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Prevalence of patellofemoral pain syndrome in young Thai athletes registered in Phitsanulok Provincial Administrative Organization Sports School, Thailand

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ABSTRACT

Background: Patellofemoral pain syndrome (PFPS) is one of the most common knee pain diagnoses in sports medicine clinics. The disorder is usually related with sports and activities of daily living and the condition may affect up to 25% of males and females who participate in sporting activities. However, only researchers in Europe, Australia, USA, and a few Asian countries have conducted studies of prevalence of PFPS. There is still a lack of good epidemiological evidence studying incidence or prevalence of PFPS in most countries. PFPS is also often related to overuse so recent changes in activities and changes in frequency, intensity, and duration of training should be considered.

Objectives: Primary aim of the study was to estimate the prevalence of PFPS in young Thai athletes and the secondary aim was to investigate the relationship between PFPS and training duration per week.

Materials and methods: Three hundred and sixty-two young Thai athletes (12-18 years) were recruited in the study. The participants completed a self-reported questionnaire known as "Anterior Knee Pain Scale (AKPS)" for the initial screening process. Participants who provided a score of less than 100 underwent further physical examination for PFPS. Details of their training schedule according to training frequency per week and types of training were given by sports coaches at school.

Results: Three hundred and ten athletes (mean age: 14.8±1.6 years) completed the Anterior Knee Pain Scale (AKPS) questionnaire. There were 51 (35 males and 16 females) out of 310 participants who reported a questionnaire score of less than 100. Nineteen (12 males and 7 males) out of 51 participants presented with PFPS with a greater prevalence in females. However, no significant difference of PFPS prevalence was found between males and females (males: 12/35 = 34%, females: 7/16 = 44%, p=0.521). The overall prevalence of PFPS was 6% (19 out of 310). PFPS was weakly related to longer sports training duration (r=0.115, p=0.042) for the overall population. When genders were considered, PFPS was weakly related to both longer general training duration (r=0.174, p=0.011) and sports training duration (r=0.147, p=0.033) for males.

Conclusion: The overall prevalence of PFPS in young Thai athletes was 6% which was a lower rate compared to previous studies. Sports training duration and sum of both training duration significantly presented weak correlation with PFPS. The results of the current study may have implications for coaches or sports teachers for planning the schedule of sports training duration for the young Thai athletes.

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Introduction

Patellofemoral pain syndrome (PFPS) is one of the most common knee pain diagnoses in sports medicine clinics.[1-5] Anterior knee pain (AKP) is a symptom that most commonly results from PFPS so the terms AKP and PFPS are often used synonymously to describe the same syndrome.[5,6] The disorder is usually related to sports and activities of daily living and the condition may affect up to 25% of males and females who participate in sporting activities.[7] The major complaint is pain around or behind the patella (retropatellar pain) usually during running, inclined walking, stair climbing, prolonged sitting with the knee in a flexed position, and squatting.[8-11] As a result, a large number of children and adolescents may be restricted in activities or perform submaximally on the sports field.[12] Limitation of physical activities can lead to a negative effect on physical development, motor skill and psychosocial development,[13,14] and can also increase risk of becoming over-weight and obese adults.[15]

Researchers in Europe, Australia, and USA have found that 25% of the general or sporting population present with PFPS.[12,16-19] Callaghan and Selfe conducted a literature review to investigate incidence or prevalence of PFPS in the United Kingdom.[1] Only 40 out of 136 articles cited rate or ratio for incidence or prevalence of PFPS and of these 15 out of 40 papers found a PFPS prevalence of 25% or 1:4 ratio in general population. However, there is still a lack of studies assessing prevalence of PFPS in most countries and Thailand is one country where prevalence of PFPS has not previously been evaluated. Thai National Statistical Office stated that in 2011, 26.1% of the Thai population 11 years old and above participated in exercise and sporting activities. When investigating the exercise participation rate in each age group, it was found that the 11-14-year age group had the highest exercise participation rate which was 60%. The second highest rate was found in the 15-24-year age group at 40%. The 60+ year age group was 23.6% and the 25-59 year age group was the lowest participation rate at 19%.[20] Whilst the young Thai population have a high exercise participation rate and there is a lack of knowledge of the prevalence of PFPS in Thailand.

