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VALIDATION STUDIES

Developing the Thai Siriraj Psoriatic Arthritis Screening Tool and validating the Thai Psoriasis Epidemiology Screening Tool and the Early Arthritis for Psoriatic Patients questionnaire

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Abstract To validate the Thai language version of the Psoriasis Epidemiology Screening Tool (PEST) and the Early Arthritis for Psoriatic Patients Questionnaire (EARP), as well as also to develop a new tool for screening psoriatic arthritis (PsA) among psoriasis (Ps) patients. This was a cross-sectional study. Ps patients visiting the psoriasis clinic at Siriraj Hospital were recruited. They completed the EARP and PEST. Full musculoskeletal history, examination, and radiography were evaluated. PsA was diagnosed by a rheumatologist's evaluation and fulfillment of the classification criteria for psoriatic arthritis. Receiver operator characteristic (ROC) curves, sensitivity, and specificity were used to evaluate the performances of the tools. The Siriraj Psoriatic Arthritis Screening Tool (SiPAT) contained questions most relevant to peripheral arthritis, axial inflammation, and enthesitis, selected from multivariate analysis. Of a total of 159 patients, the prevalence of PsA was 78.6 %. The ROC curve analyses of Thai EARP, PEST, and SiPAT were 0.90 (95 % CI 0.84, 0.96), 0.85 (0.78, 0.92), and 0.89 (0.83, 0.95), respectively. The sensitivities of SiPAT, Thai EARP, and PEST were 91.0, 83.0, and 72.0 %, respectively, while the specificities were 69.0, 79.3, and 89.7 %, respectively. All screening questionnaires showed good diagnostic performances. SiPAT could be considered as a screening tool with its desirable properties: higher sensitivity and taking less time. Thai PEST and EARP could possibly be sequentially administered for people with a positive test from SiPAT to reduce the number of false positives.

Keywords Thai Psoriatic Arthritis Screening Tool · The Psoriasis Epidemiology Screening Tool · The Early Arthritis for Psoriatic Patients questionnaire · Screening psoriatic arthritis

Introduction

Psoriatic arthritis (PsA) is a chronic inflammatory joint disease associated with psoriasis (Ps). The prevalence of PsA in Ps clinic is estimated to be around 6–42 % [1]. Early detection of PsA is important because early diagnosis and treatment cause less disease progression [2]. Up to 47 % of patients develop joint erosion within 2 years of disease onset [3], and Gladman et al. [4] reported that 43 % of established PsA patients had at least 1 joint erosion. The Group for Research and Assessment of Psoriasis and Psoriatic Arthritis has developed and established the **c**lassification criteria for psoriatic arthritis (CASPAR) [5] to classify PsA at an early stage [5]. The majority of PsA patients present with Ps up to 10 years before onset of arthritis [1]. General practitioners or dermatologists play a key role in early detection of PsA because they usually take care of Ps patients. A sensitive PsA screening tool is vital for physicians to identify Ps patients with possible PsA, allowing them to undergo further rheumatologic evaluation for definite diagnosis and proper management.

Current available screening tools include the Psoriatic Arthritis Screening and Evaluation (PASE) [6] (15

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questions), the Psoriasis Epidemiology Screening Tool (PEST) (5 questions) [7], the Early Arthritis for Psoriatic Patients questionnaire (EARP) (10 items) [8], and the Toronto Psoriatic Arthritis Screen II (ToPAS II) (13 questions with pictures) [9]. These tools were designed to screen established Ps patients except for ToPAS II, which screens both Ps patients and the general population. In different studies, PASE, PEST, ToPAS II, and EARP have been reported to have a wide range of sensitivities and specificities ranging from around 24–90 and 40–94 %, respectively [10, 11]. The differences might be due to a variety of musculoskeletal involvements among study populations. Some tools apparently perform better in polyarticular pattern than non-polyarticular pattern [10].

The prevalence of musculoskeletal patterns in PsA differs among ethnic groups [1]. The prevalence of spinal involvement in PsA may be higher in Asia than other regions [1, 12, 13]. A Thai university hospital study reported a prevalence of PsA of 43 % in Ps clinic [13], and spondylitis was the most common manifestation (83 %). To date, no screening tool verified in a Thai language version exists, and a simple tool with good discriminating properties is essential. Thus, the present study aims to validate the Thai language versions of PEST and EARP and also to develop a new tool suitable for screening PsA among Ps patients.

