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The Epidemiology Psoriatic Arthritis

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Introduction

Psoriatic arthritis (PsA) is a chronic, progressive inflammatory arthritis that is common among patients with psoriasis and may result in permanent joint damage and disability. PsA was once considered a relatively benign disease, however research over the past twenty years has significantly changed this notion. We now know that PsA is a systemic inflammatory disorder with health consequences beyond joint function such as cardiovascular disease and similar outcomes to rheumatoid arthritis (RA) including the prevalence of erosions and joint destruction.[1, 2] Additionally, we have learned that patients with PsA have highly heterogeneous disease courses.[3] Development of more uniformly accepted classification criteria in 2006 have allowed for more comparable populations among epidemiologic studies. In this review, we discuss current knowledge around the epidemiology of psoriatic arthritis including prevalence of disease characteristics, classification of adult and pediatric psoriatic arthritis, the importance of early diagnosis of PsA including methods for screening and knowledge regarding risk factors for the development of PsA. Finally, medical comorbidities associated with PsA will be discussed.

Methods

We performed a systematic review by combining “psoriasis or psoriatic arthritis” with the following MeSH terms: epidemiology, classification, diagnosis, complications, mortality in

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Ovid Medline. This resulted in 8,936 citations. After limiting to English papers, humans, and 2006 to current, 3515 citations remained. Titles and abstracts were reviewed for these remaining papers. Papers were excluded if they did not refer to psoriasis or psoriatic arthritis (N=288), were case reports (N=644), reviews or editorials (N=383), or focused on basic science or immunology topics (N=210). Finally 7,134 papers were excluded because they focused on skin psoriasis exclusively or were not relevant to the topics of interest. We also included articles prior to 2006 if cited within articles retrieved by the Medline search and if they were considered highly relevant. Abstracts from meeting conferences were not included.

Prevalence and Incidence of PsA in the Population

A number of studies have examined prevalence of PsA in countries all over the world. Prevalence estimates in the United States range from 0.06–0.25% with the lowest estimate derived from a paper that utilized International Classification of Disease ninth edition (ICD-9) codes to identify cases and the highest from articles using patient self-report of diagnosis of PsA.[4–6] Prevalence estimates in Europe range from 0.05% in Turkey[7] and the Czech Republic [8] to 0.21% in Sweden.[9–12] Only a few reports of the prevalence of PsA in South America and Asia exist and suggest that the prevalence is lower in these regions (0.07% in Buenos Aires and 0.02% in China).[13, 14] The low prevalence of PsA in China may be due to underdiagnosis as suggested in a study by Yang et al.[15] Discrepancies in the prevalence of PsA among these studies is often related to differing definitions of PsA (e.g. use of ICD9 or medical codes versus use of clinical classification criteria). The incidence of PsA in the general population has been examined by relatively few studies. The reported incidence of PsA in recent publications ranges from 3.6–7.2 per 100,000 person years.[8, 13, 16, 17] However, publications in 2001–2003 reported a much wider incidence range (0.1–23.1).[18]

Prevalence and Incidence of PsA Among Patients with Psoriasis

While PsA has a low prevalence in the general population, it is common among patients with psoriasis. Again, prevalence estimates vary considerably (range 6%–41%) depending on the definitions used (i.e. diagnostic codes, rheumatologist diagnosis, classification criteria, diagnostic codes, and the populations measured.[11, 14, 15, 19–29] Wilson et al examined the cumulative incidence of PsA over time in patients with psoriasis and reported 1.7%, 3.1% and 5.1% respectively had developed PsA at 5, 10, and 20 years after their diagnosis of psoriasis.[17] Eder et al reported an annual incidence of 1.87% in a prospective cohort of 313 patients with psoriasis.[30]

Alternative Diagnoses, Missed Diagnoses and Misclassification in Studies of Psoriatic Arthritis

