



Clinical science

The comparative performance of three screening questionnaires for psoriatic arthritis in a primary care surveillance study

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Abstract

Objectives: The objective of this study was to compare the performance of three PsA screening questionnaires in a primary care psoriasis surveillance study.

Methods: Participants with psoriasis, and not known to have PsA, were identified from general practice databases and invited to attend a secondary care centre for a clinical assessment. The three patient-completed screening questionnaires (PEST, CONTEST and CONTESTjt) were administered, along with other patient-reported measures, and a clinical examination of skin and joints was performed. Participants who demonstrated signs of inflammatory arthritis suggestive of PsA were referred, via their GP, for a further assessment in a secondary care rheumatology clinic.

Results: A total of 791 participants attended the screening visit, and 165 participants were judged to have signs and symptoms of inflammatory arthritis, of which 150 were referred for assessment. Of these, 126 were seen and 48 were diagnosed with PsA. The results for each questionnaire were as follows: PEST: sensitivity 0.625 (95% CI 0.482, 0.749), specificity 0.757 (0.724, 0.787); CONTEST: sensitivity 0.604 (0.461, 0.731), specificity 0.768 (0.736, 0.798); and CONTESTjt: sensitivity 0.542 (0.401, 0.676), specificity 0.834 (0.805, 0.859). CONTESTjt demonstrated marginally superior specificity to PEST, though the area under the ROC curve was similar for all three instruments.

Conclusion: Minimal differences between the three screening questionnaires were found in this study, and no preferred questionnaire is indicated by these results. The choice of which instrument to choose will depend on other factors, such as simplicity and low patient burden.

Keywords: psoriasis, PsA, screening tools, outcome measures

Rheumatology key messages

- Screening for prevalent PsA in people with psoriasis helps to identify previously undiagnosed PsA.
- Several patient-completed questionnaires are available to help screen for PsA in people with psoriasis.
- This study has shown no clear superiority of any of the tested screening questionnaires.

Introduction

The incidence of PsA in a psoriasis population varies between 20 and 300 per 10 000 person-years [1, 2], the wide range reflecting differences in the population setting and the methods of ascertaining a diagnosis. The prevalence of PsA also differs according to the population sampled: the prevalence is up to 30% in secondary and tertiary care, but is less in the community [3, 4]. Cross-sectional prevalence studies consistently identify previously undiagnosed cases of PsA in people

with psoriasis, and earlier identification of these people would likely mean better outcomes for them. National guidance recommends that people with psoriasis are offered an annual assessment for PsA [5]. However, this is not uniformly implemented, and the current method of assessment is not standardized. Several screening tools have been developed for identifying cases of PsA in people with psoriasis, and the annual application of such tools would partly fulfil the need to assess for PsA. In the UK, the National Institute for Clinical

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Excellence (NICE) reviewed the performance of all questionnaires and recommended the Psoriasis Epidemiology Screening Tool (PEST); in the USA, the National Psoriasis Foundation have also adopted this screening tool [6].

NICE raised concerns about the performance of the PEST, particularly in certain PsA subtypes (oligoarthritis, axial and pure enthesal disease [5]). The PEST was initially developed in a general practice setting, but has had extensive further study in both primary and secondary care settings, often in comparison with other screening questionnaires. In one such study, the most discriminatory items from PEST and the other questionnaires (PASE and TOPAS) were used to design a new instrument (CONTEST), which was subsequently tested on data from the UK, Dublin and Utah. Analysis to date has shown, as might be expected, slightly improved performance of the CONTEST questionnaire compared with the other questionnaires [4, 7].

The TUDOR trial was designed to investigate whether the early detection of undiagnosed PsA in people with psoriasis results in improved outcomes. In addition to addressing this area of uncertainty, the trial allowed for a comparison of the performance of the PEST and CONTEST questionnaires during the initial screening phase. Here we report the results of that comparison.

Methods

TUDOR was a two-arm, 2-year, prospective, multicentre, parallel-group cluster randomized controlled trial conducted in primary and secondary care in three major areas (Bath, Stoke-on-Trent, and West Yorkshire) in the UK. GP practices were randomized on a 1:1 basis to either an enhanced surveillance arm (ES), or a standard care arm. Participants, aged 18–70 y, identified as having a READ code for psoriasis (and not PsA, AS or RA) were invited by letter to take part in the study. All consenting participants in the ES arm underwent a clinical assessment by a clinician who was either a consultant rheumatologist, a clinical research fellow, or a trained allied health professional. Clinical data included history and examination data, including details of psoriasis and arthritis, if present. Arthritis assessment included a full 68/66 tender and swollen joint count, a count of dactylitic digits, a Leeds Enthesitis count, and measures of spinal movement if inflammatory back pain was reported. At the baseline visit, participants also completed the Health Assessment Questionnaire (HAQ) and the PEST and CONTEST questionnaires. All participants with suspected inflammatory arthritis, as determined by the assessing clinician, were referred to their primary care physician, requesting formal referral to a hospital-based rheumatology outpatient clinic for a full assessment, including any necessary investigations. The final diagnosis rested with the rheumatology clinic, who were blind to the study and its procedures.