Patients and methods

Study design

The present study was a cross-sectional study. The eligible population was consecutive patients visiting the Ps clinic at Siriraj Hospital, a university hospital in Thailand, between January 1, 2013, and January 31, 2015. The inclusion criteria were patients older than 18 years who were diagnosed as Ps by dermatologists and were willing to participate. Patients not willing to have musculoskeletal examination were excluded. Informed consent was obtained from all participants. The study was approved by Siriraj Institutional Review Board in compliance with the Declaration of Helsinki 1964 and its later amendments or comparable ethical standards.

Questionnaire

EARP [8] and the PEST [7] were translated from English language into Thai language following the steps suggested by Beaton et al. [14]. First, the forward translation from English language to Thai language was performed independently by 2 bilingual translators whose mother tongue was Thai. These translators were a nephrologist and a scientist with no medical background. Both were aware of the objective of the questionnaire. Second, synthesis of the translation involved review and comparison of the 2 Thai language versions by a committee of 2 rheumatologists (WK, PC), an internist (WS), and the translators. Discrepancies were resolved by consensus. Third, the back translation was performed by 2 bilingual translators translating the questionnaire back into English language. These translators were a geneticist and an engineer with no medical background. Both were unaware of the objective of the questionnaire. The 2 back translation versions were then compared by the committee and translators. Discrepancies were discussed and resolved by consensus. Fourth, an expert review committee of our researchers explored discrepancies between the original English language version, the Thai language version, and the back-translated English language version. The pre-final Thai version was consequently developed. Fifth, the pre-final version was tested by 30 Ps patients who were literate, aged more than 18 years, attending the Ps clinic at Siriraj Hospital, and invited to participate in the study. Those patients completed the questionnaires. The numbers of missing answers was recorded. The patients were asked to explain problems encountered in answering the items and the reasons for missing items, as well as to comment on wording, comprehensiveness, and relevance of the items. The Thai version of EARP and PEST was finalized after consideration of the results of the pre-testing interview.

Thai EARP and PEST were further investigated and presented to all participants in a random order to avoid completion bias. All participants filled in both questionnaires themselves. The Thai EARP had 10 items, and the Thai PEST had 5 questions together with a cartoon of joint symptoms to complete. Each positive answer of Thai EARP and PEST was scored as 1 point and the total scores were 10 and 5, respectively. Only answered questions were scored to record a positive response. Missing data were not interpolated.

Clinical assessments

After questionnaire completion, all clinical assessments of participants and their medical records were performed independently of the questionnaires. Clinical demographic data were recorded including age, sex, Ps type, nail involvement, body mass index, status of established PsA, systemic treatment of Ps or disease modifying antirheumatic drug (DMARD), non-steroidal anti-inflammatory drug (NSAID), history of inflammatory back pain following ASAS criteria [15], buttock pain, peripheral arthritis, enthesitis, and dactylitis. Past DMARD use was defined as stopping medication for at least 3 months before recruitment, while current use was defined as starting medication

at least 1 month before or stopping for less than 3 months before recruitment. Past NSAID use was defined as stopping NSAID for at least 2 weeks before recruitment, and current use was defined as starting NSAID for at least 1 day or stopping NSAID for <2 weeks before recruitment. Physical examination of peripheral joints (76 swollen/78 tender/78 damaged joint counts), entheses according to the Spondyloarthritis Research Consortium of Canada Enthesitis Index [16] and the Maastricht Ankylosing Spondylitis Enthesitis Score [17], spinal mobility following the Assessment of Spondyloarthritis International Society [18], internal rotation of the hip [19], and dactylitis were assessed by a rheumatologist (PC) independently of the questionnaire results. All willing patients underwent cervical and lumbar spine, pelvis, hands and feet radiography, and blood test for rheumatoid factors. Radiography was interpreted by a rheumatologist. Diagnosis of PsA was by a rheumatologist (PC)'s evaluation and fulfillment of the CASPAR criteria, a gold standard criteria [5]. PsA was divided into 3 major patterns: peripheral arthritis, enthesitis, and axial inflammation.

Statistical analysis

Comparison of continuous variables was determined by Student's *t* test or Mann–Whitney *U* test according to pattern of distribution. Pearson's Chi-square test or Fischer's exact test was used to compare categorical data as appropriate. A *P* value of <0.05 was considered significant. To develop a new tool, univariate logistic regression analysis was used to determine the association of each question of Thai EARP and PEST against PsA diagnosis. Items with $P < 0.1$ were further analyzed in multivariate analysis. All questions were classified into 3 groups according to the pattern of disease involvement namely peripheral arthritis, enthesitis, or axial inflammation. Items with the best correlations determined by adjusted odd ratios from each group were selected to construct a new tool. Receiver operator characteristic (ROC) curves were calculated to determine the operating characteristics of the indices and the optimal cutoff score of the new questionnaire for predicting PsA. The cut point of EARP and PEST was 3 as suggested in the original tools [7, 8]. The sensitivities, specificities, positive and negative predictive values, as well as positive and negative likelihood ratios were determined at a number of cut points. Statistical analyses were performed using the SPSS 17.0 (Chicago, IL, USA).

