A validation study of the Simple Psoriatic Arthritis Screening (SiPAS) questionnaire to screen psoriasis patients for psoriatic arthritis

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Abstract

Objective
To validate in a multicentric cohort of patients a self-administered PsA screening tool, called Simple Psoriatic Arthritis Screening (SiPAS) questionnaire, to screen psoriasis patients for signs and symptoms of PsA.

Methods
The SiPAS questionnaire was validated in a multicentric Italian cohort of psoriasis patients referred to two rheumatological centres.

Results
A total of 202 psoriasis patients were screened with SiPAS in the validation study. Sixty-two psoriasis patients (30.7%) were diagnosed with PsA. The five screening questions (1. Have you ever had a finger or a toe and/or another joint swollen and painful without any apparent reason?; 2. Occasionally, has an entire finger or toe become swollen, making it look like a 'sausage'?; 3. Do you wake up at night because of low back pain?; 4. Have you had pain in your heels?; 5. Has a doctor ever diagnosed you with psoriatic arthritis?) with a dichotomous response, demonstrated high sensitivity and specificity for predicting PsA. Likelihood ratios for individual parameters varied between 2.06 and 4.75. Using the Bayesian Analysis, the presence of three of five items answered as "yes" showed respectively a sensibility and a specificity of 79% and 87%, with a positive likelihood ratio of 6.14.

Conclusion
The SiPAS questionnaire is able to quickly screen psoriasis patients for PsA. A SiPAS score ≥3 is an indication for referral to a rheumatologist. The SiPAS needs further validation.

Key words
psoriatic arthritis, psoriasis, screening questionnaire, SiPAS

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Introduction

Psoriatic arthritis (PsA) is a disease with an estimated prevalence of 0.5% in the general population (1), while the prevalence of PsA among patients with psoriasis ranges approximately from 6% to 44%, equally distributed in males and females (2-5). An European survey of 1,511 patients with psoriasis attending a dermatology clinic revealed that 21% of them had PsA and only 3% of them were already diagnosed (6). The protean manifestations of PsA, including many domains, are challenging for early detection and clinical metrology of the disease, both from the patient perspective and from the physician perception (7-9). Early diagnosis of PsA could prevent permanent joint damage or spinal fusion and could improve long-term patient outcome. Unfortunately, delay in diagnosis is quite common: 27% of early PsA patients has erosions at the time of diagnosis (10). Several factors contribute to the delay in the diagnosis of PsA. The lack of awareness among patients of the relationship between skin disease and joint symptoms and the absence of a specific diagnostic marker are the main. However, it is not possible that for all psoriasis patients to be evaluated by a rheumatologist (6, 11), and time constraints on many dermatologists might preclude routine questioning regarding joint symptoms. Keeping in mind these issues, several screening tools, to be completed by the patient in the dermatologist's waiting room, have been designed to identify those psoriasis patients with musculoskeletal manifestations of PsA. In this respect, recent consensus guidelines for managing psoriasis, recommend using questionnaires to screen for the presence of PsA (12-14). Most of these screening questionnaires developed, such as the Psoriatic Arthritis Screening and Evaluation (PASE) (15), the Psoriasis Epidemiology Screening Tool (PEST) (16), the Toronto Psoriatic Arthritis Screen (ToPAS) (17) and the Toronto Psoriatic Arthritis Screen version 2 (ToPAS-2) (18), the Early Arthritis for Psoriatic Patients (EARP) (19), the Psoriasis and Arthritis Questionnaire (PAQ) (20), the Psoriasis and Arthritis Screening Questionnaire (PASQ) (21),

and the Center of Excellence for Psoriasis and Psoriatic Arthritis (CEPPA) (22) have been validated in a variety of independent populations. However, the sensitivity and specificity of these instruments is well under 50% when the polyarticular forms of arthritis are excluded (23).

Due to the existing problems of the screening tools available, we already developed and tested in a preliminary way a self-administered questionnaire, called Simple Psoriatic Arthritis Screening (SiPAS), to screen psoriasis patients for signs and symptoms of PsA (24).

The aim of the present study is to provide a validation of the SiPAS in a multicentric cohort of psoriasis patients.

Materials and methods

The development of a self-administerd questionnaire for screening usually follows a series of major steps, such as 1. population identification, 2. item pool development, 3. item reduction, 4. pilot-testing of the prototype instrument, and 5. validation study. The first four steps were completed in the preliminary study (24). Here is a provided a summary.