Studying the epidemiology of PsA is challenging given the absence of definitive, gold standard diagnostic tests for PsA and the heterogeneous manifestations of the disease. Additionally, patients with psoriasis often have other common reasons for joint pain such as osteoarthritis, gout and fibromyalgia, which can easily be mistaken for PsA.[31–35] When using diagnosis codes to define PsA, there is often a concern for misclassification given that patients with psoriasis could have one of these alternate diagnoses. Unfortunately, without

examination, this issue is difficult to resolve and this is often a tradeoff for the large sample sizes and rich outcome data afforded by administrative and medical record data. Similarly, studies examining outcomes in patients with PsA compared to psoriasis alone, even within a clinic-based population, may suffer from misclassification of patients with psoriasis and undiagnosed PsA. Studies examining the prevalence of PsA among patients with psoriasis have found that underdiagnosis is common.[15, 21, 26] Mease et al found a prevalence of PsA of 30% among patients with psoriasis and among the 285 patients with PsA, 117 (41%) were not previously diagnosed, suggesting a high prevalence of underdiagnosis.[26]

Defining and Classifying Psoriatic Arthritis

Classification criteria are designed to create more homogenous populations for research.[36] Several sets of classification criteria for PsA have been created since the original Moll and Wright criteria in 1973.[37] These include the Amor criteria, European Spondylarthropathy Study Group (ESSG) criteria, Vasey and Espinoza criteria, and Classification of Psoriatic Arthritis (CASPAR) criteria.[3, 38–43] There is a great deal of variability among the criteria components and test performance of each (sensitivity and specificity). Rheumatologist diagnosis is most commonly used as the reference standard.[44, 45] The CASPAR criteria are the most widely used criteria and their high sensitivity and specificity (both 90% or better in most studies but sensitivity as low as 77.3% in D'Angelo et al 2009) have been demonstrated in many settings including dermatology and rheumatology clinics, family practice clinics, and among early arthritis cohorts (despite early suggestions that CASPAR criteria are not ideal for early disease).[43, 46–51] Most recently, the Assessment of SpondyloArthritis International Society (ASAS) developed peripheral and axial spondyloarthropathy criteria. PsA could be classified under either of these criteria depending on whether axial involvement is present (Table 1).[52, 53] In a recent study by Van den Berg et al, the peripheral spondyloarthropathy criteria were found to have much lower sensitivity for early PsA compared to CASPAR criteria using the diagnosis from the treating rheumatologist as the gold standard.[47] It is unclear what role the new ASAS criteria will play in studies of PsA.[54]

Psoriatic arthritis is a heterogeneous disease

PsA is a clinically heterogeneous disorder. Five subtypes of psoriatic arthritis were initially defined by Moll and Wright: mono- or oligoarthritis, polyarthritis, distal interphalangeal (DIP) joint predominant disease, psoriatic spondylitis and/or sacroiliitis, and arthritis mutilans.[37] We now recognize that patients can have any combination of the disease features: peripheral arthritis (mono-, oligo-, or polyarticular with or without DIP involvement), enthesitis, dactylitis, spondylitis and/or sacroiliitis, as well as psoriatic nail disease.[3] Peripheral arthritis (either oligoarticular or polyarticular depending on the cohort examined) is the most common disease manifestation. Arthritis mutilans, while one of the original five subtypes of PsA identified by Moll and Wright, is felt to be overall quite rare. However, the prevalence of arthritis mutilans is difficult to determine given the varied definitions.[55] As noted, the relative prevalence of the various manifestations varies considerably by site and study (Figure 1).[15–17, 23, 29, 56–61] This is particular due to the highly varied definitions of subtypes (e.g. allowing for more than one manifestation or exclusive classification) but also may reflect different subtypes in different populations, the duration of PsA in the population studied, the duration of psoriasis before PsA onset, or age

and gender distribution of the population.[3, 60, 62] Recognizing the patient's disease features at onset and when selecting therapies may be important to understanding disease and treatment outcomes.[63] For example, polyarticular disease has been associated with more erosive disease[64] and dactylitis may not respond as well to traditional oral DMARDs.[65]