Results

A total of 159 patients were consecutively recruited in this study. The prevalence of PsA was 78.6 %. Demographic data of participants are shown in Table 1. PsA patients had a significantly higher duration of education, higher proportion of nail involvement and NSAIDs use, as well as narrower cervical rotation than Ps patients without PsA (Table 1). Other diagnoses related to musculoskeletal pain among patients with no PsA including avascular necrosis of right hip ($n = 1$), gout ($n = 1$), mechanical back pain ($n = 6$), osteoarthritis of knee ($n = 2$), and generalized osteoarthritis and degenerative change of spine ($n = 1$). Eleven PsA patients also had other musculoskeletal diseases including gout ($n = 7$), osteoarthritis of hands ($n = 2$), and knee osteoarthritis ($n = 2$).

Questionnaire testing and development of new questionnaire

Thirty patients were in a pre-final phase. There were no missing answers. One participant commented that Thai EARP questions 1, 5–7, 9, and 10 could not be differentiated between current or past symptoms. Three participants commented on question 3 of PEST that they did not know about the visual appearance of holes or pits in the nails. Thai EARP and PEST were finalized by adding 'current and/or past' of a symptom in all questions except for question 2 of both.

One hundred twenty-nine patients completed Thai EARP and PEST. The internal consistency of items from Thai EARP was good (Cronbach's alpha coefficient of 0.82) while that of Thai PEST was acceptable (Cronbach's alpha coefficient of 0.74). In univariate analysis, each question of Thai EARP and PEST was significantly associated with PsA. Only the most relevant questions from each of the 3 major patterns of disease of PsA were selected from multivariate analysis of each questionnaire (Table 2). The new questionnaire, the Siriraj PsA screening tool (SiPAT), included questions 3 and 6 of Thai EARP and the question 4 of Thai PEST about inflammatory back pain, peripheral arthritis, and heel enthesitis, respectively.

ROC curve analyses of Thai EARP, PEST, and SiPAT were good at 0.90 (95 % CI 0.84, 0.96), 0.85 (0.78, 0.92), and 0.89 (0.83, 0.95), respectively (Fig. 1; Table 3). The cutoff for the SiPAT of 1 was selected by ROC curve performance. The sensitivity was analyzed to be 91.0 %, slightly higher than Thai EARP (83.0 %) and PEST (72.0 %). Conversely, the specificity of SiPAT was slightly lower than those of Thai PEST and EARP at 69.0, 79.3, and 89.7 %, respectively. Furthermore, the negative likelihood ratio of SiPAT was lower than those of Thai EARP and PEST at 0.13, 0.21, and 0.31, respectively. Subgroup analyses of diagnostic performance by patterns of PsA were further computed (Table 3). Performances of Thai EARP, PEST, and SiPAT were still good in the 3 major patterns regardless of combinations of other patterns. However, it was reduced