The anterior knee pain scale (AKPS), also known as Kujala scale, was designed to evaluate patellofemoral pain.[21] It is a self-report questionnaire consisting of 13 items that evaluates subjective responses to specific activities and to assess the symptoms and the level of disability of patients with PFPS. The score of the questionnaire runs from a minimum of 0 to a maximum of 100 points. Lower scores represent greater pain and lack of ability. Participants who have no sign of AKP will have a score of 100.[2,3,21-23] Esculier et al conducted a systematic review of 5 self-reported questionnaires used to assess the level of symptoms and disability in people with PFPS.[2] The questionnaires included Activities of Daily Living Scale (ADLS), International Knee Documentation Committee (IKDC), Lysholm Scale (LS), Functional Index Questionnaire (FIQ) and AKPS. It was found that AKPS presented excellent test-retest reliability (intraclass correlation coefficients (ICC)>0.80) and minimal detectable change was only 9 out of 100 points. AKPS has also been translated into other languages which are Turkish, Chinese, Persian,[2] Dutch,[24] and Thai versions.[25] All translated versions appeared to be reliable and valid similar to the original English version.

Although, the causes of PFPS have still been under investigated,[8,10] in orthopaedic sports medicine, one of the most common reasons is overuse.[26] As PFPS is often related to overuse, recent changes in activities and changes in frequency, intensity, and duration of training should also be considered.[6] Training duration is an extrinsic risk factor for overuse injuries that is believed to also influence PFPS.[27] Taking any history about recent alterations in sporting activities, training program including any changes in the frequency, intensity and duration of training is very important in athletes presenting with PFPS.[6,28] However, there is no evidence demonstrating relationship between PFPS and this extrinsic risk factor, so evidence is required to prove this theory. Therefore, the primary aim of this study was to estimate the prevalence of PFPS in young Thai athletes. The secondary aim was to investigate the relationship between PFPS and training duration per week. It was hypothesised that the prevalence of PFPS in young Thai athletes would be more than 25% and PFPS and training duration per week would be related.

Materials and methods

Participants

This survey study was an observational descriptive research (cross-sectional) that recruited students in Phitsanulok Provincial Administrative Organization Sports School, Thailand. The total number of students enrolled in the school was 362 and ages ranged from 12 and 18 years. Every student in the school trained and engaged in one type of sport differently.

Procedure

The study was approved by the School of Sport & Exercise Sciences Research Ethics and Advisory Group (REAG), University of Kent at Medway (Ethics reference: Prop 53_2015_2016). The AKPS questionnaire was translated from English into Thai by the researcher. The backward translation was performed by a Thai native speaker who can read and understand English fluently. The original and translated English versions were compared. After necessary corrections were made, the final Thai version was obtained. The Thai version of the questionnaire was analysed by the intraclass correlation coefficient (ICC) 95% CI for test-retest reliability. The result showed that the translated version of the AKPS questionnaire presented very strong test-retest reliability of 0.97. The assent form for participants under 16 years, consent form for their guardians, consent form for participants at age 16 to 18, and participant information sheet were also translated into Thai. All participants and their guardians whose children were under 16 gave written informed consent prior to the participation. A total of 362 written informed consents were given. The informed consent forms were divided into 3 types: 1) one for participants under 16 (228 forms provided); 2) one for guardians of participants under 16 (228 forms provided); 3) one for participants

aged between 16 and 18 (134 forms provided).