Axial Spondyloarthropathy (AxSpA)—Axial disease or psoriatic spondylitis is present in 7–32% of patients with PsA and may be asymptomatic.[15, 23, 59, 66] Among patients with PsA without axial disease at presentation, nail dystrophy, number of radiographically damaged joints, periostitis and elevated ESR increased the risk of developing AxSpA over time.[66] Among patients with psoriatic spondylitis, younger age of disease onset was associated with HLAB-27 positivity, family history of SpA, enthesitis, and an isolated axial pattern (without peripheral arthritis). Later onset axial disease was more likely to be associated with polyarthritis and absence of inflammatory back pain. However, despite these differences, the two groups had similar patient reported outcomes including the Bath Ankylosing Spondylitis Disease Activity Index, Bath Ankylosing Spondylitis Functional Index, Bath Ankylosing Spondylitis Metrology Index, and Bath Ankylosing Spondylitis Radiology Index.[67] Recognition of AxSpA is important given differing treatment approaches and prognosis.[68, 69]

Enthesitis—Enthesitis, present in approximately half of patients, is hypothesized to be the site of disease initiation.[70] Enthesitis is generally more often found in the lower extremities with the Achilles and plantar aponeurosis the most commonly involved sites.[71] Unfortunately, examination of the entheses is often subjective, there is low interrater realibility even when standardized examination techniques are used, and tenderness on exam is often discordant with findings of inflammation on ultrasound or other imaging techniques.[72, 7373, 74] Thus, enthesitis is difficult to follow in studies of therapy effectiveness. The Leeds Enthesitis Index (LEI) is the most commonly used index in studies of PsA but others exist as well (described by Sakkas et al 2013).[71, 75] The LEI includes assessment of the lateral epicondyles, proximal Achilles, and medial femoral condyles.[75] Ultrasound and MRI examination of the enthesis has improved our understanding of enthesitis and may provide a more objective method to assess and quantify enthesitis.[76, 77]

Dactylitis—Dactylitis is a common feature in PsA, present in approximately 40% of patients at some point in their disease course, and can occur in either the feet or the hands.[65, 71, 78] About half of patients that have dactylitis have it in more than one digit.[71] MRI studies suggest that dactylitis is circumferential soft tissue edema in addition to synovitis and tenosynovitis.[79] However, in a recent radiographic and histologic evaluation of dactylitis in a child, radiographic features included enhanced signal at digital entheses in the absence of synovitis and tenosynovitis.[80] Histologically there was increased vascularity of the tenosynovium and fibromyxoid expansion of fibrous tissue with perivascular lymphocytic inflammation.

Nail Disease—Features of nail psoriasis include pitting, onycholysis, oil spots, linear pitting, and splinter haemorrhages.[25, 81–83] Nail psoriasis can be quite painful and result in decreased functional ability and quality of life.[84] The prevalence of nail disease among

patients with PsA ranges from 41–93%. In fact, most studies have found that nail disease is more common in patients with PsA than patients with psoriasis alone. The prevalence of nail disease in PsO is around 15–50%.[23, 81, 83, 85–88] Nail disease (pitting and onycholysis in particular) have been associated with inflammation at the enthesis where the extensor tendon connects to the nail unit[89] and is often correlated with DIP joint involvement.[90, 91] Furthermore, thickening of the entheses of the extensor tendon on ultrasound was more common in patients with clinical nail changes.[92] Nail psoriasis is a risk factor for the development of PsA among patient with PsA, possibly because it is an early sign of enthesial inflammation.[17]