Population identification

The purpose of this instrument is to screen psoriasis patients for the presence of PsA. So, the target population was patients with Pso but without a previous diagnosis of PsA. Subjects who were considered to have a diagnosis other than psoriasis were excluded. Additional exclusion criteria were as follows: other inflammatory rheumatological conditions (*e.g.* gout, calcium pyrophosphate dyhidrate crystal deposition, rheumatoid arthritis), medical comorbidity that would render the patient unable to partecipate fully in study procedures (*e.g.* terminal conditions such as end-stage renal disease, heart failure, or malignancy), major cognitive deficits or psychiatric symptomatology that would preclude questionnaire completion.

Item pool development

We adopted a Delphi procedure to select items for the provisional question-

Table I. The top 10 ranked items and the final five (bold lines) items satisfing the inclusion criteria for the SiPAS questionnaire.

60 experts (49 rheumatologists+11 dermatologists)	Frequency (%)	Mean importance (MI)	Frequency importance product (FIP)
1. Have you ever had a finger or a toe and/or another joint swollen and painful without any apparent reason? (Question number 1+question number 5 of PEST)	**96.67**	**2.65**	**256.17**
2. Occasionally, has an entire finger or toe became swollen, making it look like a "sausage"? (Question number 6 of PASE)	**91.67**	**2.48**	**227.33**
3. Do you wake up at night because of low back pain? (Question number 3 of EARP)	**90.00**	**2.24**	**201.60**
4. Have you had pain in your heels? (Question number 4 of PEST)	**86.67**	**2.26**	**195.86**
5. Has a doctor ever diagnosed you with psoriatic arthritis? (Question number 12 of ToPAS)	**75.00**	**2.04**	**153.00**
6. Have you ever had back pain lasting at least 3 months that was not injury related?	83.33	1.96	163.33
7. Do you feel stiffness in your hands for more than 30 minutes in the morning?	83.33	1.79	149.17
8. The morning is the worst time of day for me	76.67	1.55	118.83
9. Have you ever noticed any changes in your fingernails like pits or lifting of the nail from the nail bed?	56.67	1.98	112.20
10. Have you ever had neck pain lasting at least 3 months that was not injury related?	76.67	1.41	108.10

naire (25). The general methodology used to develop this questionnaire have been previously adopted (26, 27). The method employed for item generation was built on the experience of both rheumatologists and dermatologists. Predefined areas of screening were culled from seven existing screening questionnaires, namely ToPAS, ToPAS 2, PASE, PEST, EARP, PASQ, and CEPPA. By the end of this step 65 items were identified.

Item reduction
The necessity for item reduction was driven by the feasibility of carrying a large number of redundant items through the subsequent validation study. Obviously, a questionnaire with 65 items would be clinically impractical. Therefore, the goal was to retain 5-8 items that are the most important to the patient and are representative of PsA. In order to reduce the number of items, the following exclusion rules were applied: (a) gender based items, (b) questions requiring special equipment, (c) ambiguously worded items, (d) elimination of alternatives, (e) elimination of duplicates or similarities, (f) fusion of kindred items (*e.g*. questions 1 and 5 of PEST, referring to peripheral joint pain or swelling have been condensed in item number 1). The end result of the process of item reduction was a pool of 31 items.
This list of 31 items was submitted to 49 rheumatologist and 11 dermatologists (not previously involved in item gen-

eration). The experts were asked to rate the importance of each single item in the early detection of symptoms or signs of PsA. The importance was assigned on a Likert scale from zero to three: 0 = irrelevant; 1 = slightly relevant; 2 = quite relevant; 3 = very relevant. Then, the mean relevance scores for each item were calculated. It was considered that the mean score of an item must be at least 2.0 (possible range from 0 to 3.0) to justify inclusion into the questionnaire. Additionally, we considered the frequency with that each of the 60 physicians ranked ≥2 the individual items. For this process, questions that met a prevalence ≥70% were retained. The frequency importance product (FIP = frequency x mean relevance score) was then generated for each item. The top 10 ranked items are reported in Table I. The final questions that satisfied the criteria for the inclusion in the final questionnaire (frequency ≥70% and mean relevance score ≥2.0) were five (Table I), with a dichotomous answer ("yes" or "no"). The total score was calculated by summing the questions answered "yes" (range 0–5). The Italian translation of the five questions was performed in a consensus of three authors (FS, MDC, and MML).