Table 1 Characteristics of participants

	All participants		
	No PsA	PsA	*P* value
n (%)	34 (21.4)	125 (78.6)	
Age, years (SD)	47.4 (12.6)	46.3 (12.5)	0.638[a]
Male (%)	52.9	54.4	0.880[+]
Dur Ed, median (IQR, min, max) *y*	9.0 (10.0, 6.0, 18.0)	12.0 (7.0, 6.0, 18.0)	0.005
Dur.Ps, median (IQR, min, max) *y*	10.0 (12.0, 0.8, 20.1)	11.2 (13.6, 0.2, 52.3)	0.159[c]
Psoriatic nail (%)	29.4	71.2	<0.001[+]
Obesity (%)	61.3	40.8	0.041+
RF, *n*/*N* (%)	24/27 (88.9)	82/93 (89.1)	1.000[++]
DMARDs (%)			0.315[+]
Current	47.1	60.0	
Past	17.6	16.8	
Never	35.3	23.2	
NSAIDs (%)			<0.0001[+]
Current	2.9	20.8	
Past	8.8	28.0	
No	88.2	51.2	
Pattern of PsA (%)			
Axial inflammation	N/A	56.0	N/A
Peripheral arthritis	N/A	84.0	N/A
Enthesitis	N/A	61.6	N/A
PE (%)			
TJC ≥ 1	2.9	39.2	N/A
SJC ≥ 1	0	36.0	N/A
DJC ≥ 1	0	17.6	N/A
Enthesitis ≥ 1	0	30.4	N/A
Dactylitis ≥ 1	0	13.6	N/A
CR, mean (SD)	77.8 (6.3)	72.9 (12.5)	0.002[b]
TTW, mean (SD)	10.4 (1.5)	10.6 (2.5)	0.626[a]
OTW, median (IQR, min, max)	0 (0, 0, 6.0)	0 (0, 0, 11.0)	0.632[c]
CE, mean (SD)	3.9 (1.3)	4.3 (1.4)	0.115[a]
LF, mean (SD)	5.0 (1.2)	4.6 (1.1)	0.086[a]
LSF, mean (SD)	14.5 (4.4)	14.9 (4.2)	0.618[a]
IHR, mean (SD)	37.1 (10.2)	35.7 (10.7)	0.508[a]
Questionnaire			
EARP, mean (SD)	1.8 (2.2)	5.4 (2.5)	<0.001[b]
PEST, mean (SD)	1.2 (1.4)	3.2 (1.5)	<0.001[b]
SiPAT, mean (SD)	0.4 (0.7)	1.6 (0.9)	<0.001[b]

PsA psoriatic arthritis, *n* number of positive condition, *N* total number of participants, *SD* standard deviation, *Dur Ed* duration of patient's education, *Dur. Ps* duration of psoriasis, *IQR* interquartile range, *min* minimum, *max* maximum, *y* year, *obesity* body mass index ≥25 kg/m^2, *RF* negative serum rheumatoid factor, *DMARDs* disease modifying anti-rheumatic drugs included cyclosporine A, methotrexate, leflunomide, sulfasalazine, and anti-tumor necrotic factor alpha, *NSAIDs* non-steroidal antirheumatic disease, *PE* physical examination, TJC ≥ 1, at least one tender joint per each patient; SJC ≥ 1, at least one swollen joint per each patient; DJC ≥ 1, at least one damage joint per patient; *EARP* Thai version of the Early Arthritis for Psoriatic Patients questionnaire score, *PEST* Thai version of the Psoriasis Epidemiology Screening Tool questionnaire score, *SiPAT* Siriraj Psoriatic Arthritis screening Tool score, *CR* Cervical rotation, *TTW* tragus to wall distance, *OTW* occiput to wall distance, *CE* chest expansion, *LF* modified Schober test, *LSF* lateral spinal flexion, *IHR* internal hip rotation, *N/A* not applicable

+ Chi-square

++ Exact

[a] An independent *t* test equal variances

[b] An independent *t* test equal variances not assumed

[c] Mann–Whitney *U* test

Table 2 Multivariate analysis of the Thai version of the new Early Arthritis for Psoriatic Patients questionnaire (EARP) and the Thai version of the Psoriasis Epidemiology Screening Tool questionnaire (PEST) items

Questionnaire	Coefficient	OR	95 % CI	*P* value
EARP				
1. Do your joints hurt?	0.80	2.22	0.53, 9.34	0.276
2. Have you taken anti-inflammatory more than twice a week for joint pain in the last 3 months?	0.79	2.19	0.19, 25.71	0.532
3. Do you wake up at night because of low back pain?	1.89	6.63	0.94, 46.61	0.057
4. Do you feel stiffness in your hands for more than 30 min in the morning?	−0.08	0.92	0.12, 7.04	0.939
5. Do your wrists and fingers hurt?	1.33	3.77	0.79, 17.89	0.095
6. Do your wrists and fingers swell?	3.93	51.04	2.42, 1072.82	0.011
7. Does one finger hurt and swell for more than 3 days?	−1.83	0.16	0.01, 2.13	0.165
8. Does your Achilles tendon swell?	1.75	5.78	0.74, 44.82	0.093
9. Do your feet or ankles hurt?	−0.11	0.89	0.18, 4.38	0.888
10. Do your elbow or hips hurt?	1.72	5.58	0.88, 35.45	0.069
PEST				
1. Have you ever had a swollen joint (or joints)?	0.63	1.88	0.49, 7.28	0.360
2. Has a doctor ever told you that you have arthritis?	1.02	2.76	0.57, 13.38	0.207
3. Do your finger nails or toe nails have holes or pits?	0.35	1.42	0.49, 4.09	0.515
4. Have you had pain in your heel?	1.32	3.72	1.22, 11.30	0.020
5. Have you had a finger or toe that was completely swollen and painful for no apparent reason?	1.31	3.70	0.92, 14.94	0.066

