Vol. 2 No. 3 (2025)

ONLINE ISSN :3007-309X
PRINT ISSN :3007-3081

Journal of Medical & Health Sciences Review

PREVALENCE OF PATELLOFEMORAL PAIN SYNDROME AND ITS ASSOCIATION WITH PROLONGED SITTING, GENDER AND BMI AMONG UNIVERSITY STUDENTS

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ARTICLE INFO:

Keywords:
Patellofemoral Pain Syndrome (PFPS), Gender, Body Mass Index (BMI), Overweight, Prolonged Sitting, Gender

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Article History:
Published on 23 July 2025

ABSTRACT

Background:
University students are at greater risk of musculoskeletal disorders because of lifestyle factors such as sitting for a long time, being inactive, and unsatisfactory posture. Of all these disorders, Patellofemoral Pain Syndrome (PFPS) is found to be quite prevalent, presenting mostly as pain in the anterior knee and interfering with day-to-day functioning. Sitting for a long time, especially while working or studying, gender differences, and differences in Body Mass Index (BMI) are thought to play a major role in the development of PFPS. Though studies abroad emphasize the increasing weight of PFPS in young adults, there is sparse data on its prevalence and correlating risk factors among students at Pakistani universities, particularly in the age range of 18 to 35 years. This seems particularly true in cities where most of the academic classes take place with students often spending prolonged periods of sitting study time with very little exercise.

Objectives:
To find the prevalence of Patellofemoral Pain Syndrome (PFPS) and its association with prolonged sitting, BMI and gender in students in Universities of Islamabad.

Methodology:
The study was a descriptive cross-sectional study conducted from February 2024 to July 2024 among 384 students from different universities of Islamabad. The sampling technique used for this study is non-probability purposive sampling (which limited the generalizability of the results). Inclusion criteria included Male and Female students of universities in Islamabad, aged 18-35. A Semi-Structured questionnaire which include demographics data and SNAPPS, which fulfilled the eligibility criteria were used to identify the people with patellofemoral knee pain. Data analysis was performed using SPSS version 29, results were expressed in form of percentages and frequencies. Application of Shiparo-Wilk test showed that the data is right skewed, so Chi-square test and Cramer's V test were used to find the association.

Results:
After the approval from the ethical committee the data was collected. Every participant filled the questionnaire. 90.1% (n=346) individuals out of 384 showed no symptoms of PFPS, 9.9% (n=38) were positive of PFPS. Out of the 38 individuals, females accounted for 81.6% (n=31) in comparison with 18.4% (n=7) of males. Individuals who were PFPS positive, 5.3% (n=2) were obese I 31.6% (n=12) were overweight, 47.4% (n=18) were normal and only 15.8 % (n=6) were underweight, 47.4% (n=18) were in the normal weight category, and 31.6% (n=12) were categorized as overweight while 5.3% (n=2) were classified into the Obese I category, and none in the Obese II category. Additionally, 55.3% (n=21) PFPS individuals reported spending more than 6 hours sitting, 31.6% (n=12) reported spending 4-6 hours per day sitting down and only PFPS individuals 13.2% (n=5) reported spending 1-3 hours sitting daily.

Conclusion:
The prevalence of PFPS in university students was relatively low. Our current study found a significant association between BMI and PFPS, particularly in the overweight category. This study found no significant association between Sitting hours and PFPS in comparison to previous literature which might be a consequence of choosing a population younger in age than the population included in previous literature. Though PFPS was more prevalent in females, no significant association was observed between gender and PFPS, potentially due to disproportionate number of female participants as compared to males.

INTRODUCTION

The patellofemoral joint comprises Trochlea of femur and the Patella. This joint plays a very important role in extension and deceleration of the knee (Patel & Villalobos, 2017). Patellofemoral pain syndrome presents, gradually progressive diffused, sharp or dull pain typically occurring at the anterior part of the knee joint behind the patella but may also be present on lateral or medial sides of the patellofemoral joint and rarely even be experienced on the posterior aspect of the joint. The onset of the pain may be gradual or acute depending on the cause of pain. The pain is relieved with rest and exacerbated with movements such as squatting, climbing up and down the stairs, prolonged sitting and other repetitive activities which place the knee joint in a load bearing position. Activities resulting in flexion of Knee joint tend to exacerbate the pain. PFPS is a multifactorial disorder and is theorized to be caused by deformities or abnormalities of the joint or surrounding structures, trauma or overtraining as well as muscular imbalances resulting in imbalance of forces (Willy et al., 2019).