Pilot testing
The pilot-testing of the SiPAS questionnaire was conducted in a cross-sectional cohort of 109 psoriasis patients (24). The tool allowed us to identify 24 (22%) patients with PsA in accordance

to the Classification Criteria for Psoriatic Arthritis (CASPAR) (28). In this preliminary validation study, the likelihood ratios (LR) for having a diagnosis of PsA for each ask answered "yes" resulted respectively: +2.4 for question 1, +3.1 for question 2, +2.1 for question 3, +2.5 for question 4, and +2.0 for question 5. We affirmed that a total score ≥3 or a post-test probability (the five questions of the SiPAS questionnaire are juxtaposed to the Fagan nomogram, and the post-test probability is given by the intercepted point of the nomogram on the straight line connecting the pre-test probability (22%) and the LRs product of the questions registered as "yes") ≥80% were highly suggestive for the presence of a PsA.

Validation study
The validation study, to confirm the properties of the screening instrument, was leaded from September 2016 to February 2017 in three dermatology units (Dermatological Clinic, Università Politecnica delle Marche, Ancona; Dermatology Unit, "Carlo Urbani" Hospital, Jesi, Ancona; Dermatology Unit, "Istituto Nazionale di Riposo e Cura per Anziani - INRCA" Hospital, Ancona) that referred the Pso patients to two rheumatology units (Rheumatological Clinic, Università Politecnica delle Marche, Jesi, Ancona; Medical Clinic, Università Politecnica delle Marche, Ancona). Psoriasis patients aged >18 years able to read and understand Italian were included in the
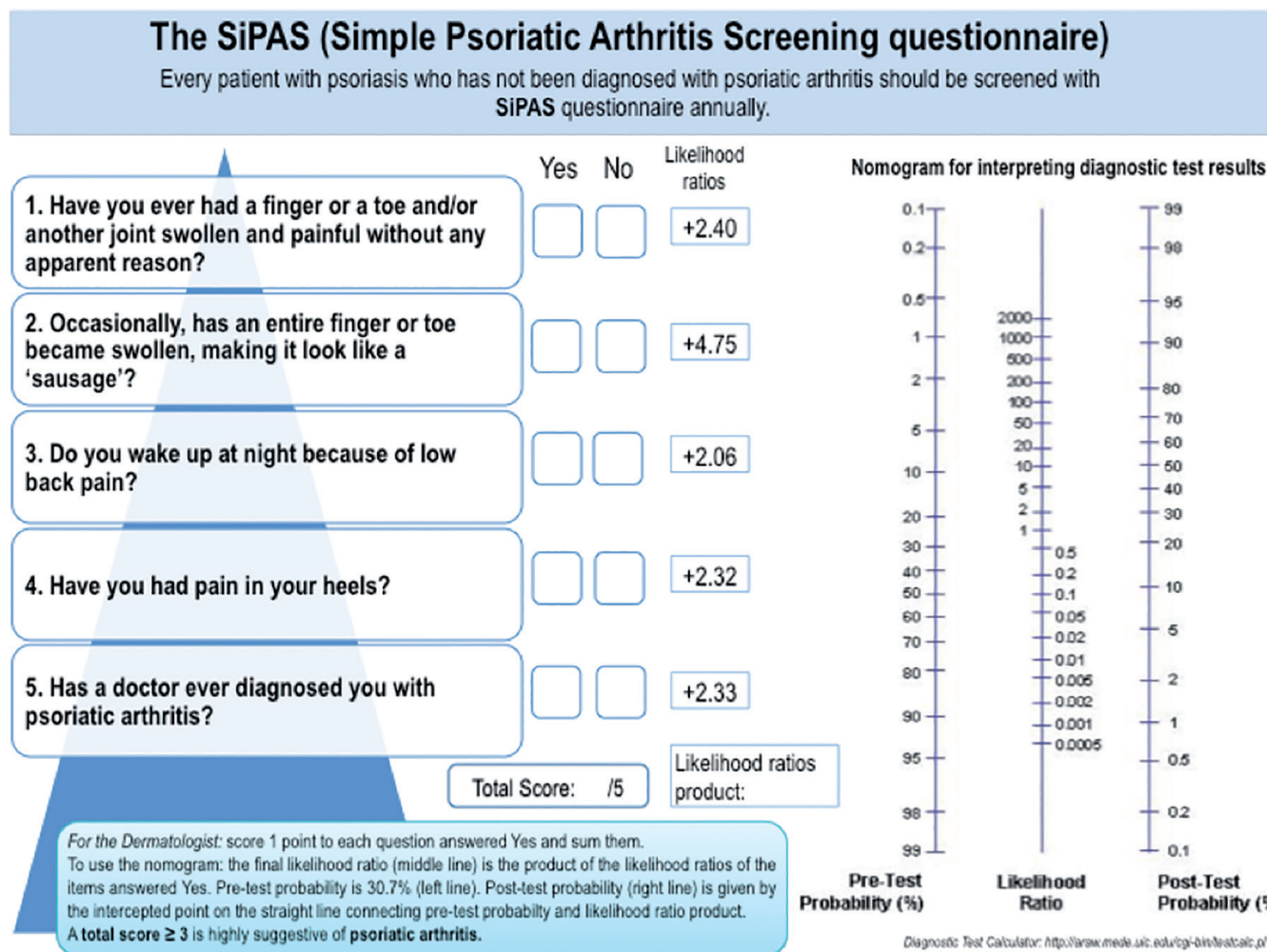
The SiPAS (Simple Psoriatic Arthritis Screening questionnaire)

