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Clinical science

The impact of psoriasis on wellbeing and clinical outcomes in juvenile psoriatic arthritis

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Abstract

Objectives: Juvenile PsA (JPsA) has varied clinical features that are distinctive from other JIA categories. This study investigates whether such features impact patient-reported and clinical outcomes.

Methods: Children and young people (CYP) were selected if recruited to the Childhood Arthritis Prospective Study, a UK multicentre JIA inception cohort, between January 2001 and March 2018. At diagnosis, patient/parent-reported outcomes (as age-appropriate) included the parental global assessment (10 cm visual analogue scale), functional ability (Childhood Health Assessment Questionnaire (CHAQ)), pain (10 cm visual analogue scale), health-related quality of life (Child Health Questionnaire PF50 psychosocial score), mood/depressive symptoms (Moods and Feelings Questionnaire) and parent psychosocial health (General Health Questionnaire 30). Three-year outcome trajectories have previously been defined using active joint counts, physician and parent global assessments (PGA and PaGA, respectively). Patient-reported outcomes and outcome trajectories were compared in (i) CYP with JPsA *vs* other JIA categories and (ii) CYP within JPsA, with and without psoriasis via multivariable linear regression.

Results: There were no significant differences in patient-reported outcomes at diagnosis between CYP with JPsA and non-JPsA. Within JPsA, those with psoriasis had more depressive symptoms (coefficient = 9.8; 95% CI: 0.5, 19.0) than those without psoriasis at diagnosis. CYP with JPsA had 2.3 times the odds of persistent high PaGA than other ILAR categories, despite improving joint counts and PGA (95% CI: 1.2, 4.6).

Conclusion: CYP with psoriasis at JPsA diagnosis report worse mood, supporting a greater disease impact in those with both skin and joint involvement. Multidisciplinary care with added focus to support wellbeing in children with JPsA plus psoriasis may help improve these outcomes.

Keywords: JIA, paediatric/juvenile rheumatology, spondylarthropathies (including psoriatic arthritis), depression, quality of life

Rheumatology key messages

- Despite improving joint activity, children with JPsA have poorer wellbeing over time than other JIA.
- Within JPsA, those with psoriasis have more depressive symptoms than those without psoriasis at diagnosis.
- A holistic approach across the multidisciplinary team is needed to manage JPsA.

Introduction

The ILAR criteria stratify JIA into different groups, with the objective of creating homogeneous subgroups for research purposes and to aid in treatment strategies [1]. Prior studies, however, have suggested that certain categories, such as juvenile PsA (JPsA), may themselves represent heterogeneous entities [2, 3]. JPsA is a rare and hence under-researched subset of JIA, classified as when the patient has a combination of

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arthritis, skin and/or nail manifestations, and can include a personal or family history of psoriasis [4]. The latter criterion allows for children and young people (CYP) with arthritis in the absence of psoriasis to be diagnosed with JPsA if they have other distinctive features of PsA alongside a relative with the skin condition. Despite the absence of psoriasis in around half of CYP with JPsA, their disease remains distinct from other subtypes of childhood arthritis; however, they are usually grouped with those who do have skin involvement for research purposes [4, 5], making the assumption that all CYP with JPsA have similar outcomes.

The impairment of JIA on patient-reported outcomes, such as pain, functional ability, quality of life, mental health and wellbeing in CYP with JIA is a well-recognized issue [6–10]. There is limited evidence for differences in these outcomes between subtypes of early JIA [7, 11–13] as more commonly, patient-reported outcomes in JIA reflect the disease as a whole, or certain JIA phenotypes such as enthesitis-related and psoriatic JIA are excluded or combined with other categories if less well-represented in certain JIA cohorts, and thus the effect of individual disease features on patient-reported outcomes is relatively unknown. Therefore, the impact of JPsA compared with other JIA categories, or that of extra-articular features such as psoriasis or nail psoriatic disease, in terms of patient-reported outcomes bears further study.