Patellofemoral Pain Syndrome (PFPS) has a global prevalence of approximately 22% to 24% among students, including those in Pakistan, although specific national data remain limited (Ali, Sajjad, Niaz, Rana, & Waseem, 2022). Reported prevalence rates for anterior knee or patellofemoral pain vary widely, ranging from 3% to 85 (Callaghan & Selfe, 2007; Neal et al., 2014). The condition affects individuals across the lifespan but is most common among those aged 12–19 years (Callaghan & Selfe, 2007; Witvrouw et al., 2014). Gender disparities are evident, with higher incidence rates in females (33/1,000 person-years) than males (15/1,000 person-years) (Boling et al., 2010). Among adolescent female athletes, the cumulative incidence was 9.66 per 100 athletes, and in high school runners, lifetime prevalence was reported at 21% in females and 16% in males (Myer et al., 2010; Tenforde et al., 2011).

Multiple studies have explored the relationship between Patellofemoral Pain Syndrome (PFPS) and factors such as prolonged sitting, BMI, gender, and age. A 2022 cross-sectional study on university

teachers in Pakistan found a significant association between prolonged sitting (average 4 hours/day) and PFPS, with prolonged sitters at higher risk, although no participants were found to have advanced PFPS (Bhatti et al., 2022). Similarly, a 2016 study reported that over half of individuals with PFPS experienced pain during prolonged sitting, highlighting the need for targeted management strategies. However, contrasting results have emerged in studies examining BMI; for instance, (Xu et al., 2018) and (Sanchis et al., 2024) found no significant link between PFPS and BMI, gender, or age, while (Hart, Barton, Khan, Riel, & Crossley, 2017) noted higher BMI in adults with PFPS and patellofemoral osteoarthritis, but not in adolescents. (Arrebola et al., 2020) also concluded that BMI did not influence pain intensity or function in women with PFPS.

In terms of demographic-specific findings, (Myer et al., 2010; Tenforde et al., 2011) reported a higher incidence and lifetime prevalence of PFPS in adolescent and female athletes. (van Middelkoop, van der Heijden, Bierma-Zeinstra, & therapy, 2017) suggested PFPS symptoms were persistent, with nearly 75% of adolescents and adults still reporting pain after one year(Ferreira et al., 2022) observed that muscle mass and body fat, rather than BMI, were more predictive of hyperalgesia and pain in PFPS patients. An Egyptian study of medical students revealed a PFPS rate of 28.76%, much greater among women, with no significant relationship identified with sitting time or BMI, but with one identified with prolonged standing (Youssef et al., 2022). (Tahir et al., 2023) supported this by demonstrating that prolonged standing, rather than sitting, was more likely to increase knee pain in university teachers. These results cumulatively suggest that even though prolonged sitting and BMI will inevitably trigger PFPS, their effect may be age-, gender-, and occupation-dependent, requiring context-dependent assessment and interventions.

This study aims to determine the prevalence of Patellofemoral Pain Syndrome (PFPS) and its association with prolonged sitting and Body Mass Index (BMI) among university students in Islamabad. While a previous study focused on teachers and identified a direct link between PFPS and sitting for over four hours per day, this research shifts the focus to students, whose academic routines often involve even longer durations of uninterrupted sitting. In this study, prolonged sitting is defined as more than six hours per day to reflect the sedentary habits common among university students. The study also explores the relationship between BMI and PFPS, given that past research has shown mixed results regarding their association.

Understanding PFPS prevalence and its risk factors among students is crucial for planning targeted preventive strategies. By examining the role of prolonged sitting, BMI, gender, and activity level, the study aims to identify high-risk groups, particularly since PFPS is reported to be more prevalent in females. The findings may guide interventions such as promoting active study habits, regular movement breaks, or ergonomic improvements in campus environments, and also contribute valuable data for future research into the causes and long-term effects of PFPS in student populations.

Materials and Methods

Design and Setting

This research employed a descriptive cross-sectional design to explore the characteristics and associations related to patellofemoral pain among university students. This was the design utilized because it facilitates measurement of variables and their correlation at a given point in time, which is sufficient for the purpose of studying prevalence and related risk factors in a given population. The investigation covered male and female students aged 18–35 years from Islamabad, Pakistan. The information was gathered on location in various universities in the city, public and private, to provide the best

representation from the student population. The data collection duration of the investigation spanned four months, from March to July 2024.