Imaging features and distinguishing characteristics from RA—Psoriatic arthritis is associated with both bone erosions and new bone formation (i.e. juxta-articular bony proliferation). Erosions occur commonly and often very early in the disease course[61, 93] Kane et al found the prevalence of erosions was 27% within the first five months of disease onset and nearly half within two years of disease onset.[93] Interestingly, Finzel et al reported the number of erosions were similar among patients with RA and PsA although the shape and location of the erosions were different between the two groups.[2] In this study, osteophytes were more commonly seen among patients with PsA than RA. The number of erosions in PsA was correlated with disease duration and the osteophyte count was correlated with age but not disease duration.[2] Juxta-articular bony proliferation (not including osteophytes) is among the most specific radiographic features of PsA (as are tuft osteolysis and interphalagenal bony ankylosis).[43, 94] However, DIP erosions, periosteoal new bone formation, and diffuse soft tissue swelling also may help distinguish RA from PsA.[94] Studies using MRI[95, 96] and ultrasound[97] examined differences among patients with RA and PsA. Findings from these studies have corroborated the differential locations of erosions between RA and PsA and the increased entheseal disease and periosteal involvement in PsA. Additionally, imaging studies have demonstrated that there is more disease activity present on imaging than noted on physical examination (nearly 75% in one study by Freeston et al) although the clinical significance of this is not well understood.[92, 98–100]

Psoriatic Arthritis in Children

Psoriasis and PsA are not limited to adults. Juvenile psoriasis has a prevalence of approximately 0.7% increasing from 0.12% at age 1 to 1.2% at age 18.[101, 102] Juvenile PsA (JPsA) accounts for approximately 6–8% of all cases of juvenile arthritis;[74, 103, 104] Unlike adult PsA, inflammatory arthritis precedes skin psoriasis in about half of children with JPsA.[105] This often makes the diagnosis and classification of JPsA quite challenging. Two sets of classification criteria for JPsA exist: the Vancouver criteria for PsA and the International League of Associations for Rheumatology (ILAR) criteria (Table 2). The ILAR criteria are the widely used criteria for classifying juvenile idiopathic arthritis (JIA) and include the following categories: oligoarticular, RF positive polyarticular, RF negative polyarticular, systemic, enthesitis-related arthritis (ERA), JPsA, and undifferentiated arthritis.[106, 107] As shown in Table 2, the ILAR criteria include a number of restrictions on the diagnosis of JPsA, placing as many as 40% of children who meet Vancouver criteria into the undifferentiated category of JIA (children who meet criteria for more than 1 JIA

category). Thus, there is some debate about how to best define JPsA.[105, 108] An improved definition for JPsA may be important as long term outcomes are potentially different among patients with JPsA compared to other forms of JIA. Among patients with JPsA, 33% still required DMARDs or bDMARDS after 15 years of follow up compared to 8–13% of patients in other JIA groups.[109]

Similar to adult PsA, JPsA is a highly heterogeneous disease.[110] The prevalence of nail disease and dactylitis (approximately 50% each) is similar to adult PsA and, enthesitis is also common (present in 27% in one study).[110] Forty to 88% have an affected first or second degree relative and axial involvement affects 10–40%.[109, 111] However, disease manifestations seem to differ by age. Stoll *et al* described two peaks in onset with the first in toddlers (1–2 years) and the second in early adolescence (age 8–12 years). Younger children (age <5) were more likely to be female and to have dactylitis, small joint involvement and a positive ANA whereas older children were more likely to have persistent oligoarthritis, spondylitis, and enthesitis.[102, 110, 112] Development of asymptomatic anterior uveitis is associated with ANA positivity and younger age of disease onset.[113] Also similar to adult psoriasis, juvenile psoriasis is associated with an increased prevalence of obesity and comorbidities (including hyperlipidemia, diabetes, hypertension and Crohn's disease).[101] This relationship has not been examined specifically in JPsA.