In terms of clinical outcome, current literature has shown that the prognosis for JPsA is approximately similar when compared with other JIA subtypes [14, 15]. However, the presence of psoriasis is known to be associated with poorer physical health and higher cumulative active joint count, compared with other JIA subtypes [16, 17]. Furthermore, there are inherent limitations in assessing disease outcome when multiple aspects of disease are combined into single outcome measures [18], as these composite measures may mask the effects of JPsA on specific features of clinical outcomes.

Recently, using a multi-variate approach to examining disease outcomes, Shoop-Worrall *et al.* identified six outcome clusters in JIA, each with a different pattern of disease impact following diagnosis [18]. This approach identified groups with different outcome patterns across clinical and patient-reported outcomes. It is currently unclear how children and young people with different features of JPsA overlap with these clusters. It is possible that a higher disease burden due to the presence of psoriasis may contribute to the disconnect seen between joint activity and parent global wellbeing scores, for example.

Better understanding of outcomes in JPsA and the factors that influence these outcomes could help predict prognosis, aid communication between clinicians, CYP and their families, as well as maximize therapeutic potential of treatments. Therefore, this study aims to compare patient-reported outcomes and disease outcome patterns between JPsA and other JIA categories. Additionally, this study explores the association between the presence or absence of psoriasis in JPsA at the time of diagnosis and these same outcomes.

Methods

Study population

CYP with a physician's diagnosis of JIA were included if recruited to the Childhood Arthritis Prospective Study (CAPS), a UK prospective, multicentre inception cohort of JIA, between January 2001 and March 2018. Ethical approval for CAPS was obtained from the Northwest Multicentre Ethics Committee (REC/02/8/104, IRAS 184042). Written informed consent was obtained from parents or guardians, and assent was given by children and young people, where appropriate.

Data collection

The details of CAPS have been published elsewhere [19]. In brief, detailed demographic, clinical and patient-reported data were extracted from medical records at initial diagnosis, 6 months and annually from 1 to 3 years later from medical records by hospital-based study nurses, and patients (or proxies) completed patient-reported questionnaires. Extracted data and questionnaires were sent to the coordinating centre at The University of Manchester. ILAR category [4] was determined by physicians and coded into clinical records. This study did not independently apply ILAR classification criteria. Physician's JIA classification based on ILAR criteria by the end of the first year from symptom onset was taken into consideration to allow for 'settling' of disease signs and for the availability of blood test results. At initial presentation to paediatric rheumatology (baseline) and each further follow-up, physicians also recorded the presence or absence of psoriasis, alongside the presence or absence of other extra-articular features (Table 1).

Outcomes

The primary outcomes of this analysis were (i) baseline patient-reported outcomes, including functional ability, wellbeing, pain, mood/depressive symptoms and health-related quality of life of both the child and parent and (ii) disease outcome trajectories, as described by Shoop-Worrall *et al.* [18].

Functional ability was assessed via the Childhood HAQ (CHAQ), which also incorporates two 100 mm visual analogue scales for wellbeing (parent global assessment) and pain, with higher scores denoting poorer outcome [20]. The functional ability component of the questionnaire assesses eight domains of function over 30 items and produces an overall score from 0 to 3, with higher scores denoting poorer functional ability. Depressive symptoms over the past 2 weeks were measured using the Moods and Feelings Questionnaire (MFQ), consisting of 33 items with possible overall scores ranging from 0 to 68, with higher scores denoting a greater number of depressive symptoms [21]. Health-related quality of life of the child was measured using the Child Health Questionnaire PF50 (CHQ) psychosocial health subscale, with higher population-standardized scores representing better outcome [22]. Health-related quality of life of the parent/proxy was measured using the General Health Questionnaire 30 (GHQ), about recent symptoms to evaluate mental state [23]. The questionnaire consisted of 60 questions using a five-point rating scale from 0 representing ('no psychiatric disturbance') to 4 ('marked psychiatric illness'). Patient-reported outcome questionnaires were completed by CYP themselves where developmentally appropriate (CHAQ/wellbeing/pain and MFQ $\geq$ 11 years) and otherwise by guardian proxies. The CHQ and MFQ were only completed by parents for CYP over the ages of 5 and 7 years, respectively.