Multivariate regression analysis (enter method) was done in each tool separately

OR odds ratio, *CI* confidence interval

if pure peripheral arthritis or axial inflammation were present. The sensitivity of PEST was the lowest, and there was substantial decrease in axial inflammation compared to peripheral arthritis. Only 1 patient had pure enthesitis, so it was not further analyzed (Table 3). The area under the curve (AUC) and sensitivities of all tools was lower in the naïve group. Thai EARP and SiPAT had comparable AUC, while Thai PEST had the lowest AUC. In addition, SiPAT had the highest sensitivity, followed by Thai EARP and PEST (Table 3).

Newly established PsA

One hundred eight (67.9 %) patients had non-established PsA at recruitment, and 74 (68.5 %) patients were subsequently diagnosed as PsA. Most of the patients had more than 1 pattern of PsA involvement. PsA patients with a known diagnosis had significantly longer durations of musculoskeletal symptoms, a higher proportion of peripheral arthritis pattern, higher swollen or damaged joint counts, and a lower proportion of axial inflammation than newly established patients (Table 4). Furthermore, established patients had a significantly higher proportion of receiving DMARDs, methotrexate, and NSAIDs than newly diagnosed patients, while Ps duration and proportion of nail involvement were comparable. Six (8.1 %) of newly established PsA had at least 1 damaged joint, a significantly lower proportion than established PsA at 16 (31.4 %). The newly established PsA patients also had a significantly lower mean tragus to wall distance than the established patients, while the other spinal ranges of motion were not significantly different (Table 4).

Discussion

This study demonstrates that Thai EARP and PEST had good performance for screening PsA in a Ps clinic. However, the sensitivities of PEST and EARP in the present study were lower than in the primary validation studies of Ibrahim et al. [7] and Tinazzi et al. [8]. The different performances among the studies may result from various characteristics of the participants [10, 20]. Different PsA patterns in the study population may influence performance of tools [10]. Haroon et al.'s [10] study reported that the sensitivities of PEST and ToPAS were significantly higher in patients with polyarticular disease than non-polyarticular patients. It may also result from a tool's performance itself. Ideally, a tool should capture all PsA manifestations. All current tools assess peripheral joints, while inflammatory axial symptoms are evaluated only in EARP [8], PASE [21], and ToPAS II [9]. Both PEST [7] and EARP [8] question about enthesitis. Coates, et al.'s study showed that PEST and ToPAS missed a higher proportion of patients with enthesitis or spinal involvement than articular disease [20]. This might result from the inability of both tools to capture