The PEST questionnaire consists of five questions, each with a simple yes/no answer. Each positive response scored 1 point: a threshold of 3 points has previously been used to indicate a positive test [8]. The CONTEST questionnaire contains 8 questions and a threshold of 4 was suggested in the development paper [7]. A further modification of the CONTEST questionnaire has been proposed—the use of the joint manikin (presented in the PEST questionnaire but not scored), in which a score of 1 was given if 6 or more joints on the manikin were ticked: in this case (CONTEST_{jt}) the optimal cut-off

was 5. The order of completion of PEST and CONTEST in the questionnaire packs was randomly assigned in a 1:1 ratio (PEST first/CONTEST first) to minimize any potential bias, i.e. an order effect.

Ethical approval for this study was given by the South West—Central Bristol Research Ethics Committee Ref: 16/SW/0161. All patients signed written consent in accordance with the Declaration of Helsinki.

Sample size and statistics

The TUDOR study aimed to recruit a minimum of 958 participants to the ES arm and assumed that 15% of these would be diagnosed with PsA at baseline. Thus, the precision estimates were based on a minimum of 144 participants with a new diagnosis of PsA (for sensitivity) and a minimum of 814 participants without PsA (for specificity).

Assuming sensitivity and specificity of the CONTEST questionnaire to be 70%, the precision of sensitivity was estimated to be a minimum of $\pm 11.2\%$ and that of specificity a minimum of $\pm 4.7\%$ (corresponding to half the width of a 95% CI around the parameter estimate), taking into account practice clustering.

Diagnostic accuracy of the PEST and CONTEST questionnaires was compared by calculating estimates and 95% CIs for differences between their sensitivity, specificity, and area under the receiver operating curve (ROC), using the diagnosis of PsA by the rheumatologist as the gold standard. Predefined decision thresholds (definition of positive results) of 4 for CONTEST, 5 for CONTEST_{jt}, and 3 for PEST were used for estimating sensitivity and specificity, but other cut-points were explored using the ROC and distance to (0, 1). Wald CIs are reported for sensitivity and specificity; Bonnet-Price CIs were also calculated as a sensitivity analysis. Positive and negative predictive values are also presented.

In the subjects with a final diagnosis of PsA, the following phenotypes were defined: polyarthritis, 5 or more swollen or tender peripheral joints using a 68 tender, 66 swollen joint count; oligoarthritis, fewer than 5 swollen or tender joints; enthesitis, 1 or more tender entheses using a combined LEI [9] and SPARCC [10] enthesitis assessment; dactylitis, one or more digits with dactylitis adjudged to be present by the examiner; axial disease, fulfilment of the modified New York criteria [11], or the ASAS criteria [12], or any radiographic or MRI evidence of SpA (such as sacroilitis or syndesmophytes) on imaging.

Results

1123 participants were recruited to the ES arm. Of these participants, 332 (29.6%) were excluded from the analysis due to not attending the baseline visit ($n = 330$, 29.4%) or not returning the PEST/CONTEST questionnaires ($n = 2$, 0.2%). A total of 791 participants attended the baseline visit and returned the PEST/CONTEST questionnaires. Of the 791 participants, there were 22 (2.8%) participants for whom a final clinical diagnosis was not available, leaving 769 participants with both index test scores and a final clinical diagnosis. At baseline, 165 participants were judged to have signs and symptoms of inflammatory arthritis, and 150 were referred for assessment. Of these, 126 were seen and received clinical judgement regarding PsA status. Of the 126, 48 (6.1%) participants were given a final diagnosis of PsA [45 were assessed

by CASPAR criteria and, of these, 38 (84.4%) had a CASPAR score of ≥ 3 , thus fulfilling the CASPAR criteria for PsA]. The participant flow is given in Fig. 1 and the patient demographics are given in Table 1.

Of the 721 participants in the ES arm with a negative PsA diagnosis, 304 (42.1%) of these participants were reported as displaying signs or symptoms of non-PsA musculoskeletal disorders. Of these, the most frequently reported were OA ($n=193$, 26.8%), mechanical back or joint pain ($n=37$, 5.1%), gout (13, 1.8%), injury (12, 1.7%) and muscular or other pain (12, 1.7%).