Ethical Statement

This research was reviewed and approved by the Research Ethics and Review Committee of Ibadat International University Islamabad (Ref no: IIUI/ERC/DPT/2021/04/17). The study was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants prior to data collection.

Sampling

A non-probability purposive sampling technique was adopted to recruit participants who fulfilled the inclusion criteria. The sample size was calculated using the Raosoft sample size calculator. Based on a total population of 141,994 students, with a 95% confidence interval, a 5% margin of error, and an assumed 50% response distribution, the minimum required sample size was estimated to be 384 participants.

Participants were included if they were male or female (Ali et al., 2022) aged between 18 and 35 years (Mujahid et al., 2019) students of universities in Islamabad. Individuals were excluded if they had congenital abnormalities of the lower limbs (Ali et al., 2022), any type of arthritis (Bhatti et al., 2022), structural deformities of the knee, recent knee trauma or fractures within the past year (Mujahid et al., 2019), history of knee surgery or dislocation within one year, any metabolic disorders, or were unable to complete the questionnaire. These criteria ensured that the study specifically captured a population relevant to patellofemoral pain without confounding physical health conditions.

Data Collection Tools and Instruments

Data were collected using both printed and online questionnaires. Printed forms were distributed under researcher supervision, while online forms were shared via Google Forms for broader accessibility. A semi structured questionnaire that included demographics and the primary tool the SNAPPS questionnaire, was designed to identify patellofemoral pain with high sensitivity, specificity, and test-retest reliability (Brady, Boonprakob, & Sport, 2021). Pain intensity was assessed using the Numeric Pain Rating Scale (NPRS), a validated self-report measure commonly used in clinical research (Lesher et al., 2006).

Statistical Analysis

All data were initially entered using Microsoft Excel and Google Sheets for cleaning and organization. Data analysis was then performed using IBM SPSS Statistics (version 29). The Shapiro-Wilk test was applied to test the normality of data distribution, revealing that the dataset was not normally distributed ($p=0.000$) and was right-skewed. As a result, non-parametric statistical tests were employed. The Chi-square test was applied to examine associations between categorical variables, with a significance threshold set at $p<0.05$. Additionally, Cramer's V was used to determine the strength of associations, interpreted as follows: 0 to 0.1 indicating no or very weak association, 0.1 to 0.3 indicating a weak association, 0.3 to 0.5 indicating a moderate association, and values above 0.5 indicating a strong association.

RESULTS

Of the total 384 university students included in the study, they were predominantly female (n = 273, 71.09%), with male participants being 111 (28.91%) (Table 1).

Table 1: Gender Distribution

Gender	No. of participants	Percentage (%)
Female	273	71.09
Male	111	28.91
Total	384	100

The age of participants ranged with a mean value of 21.22 ± 2.097 years. The mean height was 1.64 ± 0.991 meters, and the mean weight was 58.53 ± 12.747 kilograms (Table 2).

Table 2: Demographics

	Mean S.D
Age of participants	21.22 ± 2.097
Height of participants (m)	1.64 ± 0.991
Weight of participants (kgs)	58.53 ± 12.747

With regard to Body Mass Index (BMI), most students (n = 221, 57.55%) belonged to the normal BMI category. A high percentage of the participants (n = 92, 23.96%) were underweight. The overweight participants were 14.84% (n = 57) of the total sample. 2.86% (n = 11) were also classified as Obese Class I, and 0.78% (n = 3) as Obese Class II. 71 participants (18.49%) had a BMI above normal range in total (Table 3).

Table 3: Body Mass Index

BMI Categories	No. of participants	Percentage (%)
Underweight	92	23.96
Normal	221	57.55
Overweight	57	14.84
Obese I	11	2.86
Obese II	3	0.78
Total	384	100

The SNAPPS score for all participants was between a minimum of 0 and a maximum of 10, with a mean score of 1.12 ± 2.382. 90.1% (346 participants) were negative and 9.9% (38 participants) were positive for PFPS (Chart 1).