The initial screening process was that participants completed the Thai version of AKPS questionnaire which was given to the participants at school. They were provided with 1 hour to complete the questionnaire. Participants who provided a score of 100 presenting that they had no pain and disability related to PFPS[23] did not need to go through further assessment. Participants who provided a score of less than 100 underwent further investigation which was a physical examination for PFPS. Details of their training schedule per week according to training duration, frequency, and types(29) were given by sports coaches at school from interviewing. The training consisted of general training and sports training. All participants performed the same general training which was speed, agility, power, and strength training 3 or 4 days a week depending on sports they participated. Sports training was different in each sport with the training including specific skills and game-based training 6 or 7 days a week.

Diagnosis of PFPS

Determining the best tests for PFPS diagnosis is still limited.[5,30,31] In the present study, PFPS was diagnosed following the criteria in the Table 1.

Statistical analysis

Age, weight, and height were expressed as mean±SD and analysed for differences between males and females by Independent T-test. The difference of the questionnaire score between males and females was analysed by independent T-test. The prevalence was calculated as the number of PFPS cases divided by the total number of participants that completed AKPS questionnaire in the study. All the data was normally distributed. The relationship between PFPS and training duration per week was analysed by Pearson correlation (Point biserial). The continuous variable (ratio data) was training hours per week and the dichotomous variable (nominal data) was PFPS.

Results

The total number of students enrolled in the school was 362. Three hundred and forty-one consent forms were returned 1 week after they were handed out. Fifteen out of 341 participants refused to participate in the study, so there was 326 participants willing to participate. However, another 16 participants did not present on the day that the AKPS questionnaires were distributed to the participants at school, so the response rate was 90% (310/341) (Figure 1). A total of 310 questionnaires were completed by 310 participants. The participants were given 1 hour to complete the questionnaires and all the questionnaires were returned to the researcher in the same day, so this gave a return rate of 100%. Baseline characteristics of the participants are shown in Table 2. There were 51 participants who reported a questionnaire score of less than 100. No participants who met any of the criteria for AKP (Table 1) scored the maximum of 100. When gender sub-groups were considered, 35 out of the 213 males (16%) and 16 out of the 97 females (16%) scored less than 100 on the questionnaire (Table 3).

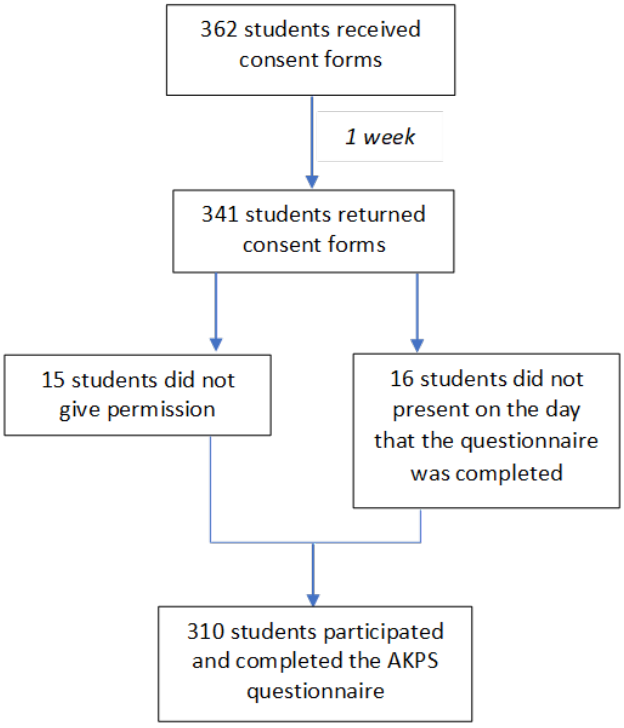

Figure 1 *Flow chart representing the number of participants participating in the study.*

Table 1 PFPS diagnosis criteria.