Sensitivity and specificity of questionnaires

The final clinical diagnoses are tabulated against questionnaire results in Table 2. Cut-off points, sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and distance to (0, 1) are given in Table 3. ROC curves demonstrating performance of the three questionnaires are given in Fig. 2. At the recommended cut-off points, the figures for sensitivity were similar (0.625, 0.604 and 0.542 for PEST, CONTEST and CONTESTjt, respectively), but the figure for specificity was higher for CONTESTjt (0.757, 0.768 and 0.834 for PEST, CONTEST and CONTESTjt, respectively).

The differences in sensitivity between the PEST and the CONTEST questionnaires are as follows: PEST—CONTEST: Wald 0.021 (−0.087 to 0.129), Bonnett-Price 0.021 (−0.097 to 0.137); PEST—CONTESTjt: Wald 0.083 (−0.030 to 0.196), Bonnett-Price 0.083 (−0.042 to 0.202). The

differences in specificity between the PEST and the CONTEST questionnaires are as follows: PEST—CONTEST: Wald −0.011 (−0.040 to 0.018), Bonnett-Price −0.011 (−0.040 to 0.018); PEST—CONTESTjt: Wald −0.076 (−0.104 to −0.049), Bonnett-Price −0.076 (−0.104 to −0.049). Area under the ROC curve (AUC) was similar for all three questionnaires [PEST: 0.787 (95% CI 0.727, 0.847); CONTESTjt: 0.765 (0.695, 0.835); CONTEST: 0.768 (0.699, 0.837)] (Fig. 2). The difference between the AUC were as follows: PEST—CONTESTjt: 0.022 (−0.023 to 0.067); PEST—CONTEST: 0.019 (−0.025 to 0.062).

Phenotype of PsA and relationship to questionnaire results

Table 4 gives the screening questionnaire results for each phenotype. Of the 48 subjects newly identified as having PsA, 16 (33.3%) had polyarthritis, 20 (41.7%) oligoarthritis, and 12 (25.0%) no peripheral arthritis. The median tender and swollen joint counts of those subjects with peripheral arthritis were 4 (IQR 2–7) and 2 (IQR 1–3) respectively, and the median skin body surface area affected by psoriasis was 4% (IQR 1.2% to 10.2%).

Of the 36 participants with peripheral arthritis, 11 (30.6%) also had enthesitis. There were 4 patients with pure enthesal disease. Of the patients with enthesitis, the median enthesitis score was 2 (IQR 1–4). Thirteen patients had dactylitis, with a median number of digits affected by dactylitis of 1 (IQR 1–2).