Chart 1: Prevalence of Patellofemoral Pain syndrome

Concerning the prevalence of PFPS cases among universities, Ibadat International University, Islamabad, had the highest percentage of positive responses with 11 students (28.9%) out of 50 having symptoms of PFPS. Among the 346 participants with no symptoms of Patellofemoral Pain Syndrome (PFPS), 86 (24.9%) were underweight, 203 (58.7%) were normal BMI, 45 (13%) were overweight, 9 (2.6%) belonged to the Obese I group, and 3 participants (0.9%) were classified as Obese II. On the contrary, out of 38 PFPS-diagnosed participants, 6 (15.8%) were underweight, 18 (47.4%) had a normal BMI, 12 (31.6%) were overweight, and 2 (5.3%) were in the Obese I category, with none in the Obese II category. Based on the Chi-square test, the p-value was obtained as 0.026, which is less than 0.05, showing a statistically significant relationship between BMI and PFPS. Moreover, the statistics imply that the probability of PFPS development is higher with BMI, especially in overweight subjects—31.6% of PFPS-positive subjects were overweight compared to a mere 13.0% in PFPS-negative subjects. Nevertheless, the 0.17 Cramer's V value indicates that even though the relationship is strong statistically, it is weak in magnitude (Table 4).

Table 4: PFPS and BMI Association

Categories	Underweight	Normal	Overweight	Obese I	Obese II	Total
NO PFPS (n) %	86	203	45	9	3	346
	24.9%	58.7 %	13.0%	2.6 %	3.5 %	100%
PFPS (n) %	6	18	12	2	0	38
	15.8%	47.4 %	31.6%	5.3 %	0.0 %	100%
Total (n) (%)	92	221	57	11	3	384
	24.0%	57.6 %	14.8%	2.9 %	0.8 %	100%
Tests for Association between BMI and PFPS						
Chi-square test	P-value = 0.026		Cramer's V Test	P-value = 0.170		

Upon comparison of sitting hours a day and PFPS, out of the 346 individuals who did not have PFPS, 37 (12%) sat for 1–3 hours a day, 93 (30.5%) sat for 4–6 hours, and 178 (57.8%) sat for greater than 6 hours a day. Among the 38 subjects who were positive for PFPS, 5 (13.2%) sat for 1–3 hours, 12 (31.6%) for 4–6 hours, and 21 (55.3%) for over 6 hours per day. Even though over half of the PFPS-positive participants spent over 6 hours sitting per day, the Chi-square test provided a p-value of 0.970, much greater than 0.05, showing no significant association between sitting time and PFPS. This is also attested by the Cramer's V value of 0.013 that indicates there is no significant association between these variables (Table 5).

Table 5: PFPS and prolonged sitting Association

Categories	1-3 hour/day	4-6 hours/day	>6 hours/day	Total
No PFPS (n)	37	93	178	308
(%)	12%	30.5%	57.8%	100 %
PFPS (n)	5	12	21	38
(%)	13.2%	31.6%	55.3%	100 %
Total (n)	42	105	199	384
(%)	10.9%	27.3%	51.8%	100 %
Tests for Association between Sitting Hours and PFPS				
Chi-square test	P-value=0.970	Cramer's V test	p-value = 0.013	

In terms of the gender and PFPS association, among a total of 384 participants, 273 (71.1%) were females and 111 (28.9%) were males. Among the 346 participants who did not report PFPS, 242 (89%) were females and 104 (93%) were males. Out of the 38 PFPS-positive participants, 31 (81.6%) were females, and 7 (18.4%) were males. Based on these results, 11% of the total female participants were found to experience PFPS compared to 6% of the total male participants. The Chi-square test gave a p-value of 0.133, which is higher than 0.05, meaning there is no statistically significant relationship between gender and PFPS. Equally, the value of Cramer's V was obtained as 0.077, indicating no strong association between gender and PFPS in this population (Table 6).

Table 6: PFPS and Gender Association

Categories	Male	Female	Total
No PFPS (n)	104	242	346
(%)	93%	89%	100%
PFPS (n)	7	31	38
(%)	18.4%	81.6%	100%
Total (n)	111	273	384
(%)	28.9%	71.1%	100%
Tests for Association between Gender and PFPS			
Chi Square test	0.133	Cramer's V test	0.077

DISCUSSION

Out of our 384 students whom we examined, 346 (90.1%) of the 384 subjects were asymptomatic for PFPS and 38 (9.9%) were PFPS positive.

Our findings indicate a 9.9% PFPS prevalence, significantly lower than the estimated global PFPS prevalence in students, at 22% to 24% (Ali et al., 2022). This suggests that PFPS may be less common in our study cohort than in the global student population. The prevalence of PFPS has been reported to be extremely variable and has been estimated to vary from 3% to 85% for anterior knee or patellofemoral pain (Callaghan & Selfe, 2007; Neal et al., 2014). Our 9.9% prevalence lies within this broad range but nearer the lower end.