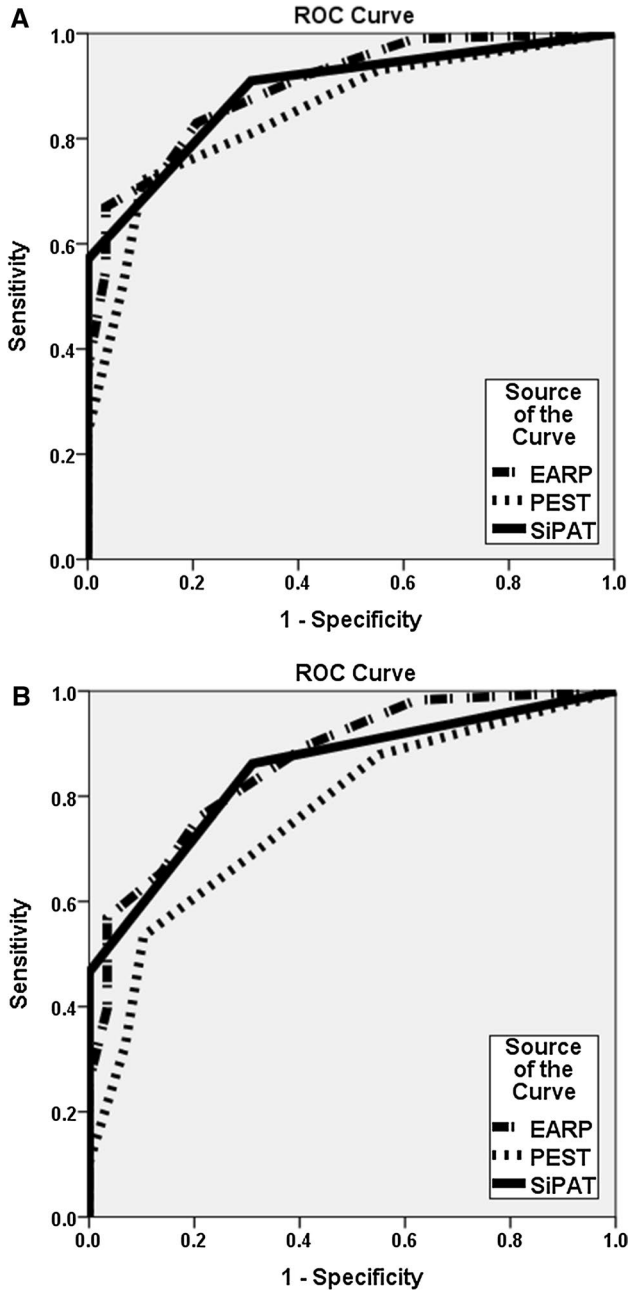

Fig. 1 Receiver operator characteristic (ROC) curves of the Thai version of the Early Arthritis for Psoriatic Patients questionnaire (EARP), the Thai version of the Psoriasis Epidemiology Screening Tool questionnaire (PEST), and Siriraj Psoriatic Arthritis Screening Tool (SiPAT): **a** all participants; **b** non-established psoriatic arthritis group at recruitment

all PsA features. Thai PEST in the present study had a very low sensitivity in pure axial inflammation. This was expected because it did not question about axial involvement. The proportion of pure axial involvement in the present study was 4.7 %, which was lower than the 17.0 % in Coates's study [20]. The lower proportion of patients with axial involvement in the present study might have contributed to the higher sensitivity of PEST found compared with Coates's study [20]. Recall bias may also explain the different performances among the studies because PsA patient already knowing the diagnosis may recall their symptoms better than those who are naïve. Haroon's study reported that the sensitivity of PEST in the established PsA group was much higher than in the unknown diagnosis group at 86 and 27.5 %, respectively [10]. The sensitivities of Thai PEST and EARP in the present study were slightly lower in the naïve PsA group but remained reasonable for EARP (Table 3).

Moll and Wright described 5 clinical patterns of PsA: (1) distal joint arthritis, (2) symmetric polyarthritis, (3) asymmetric oligoarthritis, (4) spondylo-arthropathy, and (5) arthritis mutilans. However, PsA patients may have more than 1 pattern simultaneously, and patterns may change during life [4]. To simplify classification for the practitioner, PsA may be classified into 3 major patterns: (1) peripheral joint arthritis, (2) axial inflammation, and (3) enthesitis. Thai SiPAT followed this concept and consisted of 3 questions. The sensitivities of Thai SiPAT were slightly higher, and the specificities were slightly lower than those of Thai EARP and PEST in all 3 patterns (Table 3). The AUC of SiPAT was comparable to those of Thai EARP, and PEST at 0.89, 0.90, and 0.85, respectively. SiPAT missed 9 % of PsA cases, while Thai EARP and PEST missed 17 and 18 %, respectively. Of PsA patients missed by the SiPAT, 8 (8 %) patients were peripheral arthritis pattern (data not shown); they answered as fingers hurt ($n = 3$), feet or ankles hurt ($n = 3$), elbows or hips hurt ($n = 2$), and finger hurt ($n = 1$) and swelling for more than 3 days ($n = 1$). The SiPAT had only 1 question about peripheral arthritis (wrists and fingers swelling). Therefore, it missed identifying wrists and fingers pain or other joints. SiPAT over identified a higher proportion of PsA cases (31.0 %) than Thai EARP and PEST (20.7 and 10.3 %, respectively). Thus, the SiPAT could be a simple and user-friendly tool composed of only 3 questions. It has good performance as a screening tool for PsA among Ps patients in clinical practice, especially for non-rheumatologists.

A good and simple screening tool for PsA is needed to identify PsA patients at an early stage because several studies have shown that delayed diagnosis of PsA is a factor in joint damage progression [2, 22]. In the present study, Thai EARP could detect 75.9 % of new PsA patients, which was higher than Thai PEST (53.4 %). However, SiPAT had the highest sensitivity to detect new PsA patients (86.2 %). The newly established PsA patients in the present study had a significantly lower proportion of patients with at least 1 damaged joint than the established PsA patients, which is similar to Gladman's study [2, 4]. Detection of PsA at an early stage may result in early treatment to stop or reduce

Table 3 Performance of Thai version of the Early Arthritis for Psoriatic Patients questionnaire (EARP), Thai version of the Psoriasis Epidemiology Screening Tool (PEST), and the Siriraj Psoriatic Arthritis Screening Tool (SiPAT)