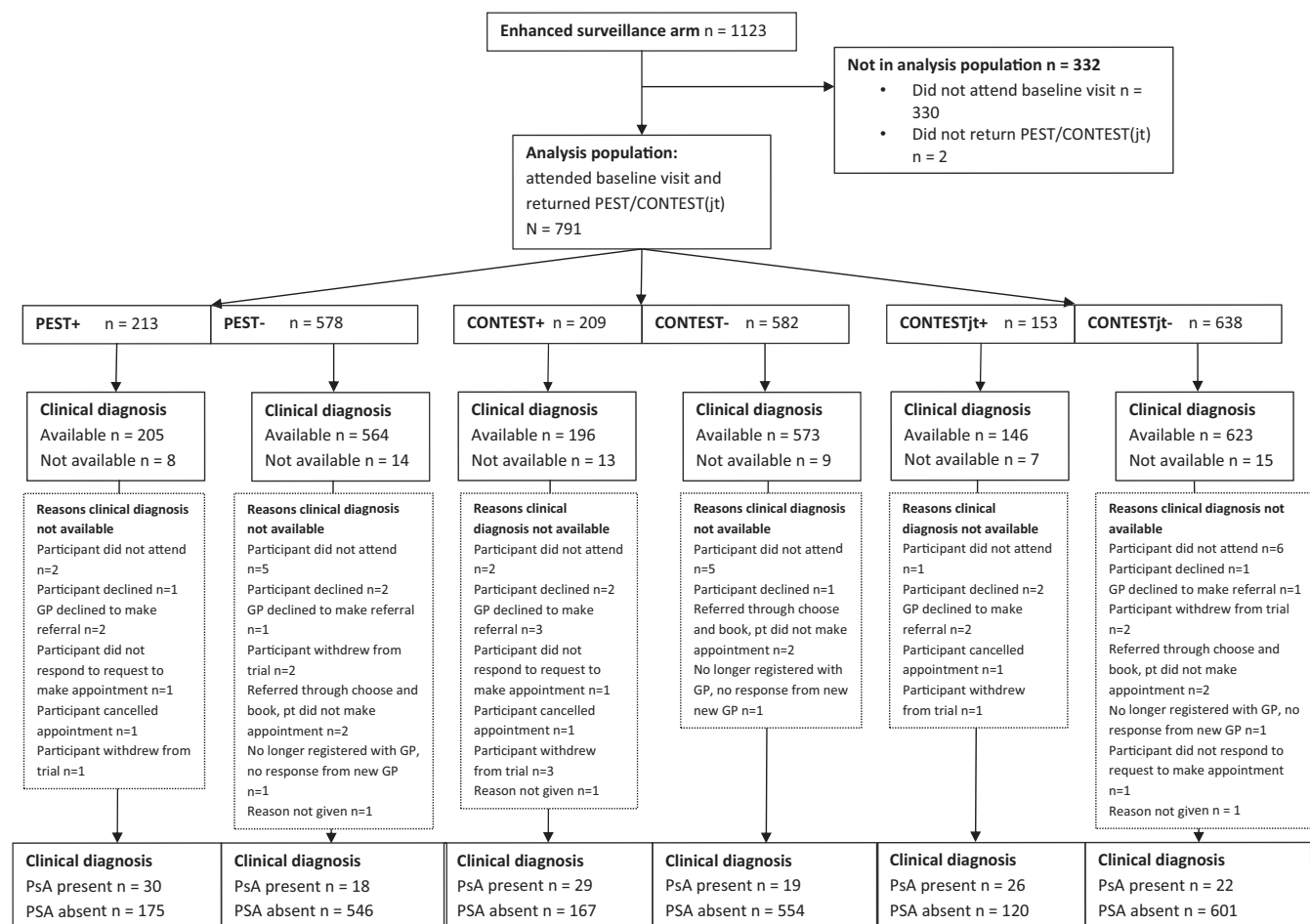


Figure 1. Participant flow. pt: patient

Table 1. Patient demographics and clinical scores

	Clinical diagnosis: PsA positive N = 48	Clinical diagnosis: PsA negative N = 721	Clinical PsA diagnosis not known N = 22	All participants N = 791
Age at registration (years)				
Mean (s.d.)	51.5 (11.96)	52.4 (12.78)	50.5 (14.12)	52.3 (12.76)
Gender				
Male	26 (54.2%)	340 (47.2%)	13 (59.1%)	379 (47.9%)
Female	22 (45.8%)	380 (52.7%)	9 (40.9%)	411 (52.0%)
Missing ^a	0 (0.0%)	1 (0.1%)	0 (0.0%)	1 (0.1%)
Ethnicity				
White	47 (97.9%)	688 (95.4%)	22 (100.0%)	757 (95.7%)
Asian/Asian British	1 (2.1%)	15 (2.1%)	0 (0.0%)	16 (2.0%)
Missing	0 (0.0%)	9 (1.2%)	0 (0.0%)	9 (1.1%)
Mixed/Multiple ethnic groups	0 (0.0%)	6 (0.8%)	0 (0.0%)	6 (0.8%)
Black/African/Caribbean/Black British or other ethnic group	0 (0.0%)	2 (0.3%)	0 (0.0%)	2 (0.3%)
Not stated	0 (0.0%)	1 (0.1%)	0 (0.0%)	1 (0.1%)
Age at psoriasis diagnosis (years)				
Mean (s.d.)	24.0 (15.76)	28.3 (16.62)	28.7 (14.66)	28.0 (16.53)
Missing	2	43	0	45
Current medical conditions				
Hypertension	4 (8.3%)	78 (10.8%)	1 (4.5%)	83 (11.5%)
Asthma	4 (8.3%)	65 (9.0%)	1 (4.5%)	70 (9.7%)
OA	7 (14.6%)	52 (7.2%)	2 (9.1%)	61 (8.5%)
Diabetes	3 (6.3%)	42 (5.8%)	0 (0.0%)	45 (6.2%)
Thyroid dysfunction	4 (8.3%)	25 (3.5%)	2 (9.1%)	31 (4.3%)
IBD	1 (2.1%)	26 (3.6%)	0 (0.0%)	27 (3.7%)
Hypercholesterolaemia	0 (0.0%)	16 (2.2%)	0 (0.0%)	16 (2.2%)
Ischaemic heart disease	0 (0.0%)	9 (1.2%)	0 (0.0%)	9 (1.2%)
Kidney disease	0 (0.0%)	8 (1.1%)	0 (0.0%)	8 (1.1%)
Chronic liver disease	0 (0.0%)	4 (0.6%)	0 (0.0%)	4 (0.6%)
Myocardial infarction	0 (0.0%)	3 (0.4%)	0 (0.0%)	3 (0.4%)
PASI score				
Mean (s.d.)	4.8 (3.33)	3.2 (3.05)	3.9 (2.98)	3.3 (3.09)
Missing or n/a	4	122	2	128
Nail involvement				
Present	34 (70.8%)	322 (44.7%)	17 (77.3%)	373 (47.2%)
Absent	13 (27.1%)	371 (51.5%)	4 (18.2%)	388 (49.1%)