In our study with a total of 384 students, 38 students had PFPS. Out of them 6 were underweight (24%), 18 had normal weight (47.4%), 12 were overweight (31.6%), 2 were in the obese I category (5.3%) and no were in the obese II category and found a significant association between Patellofemoral Pain Syndrome (PFPS) and BMI, particularly in individuals classified as overweight. Our findings are consistent with those of Ali et al., conducted in Pakistan on university students aged 19-25 in 2022, which also showed an association between PFPS and BMI (overweight). Similarly, (Youssef et al., 2022), conducted a study in Cairo in 2022 on medical students aged 18-25, reported a similar association. However, our findings contrast with those of (Sanchis et al., 2024), from Brazil conducted a study in 2024, which involved children and adolescents aged 10-18 and found no association between PFPS and BMI.

Additionally, (Xu et al., 2018), conducted a study in China in 2018 on young adults, also reported no association between PFPS and BMI. This discrepancy could be due to differences in age groups, geographical locations, or cultural factors that influence physical activity levels and body composition. Moreover, (Hart et al., 2017) conducted a study in Canada in 2016, found

no association in adolescents but did find an association in young adults, suggesting that age might play a crucial role in the relationship between PFPS and BMI.

In our study of 384 individuals, we looked at whether the amount of time spent while sitting is linked to PFPS. We found that there is not any significant connection between sitting time and PFPS. Students with PFPS 13.2% spent 1-3 hours on sitting 31.6% spent 4 -6 hours on sitting and 55.3% spent >6 hours on sitting.

(Bhatti et al., 2022), focused on university teachers aged 25-50 and found an association between PFPS and prolonged sitting (defined as sitting for more than 4 hours per day). (Tahir et al., 2023), examined a similar group of university teachers aged 27-60 and found a negative correlation between knee pain and prolonged sitting, but a weak positive correlation between knee pain and prolonged standing. The weak positive correlation between standing and knee pain in this study may suggest that other factors, such as prolonged static postures (whether sitting or standing), could contribute to knee pain, but not necessarily PFPS specifically. Our findings suggest that in a younger, more active population, prolonged sitting may not be a significant risk factor for PFPS.

In our Study, out of the 384 participants, 273 were females (71.1%), and 111 were males (28.9%). For those with PFPS, there were 31 females (81.6%) and 7 males (18.4%). Though PFPS was more prevalent in females, no significant association was observed between gender and PFPS.

This finding contrasts with (Boling et al., 2010), conducted in the USA in 2010, which reported a higher incidence rate of PFPS in women (33/1000 person-years) compared to men (15/1000 person-years). Similarly, (Myer et al., 2010), also conducted in the USA in 2010, found a higher cumulative incidence risk for new unilateral PFPS in adolescent female athletes. Furthermore, (Tenforde et al., 2011), conducted in Austin in 2011, reported a higher lifetime prevalence of PFPS among high school female runners (21%) compared to their male counterparts (16%). In addition, Youssef et al., conducted in Cairo in 2022 on medical students aged 18-25 also found a higher prevalence of PFPS in females (23.5%) compared to males (5.3%).

Although females comprised a large proportion of our participants, the relatively small number of male participants might have limited the statistical power to detect gender differences.

CONCLUSION

The prevalence of PFPS in university students was relatively low. Our current study found a significant association between BMI and PFPS, particularly in the overweight category. This study found no significant association between Sitting hours and PFPS in comparison to previous literature which might be a consequence of choosing a population younger in age than the population included in previous literature. Though PFPS was more prevalent in females, no significant association was observed between gender and PFPS, potentially due to disproportionate number of female participants as compared to males.

Limitations

The study was limited by small sample size.

There were twice as many females as males in the study.

No physical examination was performed during the study.

The study used purposive sampling for data collection which limited the generalizability of the findings to the broader population.

Recommendations

There should be an increased sample size in the future study that would be a better representation of the population and will enable more accurate conclusions.

In order to prevent gender biasness, it is recommended that future studies try to give a more equitable representation of males and females. This will allow the findings to be more generalizable across the gender.

Physical checks should be incorporated in subsequent data gathering procedures. This will enable appropriate analysis of the condition.

Future research should attempt to utilize random sampling strategies instead of purposive sampling, this will enhance the generalizability of results.

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