In a subset of CYP included in the current analysis (those recruited to CAPS before January 2015 with available longitudinal outcomes), previous disease outcome trajectories have been described. These were identified using group-based trajectory modelling, an unsupervised statistical-learning method

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Table 1. Baseline characteristics of the whole cohort, JPsA and those with and without psoriasis in JPsA

Characteristic	Data availability within the whole cohort, *n* (%)	*n* (%) or median (IQR)			
		Whole cohort	JPsA (total)[a]	JPsA with psoriasis	JPsA without psoriasis
n	1653	1653	111	34	63
Demographic					
Female	1653 (100)	1070 (64.7%)	62 (55.9%)	20 (58.8%)	34 (54.0%)
White ethnicity	1594 (96.4)	1212 (76.0%)	93 (84.6%)	26 (76.5%)	55 (88.7%)
Age at first paediatric rheumatology appointment, years	1637 (99.0)	7.6 (3.5, 11.8)	10.9 (5.0, 13.3)	12.7 (10.4, 14.6)	8.3 (3.2, 12.7)
Disease duration onset to first paediatric rheumatology appointment, months	1350 (81.7)	5.5 (2.6, 14.2)	5.4 (2.7, 28.4)	5.1 (3.5, 11.9)	5.9 (2.8, 36.9)
BMI *z*-scores	1216 (73)	0.4 (−0.4, 1.2)	0.5 (−0.3, 1.4)	0.7 (−0.4, 1.9)	0.3 (−0.7, 1.3)
ILAR category					
Systemic	1643 (100)	104 (6.3)	N/A	N/A	N/A
Persistent oligo		718 (43.6)	N/A	N/A	N/A
Extended oligo		89 (5.4)	N/A	N/A	N/A
RF –ve poly		365 (22.2)	N/A	N/A	N/A
RF +ve poly		68 (4.1)	N/A	N/A	N/A
ERA		90 (5.5)	N/A	N/A	N/A
JPsA		111 (6.7)	N/A	N/A	N/A
Undifferentiated		108 (6.5)	N/A	N/A	N/A
Clinical					
Active joint count	1379 (83.4)	2 (1, 5)	3 (2, 6)	3 (1, 8)	3 (2, 5)
Limited joint count	1379 (83.4)	1 (1, 4)	2 (1, 5)	2 (0, 4)	2 (1, 4)
ESR, mm/h	1171 (70.8%)	20 (8, 46)	15 (6, 41)	13 (5, 33)	23 (8, 42)
CRP, mg/l	1115 (67.5)	7 (4, 22)	5 (4, 14)	4 (1, 9)	6 (4, 15)
Physician global assessment (0–10 cm)	1052 (63.6)	2.9 (1.5, 5.0)	2.9 (1.2, 4.0)	3.2 (1.5, 5.0)	2.4 (1.2, 3.9)
cJADAS10 score (0–30)	651 (39.4)	9.1 (4.8, 14.5)	8.6 (4.7, 12.9)	10.4 (6.5, 15.9)	6.6 (3.6, 9.8)
Psoriasis	1471 (89.0)	45.0 (3.1)	34 (35.1)	34 (100.0)	0 (0.0)
Nail abnormalities (pitting or onycholysis)	1426 (86.3)	22.0 (1.5)	11 (12.4)	6 (20.7)	4 (6.9)
Dactylitis, *n* (%)	1412 (85.4)	61.0 (4.3)	22 (24.2)	8 (26.7)	12 (20.7)
Sacroiliac tenderness and/or inflammatory spinal pain	1407 (85.1)	24.0 (1.7)	0 (0.0)	0 (0.0)	0 (0.0)
Radiological sacroilitis	1291 (78.1)	2.0 (0.2)	0 (0.0)	0 (0.0)	0 (0.0)
Family history of psoriasis in more than one first degree relative	560 (33.9)	69.0 (12.3)	15 (46.9)	5 (50.0)	10 (45.5)
Patient-reported outcomes					
Parental global assessment (0–10 cm)	1061 (64.2)	2.4 (0.6, 5.0)	2.6 (0.5, 4.6)	2.9 (0.5, 4.1)	1.8 (0.2, 4.3)
CHAQ functional ability score (0–3)	952 (57.6)	0.8 (0.1, 1.4)	0.4 (0.1, 1.3)	0.3 (0.1, 1.4)	0.4 (0.1, 1.0)
Pain (0–10 cm)	1057 (63.9)	3 (0.8, 6.0)	2.5 (0.6, 5.7)	3.1 (1.3, 6.4)	2.0 (0.4, 4.7)
Mood (MFQ) (0–68)	372 (22.5) (30% of JPsA cohort)	11 (5.0, 21.5)	11 (4, 16)	13 (5, 27)	11 (4, 12)
CHQ child psychosocial health (0–100 standardized scale)	509 (30.8) (38% of JPsA cohort)	50.0 (39.9, 55.7)	50.9 (42.5, 55.7)	50.4 (40.6, 59.8)	52.0 (49.0, 55.6)
GHQ parent psychosocial health (0–100 mm)	678 (41.0)	29 (22, 38)	29.0 (22.5, 32.5)	25 (20, 30)	28 (23, 33)