Recognition of Early Psoriatic Arthritis

"Early" PsA is generally considered within the first two years of symptom onset.[114] Increasing evidence supports the early diagnosis and treatment of PsA in order to improve long term outcomes.[114–117] Gladman et al found patients presenting within 2 years of symptom onset had significantly less disease progression after adjusting for baseline characteristics including start of DMARD therapy at the first visit.[115] Treatment outcomes may also be different among patients with early PsA.[118] A cohort study within the Swedish Early Psoriatic Arthritis Register found that shorter symptom duration at diagnosis and start of therapy was a predictor of minimal disease activity at 5 years, again suggesting that the earlier disease is identified, the better the outcomes.[119] Sorensen et al recently reported an improvement in the delay from symptoms to diagnosis among patients with PsA and RA in Denmark.[120] However, underdiagnosis still remains a significant problem.[26]

Subclinical Disease in Patients with Psoriasis

Given that early initiation of therapy may decrease joint damage and improve long term outcomes, how early should therapy be initiated? It has long been recognized that patients may not report symptoms of joint pain or may not be aware of joint inflammation. Several studies demonstrate that patients with psoriasis often have "subclinical" joint and entheseal inflammation.[121, 122] The prevalence of subclinical synovitis and enthesopathy among patients with psoriasis ranges from 3 to 46% and 7 to 33%, respectively. In most studies, the frequency of these findings are significantly higher in patients with psoriasis than in healthy controls.[92, 123–128] The meaning of subclinical joint inflammation remains unclear. However, some patients with subclinical inflammation go on to develop symptomatic PsA.[129]

Improving Detection of Psoriatic Arthritis among Patients with Psoriasis

How can we better identify PsA? Understanding risk factors for PsA among patients with psoriasis could help identify patients with psoriasis who are more likely to develop the disease.[130] Additionally, the use of screening tools for PsA in dermatology clinics could facilitate improved recognition of existing disease.

Risk Factors for Psoriatic Arthritis—A handful of studies have examined risk factors for PsA among patients with psoriasis (**Box 1**). Most of the risk factors identified have not been replicated in additional studies with the exception of obesity, family history of PsA, and injuries or trauma.[131, 132] Smoking is generally considered to be a risk factor for psoriasis.[133–135] However, studies of smoking as a risk factor for PsA are mixed with one suggesting an inverse association and one suggesting a positive association.[134, 136]

Screening for Psoriatic Arthritis—Screening for PsA can be as simple as asking about the presence of arthralgias to the use of validated screening tools.[146–148] Several groups have developed questionnaires to assist in identification of psoriasis patients with PsA. These questionnaires each have a cut off value which suggests a high likelihood of having inflammatory arthritis, prompting subsequent rheumatology evaluation. [148] Screening tools generally should have high sensitivity[149] but given the difficulty with access to rheumatology in many countries, screening for PsA should ideally also have high specificity. Most of the screening tools developed have relatively high sensitivity and specificity in the initial validation studies. However, subsequent studies have noted decreased sensitivity and/or specificity when applied in new populations.[24, 150–152] No studies have examined the effectiveness of a screening tool versus usual care in capturing patients with PsA and the overall impact of screening on health care utilization.

Comorbidities in Psoriatic Arthritis

Over the past decade, our understanding of PsA as systemic disease has significantly expanded.[164] Approximately 40% of patients with PsA had three or more comorbid conditions and the presence of a comorbidity was associated with decreased quality of life.[165] Comorbidities reported to have an increased prevalence or incidence in PsA are reported in **Box 2**. Longitudinal studies suggesting increased incidence are denoted by the asterisk. The increased risk for metabolic abnormalities including cardiovascular disease and diabetes have been the most striking and of greatest importance to management of patients with PsA.[166] While one study has suggested a risk of malignancy similar to RA, population based studies have not suggested an increased risk of cancer, including lymphoma, compared to controls.[167–169] Osteoporosis is similarly debated; however, most studies do not suggested an increased prevalence of osteoporosis.[170–172] Increased prevalence of diffuse skeletal hyperostosis (DISH)[173], monoglonal gammopathy[174], and iridocyclitis[175] compared to general population statistics have also been reported. Despite the increased prevalence of comorbidities, recent studies have not found an increased risk of mortality among patients with PsA.[5, 176–180]

Summary

Psoriatic arthritis is a chronic inflammatory arthritis with potentially significant functional disability and poor outcomes including cardiovascular disease. Early detection of psoriatic arthritis is important for improvement in long term outcomes. Use of screening tools and improved knowledge of risk factors could improve early detection.

