

Epidemiology and Risk Factors of Patellofemoral Osteoarthritis in Adults: A Population-Based Study in Southern Thailand

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Objective: Study the epidemiology and factors associated with patellofemoral osteoarthritis.

Material and Method: A population-based survey was undertaken in Songkhla, a province in the southern part of Thailand. Residents aged 40 years and older were sampled using primary care units as a primary sampling frame, stratified by age and sex. All participants were taken to a private clinic for an interview and radiographic examination, including anterior-posterior, lateral and skyline views of both knees. Types and severities of involvement in each compartment were graded by one musculoskeletal radiologist.

Results: Of the eligible 694 subjects, 576 (81.4%) agreed to participate in the present study. The prevalence of radiographic patellofemoral osteoarthritis was 37.9%, of which 96% was bilateral involvement. Isolated patellofemoral osteoarthritis was the most common pattern in males (18.0%), while the combined pattern (involvement of both tibiofemoral and patellofemoral compartments) was the most common pattern in females (31.2%). Elderly (OR = 8.8, 95% CI: 5.1-15.3) and obese (OR = 7.9, 95% CI: 3.3-15.3) were independent risk factors predicting patellofemoral osteoarthritis.

Conclusion: There was a high prevalence of patellofemoral osteoarthritis among Thais over 40 years of age, associated with age and obesity.

Keywords: Epidemiology, Risk factors, Patellofemoral osteoarthritis

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Knee osteoarthritis is a common disabling disease in the elderly⁽¹⁾ with high prevalence⁽²⁻⁵⁾. However, most available epidemiological studies have focused only on the tibiofemoral joint^(3,5-8). Recently, patellofemoral osteoarthritis has been of increasing concern because of its significantly greater associated disability compared to tibiofemoral knee osteoarthritis^(9,10). The prevalence of patellofemoral osteoarthritis has been reported to be from 6.9% to 36.1%⁽⁹⁻¹³⁾. The pathogenesis of each compartment-specific type of knee osteoarthritis remains unclear. Both systemic and local factors have been linked to each pattern of involvement. Coggon et al⁽¹⁴⁾ reported the risk factors associated with patellofemoral osteoarthritis were a family history of osteoarthritis

and the presence of Heberden's nodes. McAlidon et al⁽¹¹⁾ found that patellofemoral osteoarthritis shared the same risk factors as tibiofemoral osteoarthritis. While Roemer et al⁽¹²⁾ revealed that the risk factors of patellofemoral cartilage loss overlap partially with those for tibiofemoral osteoarthritis, but also seem to be distinct. However, these and other related studies were done in Western countries where the ethnic and cultural life styles are different from Eastern countries. To recent knowledge, there has been no epidemiologic study on the prevalence and risk factors of patellofemoral osteoarthritis in Asians. The objective of the present study was to document the prevalence and risk factors associated with patellofemoral osteoarthritis in Thai people, a subgroup of East Asian people.

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Material and Method

The present study was approved by the Ethics Committee of the Faculty of Medicine, Prince of Songkla University. All patients gave written

informed consent before being enrolled in the present study. The present study was a cross-sectional population-based study conducted in Songkhla province in the southern part of Thailand between April 2008 and April 2010. The authors included residents 40 years or older without other rheumatic diseases such as gout or rheumatoid arthritis. The cluster sampling was performed, using primary care units as the primary sampling unit.

Of the 228 primary care units in the province, 24 clusters were chosen based on probability proportional to size. The population in each selected cluster was stratified by age and gender with a total number per cluster of 24 people. Face-to-face interviews were conducted with all subjects by one trained nurse, who obtained details including demographic data, body mass index (BMI), history of previous knee injuries, family history of osteoarthritis, and history of knee pain. Radiographs of both knees were taken, including weight bearing antero-posterior and skyline views using the method by Devies⁽¹⁵⁾ by one musculoskeletal-trained technician.

Patterns and severity of osteoarthritis were graded from 0 to 3 by one musculoskeletal radiologist (0: normal, 1: osteophyte without joint space narrowing, 2: moderate joint space narrowing, and 3: marked joint space narrowing). Grade 1 or more was classified as patellofemoral involvement.

The patterns of involvement were categorized into three groups, isolated patellofemoral, isolated tibiofemoral and combined pattern. Isolated patellofemoral involvement referred to involvement without any tibiofemoral osteoarthritis. Isolated tibiofemoral referred to involvement in medial involvement in either lateral tibiofemoral compartment without patellofemoral osteoarthritis. A combined pattern was defined as involvement in both patellofemoral and tibiofemoral compartments.

The reliability of the radiographic evaluations was tested by having fifty knee radiographs with different severities independently evaluated by two musculoskeletal radiologists blinded to the clinical results twice, one month apart. This test showed that the reliability (kappa statistic) of the radiographic evaluations was at a good to excellent level of agreement in both intra-rater (0.74-0.86) and inter-rater reliability tests (0.62-0.85) for each site of involvement.