[a] Including those for whom psoriasis data were unavailable. +ve: positive: –ve: negative; CHAQ: Childhood HAQ; CHQ: Child Health Questionnaire PF50; cJADAS10: clinical Juvenile Arthritis Disease Activity Score 10; ERA: Enthesitis-related Arthritis; GHQ: General Health Questionnaire 30; IQR: interquartile range; JPsA: juvenile PsA; MFQ: Moods and Feelings Questionnaire; N/A: not applicable.

that can uncover clusters of CYP with shared patterns of disease impact (trajectories) over time. Over the 3-year period following diagnosis, six clusters were identified within an optimal-fitting, clinical-plausible model. These clusters were defined by shared trajectories across the three core outcome variables included in the clinical Juvenile Arthritis Disease Activity Score 10 (cJADAS10) [24, 25]: active joint count up to 10, physician's global assessment of disease (PGA) and parent global assessment (PaGA) [18]. Clusters are described as: (i) low–remission: low activity at diagnosis reducing to remission, (ii) low–low: low activity at diagnosis that remained low, without remission, (iii) low–persistent: low joint activity and physician scores that decrease, but persistently raised wellbeing scores, (iv) high–low: high activity at diagnosis that reduces, (v) high–low–high: high activity that reduces and then flares, and (vi) high–persistent: high joint activity and physician scores at diagnosis that reduce, but persistently raised wellbeing scores. Specific cluster membership for each CYP included in both the current and previous analysis was previously derived and used here as an outcome of interest for those children [18].

Statistical analysis

BMI was calculated using height and weight data collected at initial presentation to paediatric rheumatology. This was transformed to age and gender-standardized *z*-scores using 2007 WHO BMI-for-age data [26].

Patient-reported outcomes at diagnosis were compared between JPsA and other JIA categories combined with the Kruskal–Wallis test and with each individual JIA category

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with the Mann–Whitney *U*-test. These outcomes were then compared between CYP with JPsA with and without psoriasis at arthritis diagnosis descriptively and with the Mann–Whitney *U*-test.

Subsequently, univariable and multivariable linear regression models, adjusted for age at first presentation, gender, disease duration at initial presentation to paediatric rheumatology, ethnicity, and number of active joints at first presentation, were used to explore associations with baseline patient-reported outcomes between JPsA and other ILAR categories (both other JIA as a whole and individual categories), and the presence or absence of psoriasis within JPsA at baseline.

Univariable and multivariable multinomial logistic regression models compared previously defined disease outcome trajectories: (i) patients with JPsA were compared with other JIA categories as a whole and with individual categories, and (ii) JPsA with psoriasis was compared with those without psoriasis via univariable and multinomial logistic regression models. Multivariable models adjusted for age at first presentation, gender, disease duration, ethnicity and number of active joints at first presentation. A Benjimini–Hochberg false discover rate corrected for multiple comparisons, with the *q*-value threshold set at 0.2.