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KEY POINTS

- Psoriatic arthritis is a clinically heterogeneous inflammatory arthritis that is common among patients with psoriasis.
- PsA remains under-diagnosed.
- Early identification of PsA is important in order to improve long term outcomes.
- Knowledge of risk factors for PsA and use of screening tools may improve recognition of PsA among patients with psoriasis.

SYNOPSIS

Psoriatic arthritis (PsA) is a chronic systemic inflammatory disorder characterized by joint and entheseal inflammation with prevalence 0.05–0.25% of the population and 6–41% of patients with psoriasis. PsA is a highly heterogeneous inflammatory arthritis. In this review, we discuss current knowledge regarding the epidemiology of PsA including disease manifestations, classification criteria for adult and juvenile PsA, methods for recognizing early PsA including use of screening tools and knowledge on risk factors for PsA, and medical comorbidities associated with PsA.

Box 1: Potential Risk Factors for Psoriatic Arthritis

Nail Dystrophy

Injury/Trauma/Bone Fracture[137, 138]

Family history of psoriatic arthritis[139, 140]

Obesity[141, 142]

Elevated BMI at age 18[143]

Smoking*[134, 136, 138]

Lifting cumulative loads of >100 pounds/hour[138]

Severe psoriasis[139]

Psoriasis location: scalp lesions, intergluteal/perianal lesions[17]

Corticosteroids in the 2 years prior to psoriasis onset (through PsA onset)[144]

Rubella vaccinations[137]

Recurrent oral ulcers[137]

Moving to a new house[137]

Infections requiring antibiotics[138]

Hypercholesterolemia[145]

Box 2: Comorbidities Associated with PsA

Hypertension[61, 181–183]

Dyslipidemia[61, 181–183]

Diabetes/Insulin Resistance*[184, 185]

Metabolic Syndrome[186–188]

Obesity[11, 186, 187]

Cardiovascular disease including myocardial infarction and cerebrovascular disease*[1, 166, 189–191]

Depression and Anxiety[192]

Crohn's disease* [193, 194]

Ulcerative colitis[193]

Keratoconjunctivitis sicca[195]

Hypothyroidism[196]

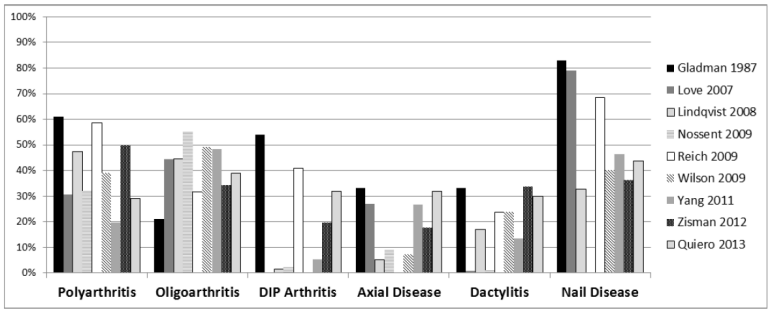

Figure 1. Variability of Disease Characteristics by Study

The prevalence of oligoarthritis, polyarthritis, axial disease, dactylitis and nail disease in a handful of studies is shown above. These manifestations of psoriatic arthritis, the definitions of the manifestations, and the populations included vary considerably by study. For example, Gladman, Lindqvist and Love present data for patients at the first visit whereas Wilson and Reich report data at incident diagnosis. Lindqvist represents a population of patients with early disease (<2 years duration). Axial disease particularly defined quite differently by study. Lindqvist used the original Moll and Wright subgroups to classify patients. Therefore, in that particular study, axial disease as represented here only refers to patients without peripheral arthritis (those patients are classified as oligo- or polyarthritis). In Love et al., axial disease represents patients with inflammatory back pain.

Table 1

Commonly used classification criteria for PsA* and new ASAS criteria for peripheral and axial SpA.