Every patient with psoriasis who has not been diagnosed with psoriatic arthritis should be screened with **SiPAS** questionnaire annually.

	Yes	No	Likelihood ratios
1. Have you ever had a finger or a toe and/or another joint swollen and painful without any apparent reason?	☐	☐	+2.40
2. Occasionally, has an entire finger or toe became swollen, making it look like a 'sausage'?	☐	☐	+4.75
3. Do you wake up at night because of low back pain?	☐	☐	+2.06
4. Have you had pain in your heels?	☐	☐	+2.32
5. Has a doctor ever diagnosed you with psoriatic arthritis?	☐	☐	+2.33

Total Score: /5

Likelihood ratios product:

Nomogram for interpreting diagnostic test results

Pre-Test Probability (%) — Likelihood Ratio — Post-Test Probability (%)

Diagnostic Test Calculator: http://araw.mede.uic.edu/cgi-bin/testcalc.pl

For the Dermatologist: score 1 point to each question answered Yes and sum them.
To use the nomogram: the final likelihood ratio (middle line) is the product of the likelihood ratios of the items answered Yes. Pre-test probability is 30.7% (left line). Post-test probability (right line) is given by the intercepted point on the straight line connecting pre-test probabilty and likelihood ratio product.
A **total score ≥ 3** is highly suggestive of **psoriatic arthritis**.

Fig. 1. The graphic representation of the SiPAS questionnaire.

study. Exclusion criteria were the same of the pilot-testing phase. Psoriasis was diagnosed by a dermatologist on the basis of the results of clinical and/or histologic examinations. The subjects filled in the SiPAS in the dermatologic setting, in order that the assessment would not impact the response to the questionnaire. Then, patients were assessed by a rheumatologist (blinded to the SiPAS results, but aware that the subjects were suffering from psoriasis and were sent from the dermatologist) in accordance to a standard protocol, including a complete history and physical examination, routine laboratory tests, and rheumatoid factor evaluation. Radiographs, magnetic resonance imaging, and articular ultrasound were performed if needed. Two rheumatologists (MDC and MML) examined the patients. The rheumatologists diagnosed a patient with PsA applying the

CASPAR classification criteria (28). All patients agreed to be enrolled in the study and gave their informed consent for anonymous analysis of data. The study was approved by the Ethics Boards of the University-Hospital (Comitato Unico Regionale - ASUR Marche) and was conducted in accordance with the principles expressed in the Helsinki Declaration.

Statistical analysis and SiPAS interpretation
Sensitivity and specificity of a diagnostic test, in combination with the pre-test probability (the prevalence of the condition), allow the calculation of the post-test probability of the target disorder after a positive or negative test. We estimated the post-test probability applying the Bayesian Analysis Model method (http://araw.mede.uic.edu/cgi-bin/testcalc.pl).