Results

Study population

A total of 1653 CYP with JIA were included in the current study, of which 111 (6.7%) had JPsA at diagnosis (Table 1). In the whole cohort, the majority were female (64.7%) and 76% were Caucasian. The median age at which the participants attended their first paediatric rheumatology appointment was 7.6 years (interquartile range [IQR] 3.5–11.8).

Within the JPsA group, 62 (55.9%) were female and the median age at which the participants attended their first paediatric rheumatology appointment was 10.9 years (IQR 5.0–13.3) (Table 1). Those with psoriasis presented later at median age of 12.7 years (IQR 10.4–14.6) than those without psoriasis at median age of 8.3 years (IQR 3.2–12.7, $P = 0.001$). Disease duration onset to first paediatric rheumatology appointment was 5.1 months and 5.9 months for those with psoriasis and without psoriasis, respectively ($P = 0.714$).

A comparison of patient-reported outcomes and outcome trajectories between JPsA *vs* other ILAR categories

Differences in patient-reported outcomes

At first presentation, there were no significant differences between PsA and non-PsA in terms of median parental global assessment ($P = 0.206$), median CHAQ functional ability score ($P = 0.191$), median pain ($P = 0.375$), median CHQ child psychosocial score ($P = 0.183$), median GHQ parent psychosocial health ($P = 0.309$) or median MFQ depressive symptom score ($P = 0.337$).

Using individual ILAR categories, several categories of JIA were associated with worse patient-related outcomes at baseline as compared with JPsA (Supplementary Table S1, available at *Rheumatology* online). There were no statistically significant differences in parental global assessment or mood when comparing between PsA and the other individual ILAR subtypes.

Differences in disease outcome trajectory

A total of 86/111 (77%) children and young people with JPsA had available trajectory assignment data and could be included in the following analyses. Those with available trajectory data were more likely to be white (94% in available cohort, 50% in missing cohort), but did not differ significantly in any other demographic, clinical or patient-reported outcome data (Table 1) at baseline compared with those without trajectory data.

In univariable regression analysis, JPsA patients were identified as twice as likely to belong to the low–persistent *vs* low–remission group than other types of JIA (Relative Risk Reduction, RRR = 2.42; 95% CI: 1.25, 4.67; $P = 0.008$). When adjusted for age, gender, ethnicity, disease duration and number of active joints, these children were still twice as likely to be in the low–persistent group, having persistent poor wellbeing scores despite improvements in joint counts and physician global scores than other JIA categories (RRR = 2.35; 95% CI: 1.20, 4.59; $P = 0.013$) (Table 2). There were no statistically significant differences between JPsA and non-JPsA categories in belonging to other disease outcome trajectory clusters.

When ILAR categories were separated, compared with children with JPsA, children with both RF-negative and RF-positive polyarthritis had higher odds of trajectories with greater active joints at diagnosis (high–low, high–low–high, high–persistent). Children with persistent oligoarthritis had consistently better outcomes than those with JPsA (who were not split according to oligoarticular or polyarticular joint patterns), with lower odds of relapse trajectory (high–low–high: RRR = 0.11; 95% CI: 0.04, 0.29; $P \leq 0.001$) and lower odds of high disease activity with persistent raised wellbeing scores (high–persistent; RRR = 0.03; 95% CI: 0.01, 0.13; $P \leq 0.001$) (Table 3).

Comparing patient-reported outcomes and outcome trajectories between JPsA with and without psoriasis

Differences in patient-reported outcomes

Children with psoriasis at diagnosis of JPsA scored, on average, 10 points higher on the baseline MFQ than those without psoriasis ($P = 0.039$) (Fig. 1) (Supplementary Table S2, available at *Rheumatology* online). There were no significant differences in terms of parental global assessment ($P = 0.449$), CHAQ functional ability score ($P = 0.280$), pain ($P = 0.342$), CHQ child psychosocial score ($P = 0.522$) or GHQ parent psychosocial health ($P = 0.721$) between those with and without psoriasis in JPsA.

