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RESEARCH ARTICLE

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Real-world outcomes and drug survival of brodalumab: results from the German Psoriasis Registry PsoBest

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ABSTRACT

Brodalumab, a human monoclonal antibody that targets interleukin-17 receptor A (IL-17RA), is approved in the US and EU for treatment of adults with moderate-to-severe plaque psoriasis. Although brodalumab has demonstrated efficacy and safety vs placebo in clinical trials of patients with psoriasis and psoriatic arthritis (PsA), real-world evidence is needed to evaluate long-term effectiveness and safety of brodalumab in routine care. This interim analysis of the German Psoriasis Registry PsoBest examined patient profiles, treatment outcomes, and drug survival of first-time use of brodalumab for 12 months in adult patients with moderate-to-severe plaque-type psoriasis (with and without PsA) (data cutoff: June 30, 2021). Clinician and patient-reported outcomes of the total cohort ($n=227$; PsA, $n=38$) indicated a rapid response to brodalumab treatment within the first 3 months, which was maintained up to 12 months. The overall one-year drug survival rate was 76.2%, the mean time to discontinuation was 8.3 months. Reasons for discontinuation were mainly loss/lack of effectiveness, followed by adverse events, contraindication and skin clearance. In sum, brodalumab demonstrated rapid and sustained effectiveness and was well-tolerated over 12 months in German patients with moderate-to-severe psoriasis and PsA in a real-world setting.

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KEYWORDS
Psoriasis; psoriatic arthritis; brodalumab; PsoBest; real-world

1. Introduction

Psoriasis is an immune-mediated chronic inflammatory disease that affects 2-4% of the population in western countries (1, 2). The most common disease variant is plaque psoriasis (about 85% of cases), which typically manifests as erythematous plaques with thick scaling on limbs, trunk, and scalp (3). Approximately 30% of patients with psoriasis develop psoriatic arthritis (PsA), an inflammatory arthritis characterized by asymmetric oligoarthritis, enthesitis, and/or dactylitis (4–6). Individuals with psoriasis show substantial comorbidity with other diseases (e.g., cardiovascular and psychiatric disease) starting even in childhood (7) and a high burden of disease that negatively impacts patient quality of life (QoL) and life course (8, 9).

Psoriasis pathogenesis involves chronic activation of the interleukin-23/interleukin-17 (IL-23/IL-17) signaling pathway (10). Brodalumab is a monoclonal antibody approved in the United States and European Union for the treatment of adults with moderate-to-severe plaque psoriasis (11, 12). It is the first biological therapy that specifically targets the subunit A of the IL-17 receptor, inhibiting downstream signaling of multiple IL-17 family cytokines which may contribute to psoriasis pathogenesis (13). In phase 3 clinical trials, brodalumab-treated patients with moderate-to-severe psoriasis achieved high levels of skin clearance for up to 52 weeks (14, 15), with longer sustained response and greater cumulative clinical treatment benefits versus ustekinumab (16, 17). Pooled data from the phase 3 AMAGINE-2 and −3 trials showed that brodalumab was well-tolerated and resulted in high levels of skin clearance that were rapidly achieved and maintained through Week 120 (18). Additionally, brodalumab has demonstrated efficacy in psoriasis patients with PsA in both phase 2 and 3 clinical trials (19, 20).

Recent real-world data in patients from Italy (21,22) and Greece (23–25) showed brodalumab led to rapid and sustained improvements in symptoms and QoL with a favorable safety profile. However, a more comprehensive evaluation of the long-term ability of brodalumab to maintain effectiveness and safety in routine clinical practice in psoriasis patients with vs without PsA is needed. Here, we present interim descriptions of patient profiles, treatment outcomes, and drug survival of brodalumab in psoriasis patients, with and without PsA, from the German Psoriasis Registry PsoBest.

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2. Methods

2.1. Patient population

The German Psoriasis Registry PsoBest documents the long-term course of moderate-to-severe psoriasis (26) in patients initiating systemic treatment (non-biologics, biologics including biosimilars) for the first time. Patient observation time is up to ten years, regardless of subsequent treatment course. Follow-up visits in clinical settings are conducted at intervals of 3 months in the first half-year and every 6 months thereafter. Clinical outcomes, patient benefits, treatment regimens, and drug safety are measured and reported on a regular basis (27).

The registry includes adult patients (≥18 years) with moderate-to-severe plaque-type psoriasis, with and without PsA; patients diagnosed with pure forms of inverse or pustular psoriasis are not included. To minimize selection bias for 12-month drug survival due to early censored cases in ongoing data collection, only patients who had the chance of being observed for at least 12 months were selected (registry inclusion before June 30, 2020) from the quality-assured PsoBest dataset with a data cutoff of June 30, 2021 (Figure S1). Selection of all patients who initiated brodalumab treatment (dosing of 210 mg every two weeks) for the first time resulted in an analysis set of 227 patients. PsA involvement was determined by an algorithm developed in cooperation with rheumatologists published elsewhere (5).

