEFS scores ($R^2=0.31$). The regression equation indicated that for every unit increase in AKPQ, LEFS scores increased by 0.563 units ($\beta=0.563$). These findings suggest that higher AKPQ scores are associated with better lower extremity functional outcomes.

DISCUSSION

There were 357 young female university students in this study who showed that a patellofemoral pain syndrome (PFPS) prevalence of 12-16% based on Clarke's test results. These findings lie on the lower part of the population range of PFPS (15-45%) prevalence in the diverse populations[22], with annual prevalence rates of approximately 22.7% in the general population and 28.9% in adolescents[23]. This is lower than the

prevalence of 28.8% among Arab medical students where females recorded disproportionately higher incidences[24] and higher than the incidences of 6.14% among Thai athletes[25]. The prevalence in females could be associated with biomechanical peculiarities. The females tend to have high quadriceps activity and less hamstring activity on certain movements thus having a lower hamstring-to-quadriceps [H:Q] ratio than men[26]. Also, the research shows that dominant limbs in young females have higher knee joint laxity than their non-dominant limbs, and genu recurvatum has been found to be associated with high knee joint laxity[27]. A number of methodological and contextual issues can explain why PFPS had a lower prevalence in this study than the rest of the world[22]. First, most studies on prevalence have used populations that are athletic, military or occupationally active, but the current study used the population that was mostly non-athletic, consisting of university students with moderate activity levels[25]. Second, diagnostic methodology plays a huge role in prevalence estimates; the test by Clarke has high specificity but low sensitivity such that it gives correct estimates of the symptomatic PFPS and might underestimate the subclinical cases[6]. Third, the issue of the symptom manifestation in the university populations is due to the sociocultural and lifestyle variables, including the protracted sitting at the point of studying, in agreement with the prior literature[3].

Although it is at the lower level of the world prevalence distribution, the prevalence of the Clarke test at 12-16% is still clinically significant. Such a result implies that PFPS is prevalent among non-athletic populations, albeit with lesser prevalence than among more physically active ones, whose symptoms are defined by lifestyle requirements and activity habits. This activity-specific manifestation of PFPS in young non-athletic women can be seen in the functional outcome measures used in this paper which shows that PFPS in this population group is functionally expressed as an activity-specific dysfunction and not crippling and global impairment[22].

According to the Ely test, 27-33% of the participants showed tightness of the quadriceps, which was mostly of mild character. The results of this study are consistent with the existing literature that has found muscle tightness as a major risk factor of developing PFPS. Witvrouw et al. established that low quadriceps and gastrocnemius range of motion were significant predictors of the development of anterior knee pains in athletes. Also, it has been found out that the amount of muscle tension was one of the main extrinsic causes of patellofemoral overload during dynamic tasks[28].

It is interesting to note that the prevalence of quadriceps tightness is high among this sedentary group of university students; therefore, it is estimated that sitting and lack of physical activity are factors contributing to adaptive muscle shortening[3]. Resistant to adaptive lengthening, the rectus femoris muscle is a biarticular structure that lies between the hip and knee joints and that is especially vulnerable to the adaptive shortening in those people who retain hip and knee flexion positions during the study sessions[29]. This outcome highlights that muscle flexibility is a preventive intervention that should be addressed in university populations[28, 29].

Quadriceps tightness is a complex relationship with PFPS pathogenesis. Muscle tightness may limit knee flexion range of motion, change patellofemoral joint loading patterns and be a part of compensatory movement strategies which increase patellofemoral joint stress. Also, tightness of quadriceps can lead to a reduction in the capacity to use an eccentric control of muscles during a task, like going down the stairs, which might enhance patellofemoral pain. The reported high prevalence of tightness of the quadriceps in about the third of this group implies that flexibility programs should get priority in PFPS prevention programs[28].

The outcomes of the the Anterior Knee Pain Questionnaire (AKPQ) indicated that half of the sample 54.9% had excellent knee function, and another half 31.1% had good knee function. The average AKPQ score of 86.98 ± 14.16 represents a general good to excellent knee functioning in this group; nevertheless, 13.9% of the respondents reported fair or poor knee functioning (scores <50) which suggests that there is a clinically significant subgroup experiencing significant anterior knee pain and impairments in their functioning [30].

The Lower Extremity Functional Scale (LEFS) indicated that 71.2% of the respondents experienced mild functional limitations (60-79) and 22.4% experienced moderate functional limitations (40-59). The LEFS score means 64.71 ± 14.30 show that the functional limitations are mild in general (no one had the highest score of 80 (no limitation)[21]. The trend also indicates that even those who do not have clinically significant PFPS still have some form of lower extremity functional limitation, which is probably due to the sedentary lifestyle factors[3].