Comparisons among combinations of items were ranked for their ability to identify disease the calculation of the positive LR (LR+). The LR reflects the direction and strength of evidence provided by a test result. It is calculated by dividing the likelihood of the test result among patients with the condition by the likelihood of this same test result among patients without the condition. The values of the LR range from zero to infinity. The interpretation of likelihood ratios is intuitive: the larger the positive likelihood ratio, the greater the likelihood of disease; the smaller the negative likelihood ratio, the lesser the likelihood of disease. If the LR is close to 1, then the test will not provide much information. It was aforementioned that the SiPAS questionnaire put together the five screening items with the Fagan nomogram (Fig. 1). The Fagan nomogram is widely recognised as a conveni-
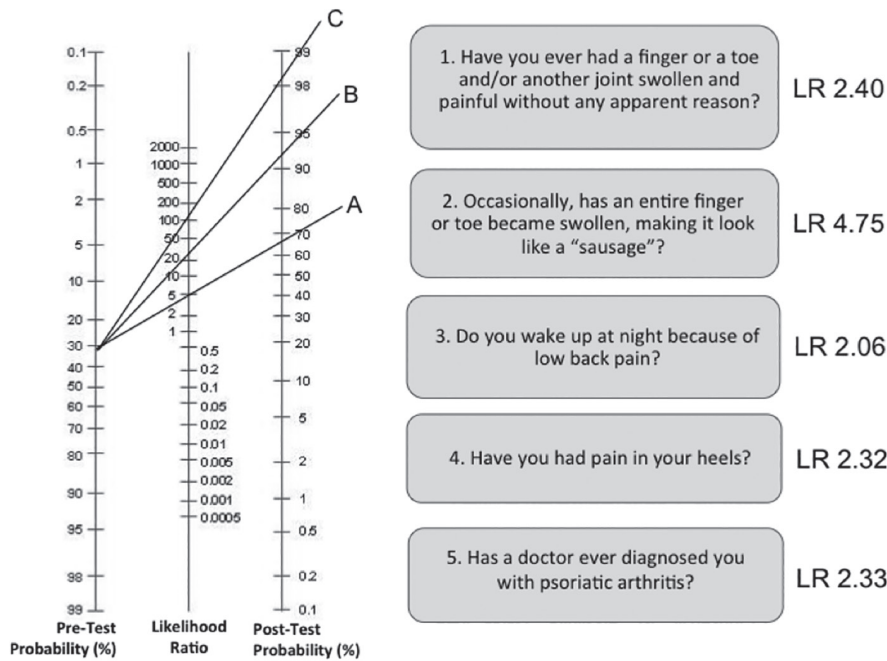
Fig. 2. Examples of application of the nomogram in the calculation of the post-test probability.
To calculate the actual disease probability in a given patient with psoriasis, the likelihood ratios (LR) of each item characteristic in that patient can be multiplied. The resulting LR product depends on both the number of characteristics and the LR of each item. It is first necessary to calculate separately the likelihood ratio of positive and negative test results (LR+ and LR– , respectively) using conventional formulae (LR+= DSe/(1–DSp) and LR–= (1–DSe)/DSp). Given that the patient came from a high-risk population with an estimated prevalence of 30.7%, the likelihood ratio product of the two questions about inflammatory back pain (item 3) and about entheseal involvement (item 4) is 4.78 with a result-ant post-test disease probability of 67.9% (line A). The likelihood ratio product of the three questions about entheseal involvement (item 4), joint pain/swelling (item 1) and dactylitis (item 2) is 26.4, with resultant post-test disease probability of 92.1% (line B). The likelihood ratio product of all the five items is 128, with resultant post-test disease probability of 98.3% (line C).

ent graphical calculator and is frequently referenced in evidence-based medicine and clinically applied epidemiology textbooks. To use the Fagan nomogram (as depicted in Fig. 2), a line must be drawn from the estimated pretest probability (left axis) through the likelihood ratio (LR) of the observed test result (centre axis) and the intersection of the line with the right axis provides the post-test probability (30). The Bayes' theorem, and thus the nomogram, is the proper approach to interpret the result from one test at a time. The nomogram can be downloaded at: https://mclibrary. duke.edu/sites/mclibrary.duke.edu/files/ public/guides/nomogram.pdf
Figure 2 presents the single LR+ of each SiPAS item (discussed below) and the combined LRs of possible scenari-os, with examples of the nomogram in-terpretation. In this case, with a screen-ing tool of five items, the final LR+ is the product of the questions answered in affirmative way.