Table 2. Disease outcome trajectories between PsA and other ILAR categories—multivariable regression

Long-term outcomes	RRR (95% CI)	*P*-value
Low–remission	(base outcome)	(base outcome)
Low–low	1.23 (0.61, 2.47)	0.558
High–low	1.00 (0.45, 2.18)	0.991
High–low–high	1.78 (0.80, 3.99)	0.161
Low–persistent	2.35 (1.20, 4.59)	0.013[a]
High–persistent	1.49 (0.64, 3.47)	0.360

[a] Remains statistically significant under false discovery rate correction for multiple comparisons. RRR = relative risk reduction.

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Table 3. Disease outcome trajectories between PsA *vs* other individual ILAR categories–multivariable

ILAR	Coefficient (95% CI)	*P*-value
Low–low		
Ref—PsA	Reference	Reference
Systemic JIA	0.63 (0.22, 1.79)	0.388
Persistent oligoarthritis	0.71 (0.35. 1.45)	0.349
Extended oligoarthritis	3.59 (1.18. 10.92)	0.024[a]
RF −ve polyarthritis	1.52 (0.64, 3.61)	0.342
RF +ve polyarthritis	2.01 (0.41, 9.83)	0.390
ERA	0.74 (0.24. 2.24)	0.594
Undifferentiated	0.44 (0.13, 1.50)	0.189
High–low		
Ref—PsA	Reference	Reference
Systemic JIA	2.01 (0.74, 5.43)	0.170
Persistent oligoarthritis	0.15 (0.06, 0.37)	<0.001[a]
Extended oligoarthritis	2.93 (0.85, 10.13)	0.090
RF −ve polyarthritis	7.33 (3.01, 17.82)	<0.001[a]
RF +ve polyarthritis	6.11 (1.35, 27.57)	0.019[a]
ERA	1.07 (0.33, 3.46)	0.907
Undifferentiated	2.25 (0.78, 6.44)	0.132
High–low–high		
Ref—PsA	Reference	Reference
Systemic JIA	1.12 (0.38, 3.33)	0.841
Persistent oligoarthritis	0.11 (0.04, 0.29)	<0.001[a]
Extended oligoarthritis	3.20 (0.90, 11.42)	0.073
RF −ve polyarthritis	3.45 (1.36, 8.71)	0.009[a]
RF +ve polyarthritis	4.14 (0.88, 19.55)	0.072
ERA	0.79 (0.23, 2.76)	0.713
Undifferentiated	0.52 (0.13, 2.05)	0.351
Low–persistent		
Ref—PsA	Reference	Reference
Systemic JIA	0.42 (0.14, 1.23)	0.114
Persistent oligoarthritis	0.29 (0.14, 0.58)	0.001[a]
Extended oligoarthritis	2.05 (0.65, 6.51)	0.223
RF −ve polyarthritis	0.84 (0.35, 2.04)	0.703
RF +ve polyarthritis	2.09 (0.46, 9.45)	0.336
ERA	0.83 (0.31, 2.24)	0.720
Undifferentiated	0.36 (0.11, 1.21)	0.099
High–persistent		
Ref—PsA	Reference	Reference
Systemic JIA	0.55 (0.14, 2.16)	0.396
Persistent oligoarthritis	0.03 (0.01, 0.13)	<0.001[a]
Extended oligoarthritis	1.64 (0.33, 8.10)	0.546
RF −ve polyarthritis	4.76 (1.81, 12.51)	0.002[a]
RF +ve polyarthritis	5.02 (1.05, 24.02)	0.043
ERA	1.55 (0.50, 4.86)	0.450
Undifferentiated	1.53 (0.47, 5.01)	0.482

[a] Remains statistically significant under false discovery rate correction for multiple comparisons. ERA: Enthesitis-related Arthritis; +ve: positive; –ve: negative.

Differences in disease outcome trajectory

In univariable analysis, children with psoriasis in JPsA had higher odds of persistent raised wellbeing scores, which indicate lower wellbeing, despite improving joint counts and physician scores (low–persistent group) than those without psoriasis. This association attenuated in multivariable analysis. Instead, those with psoriasis were more likely to be in a remission disease impact course, and those without psoriasis more likely to have persistently low disease (low–low: RRR = 0.12; 95% CI: 0.01, 0.90; $P = 0.040$) (Supplementary Table S3, available at *Rheumatology* online).