Statistical analysis

The prevalence of osteoarthritis was analyzed and cross-tabulated against sex. Crude associations

with various factors were tested by Chi-square. Logistic regression analysis was used to identify factors independently associated with patellofemoral osteoarthritis. Significant was set at $p < 0.05$. The data were analyzed by STATA software (version 7.0, STATA Corporation, 2001).

Results

Five hundred and seventy-six subjects (81.4%) agreed to participate in the present study. The mean age, BMI, history of injury and family history of knee osteoarthritis were similar in both sexes except a higher proportion of males were smokers. The prevalence of radiographic patellofemoral osteoarthritis was 37.9%, of which 96% was bilateral involvement. Isolated patellofemoral osteoarthritis was the most common pattern in males (18.0%), while the combined pattern (involvement of both tibiofemoral and patellofemoral compartments) was the most common pattern in females (31.2%). Seventy-nine percent of patients having radiographic patellofemoral osteoarthritis complained of current knee pain.

There were two independent risk factors associated with radiographic patellofemoral involvement in knee osteoarthritis: age group and BMI. Participants aged 60 to 69 had a risk of 7.8 times higher than those aged 40 to 49 for developing patellofemoral osteoarthritis. In a similar way, higher BMI was associated with a higher risk of having a radiographic appearance of patellofemoral osteoarthritis. The risk increased about 8 times in those with BMI higher than 30 kg/m² greater than normal people. However, sex, smoking status, history of knee injury and family of knee osteoarthritis were not associated with radiographic patellofemoral osteoarthritis in the present study (Table 1).

Discussion

The present study revealed the highest prevalence of patellofemoral osteoarthritis (37.9%) ever reported from the community-based study. Age and BMI were independent risk factors of patellofemoral osteoarthritis, and only BMI was associated with symptom of knee pain among those having patellofemoral osteoarthritis.

The reported incidence of patellofemoral osteoarthritis varies from 6.9% to 36.1% depending on the type of survey, location of the study, diagnostic criteria and radiographic view(s) used^(9,11,13). This study revealed prevalence higher than all of these studies of patellofemoral osteoarthritis from a

Table 1. Association between factors associated with patellofemoral osteoarthritis

Risk factor	Prevalence PFOA (%)	Crude odds ratio	Adjusted odds ratio	p-value [#]
Age group (year)				<0.001*
40 to 49 (n = 109)	54.8	1	1	
50 to 59 (n = 86)	45.2	2.5 (1.5-4.1)	2.9 (1.7-5.0)	
60 to 69 (n = 51)	64.6	5.5 (3.3-9.2)	7.8 (4.4-13.9)	
≥ 70 (n = 330)	63.1	5.2 (3.1-8.7)	8.8 (5.1-15.3)	
BMI (kg/m ²)				<0.001*
< 20 (n = 79)	31.6	1	1	
20 to 24.9 (n = 272)	43.0	1.6 (0.9-2.8)	1.8 (1.0-3.1)	
25 to 29.9 (n = 170)	59.4	3.2 (1.8-5.6)	4.5 (2.3-8.7)	
≥ 30 (n = 55)	70.9	5.3 (2.5-11.2)	7.9 (3.3-18.8)	
Sex				0.488
Male (n = 288)	39.3	1	1	
Female (n = 288)	58.1	2.1 (1.5-3.0)	1.2 (0.7-2.2)	
Smoking status				0.587
Never (n = 325)	55.7	1	1	
Former (n = 117)	49.6	0.8 (0.5-1.2)	0.9 (0.5-1.8)	
Current (n = 134)	32.1	0.4 (0.2-0.6)	0.7 (0.4-1.4)	
History of knee injury				0.260
No (n = 543)	51.6	1	1	
Yes (n = 33)	57.6	1.4 (0.7-2.9)	1.6 (0.7-3.4)	
Family history of osteoarthritis				0.218
No (n = 489)	48.3	1	1	
Yes (n = 86)	53.5	1.2 (0.8-1.9)	1.2 (0.7-2.1)	

From likelihood ratio test

community survey. Various factors could explain this finding. Firstly, most Asian people have a lot of floor activity in their daily life, such as squatting, kneeling, and sitting in the lotus position. All of these activities require deep knee bending beyond 130 degrees, which increases the patellar joint contact pressure^(14,15), which in turn increases the risk of osteoarthritis. Secondly, the authors used both antero-lateral and skyline views, which have the highest accuracy for detecting patellofemoral osteoarthritis. Most previous studies have used only antero-lateral projections⁽¹⁶⁾. Since patellofemoral osteoarthritis is more commonly associated with significant knee pain than tibiofemoral osteoarthritis^(17,18) and the elderly population is increasing all over the world, the diseases associated with the elderly will increase as a proportion of overall health care budgets.