Criteria	Comment	Study
Pain behind or around the patella following prolonged sitting with knee flexed, rising from sitting, or pain during activities such as ascending or descending stairs, squatting, kneeling, or running	Common in PFPS	Dixit et al., 2007; Crossley et al., 2016; Cook et al., 2010
Tenderness on palpation of medial or lateral retinaculum	Common in PFPS	Dixit et al., 2007
Full range of motion of the knee joint	Common in PFPS	Dixit et al., 2007; Crossley et al., 2016

Table 1 PFPS diagnosis criteria. (continued)

Criteria	Comment	Study
No knee effusion	Sign of articular cartilage injury, chondromalacia patellae, loose bodies, patellofemoral osteo-arthritis	Dixit et al., 2007; Crossley et al., 2016
No locking of the knee joint	As locking suggests a meniscal tear or loose bodies in the joint.	Dixit et al., 2007
No localised pain at the inferior patellar pole	This suggests patellar tendi-nopathy.	Crossley et al., 2016
No localised tenderness and swelling around the tibial tuberosity	This suggests Osgood Schlatter disease.	Crossley et al., 2016
No morning stiffness, involvement of multiple joints or tendons, and joint swelling	This refers to systemic joint disease.	Crossley et al., 2016

Table 2 Baseline characteristics of the participants.

	Male (N = 213)		Female (N = 97)		*p* value	Total (N = 310)	
	Mean±SD	Max:Min	Mean±SD	Max:Min		Mean±SD	Max:Min
Age (year)	14.8±1.6	18:12	14.7±1.7	18:12	0.645	14.76±1.63	18:12
Weight (kg)	52.3±9.4	85:28	51.5±8.6	82:32	0.471	52.01±9.14	85:28
Height (cm)	165.9±9.0	185:136	160.7±6.9	178:145	<0.001*	164.31±8.74	185:136

Notes: *s: second, CI: confidence interval*

Table 3 Number and percentage of participants who had the questionnaire score of 100 and less than 100.

Score	Number of participants (N = 310)	Percentage	Male		Female	
			N = 213	%	N = 97	%
<100	51	16	35	16	16	16
100	259	84	178	84	81	84

Nineteen out of 51 participants (37%) who had a questionnaire score of less than 100 had signs and symptoms commensurate with a diagnosis of PFPS as shown in Table 4. There was no significant difference of average AKP scores between the positive and negative group (p=0.740). When gender sub-groups were considered, 12 out of 35 males (34%) and 7 out of 16 females (44%) had signs and symptoms commensurate with a diagnosis of PFPS indicating a higher prevalence of PFPS in females but a significant difference between these 2 proportions was not found (p=0.521). Overall, the prevalence of PFPS in young athletes registered at Phitsanulok Provincial Administrative Organization Sports School, Thailand who participated in this study was 6% (19 out of 310).

Table 4 Number and percentage of participants whose scores were less than 100 and were diagnosed with or without PFPS.

PFPS	Number of participants (N = 51)	Average AKP score	Percentage	Male		Female	
				N = 35	%	N = 16	%
Positive	19	81.47	37	12	34	7	44
Negative	32	82.38	63	23	66	9	56

Participants who performed the same sport had the same training duration and frequency. Football, athletics, and futsal had the same general training duration which was 6 hours per week while volley ball was 8 hours per week. Football, volleyball, and futsal had longer sports training duration which was 10.5 hours per week compared to athletics that was 9 hours per week. PFPS was weakly correlated with longer sports training duration (r=0.107, p=0.042) and sum of both training duration (r=0.122, p=0.031). Significant correlations were not found between PFPS and general training duration, age, weight, and height (Table 5).

Table 5 Correlations between PFPS and general training duration, sports training duration, age, weight, and height.

	General training duration (hours/week)	Sports training duration (hours/week)	Age (year)	Weight (kg)	Height (cm)
PFPS r	0.107	0.115	-0.070	-0.034	-0.065
***p* value**	0.061	0.042*	0.217	0.549	0.257

** Correlation is significant at 0.05*

When the gender sub-groups were analysed, PFPS was found to be weakly related to longer general training duration (r=0.174, *p*=0.011) and sports training duration in males (r=0.147, *p*=0.033) whilst age, weight, and height were not associated with PFPS. There were no significant correlations between any variables in females (Table 6).