Missing	1 (2.1%)	28 (3.9%)	1 (4.5%)	30 (3.8%)
Dactylitis				
Present	14 (29.2%)	15 (2.1%)	1 (4.5%)	30 (3.8%)
Absent	34 (70.8%)	701 (97.2%)	21 (95.5%)	756 (95.6%)
Missing	0 (0.0%)	5 (0.7%)	0 (0.0%)	5 (0.6%)
Tender and/or swollen joints				
Present	36 (75.0%)	220 (30.5%)	15 (68.2%)	271 (34.3%)
Absent	12 (25.0%)	497 (68.9%)	7 (31.8%)	516 (65.2%)
Missing	0 (0.0%)	4 (0.6%)	0 (0.0%)	4 (0.5%)
Of those reporting tender joints, number of tender joints				
Mean (s.d.)	6.2 (6.28)	3.4 (3.86)	3.8 (3.34)	3.8 (4.36)
Median (range)	4.0 (1.0, 24.0)	2.0 (1.0, 21.0)	2.0 (1.0, 10.0)	2.0 (1.0, 24.0)
IQR	2.0, 7.0	1.0, 4.0	1.0, 6.0	1.0, 5.0
N	33	181	13	227
Of those reporting swollen joints, number of swollen joints				
Mean (s.d.)	2.3 (1.31)	2.5 (2.37)	2.8 (2.64)	2.4 (2.22)
Median (range)	2.0 (1.0, 5.0)	2.0 (1.0, 13.0)	2.0 (1.0, 8.0)	2.0 (1.0, 13.0)
IQR	1.0, 3.0	1.0, 3.0	1.0, 3.0	1.0, 3.0
N	21	94	6	121
Participant currently has inflammatory back pain				
Yes	12 (25.0%)	67 (9.3%)	8 (36.4%)	87 (11.0%)
No	23 (47.9%)	298 (41.3%)	8 (36.4%)	329 (41.6%)
Missing	13 (27.1%)	356 (49.4%)	6 (27.3%)	375 (47.4%)
BASMI score				
Mean (s.d.)	2.0 (0.80)	2.2 (0.97)	2.3 (1.33)	2.2 (0.97)
Median (range)	2.0 (0.8, 3.2)	2.0 (0.6, 5.2)	1.9 (1.0, 4.6)	2.0 (0.6, 5.2)
IQR	1.4, 2.0	1.8, 2.8	1.4, 2.8	1.4, 2.8
Missing	3	25	2	30

(continued)

Table 1. (continued)

	Clinical diagnosis: PsA positive N = 48	Clinical diagnosis: PsA negative N = 721	Clinical PsA diagnosis not known N = 22	All participants N = 791
N	9	42	6	57
HAQ-DI score				
Mean (s.d.)	0.310 (0.469)	0.171 (0.414)	0.324 (0.504)	0.184 (0.422)
Median (range)	0.063 (0.000, 2.125)	0.000 (0.000, 3.000)	0.125 (0.000, 1.750)	0.000 (0.000, 3.000)
IQR	0.000, 0.500	0.000, 0.125	0.000, 0.375	0.000, 0.125
Missing	0	1	0	1

^a The demographic screening questionnaire was completely missing for one participant.
HAQ-DI: Health Assessment Questionnaire Disability Index.