There is still debate about the risk factors associated with different patterns of knee osteo-

arthritis^(9,11,13). Our study found that the risk factors associated with patellofemoral osteoarthritis are the same risk factors of knee osteoarthritis in general, including most importantly age and body mass index, which is in contrast to a previous study, which suggested that family history and presence of Heberden's nodes are the only risk factors⁽¹¹⁾. Some possible explanations for this discrepancy could be first, the imprecision of the radiographic view used to evaluate knee osteoarthritis in Coggon's study, which used lateral knee radiographs. Second, Coggon's study was a case-control study, while the present study was a community survey. It is difficult to have a perfect match among case and control groups, which might have affected the strength and direction of their results. The results suggested that the pathogenesis of patellofemoral arthritis might share a common pathway with tibiofemoral osteoarthritis rather than having a different pathomechanism. In addition, tibiofemoral

osteoarthritis can result in abnormal patellar kinematic from various malalignments leading to increased risk of patellofemoral involvement. Age and BMI are well-known risk factors associated with knee osteoarthritis, and increasing age has been associated with decreasing cartilage thickness and impaired cartilage ability to repair itself^(5,7). The present study confirmed that increasing age not only leads to increased risk of developing patellofemoral osteoarthritis, but also is associated with the disease severity. Obesity is a strong modifiable risk factor for patellofemoral osteoarthritis. Increased patellofemoral joint pressure from obesity aggravates the wear and tear process. In addition, an increased mechanical load can stimulate the pain cascade pathway through instability or a biochemical response, resulting in more clinical symptoms than normal or underweight people^(5,12,16).

Previous studies of knee osteoarthritis have reported some discordance between radiographic abnormalities and knee pain. The present study found that 79.6% of patients with radiographic abnormalities consistent with patellofemoral arthritis reported pain at the involved site. This might indicate that the patellofemoral compartment is more sensitive to joint impairment than the tibiofemoral compartment, so understanding the mechanism of arthritis that will help find treatments to reduce the problem is important.

Several limitations to the present study should be noted. First, since the study was a cross-sectional survey, temporal relationships cannot be established. Second, although the participation was high at 84%, the setting was a community survey based only on primary care facilities, and the many residents who were not included may have had different characteristics from the participating group, leading to distortion of the risk estimates. Third, not all potential confounders such as Heberden's node and occupation were included in the final model, which might have distorted the strength and direction of association.

In conclusion, the authors found a high prevalence of patellofemoral osteoarthritis in Thai over 40 years of age, with risk factors similar to previously reported risk factors of knee osteoarthritis.

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Potential conflicts of interest

None.

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ระบาดวิทยาและปัจจัยเสี่ยงข้อต่อสะบ้าเสื่อมในผู้ใหญ่: การสำรวจอิงกลุ่มประชากรในภาคใต้ ประเทศไทย

บุญสิน ตั้งตระกูลวนิช, ปรเมศวร์ สุวรรณโณ

จุดประสงค์: เพื่อศึกษาระบาดวิทยาและปัจจัยเสี่ยงเกี่ยวข้องกับข้อต่อสะบ้าเสื่อม

วัตถุประสงค์และวิธีการ: เป็นการสำรวจอิงกลุ่มประชากรอายุ 40 ปี หรือมากกว่า สุ่มจากหน่วยดูแลปฐมภูมิเป็นโครง จำแนกโดยอายุและเพศ ผู้เข้าร่วมได้รับการสัมภาษณ์ การตรวจทางรังสีวิทยาข้อเข่าทั้งสองข้าง ทั้งมุมหน้าหลัง มุมข้าง และมุม skyline ณ คลินิกส่วนตัว ส่วนชนิดและความรุนแรงอันเกี่ยวข้องในแต่ละส่วนได้รับการแบ่งระดับโดยรังสีแพทย์ท่านเดียว

ผลการศึกษา: ประชากร 576 ราย (ร้อยละ 81.4) ใน 694 ราย เข้าร่วมในการศึกษาอุบัติการณ์ของข้อต่อสะบ้าเสื่อม โดยภาพรังสี เท่ากับร้อยละ 37.9 ในจำนวนนี้ร้อยละ 96 เป็นสองข้าง ข้อต่อสะบ้าเสื่อมอย่างเดียพบในผู้ชาย (ร้อยละ 18.0) ขณะที่ข้อต่อสะบ้า และข้อเข่าเสื่อมพบมากที่สุดในผู้หญิง (ร้อยละ 31.2) ความสูงวัย (OR = 8.8, 95% CI: 5.1-15.3) และความอ้วน (OR = 7.9, 95% CI: 3.3-15.3) เป็นปัจจัยเสี่ยงอิสระทำนายข้อต่อสะบ้าเสื่อม

สรุป: ข้อต่อสะบ้าเสื่อมมีอุบัติการณ์สูงในประชากรไทยอายุมากกว่า 40 ปี เกี่ยวข้องกับปัจจัยเสี่ยงเรื่องความสูงวัยและความอ้วน