Results
A total of 230 subjects were evaluated. All participants were affected by psoria-sis and underwent to the administration of the SiPAS questionnaire during the visit to the dermatologists. Of these, af-ter the rheumatologic evaluation 46 pa-tients were diagnosed as having another rheumatic disease mimicking PsA, and were excluded. Respectively, in eight patients was diagnosed a gout, in five subjects was diagnosed an erosive hand osteoarthritis, in four partecipants was detected a Modic type 1 lesion at the lumbar spine, in one patient was present a complex regional pain syndrome type 1 at the hip level, and in 29 patients was diagnosed a fibromyalgia. Eleven pa-tients did not complete the evaluation process. The remaining 202 patients (117 women and 85 men; respectively the 42.07% and the 57.93%, with a mean age of 49 years) were evaluated by a rheumatologist, out of which 62 were diagnosed with PsA and 140 were

thought to not have PsA. Hence, the prevalence of PsA in our population was estimated to be 30.69%.
Among the 62 patients diagnosed with PsA, the 100% answered "yes" at least in one of the five items. Fifty-nine (95.16%) patients filled in at least two "yes", 49 (79.03%) patients put at least three "yes", and 17 (27.41%) patients wrote up four "yes". No patient placed five "yes". On the other hand, in the 140 patients without PsA, 51 (36.42%) pa-tients replied zero "yes", 89 (63.57%) subjects put at least one "yes", 52 (37.14) patients replied at least two "yes", 16 (11.49%) partecipants an-swered at least three "yes", while 4 (2.86%) patients placed four "yes" (Ta-ble III). No psoriasis patient without ar-ticular disease filled in five "yes".
The disease probability was based on the self-reported presence of signs and symptoms of PsA that could be related to the questions about joint pain/swell-ing (item 1), dactylits (item 2), inflam-matory back pain (item 3), entheseal involvement (item 4) and previous di-agnosis of arthritis (item 5).
Among the screening items, dactylitis had the best LR+ (4.75). Sensitivity, specificity, and LR+ of the screening items are summarised in Table II.
As already mentioned, to calculate the PsA probability in a given patient with psoriasis with the SiPAS questionnaire, the LRs of each items in that patient have to be multiplied. For example, the LRs product of the two questions about entheseal involvement (2.32) and inflammatory back pain (2.06) was 4.78, with resultant post-test disease probability of 67.9%. The LR product of the three questions about joint pain/ swelling involvement (2.40), dacty-litis (4.75), and entheseal involvement (2.32) was 26.45, with a resultant post-test disease probability of 92.1%. The LR product of all the five items was 128, with a resultant post-test disease probability of 98.3%.
The presence of at least three of five items answered as "yes", showed re-spectively a sensibility and a specific-ity of the 79% and 87%, with a LR+ di 6.14. This circumstance (at least 3 "yes") can be considered as the cut-off point for the dermatological referral.

Table II. Sensitivity, specificity, positive and negative predictive values, likelihood ratios, and post-test probabilities of various screening questions (202 psoriasis patients, 62 with a concomitant psoriatic arthritis, pre-test probability 0.3069).

	Item 1 Have you ever had a finger or a toe and/or another joint swollen and painful without any apparent reason?	Item 2 Occasionally, has an entire finger or toe became swollen, making it look like a "sausage"?	Item 3 Do you wake up at night because of low back pain?	Item 4 Have you had pain in your heels?	Item 5 Has a doctor ever diagnosed you with psoriatic arthritis?	At least 3 items answered "Yes"
Sensitivity	0.79	0.64	0.51	0.53	0.50	0.79
Specificity	0.67	0.86	0.75	0.77	0.78	0.87
Positive likelihood ratio	**2.40**	**4.75**	**2.06**	**2.32**	**2.33**	**6.14**

Table III. SiPAS questionnaire results in the patients diagnosed with and without psoriatic arthritis.