2.2. Comorbidity and comedication

Data on comorbidity and comedication at baseline was assessed using a list of predefined conditions and diagnoses with limited verbatim additions (Methods S1). The existence of comorbidity was assumed if medication in the treatment of a comorbidity was utilized, and verbatim diagnoses were assigned to comorbidity categories. With direct questioning for relevant diagnoses and the possibility of adding limited verbatim text, we assume that overestimation by suspected comorbidity is improbable.

2.3. Clinician- and patient-reported outcomes

The Psoriasis Area and Severity Index (PASI) (28, 29) was used for the assessment of clinical response, which was defined as achieving 75%, 90%, or 100% improvement in PASI relative to baseline (PASI-75/90/100). For PsA, a 10-point visual analogue scale (VAS) was utilized to determine PsA severity. Affected joints were recorded by the dermatologist, and the number of swollen and painful joints was calculated.

Patient-reported outcomes (PROs) included scores from two validated patient-reported questionnaires, including the Dermatology Life Quality Index (DLQI) (30, 31) and Patient Benefit Index (PBI) (32). The proportion of patients who achieved a DLQI score between 0 and 1 (indicating no impact on patient's life), a PBI score of at least 1 (indicating a minimum clinically-relevant benefit), and a PBI score between 3 and 4 (indicating a high clinically-relevant benefit) were calculated.

Since routine health care in a real-world setting does not exactly follow registry design, the dates of dermatology visits usually differ from the planned dates of measurement. All parameters were evaluated at baseline and visits 2 (3 ± 1 months), 3 (6 ± 1 months), and 4 (12 ± 2 months). Treatment start was allowed 14 days prior to and up to 4 weeks after the baseline visit. All visits between initiation and termination of brodalumab treatment were included in the analyses, regardless of the completeness of visits for each individual patient across time.

2.4. Treatment discontinuation and 12-month drug survival

Treatment phase was defined as the time between initiation and first stop of therapy. Treatment discontinuation was defined as an observed stop of the first treatment phase with no restart of treatment within the following 90 days, which could include censoring, i.e. a "not yet"-observation (ongoing data collection) resulting in "no stop observed" at the date of the last visit reported or at data cutoff. Reasons for treatment discontinuation were categorized as skin clearance, adverse events (AEs), onset of contraindication, lack/loss of effectiveness, other, and unknown. To gain insight into the nature of AEs that resulted in treatment discontinuation, MedDRA® (MedDRA® trademark is registered by ICH) Preferred Term (33), System Organ Class, severity rating, treatment days to event, recovery, and causality are listed.

To minimize bias in interim drug survival analysis (34), the drug survival window was restricted to one-year drug survival and only patients having the chance of a one-year observation were selected (i.e. registered one year before data cutoff) (34). Treatment time for patients observed and on treatment for more than one year (i.e. censored at the end of the drug survival interval) was set to 12.01 months, which was necessary for correct estimation of patients at risk at exactly 12 months.

2.5. Statistical analysis

For comparison of the psoriasis only (Pso) and PsA subgroups, chi-squared tests were performed on categorical variables and *t*-tests on continuous variables. For comparison of comorbidity/comedication, a stepwise Fisher's Exact test strategy was applied: Main categories of conditions were compared with presence and medication. Subsumed conditions were compared to identify specific differences in comorbidity only if a significant difference was detected for the main category.

For drug survival, Kaplan-Meier curves were generated, and a log-rank test was performed to compare drug survival times between the two subgroups. The significance level was set at $\alpha \leq 0.05$ for all tests. Analyses were performed using SPSS v. 26 (IBM, NY, USA) and figures were generated using GraphPad Prism 9 (GraphPad Software Inc., MA, USA).

3. Results

3.1. Baseline

3.1.1. Patient characteristics

The analysis included a subset of patients from the full PsoBest registry dataset ($N = 12{,}975$) with a data cutoff of June 30, 2021. In total, 227 patients were eligible for the present analyses (Figure S1). For the total cohort ($N = 227$), patients were, on average, middle-aged (mean: 49.9 years), predominately male (69.2%), and had a mean disease duration of 22.0 years ($n = 211$). Of the total cohort, 55.1% received previous systemic treatment but no prior biologic therapy, and 31.7% received another biologic therapy prior to switching to brodalumab. Mean values in the total cohort for PASI, percent body surface area (BSA), and DLQI were 18.0 ($n = 224$), 29.6% ($n = 214$), and 12.5 ($n = 220$), respectively (Table 1).