Moll and Wright	CASPAR	Peripheral SpA		Axial SpA	
All three of the following:	Inflammatory articular disease (joint, spine or enthesial) with ≥3 points from the following 5 categories:	Arthritis or enthesitis or dactylitis plus either:		Sacroiliitis on imaging plus ≥1 SpA feature	HLA-B27 plus ≥2 SpA feature
1. Inflammatory arthritis (peripheral arthritis or sacroiliitisor spondylitis) 2. Psoriasis 3. Negative rheumatoid factor (usually)	1. Current psoriasis (2 pts), personal history of psoriasis or family history of psoriasis (1 Pt) 2. Psoriatic nail dystrophy (onycholysis, pitting or hyperkeratosis) on exam (1 pt) 3. Negative rheumatoid factor (1 pt) 4. Current dactylitis or history of dactylitis recorded by rheumatologist (1 pt) 5. Evidence of juxtaarticular new bone formation (excluding osteophytes) on plain radiographs of the hand or foot (1 pt)	≥1 SpA feature: Uveitis Psoriasis Crohn's/ ulcerative colitis Preceding infection HLA-B27 Sacroiliitis on imaging	≥2 other SpA features: Arthritis Enthesitis Dactylitis Inflammatory back pain ever Family history of SpA	SpA features: Inflammatory back pain Arthritis Enthesitis Dactylitis Psoriasis Crohn's/ulcerative colitis Good response to NSAIDs Family history of SpA HLA-B27 Elevated CRP	

* See Table 1 from Eder L & Gladman DD Curr Rheumatol Rep 2013; 15:316 for comparison of additional classification criteria.

Table 2

Comparison of Vancouver criteria for JPsA and ILAR criteria for JPsA*

	Vancouver	ILAR
Inclusion	Arthritis plus psoriasis OR Arthritis plus at least 2 of the following: dactylitis, nail pits, family history of first-or second-degree relative, psoriasis-like rash	Arthritis plus psoriasis OR Arthritis plus at least two of the following: dactylitis, nail pits or onycholysis, family history of first-degree relative
Exclusion	None	Arthritis in HLA-B27 positive male ≥6 years old AS, ERA, sacroilitis with IBD, reactive arthritis, or acute anterior uveitis, OR history of one of these disorders in a first-degree relative. Presence of IgM RF on at least two occasions at least 3 months apart. The presence of systemic JIA Arthritis fulfilling ≥2 JIA categories

Under the Vancouver criteria, definite JPsA is arthritis plus psoriasis or arthritis plus 3 minor criteria.

Presence of 2 minor criteria is considered probable JPsA.

Abbreviations: JPsA=juvenile psoriatic arthritis; ILAR = International League of Associations for Rheumatology; AS = ankylosing spondylitis; ERA = enthesitis-related arthritis; IBD = inflammatory bowel disease; RF = rheumatoid factor; JIA = juvenile idiopathic arthritis

Adapted from Stoll M, Lio P, Sundel RP and Nigrovic PA. Arthritis Care and Research 2008; 59(10): 51–58; with permission.

* Arthritis must be of unknown etiology, begin before the sixteenth birthday, and persist for at least 6 weeks.