Table 6 Correlations between PFPS and general training duration, sports training duration, age, weight, and height.

	General training duration (hours/week)		Sports training duration (hours/week)		Age (year)		Weight (kg)		Height (cm)	
	M	F	M	F	M	F	M	F	M	F
PFPS r	0.174	-0.001	0.147	0.068	-0.107	0.002	-0.016	-0.071	-0.082	0.000
***p* value**	0.011*	0.995	0.033*	0.506	0.118	0.983	0.822	0.489	0.232	0.998

** Correlation is significant at 0.05*

Discussion and Conclusion

The prevalence of PFPS in young athletes registered at Phitsanulok Provincial Administrative Organization Sports School, Thailand was found to be 6% (19/310) with a higher prevalence in females. The initial hypothesis that prevalence of PFPS would be higher than 25% was therefore rejected. The prevalence in the present study was found to be lower than reported in previous studies. Evidence from the Europe, USA, and Australia has reported levels of prevalence of PFPS of 25% for general or sporting populations.[1] Barber Foss et al found that AKP was present in 26.6% of adolescent female athletes screened over 3 years[23] while Roush and Curtis stated that the estimated prevalence of AKP in 18-35-year-old females was 12%.[5] Nejati et al also investigated prevalence of PFPS in Iranian female athletes and it was found that the prevalence was 16.74%.[4] Callaghan and Selfe stated that most PFPS prevalence studies recruited university athletes, competitive athletes, and male military.[1] A possible reason for the low prevalence of PFPS found in this present study may be that these young Thai athletes were still at the beginning level of sports training and competition compared to those in the previous studies, so their training schedule and intensity may not be as high as competitive athletes or from the military. However, children and adolescents are still at risk of lower extremity injuries. A previous study characterized sport injuries and verify related factors with injuries in children (aged up to 12 years) and adolescents (aged 12-18 years). Duration of training (years) and weekly hours of practice were observed and it was found that both duration of training and hours of practice were associated with injuries among adolescents as injured athletes presented with higher duration of training and weekly hours of practice.[32] Table 4 shows that 32 of 51 participants presented with the questionnaire score of less than 100 but were not diagnosed with PFPS. AKPS questionnaire was not only developed to respond to six activities associated with AKP but also symptoms such as inability to weight bear through the affected limb, swelling, abnormal patellar movement, muscle atrophy, and knee flexion limitation.[33] It is possible that these 32 participants may have presented with these symptoms.

The prevalence of PFPS in the present study was found to be higher in the female participants compared with the male participants but a significant difference was not found. However, the result of females presenting with higher PFPS prevalence supports the knowledge that PFPS occurs more frequently in females compared with males.[3-5,12,23,34] Boling et al examined the association between gender differences and prevalence and incidence of PFPS in 1525 participants from the United States Naval Academy (USNA).[34] After following for 2.5 years, they found the prevalence of PFPS in females and males was 15.3% and 12.3% respectively. The incidence rate in females was 33/1000 person-years whilst 15/1000 person-years was found in males. Similarly, Phillips and Coetsee investigated the incidence of AKP in 11-17-years-olds school males and females.[12] Their results showed that AKP was common among children between 11-17 years with a peak during 12-15 years in females. There are anatomical and biomechanical factors that may lead to a higher prevalence of PFPS in the females compared to the males.[34] One of those factors is the difference in quadriceps angle (Q-angle)[34] as females have larger Q-angles than males[35] and a greater Q-angle is a risk factor for PFPS.[36] Theoretically, a greater Q-angle increases the lateral pull of the quadriceps muscle and potentiates patellofemoral joint disorders.[35,37] Lower extremity muscle strength is believed to be another risk factor for PFPS.[38,39] Females have been reported to be significantly weaker