Table 2. Questionnaire result tabulated by final clinical diagnosis

	Clinical diagnosis			Total
	PsA positive	PsA negative	PsA status not known	
PEST				
PsA positive	30 (3.8%)	175 (22.1%)	8 (1.0%)	213 (26.9%)
PsA negative	18 (2.3%)	546 (69.0%)	14 (1.8%)	578 (73.1%)
Total	48 (6.1%)	721 (91.2%)	22 (2.8%)	791 (100%)
CONTESTjt				
PsA positive	26 (3.3%)	120 (15.2%)	7 (0.9%)	153 (19.3%)
PsA negative	22 (2.8%)	601 (76.0%)	15 (1.9%)	638 (80.7%)
Total	48 (6.1%)	721 (91.2%)	22 (2.8%)	791 (100%)
CONTEST				
PsA positive	29 (3.7%)	167 (21.1%)	13 (1.6%)	209 (26.4%)
PsA negative	19 (2.4%)	554 (70.0%)	9 (1.1%)	582 (73.6%)
Total	48 (6.1%)	721 (91.2%)	22 (2.8%)	791 (100%)

Table 3. Cut-off points, sensitivity, specificity, positive predictive value, negative predictive value, and distance to (0, 1)

Cut-off point	True positive	True negative	False positive	False negative	Sensitivity	Specificity	PPV	NPV	Distance to (0, 1)
PEST									
1	47	208	513	1	0.979	0.288	0.084	0.995	0.712
2	42	404	317	6	0.875	0.560	0.117	0.985	0.457
3	30	546	175	18	0.625	0.757	0.146	0.968	0.447
4	21	654	67	27	0.438	0.907	0.239	0.960	0.570
5	6	708	13	42	0.125	0.982	0.316	0.944	0.875
CONTESTjt									
1	47	138	583	1	0.979	0.191	0.075	0.993	0.809
2	44	286	435	4	0.917	0.397	0.092	0.986	0.609
3	36	419	302	12	0.750	0.581	0.107	0.972	0.488
4	31	525	196	17	0.646	0.728	0.137	0.969	0.446
5	26	601	120	22	0.542	0.834	0.178	0.965	0.488
6	21	651	70	27	0.438	0.903	0.231	0.960	0.571
7	14	687	34	34	0.292	0.953	0.292	0.953	0.710
8	10	709	12	38	0.208	0.983	0.455	0.949	0.792
9	3	719	2	45	0.063	0.997	0.600	0.941	0.938
CONTEST									
1	47	142	579	1	0.979	0.197	0.075	0.993	0.803
2	44	300	421	4	0.917	0.416	0.095	0.987	0.590
3	34	451	270	14	0.708	0.626	0.112	0.970	0.475
4	29	554	167	19	0.604	0.768	0.148	0.967	0.459
5	25	634	87	23	0.521	0.879	0.223	0.965	0.494
6	16	678	43	32	0.333	0.940	0.271	0.955	0.669
7	10	708	13	38	0.208	0.982	0.435	0.949	0.792
8	3	719	2	45	0.063	0.997	0.600	0.941	0.938

Currently accepted and used cut-offs for a positive test are in bold type. PPV: positive predictive value; NPV: negative predictive value.

Two of these patients had dactylitis recorded but no other peripheral arthritis.

Of those with peripheral arthritis, 10 also had axial disease, though the status of axial involvement could not be confirmed in 6 subjects. In addition, there was 1 patient with pure axial disease.

In 5 patients there was no peripheral disease recorded (of these, 3 also did not have any axial disease, but axial disease status could not be confirmed in the other 2). These patients had answered positively to previous swollen joints or inflammatory back pain and were adjudged to have PsA on consultant review.