Tool	Area under the curve (95 % CI)	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	LR+	LR−
All psoriatic arthritis patients (n = 100)							
EARP	0.90 (0.84, 0.96)	83.0	79.3	93.3	57.5	4.00	0.21
PEST	0.85 (0.78, 0.92)	72.0	89.7	96.0	47.1	7.00	0.31
SiPAT	0.89 (0.83, 0.95)	91.0	69.0	91.0	69.0	2.94	0.13
Peripheral arthritis (n = 84)							
EARP	0.92 (0.87, 0.97)	88.1	79.3	92.5	69.7	4.25	0.15
PEST	0.88 (0.81, 0.94)	78.6	89.7	95.7	59.1	3.80	0.24
SiPAT	0.89 (0.83, 0.95)	90.5	69.0	89.4	71.4	2.92	0.14
Axial inflammation (n = 57)							
EARP	0.91 (0.85, 0.97)	84.2	79.3	88.9	71.9	4.07	0.20
PEST	0.85 (0.76, 0.93)	73.7	89.7	93.3	63.4	7.16	0.29
SiPAT	0.91 (0.86, 0.97)	93.0	69.0	85.5	83.3	3.0	0.10
Enthesitis (n = 61)							
EARP	0.92 (0.87, 0.98)	88.5	79.3	90.0	76.7	4.28	0.15
PEST	0.88 (0.81, 0.95)	78.7	89.7	94.1	66.7	7.64	0.24
SiPAT	0.93 (0.88, 0.98)	96.7	69.0	86.8	90.9	3.12	0.05
Pure peripheral arthritis (n = 22)							
EARP	0.81 (0.69, 0.93)	68.2	79.3	71.4	76.7	3.29	0.40
PEST	0.80 (0.67, 0.92)	59.1	89.7	81.2	74.3	5.74	0.46
SiPAT	0.77 (0.64, 0.91)	77.3	69.0	65.4	80.0	2.49	0.33
Pure axial inflammation (n = 6)							
EARP	0.86 (0.72, 1.00)	66.7	79.3	40.0	92.0	3.22	0.42
PEST	0.68 (0.44, 0.92)	33.3	89.7	40.0	86.7	3.20	0.74
SiPAT	0.84 (0.63, 1.00)	83.3	69.0	35.7	95.2	2.69	0.24
New established patients (n = 58)*							
EARP	0.87 (0.79, 0.94)	75.9	79.3	88.0	62.3	3.67	0.30
PEST	0.77 (0.67, 0.87)	53.4	89.7	91.2	49.1	5.18	0.52
SiPAT	0.85 (0.77, 0.93)	86.2	69.0	84.7	71.4	2.78	0.20

Cut point of EARP and PEST was three, while cut point of SiPAT was one. Patients with no PsA ($n = 29$) were included in all situations

CI confidence interval, *n* number of patients with the condition, *PPV* positive predictive value, *NPV* negative predictive value, *LR+* positive likelihood, *LR−* negative likelihood

* Newly established patients, computed only psoriasis patients who were not established psoriatic arthritis before recruitment

the progression of damage, which is possible with current medication available [23]. Therefore, detection of PsA at an early stage is important.

The strength of this study was all participants which were evaluated by a rheumatologist who was naïve about the questionnaire results. Full musculoskeletal investigation was also offered to all participants. Unfortunately, some refused to have imaging performed; however, most could be diagnosed as PsA by CASPAR. Also, possible patterns of PsA were further computed to estimate the performance of the tools according to musculoskeletal involvement. The performance of each tool decreased in pure peripheral arthritis or axial inflammation from combination involvement, and it was different among tools. Selecting the suitable tool for specific pattern of disease may help.

There were some weaknesses in the study. First, this study included both diagnosed and undiagnosed PsA patients. Established patients might have attempted to recall all symptoms. This may have resulted in overly sensitive tools; however, the present study demonstrated the performance of the tools in both established and unknown diagnoses groups. Second, patients taking systemic medication or NSAIDs for effectively controlling musculoskeletal symptoms were included. NSAIDs might have caused mimicking or a decrease in PsA prevalence. The collected status of such medications if they were used was defined as 'never,' 'past,' and 'current' to determine the result of the study. Third, although the study population was consecutive Ps patients who visited the Ps clinic, were willing to participate, and had musculoskeletal examination; people

Table 4 Comparison of characteristics of newly diagnosed psoriatic arthritis patients and established PsA patients