	Zero answers "yes"	At least 1 answer "yes"	At least 2 answers "yes"	At least 3 answers "yes"	At least 4 answers "yes"	At least 5 answers "yes"
Patients diagnosed with PsA (n. 62)	0 (0%)	62 (100%)	59 (95.16%)	49 (79.03%)	17 (27.41%)	0 (0%)
Patients without PsA (n. 140)	51 (36.42%)	89 (63.57%)	52 (37.14%)	16 (11.49%)	4 (2.86%)	0 (0%)

Discussion

Early diagnosis of PsA is very important as early treatment can prevent joint damage, improve long-term patient outcomes, and can avoid unnecessary morbidity (31-34). Results from the Multinational Assessment of Psoriasis and Psoriatic Arthritis Survey (MAPP) showed that 44% of patients with psoriasis reported having joint pain, and ~33% of these patients reported having symptoms resembling enthesitis and/or dactylitis (5). In the PREPARE (Prevalence of Psoriatic Arthritis in Adults with Psoriasis: An Estimate From Dermatology Practice) multicentre study (35), subjects diagnosed with psoriasis by dermatologists were also evaluated by rheumatologists. PsA was diagnosed in almost one third of psoriasis patients, and of these, 41% had not been aware they had PsA before participating in the study. Similarly, a French study showed that up to 29% of patients with psoriasis seen by dermatologists have undiagnosed PsA (36). The challenge is to identify early those subjects with musculoskeletal disease. Dermatologists are requested to interview patients with few key questions regarding peripheral inflammatory pain, axial inflammatory pain, entheseal involvement or dactylitis, in order to uncover evidence of PsA and prompt a subsequent rheumatological referral (35, 36), and to date many validated screening questionnaire are available (15-22).

Recently different works directly compared questionnaires with the aim to identify one questionnaire that can be recommended for routine clinical use (36). Three head-to-head comparisons showed conflicting results, all recognising problems in identifying PsA. The PREPARE study pointed out that PASQ, PEST, and ToPAS are useful screening tools that can help dermatologists identify patients without PsA and patients with possible PsA who may benefit from rheumatologist assessment (35). In the Comparison of Three Screening Tools to Detect Psoriatic Arthritis in Patients with Psoriasis (CONTEST) study, Coates *et al.* compared head-to-head PASE, PEST, and ToPAS in secondary care dermatology clinics in 10 centres in the United Kingdom (38). The sensitivities and specificities of all three questionnaires were lower than previously found, with slightly disappointing areas under the

Table IV. Comparative performance of the screening tools questionnaires for psoriatic arthritis in patients with psoriasis.

Screening tool	Setting	Items (number)	Visual supports	Cut-off	Sensitivity (%)	Specificity (%)
PASE	Dermatology and rheumatology clinics	15	-	47 44	24-82 76-78	50-73 40-76
ToPAS and ToPAS2	Dermatology, phototherapy, rheumatology and family medicine clinics	12 12	Skin, nail images. Also inflamed joints and dactylitis in ToPAS2	8 8	41-87 96	55-93 99
PEST	Primary care	5	Mannequin (areas of tenderness)	3	28-92	45-78
PASQ and ePASQ	Dermatology and rheumatology clinics	10 8	Mannequin (joint involved)	7 7	67-93 88-98	75 75
EARP	Dermatology clinics	10	-	3	79-85	35-92
CEPPA	Dermatology clinics	5	-	3	87	71
SiPAS	Dermatology clinics	5	Fagan nomogram (for dermatologists)	3	79	87

curve (AUCs) of approximately of 0.6. In particular, sensitivities, specificities, and AUCs of the receveir operating characteristic curves were respectively: PASE 74.5%, 38.5%, 0.594; PEST 76.6%. 37.2%. 0.610; ToPAS 76.6%, 29.7%, 0.554. More recently, Walsh *et al*. assessed patients with psoriasis who completed the PASE, PEST, and ToPAS questionnaires (39). Even in this work, the sensitivities of the screening tools were similar (68–85%) to those of the PREPARE study (67–84%). However, compared to PREPARE study, specificities were lower both in CONTEST study and in the work of Walsh and colleagues (30–39% and 45–55% *vs*. 64–75%, respectively). Haroon *et al*. evaluated the performance of PASE, PEST, and ToPAS tools in a population of patients with severe psoriasis but without established PsA (23). Lower sensitivities (24–41%) were found compared to the overall PREPARE population (67–84%). However, a conclusive and univocal judgement about the most suitable screening questionnaire has not yet been found. A latest comparison included also the EARP questionnaire (40). Compared to PASE, PEST, and ToPAS-2, EARP revealed the best sensitivity (91%, and specificity 88%), while ToPAS-2 had the superior specificity (97%, with a sentivity of 44%). Table IV summarises the main features of the screening tools mentioned.