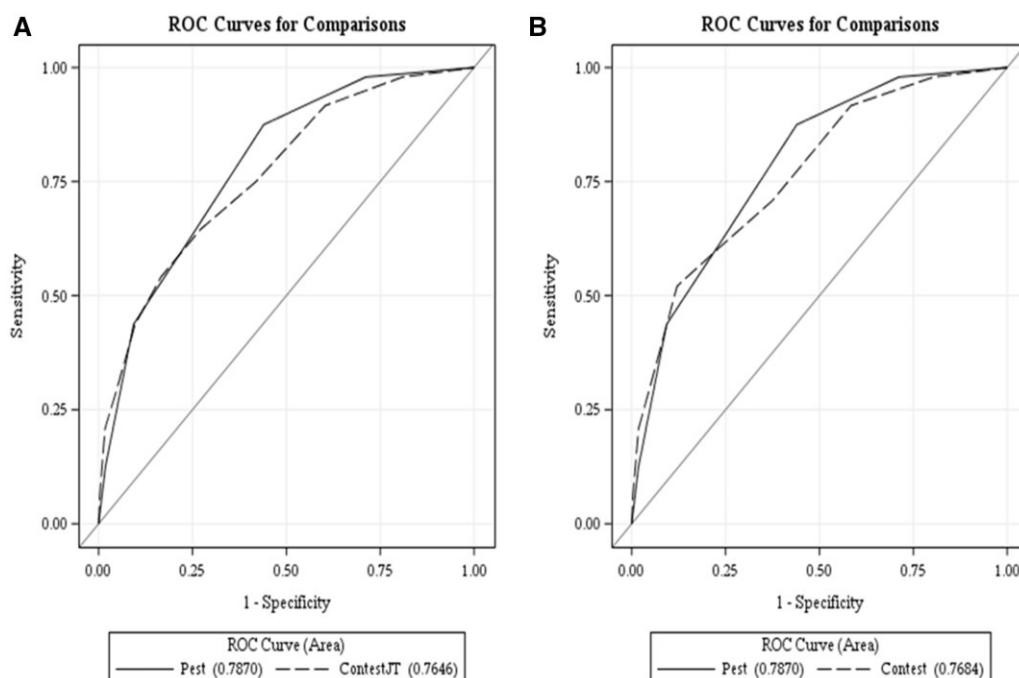


Figure 2. ROC curves comparing PEST, CONTESTjt and CONTEST. (A) PEST and CONTESTjt. (B) PEST and CONTEST. ROC: receiver operating characteristic

Table 4. Screening questionnaire results by PsA phenotype in patients diagnosed with PsA

Phenotype	PEST+	CONTESTjt+	CONTEST+	Total
Peripheral disease				
Polyarthritis	13 (81)	12 (75)	12 (75)	16 (100)
Oligoarthritis	13 (65)	10 (50)	11 (55)	20 (100)
Enthesitis				
Enthesitis with peripheral arthritis	10 (91)	9 (82)	10 (91)	11 (100)
Enthesitis without peripheral arthritis	1 (25)	2 (50)	3 (75)	4 (100)
Dactylitis				
Dactylitis with peripheral arthritis	8 (73)	9 (82)	9 (82)	11 (100)
Dactylitis without other peripheral arthritis	0	0	0	2 (100)
Axial disease				
Axial disease with peripheral disease	6 (60)	4 (40)	4 (40)	10 (100)
Axial disease without peripheral disease	0	0	0	1 (100)
No current axial or peripheral disease				
No current peripheral or axial disease	2 (67)	1 (33)	2 (67)	3 (100)
No current peripheral disease and axial disease status not known	1 (50)	1 (50)	1 (50)	2 (100)

Note, peripheral arthritis refers to tender and swollen joints; peripheral disease refers to any of tender and swollen joints, enthesitis, and dactylitis. The row figures represent the number of cases and the percentage is in parentheses.

From Table 4, in terms of peripheral arthritis, the PEST questionnaire was slightly superior in identifying subjects with both poly- and oligo-arthritis, but slightly inferior in identifying pure enthesitis. Only one patient had pure axial disease, and none of the screening tools identified this patient.

Discussion

This community surveillance study of people with psoriasis comparing different screening tools for PsA found they had very similar performance, with a larger gain in specificity for CONTESTjt, albeit in conjunction with loss of sensitivity; there was no difference between the questionnaires in terms of the AUC.

PsA is a complex heterogeneous disease with several clinical phenotypes and, as such, provides a challenge for

identification by patient-completed questionnaires. A number of such tools are available and are widely implemented in practice, but none are optimal. The PEST, similar to the PURE-4 [13], was developed using statistical regression using a number of clinical variables; others like the ToPAS [14] and EARP [15] were developed by expert consensus, the latter focusing on regional musculoskeletal symptoms. The CONTEST questionnaires amalgamated the best-performing items from a number of screening tools and, as such, demonstrated marginal superiority in performance [7]. In any screening study, the performance of instruments will vary according to the study methodology and population. A study comparing PEST, PASE and ToPAS in hospital settings found very similar results for each questionnaire, with mostly equivalent sensitivity and specificity, though the latter were much worse than the specificities found in instrument development [16]. A

study specifically comparing the PEST and CONTEST questionnaires, conducted in a primary care setting, also found equivalent performance, with figures for sensitivity and specificity similar to those found in this study [4]. A further study from Dublin found poor sensitivities and excellent specificities for screening questionnaires in a secondary care setting, but prescreening of participants for other musculoskeletal disease may have produced these results [17]. Despite the above comments about methodology and population, a systematic literature review and meta-analysis has been conducted, noting the marked heterogeneity between studies; it was concluded that the EARP had the best sensitivity, though with some loss of specificity [18].