Table 3

Available Screening Tools

Screening Tool	Publication(s)	Description and Caveots	Validation Population	Test Characteristics in Initial Studies	Test Characteristics in Subsequent Studies
Psoriatic Arthritis Screening and Evaluation (PASE)	Husni 2007[153] Dominquez 2009[154] Ferreyra 2013[155]	Total of 15 questions with score range 15–75. Has been translated into Spanish. Captures disease activity so use of concomitant therapy may change results.[156, 157]	Patients with psoriasis, PsA before therapy, and osteoarthritis. The reference standard was rheumatologist's diagnosis and Moll and Wright Criteria.	Cut-off 47/75 Sensitivity 82% Specificity 73% Cut-off 44/75 Sensitivity 76% Specificity 76% Spanish Version: Cutoff 34/75 Sensitivity 76% Specificity 74%	Haroon 2013: Sensitivity 24% Specificity 94% Coates 2013: Sensitivity 75% Specificity 39% Walsh 2013: Cutoff 44 Sensitivity 76% Specificity 41% Cutoff 47 Sensitivity 63% Specificity 52%
Toronto Psoriatic Arthritis Screen (ToPAS)	Gladman 2009[158]	12 questions. This questionnaire is unique in its inclusion of photographs of inflamed joints and dactylitis.	Patients with PsA, psoriasis, general dermatology, general rheumatology and family medicine. The reference standard was a rheumatologist diagnosis of PsA.	Cut-off 8/12 Psoriasis 89.1%, 86.3%; Dermatology 91.9%, 95.2%; Rheumatology 92.6%, 85.7%; Family medicine 90.4%, 100%.	Mease 2014: Sensitivity 77% Specificity 72% Haroon 2013: Sensitivity 41% Specificity 90% Coates 2013: Sensitivity 77% Specificity 30% Walsh 2013: Sensitivity 60% Specificity 55%
Psoriasis Epidemiology Screening Tool (PEST)	Ibrahim 2009[159]	5 questions (swollen joints, history of arthritis, heel pain, nail pitting, dactylitis) and a manikin. The manikin does not add to the discriminative ability or scoring but may be helpful to the clinician.	Patients with psoriasis identified by medical codes, mailed questionnaire and 55% of the respondents were examined. The reference standard was a rheumatologist diagnosis.	Cut-off 3/5. Sensitivity 92% Specificity 78%	Mease 2014: Sensitivity 84% Specificity 75% Haroon 2013: Sensitivity 28% Specificity 98% Coates 2013: Sensitivity 77% Specificity 37% Walsh 2013: Cutoff 44

Screening Tool	Publication(s)	Description and Caveots	Validation Population	Test Characteristics in Initial Studies	Test Characteristics in Subsequent Studies
					Sensitivity 69% Specificity 47%
Electronic Psoriasis and Arthritis Screening Questionnaire (ePASQ)	Khraishi 2011[160]	Ten yes or no questions plus two follow up questions with weighted scoring for each and a diagram to mark painful joints which is also weighted.	Patients with suspected early PsA. The reference standard was CASPAR criteria.	Cut-off 7/15 Sensitivity 98% Specificity 75% Cut-off 8/15 Sensitivity 88% Specificity 75%	Mease 2014: Sensitivity 67% Specificity 64%
Early Arthritis for Psoriatic Patients (EARP)	Tinazzi 2012[161]	Ten items questionnaires with yes or no answers asking about joint and/or tendon pain, swelling and stiffness.	Patients with psoriasis but not systemic therapy. Patients with existing arthritis were excluded. The reference standard was CASPAR criteria applied by a rheumatologist.	Cut-off 3/10 Sensitivity 85% Specificity 92%	N/A
CEPPA Screening Tool	Garg 2014[162]	5 questions inquiring about history of joint pain or swelling, morning stiffness, diagnosis of PsA, history of joint xrays, and presence of nail changes.	All adults presenting for psoriasis evaluation within dermatology (with or without PsA). Only patients reporting joint pain were examined. The reference standard was a rheumatologist's diagnosis.	Cut-off 3/5 Sensitivity 86.9% Specificity 71.3%	N/A
CONTEST and CONTESTjt	Coates 2014[163]	Developed from combinations of questions from PASE, PEST, and TO PAS. Validated within Dublin and Utah cohorts using data from Haroon et al and Walsh et al.	Patients with psoriasis. Patients reaching the previously published cutoff for either PASE, PEST or ToPAS were invited for physical exam. The reference standard was CASPAR criteria.	CONTEST: Cut-off 4/8 Sensitivity 38–86% Specificity 35–89% CONTESTjw: Cut-off 5/8 Sensitivity 57–89% Specificity 37–71%	N/A

The sensitivity and specificity used for the subsequent studies was for the cohort of patients with psoriasis but without previous diagnoses of psoriatic arthritis.