than males on measurements of hip abduction, hip extension, hip lateral rotation, and quadriceps strength.[38,39] This muscle weakness places the females at a higher risk of joint pain and injuries, including PFPS.[12] The current study only investigated point prevalence of PFPS and period prevalence and incidence rate were not investigated. For a chronic condition such as PFPS, the manifestation is often intermittent. As a result, point prevalence, based on a single assessment at one point of time, is likely to underestimate the prevalence of PFPS in the Thai athletes.[1,5] As period prevalence and incidence rates include a specific period of time,[1,5] reporting period prevalence or incidence rates helps to normalise for the time factor. Nevertheless, point prevalence is useful to find if a number of cases increase or decrease the next time that another point prevalence is investigated.[1,5]

The secondary aim of this study was to investigate the relationship between PFPS and training duration per week. The second hypothesis of PFPS being significantly related to training duration per week was only partially supported. There were no significant correlations between PFPS and general training duration, age, weight, and height for the overall group of participants. However, PFPS was found to be significantly related (r=0.107, *p*=0.061) to longer sports training duration which supported the second hypothesis. This finding supports the literature that PFPS is more common among physically active population.[1-5,12,40,41] In individuals with PFPS, training errors such as changes in frequency, intensity, and duration of training can contribute to PFPS.[6] Importantly, when gender sub-groups were considered, the male participants presented with significant correlations between PFPS and both general training duration and sports training duration whilst there were no significant correlations between PFPS and other variables. A possible reason that longer general and sports training duration were significantly associated with PFPS in the male group but were not in the female group may be a small sample size of the females as both genders had the same training duration (general training duration: 6-8 hours per week, sports training duration 9-10.5 hours per week). In the present study, there were 97 females competing AKPS questionnaire and only 7 females were diagnosed with PFPS. When summing up general and sports training duration, a significant relationship with PFPS was also found. The result supports the study of Vanderlei et al who found that duration of training and weekly hours of practice were associated with intrinsic and extrinsic risk factors for lower extremity injuries in adolescent aged 12-18 years.[32] However, all correlations found in this study were weak correlations. Age, weight, and height were not significantly correlated with PFPS in both genders. There were no significant differences of age (*p*=0.645) and weight (*p*=0.471) between male and female participants in the present study but a significant difference of height was found (*p*=0.000) (Table 2). However, this significant difference of height should have no effect on the result as Pappas and Wong-Tom (2012)[41] conducted a systematic review on risk factors and prospective predictors for PFPS and concluded that anthropometric variables including age, weight, and height were not associated with PFPS. However, as the PFPS cases diagnosed in the present study was only a small number

There were several limitations of the current study, firstly the data collection only took place at one school and this limits the generalisation of the findings to a general Thai population of this age group. Secondly, there was a few PFPS cases diagnosed in the present study. This may be the reason that correlations between PFPS and general and sports training duration were not found in females and may lead to type II error. Thirdly, the current study was a point prevalence study which a specific period of time was not included. Future studies of prevalence of PFPS in other groups of Thai population or in other schools with the same age range are required to clarify if the results will be similar to the present study. Statistical power calculation for the sample size is also required to reduce type II error. Period prevalence and incidence rates should be considered to normalise the time factor.

Conclusion

The overall prevalence of PFPS in young Thai athletes was found to be 6%, which is lower than previously reported levels of prevalence. Female participants presented with a higher overall prevalence of PFPS than their male counterparts, but no significant difference was found. PFPS was significantly related to longer sports training duration in the overall population. However, PFPS was only significantly related to longer general training duration and sports training duration in the males. Even though the correlations were found weak, the results of the current study may provide implications for coaches or sports teachers for planning the schedule of sports training duration.

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Conflict of interest

The authors report no conflicts of interest in this research.

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