A criticism of the PEST questionnaire has been its fallibility in identifying certain phenotypes of PsA—notably oligoarthritis, enthesitis (except at the Achilles insertion) and axial disease. The current study found the PEST slightly superior to the CONTEST questionnaires in identifying peripheral arthritis, both oligo- and poly-articular disease, though better in cases of polyarthritis than oligoarthritis. Cases of pure enthesitis were uncommon ($n=4$), so it is difficult to draw firm conclusions, but PEST was inferior to CONTEST in identifying this domain. The CONTEST questionnaire includes questions about back and neck pain so would be expected to identify more cases of axial disease: in this study there was only one case of pure axial disease, which none of the questionnaires identified. However, it must be noted that the pure axial phenotype of PsA is uncommon, and cases with concomitant peripheral and axial disease will be identified by instruments that address only the peripheral joints, as in this study.

The cut-offs for each questionnaire were derived from previous work, but this study allowed a further examination of these cut-offs (Table 3). The optimum cut-off is described by the best combination of sensitivity and specificity, allowing that these two figures are reciprocal—what is gained by optimizing one is lost in the other. Combining the optimal sensitivity and specificity requires an appreciation of this and may be done in several ways. In this study, the nearest distance to the ROC curve (distance 0, 1 in Table 3) indicates that the predefined cut-offs of 3 for the PEST and 4 for the CONTEST are optimal, but the cut-off for CONTESTjt might be more optimal as 4.

As the majority of cases of PsA have pre-existing psoriasis, this provides an ideal opportunity to screen for PsA in this population, and previous studies have shown a high prevalence of unrecognized disease in secondary care patients with psoriasis [16]. The ideal screening test should have high sensitivity so as not to miss cases of disease, and ideally high specificity in order not to identify cases with other musculoskeletal disorders. Observational studies suggest that the earlier the diagnosis (and treatment) the better the outcome in PsA, providing further support for regular screening [19, 20]. In the UK, NICE has recommended that the recommended period between screening tests is 12 months, though this was only consensus based (<https://www.nice.org.uk/guidance/cg153/chapter/1-recommendations>, accessed 16 December 2022). The ‘parent’ study within which the current investigation took place (TUDOR) is designed to assess the benefit of early diagnosis (and intervention) on the outcome of PsA and is the first prospective study in this field. However, it must be recognized that the patients identified with PsA at baseline are likely to be unrecognized prevalent cases, and those picked up at subsequent study visits are more

likely to be incident cases, in which case a different approach to screening may be required.

There are several limitations to this study. First, the lower-than-expected prevalence of undiagnosed PsA, and the lower figure for specificity with CONTESTjt (54.2% *vs* 70% estimated), reduced the precision of the estimates of sensitivity and specificity: the revised estimates for CONTESTjt are $\pm 13.8\%$ and $\pm 2.7\%$ for sensitivity and specificity, respectively. Second, where participants were not diagnosed with PsA, alternative diagnoses were not systematically collected, so this information was available for less than half (42.1%) of the PsA-negative participants. Third, some patients judged to have PsA by the research clinician may not have been referred by the primary care physician for a rheumatology clinic assessment. Fourth, clinical judgement formed the basis of final PsA diagnosis, in preference to the patient fulfilling the CASPAR criteria, though 84% of those diagnosed with PsA clinically did fulfil the CASPAR criteria. In early disease, the CASPAR criteria may not be fulfilled, though it has been shown that the CASPAR criteria can function well in an early-arthritis cohort [21]. Fifth, as the COMPARE analysis population was restricted to participants who attended the baseline assessments, there is a potential risk that the participants who did not attend the baseline assessments may have different characteristics and outcomes compared with the participants who did attend. And, as patients were referred through standard NHS routes, a significant delay occurred between initial study assessment and the rheumatology specialist outpatient review. Participants may have had symptoms that fluctuated over this time, but it is likely that assessing clinicians would have asked about present and recent symptoms and signs of PsA. Finally, although this study recruited in four diverse areas of England, over 95% of participants self-identified as white, making the results applicable to this group only.

In conclusion, this study has shown no difference in sensitivity between CONTEST and CONTESTjt in comparison with PEST, but a statistically significant improvement in specificity for CONTESTjt compared with PEST, though the magnitude of that difference was minimal, and the overall performance of the instruments, as reflected in the AUC, was similar. The PEST questionnaire has now been in the public domain for 13 years, is a simple and quick test to administer and complete, is available in several languages, has been adopted by several organizations and has been studied in community and hospital settings, both on its own and compared with other tools. As no overall significant differences between the PEST and the CONTEST questionnaires have been demonstrated in this study, there is no reason to stop using the PEST in favour of these alternatives at this time. Without further head-to-head studies, in varied populations, the same cannot be said of other screening questionnaires but, to date, other studies in secondary care have not shown major differences in performance for the different questionnaires.

Data availability

The data underlying this article may be shared on reasonable request to the study Chief Investigator, Prof Neil McHugh.

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