Discussion

This study shows that JPsA patients with psoriasis at diagnosis reported worse mood and greater depressive symptoms compared with those without psoriasis. Despite the distinctive clinical features of JPsA that separates this diagnosis from other JIA subtypes (i.e. skin and nail involvement), there were no statistically significant differences in patient-reported outcomes overall at diagnosis, potentially reflecting differences in disease impact or lack of specificity in outcome measures. However, comparison between JPsA and individual JIA subtypes revealed statistically significant differences in several patient-reported outcomes. JIA subtypes known to have more severe outcomes, e.g. systemic JIA and RF positive, often had worse patient-reported outcomes than JPsA, corroborating previous evidence of worse outcomes in these subtypes [7, 27, 28]. The overall similarity between JPsA and many of the other JIA categories in terms of patient-reported outcome at diagnosis is likely reflective of general high impact of as-yet-untreated JIA on daily experiences [12]. In addition, associations between individual features of JPsA and outcome compared with other JIA may be masked by treating this category as one homogeneous diagnosis. Therefore, this study sought to understand the impact of disease presentation including psoriasis within JPsA.

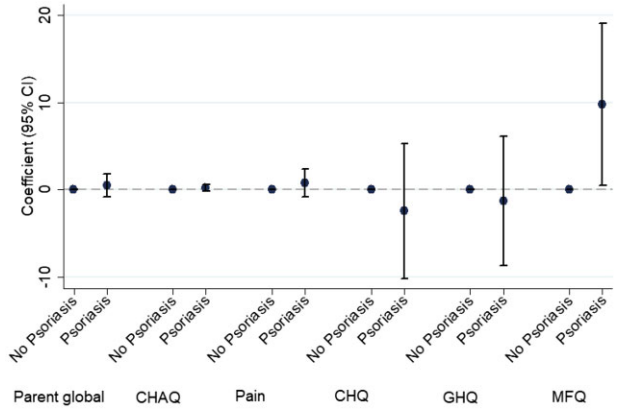

Figure 1. Multivariable associations with patient reported outcomes in JPsA patients with psoriasis ($n = 34$) *vs* those without psoriasis ($n = 63$). CHAQ: Childhood HAQ; CHQ: Child Health Questionnaire PF50; GHQ: General Health Questionnaire 30; JPsA: juvenile PsA; MFQ: Moods and Feelings Questionnaire

Within JPsA, the presence of psoriasis at time of diagnosis was independently associated with increased depressive symptoms even when adjusting for CYP demographics and JIA features such as active joint count, in the smaller number of CYP for whom the MFQ was age-appropriate (≥7 years) and completed. This increase in depressive symptoms in JPsA patients with psoriasis could be related to the more severe disease picture seen in this subgroup of JPsA when compared with those without psoriasis [16], or the impact of visible signs of disease, namely fingernail abnormalities [29], which may be particularly distressing in school-aged young people [30]. Despite similar joint counts, those with psoriasis in the current study more often presented with additional extra-articular features such as dactylitis and nail abnormalities, than those without psoriasis, which could also affect mood. This has been supported by previous studies that showed mean Children's Dermatology Life Quality Index (CDLQI) scores varying between 5.4 and 9.2 in children with psoriasis, indicating moderate effect on these children's quality of life [31–34]. A score of 0 or 1 on the CDLQI would indicate no effect on quality of life [34].

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In adults with PsA, the presence of psoriasis is more common, often preceding arthritis, conversely to JIA, where joint involvement often precedes the onset of psoriasis [35]. Like in JPsA, studies of patient-reported outcomes often look at the disease as a whole; with the burden of adult PsA reported to include mental health issues, fatigue, sleep disorders and poor body image [36]. The severity of psoriasis has been associated with poorer psychosocial health [37], with its visibility impacting psychosocial function through self-consciousness, embarrassment and depression [38, 39]. Therefore, the management of psoriasis in PsA across the life course must be prioritized to reduce these burdens.