	Newly established psoriatic arthritis patients ($N = 74$)	Established Psoriatic arthritis patients ($N = 51$)	P value
Age, mean (SD) *y*	45.7 (13.3)	47.1 (11.3)	0.522[a]
Male (%)	51.4	58.8	0.410[+]
Duration Ps, median (IQR, min, max)	10.4 (15.7, 0.2, 38.2)	12.3 (10.1, 0.3, 52.3)	0.277[c]
Psoriatic nail (%)	71.6	70.6	0.900[+]
Positive RF, *n*/*N* (%)	8/63 (12.7)	2/29 (6.9)	0.496[++]
Duration of PsA symptoms, median (IQR, min, max) *y*	2.1 (4.1, 0.04, 39.1)	7.4 (7.8, 0.3, 26.8)	<0.001[c]
Pattern of involvement (%)			
Axial inflammation	63.5	45.1	0.042[+]
Peripheral joint	73.0	100	<0.001[+]
Enthesitis	60.8	62.7	0.827[+]
DMARDs (%)			<0.001[+]
Current	43.2	84.3	
Past	20.3	11.8	
Never	36.5	3.9	
Methotrexate (%)			<0.001[+]
Current	31.1	64.7	
Past	25.7	21.6	
Never	43.2	13.7	
Cyclosporine A (%)			0.822[++]
Current	12.2	9.8	
Past	5.4	7.8	
Never	82.4	82.4	
Other DMARDs (%)			<0.001[++]
Current	0	29.4	
Past	2.7	17.6	
Never	97.3	52.9	
NSAIDs (%)			0.027[+]
Current	14.9	29.4	
Past	24.3	33.3	
No	60.8	37.3	
Physical examination			
Tender joint count, median (IQR, min, max)	0 (2, 0–51)	0 (2, 0–22)	0.066[+]
Swollen joint count, median (IQR, min, max)	0 (1, 0–20)	0 (3, 0–23)	0.031[c]
Damaged joint count, median (IQR, min, max)	0 (0, 0, 8)	0 (1, 0, 45)	0.001[c]
Enthesitis, median (IQR, min, max)	0 (1, 0, 22)	0 (1, 0, 11)	0.483[c]
Dactylitis, median (IQR, min, max)	0 (0, 0–2)	0 (0, 4, 4)	0.110[c]
Cervical rotation, mean (SD) degree	73.2 (11.4)	72.4 (14.0)	0.736
Tragus to wall distance, mean (SD) cm	10.2 (2.3)	11.2 (2.7)	0.048[b]
Occiput to wall, median (IQR, min, max) cm	0 (0, 0, 10.5)	0 (0, 0, 11.0)	0.724[c]
Chest expansion, mean (SD) cm	4.3 (1.4)	4.2 (1.5)	0.728[a]

Table 4 continued

	Newly established psoriatic arthritis patients ($N = 74$)	Established Psoriatic arthritis patients ($N = 51$)	P value
Modified Schober, mean (SD) cm	4.7 (0.9)	4.5 (1.3)	0.479[b]
Lateral spinal flexion, mean (SD) cm	15.3 (4.1)	14.4 (4.4)	0.264[a]
Internal hip rotation, mean (SD) cm	37.3 (10.4)	33.5 (10.8)	0.070[a]

n number of positive condition, *N* total number of participants, *SD* standard deviation, *y* year, *Dur. Ps* duration of psoriasis, *IQR* interquartile range, *min* minimum, *max* maximum, *RF* positive serum rheumatoid factor, *DMARDs* disease modifying anti-rheumatic drugs included cyclosporine A, methotrexate, leflunomide, sulfasalazine, and anti-tumor necrotic factor alpha agent (aTNF); other DMARDs included leflunomide, sulfasalazine, anti-tumor necrotic factor alpha agent, *NSAIDs* non-steroidal anti-inflammatory drugs

[+] Chi-square

[++] Exact

[a] An independent *t* test equal variances

[b] An independent *t* test equal variances not assumed

[c] Mann–Whitney *U* test

with musculoskeletal symptoms may have been more likely to participate. This might have led to a higher prevalence of PsA in the sample of the present study. Finally, because SiPAT was developed from the characteristics of the current study population, the performance might not be similar in other populations. Therefore, further validation in other populations is needed.

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Compliance with ethical standards

Conflict of interest PC has received research grant from Pfizer (Thailand), Ltd, and a speaker honorarium from Pfizer, Janssen and Astellas (<$ 10, 000 each). WK has received a speaker honorarium from Pfizer, Janssen, and Astellas (<$ 10, 000 each). LW, VS, CP, and PS have no conflicts of interest.

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Informed consent Informed consent was obtained from all participants included in the study.

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