These results prove that the severity of PFPS is connected with the activity and the quality of life. Collins et al. recorded that compared to those without PFPS, patients affected by PFPS scored worse on both condition-specific and generic health status measures, and anterior knee pain causes a very critical negative effect on such measures[31]. The functional limitation in this population is

activity specific, which is a characteristic way that PFPS presents in young non-athletic women and the symptoms are seen during activities that are associated with knee flexion loading[22].

The results of the linear regression showed that there is a significant positive correlation between AKPQ and LEFS scores ($R^2 = 0.311$, $p < 0.001$), where one-point increase in the AKPQ score results in a 0.563-point increase in the LEFS score. This medium effect size shows that knee specific deficits were strong predictors of general lower extremity functional outcomes[32]. The second implication of the $R^2 = 0.311$ is that the AKPQ scores can explain about 31.1% of the differences in LEFS scores, which means that the antecedent knee pain is an important predictor of lower extremity functioning, but other factors also play a significant role in limiting the functions[32].

The moderate strength of this association represents the multifactorial nature of the lower extremity dysfunction in PFPS[32]. In addition to anterior knee pain, there are other causes of the condition that may result in functional limitations and these include hip muscle weakness, lack of core stability, lower extremity alignment abnormalities, and dynamic knee valgus[32,33,34]. It has been established that PFPS patients experience muscle mechanical imbalances, including quadriceps and gluteus medius muscle atrophy, and loss of strength in the quadriceps that shows a direct relationship with proprioceptive loss [33,34].

The high correlation between the AKPQ and LEFS scores is in favour of knee-specific assessment tools as screening tools to identify people at risk of extended lower extremity functional limitations[32]. Nonetheless, the moderate level of R^2 also highlights the importance of thorough evaluation involving several areas of impairment other than anterior knee pain itself[32,33,34].

The results of the current research can be of significant value to the prevention and treatment of patellofemoral pain syndrome (PFPS) among university students. The prevalence of quadriceps tightness (27-33%) as well as the prevalence in the functional limitations suggests the necessity to adopt early and specific preventive measures among young and sedentary students[28]. Sedentary lifestyles, lack of physical exercise and bad posture habits usually present in the academic setting can enhance the stress on the patellofemoral joint and lead to the development of PFPS[3,28]. Movement retraining and gait modification deal with the maladaptive motor patterns and have been reported to be effective in decreasing the pain and enhancing the functionality of people with PFPS[22]. Also, there is research to support combined hip and knee strengthening in comparison to knee exercises alone[14,3].

University-based programs involving ergonomic education, frequent body breaks and multimodal exercise program could be used to mitigate the risk of PFPS and lower extremity functioning among this group.

The research was constrained by the cross-sectional nature which could not lead to a causal relationship of PFPS, tightness of the quadriceps and functional limitations. The sample was selected to comprise young female university students of one institution only, which reduced the possibility of generalization. Also, other important biomechanical variables were not examined in the study, including hip and core muscle strength, dynamic knee valgus, or the morphology of patellafemoral joints.

CONCLUSION

The current research indicated that a significant percentage of the sampled participants showed positive patellofemoral findings on Clarke test, with some of them complaining about fair to poor knee performance on the AKPQ and more than a third experienced tightness of the quadriceps in the Ely test. These results prove that PFPS is widespread in young females and negatively influences the daily mobility and lower extremity performance. The findings support the need to screen and implement preventive measures at an early age to ensure that musculoskeletal health is preserved in both active and inactive groups.

DECLARATIONS & STATEMENTS

Author's Contribution

AA: substantial contributions to the conception and design of the study.

AS, SN, A, LT, ZF, and ZM: acquisition of data for the study.

A, ZF, and ZM: interpretation of data for the study.

A and ZF: analysis of the data for the study.

AS, SN, A, LT, ZF, and ZM: drafted the work.

AS, SN, A, LT, ZF, and ZM: revised it critically for important intellectual content.

AS, SN, A, LT, and ZF: final approval of the version to be published and agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All authors contributed to the article and approved the submitted version.

Ethical Statement

This cross-sectional study was done at the University of Sialkot from November 2024 to April 2025 after ethical approval from research ethical committee of University of Sialkot (Ref: USKT/FAHS/RECLetter-00063).

AI Use Statement

The authors used Grammarly to improve language clarity during manuscript preparation. Generative AI tools such as Scispace and Semantic Scholar were used to assist with literature summarization and refinement of the research rationale. All interpretations, conclusions, and

original ideas remain solely those of the authors and approved by the authors.

Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The data presented in this study are available on request from the corresponding author.

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Funding Sources

None to declare.

Conflicts of Interest

None to declare.

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