Certainly, further refinement of questionnaires is needed to enhance their specificity and sensitivity.

The CONTEST questionnaires were the first attempt to derive a new screening questionnaire starting from the most discriminative items of the already existing tools (41, 42).

We aimed to develop and validate a new easy, quick, and well working PsA screening tool. Our preliminary analysis attempted to identify the most discriminatory questions from any of the available questionnaires, starting from the opinion of the experts. The Delphi study selected the five items with marked percentages of choises among rheumatologists and dermatologists (24). Compared to ToPAS, PAQ, EARP, and PASE, the SiPAS described here, similarly to PEST, has only five

Fig. 3. The SiPAS calculator.

parameters, making it a quick screening tool for dermatologists with comparable sensitivity and specificity. The Scottish Intercollegiate Guidelines Network (SIGN) guidelines recognised a five-items instruments as an appropriate screening tool for a high volume clinical setting (13).

We have used LRs for each question in combination with pre-test probability of PsA in a psoriasis population to calculate the post-test probability of presence of PsA. This methodology, used also in the validation of CEPPA questionnaire (22), has advantages over sensitivity and specificity. It presents the overall usefulness of a diagnostic test balancing both sensitivity and specificity, and it allows the user to predict the probability of the disease based on patient characteristics (43). Bayes' theorem provides a useful method to estimate the risk for disease given the a priori risk and the LR of a diagnostic test (44).

The LRs, implemented with the Fagan nomogram (30), are particularly useful for developing a diagnostic ladder based on a composition of diagnostic tests or clinical symptoms or multi-item questionnaire. The Fagan nomogram is the simplest of Bayes' theorem calculators to help practitioners to determine the probability of a patient truly having a condition of interest given a particular test result. It is particularly useful for the clinical practice when speed is favoured over precision without the need of a calculator or computer (30). For example, the 30.7% probability of

PsA in the population of patients with psoriasis, increases to 50.7% for a patient with entheseal involvement (item 4), to 71.1% if this patient also has joint pain/swelling (item 1), to 92.1% if is reported a dactylitis too (item 2). The LRs product of all the five items was 128, with resultant post-test disease probability of 98.3%.

The validation study confirmed the good properties of the instrument already explored in the pilot testing. In this multicentric validation, we found a slightly higher prevalence of PsA (30.7% *vs*. 22%). The LRs of all the items resulted comparable to those of the previous work, except for item 2. For dactylitis, the LR was augmented more than one point (4.75 *vs*. 3.1). In a higher number of patients, this remark confirms the fact that dactylitis is a very specific symptom of PsA.

In summary the LRs represent simple instruments to build a diagnostic algorithm aligned to the daily clinical practice. This is in accord with the generally accepted principles of decision analysis (43).

In subjects in whom there is a suspicion of PsA, a SiPAS score ≥3 is an indication for referral to a rheumatologist.

Two main limitations to this study may have introduced bias. First of all, the voluntary participation of rheumatologists and dermatologists could have affected the results. In this referral model, rheumatologists were aware that patients were sent by a dermatologist, and this fact could have introduced an evalution bias. However, the prevalence of

PsA is consistent with previous Italian works (2). Secondly, a potential weakness is that the proposed LRs were defined in three centres in a relatively limited geographical area. Therefore, the results may not be generalisable to all countries, since populations with different cultural values (*e.g.* on pain, or on physical limitations in general) may respond differently to the questionnaire items. Finally, this questionnaire has not been validated in a prospective cohort. As demonstrated in previous studies, the sensitivity and specificity of screening questionnaires may vary widely when validated in different populations (45).

Their performance against other proposed screening instruments for PsA should be evaluated in other clinics and for other study designs.

In conclusion, the SiPAS questionnaire can be a powerful tool to help dermatologists to quickly screen PsA. Based on the available literature (46) and our personal experiences (47-49), we considered useful the development of a mobile phone app of SiPAS questionnaire, called "SIPAS calculator" (Fig. 3), to simplify and assist the dermatologist during his clinical practice. The performance of the SiPAS questionnaire, against other proposed screening instruments for PsA should be evaluated in other clinics in future studies.

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