When looking at outcome trajectories, CYP with JPsA were more likely to have poorer wellbeing despite improvements in joint counts and physician global scores over time, compared with other JIA categories. This could be due to a range of factors, potentially confounded by inherent disease course characteristics in other types of JIA, such as persistent oligoarthritis or systemic JIA, which are often reported to remit earlier than other categories [40]. It is likely that the unique extra-articular features of JPsA may also contribute to this trend, with visible manifestations such as psoriasis having a negative impact on wellbeing [30].

Those with psoriasis within JPsA were more likely to be in a 'remission' than 'low disease' trajectory compared with those without psoriasis. This may suggest different types of joint disease or other extra-articular features in those with and without psoriasis, with correspondingly different disease courses, or different treatment strategies for those with psoriasis in JPsA. Further study is required to explore how treatments can be tailored to PsA based on disease features and associated outcome.

This is the first and largest study to date that assesses the impact of psoriasis in JPsA on patient-reported outcomes and disease outcome trajectories from diagnosis. The data were collected from multiple centres across the UK and therefore are more likely generalizable to the general population of JIA. Additionally, CYP across different ages were included in this inception cohort. Because the clinical features were captured at diagnosis, this study highlights opportunities for early interventions to improve prognosis.

The findings of this study should be interpreted in light of several limitations. Parents of younger CYP often act as proxies when reporting certain questionnaires. This study does not account for whether it was the child or parent who completed the questionnaires. Inconsistency between child and proxy reports has been observed [41–43]. However, because the median age at onset for the JPsA patients in our study is older than most JIA subtypes, this issue of discordance between patients and their proxies may be diminished in this disease category, and age at diagnosis was adjusted for in all multivariable models. CHQ and MFQ questionnaires were only completed for CYP over the ages of 5 and 7 years, respectively. Therefore, conclusions regarding these outcomes only apply to these age ranges. Further outcome development is needed to assess health-related quality of life and mood in younger children. When studying longitudinal outcomes, misclassification might have occurred when particular features such as psoriasis occur after the initial diagnosis and disease classification. However, this would attenuate associations seen, so associations between the presence of psoriasis and outcomes are at least as large as those reported. Additionally, the 3-year trajectories were based on treatments given in real-world clinical practice, without adjusting or stratifying for different treatment patterns. Therefore, it is possible that CYP with JPsA who fall into the different outcome trajectory groups may have had different treatments, particularly since more aggressive or targeted treatment strategies may be employed for CYP who present with both joint and skin disease manifestations. Furthermore, because the Psoriasis Area and Severity Index (PASI) scores are not validated in children, the extent of psoriasis in CYP from CAPS is unknown. Hence, there is a need for JPsA-specific disease measures. The adaptation of tools used in adult rheumatology such as the PASI [44] and the PsAID questionnaire [45] may also aid in better assessment and personalized therapies for CYP with this disease. Both cross-sectional and longitudinal outcomes may have been affected by other extra-articular features of JPsA. While this study focused on psoriasis, future work should seek to understand the impact of other individual aspects of JPsA on patient-reported and clinical outcome in this disease. The current study utilized three core outcome variables informing the cJADAS to understand outcome. However, comparing JPsA to other JIA categories was challenging as oligoarthritis is naturally funnelled to the Low groups and polyarthritis the High groups because their disease is defined by the number of joints. Unlike oligoarthritis and polyarthritis, JPsA is not defined by active joint count and further studies should explore whether joint counts within JPsA influence outcome. Finally, despite this being one of the largest inception cohorts of JIA globally, the rare nature of JPsA limited the sample size available to study. Collaborative efforts to pool cohorts of JPsA in order to study outcome would improve research efforts in this field.

Conclusion

The better understanding of the impact of psoriasis on depressive symptoms and persistent poor wellbeing should encourage the need for clinical evaluation of the emotional state of children and young people with JPsA. Whilst diagnosing and treating the condition early remains important, this study highlights the need for multidisciplinary management of JPsA.

Supplementary material

Supplementary material is available at *Rheumatology* online.

Data availability

Information regarding applying for access to CAPS data can be found online, available at Clinicians and researchers – CAPS (caps-jia.org.uk).

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