Table 1. Patient characteristics at baseline.

	Total (*N* = 227)	Pso (*N* = 189)	PsA (*N* = 38)	Pso vs PsA *p*- value
Mean age, y (SD)	49.9 (14.6)	49.1 (14.8)	53.8 (13.2)	0.069
Female, %	30.8	29.1	39.5	0.206
Mean duration of disease, y (SD)	22.0 (15.7), *n* = 211	20.6 (14.9), *n* = 174	28.3 (18.0), *n* = 37	**0.007**
Prior systemic therapy but no prior biologic therapy*, %	55.1	56.6	47.4	0.296
Prior biologic therapy*, %	31.7	30.2	39.5	0.260
No prior systemic therapy*, %	13.2	13.2	13.2	0.991
Prior (additional) phototherapy*, %	44.1	45.5	36.8	0.326
Mean PASI (SD)	18.0 (11.0), *n* = 224	18.4 (10.8), *n* = 186	16.0 (11.8)**	0.222
Mean BSA involvement, % (SD)	29.6 (21.4), *n* = 214	29.7 (20.2), *n* = 177	29.6 (26.9), *n* = 37	0.983
Mean DLQI (SD)	12.5 (7.5), *n* = 220	12.7 (7.3), *n* = 183	11.4 (8.5), *n* = 37	0.342
Mean VAS (SD)	4.2 (2.5), *n* = 37	–	4.2 (2.5), *n* = 37	–
Mean number of swollen joints (SD)	7.2 (12.5), *n* = 31	–	7.2 (12.5), *n* = 31	–
Mean number of tender joints (SD)	8.6 (13.1), *n* = 34	–	8.6 (13.1), *n* = 34	–

*Non-biologics: Apremilast, Cyclosporine, Dimethylfumarate, Fumaric Acid Esters, Leflunomid, Methotrexate, Retinoids, Tofacitinib, systemic psoralen plus UV-A therapy. Biologics: Abatacept, Adalimumab, Certolizumab, Efalizumab, Etanercept, Golimumab, Guselkumab, Infliximab, Ixekizumab, Risankizumab, Secukinumab, Tildrakizumab, Ustekinumab and all biosimilars licensed in Germany. Phototherapy: UV, systemic psoralen plus UV-A. If a patient received a medication out of the non-biologic and the biologic group, the prior treatment was categorized as "prior biologic therapy." If the prior treatment was counted in the category "no prior systemic therapy," the patient received neither a medication of the non-biologic or biologic group. **n is given within cells only if sample size differs from cohort size (= *N*).
Significant *p*-values ($p \leq 0.05$) from Chi²- and *t*-test are marked bold.
BSA, body surface area (range 0-100); DLQI, Dermatology Life Quality Index (range 0-30); n, number of patients in analysis set; PASI, Psoriasis Area and Severity Index (range 0-72); PsA, psoriatic arthritis; Pso, psoriasis; SD, standard deviation; VAS, Visual Analogue Scale (range 0-10); y, years.

Of the total cohort, 83% (189/227) had psoriasis (of the skin, Pso) and no psoriatic arthritis and 17% (38/227) had both psoriasis and psoriatic arthritis (PsA). Patient characteristics at baseline were similar between the Pso and PsA subgroups; the only statistically significant difference was a greater mean disease duration in patients with PsA (Mean: 28.3; SD: 18.0) vs Pso (Mean: 20.6; SD: 14.9), $p \leq 0.007$ (Table 1). The PsA subgroup had a numerically higher mean age (Pso: 49.1 vs PsA: 53.8 years), the proportion of female patients (Pso: 29.1% vs PsA: 39.5%), and the proportion of patients who had received another biologic therapy before switching to brodalumab (Pso: 30.2% vs PsA: 39.5%) (Table 1).

3.1.2. Comorbidity and comedication

In the total cohort, the most frequent comorbidity at baseline was cardiovascular disease (34.4%, *n* = 78/227), followed by psychiatric, sleep and addictive disorder (25.1%, *n* = 57/227), and metabolic disease (18.5%, *n* = 42/227) (Table S1). The presence of arthritis (rheumatoid or psoriatic) was the only relevant statistically significant difference in comorbidity/comedication between the Pso and PsA subgroups (Table S2).

3.2. Clinician-assessed outcomes

In the total cohort, mean PASI decreased from baseline (18.0, *n* = 224) to 12 months (2.3, *n* = 68) (Figure 1a). Likewise, mean BSA decreased from baseline (29.6, *n* = 214) to 12 months (3.1, *n* = 67) (Figure 1b). PASI-75, PASI-90, and PASI-100 achievement increased from 3 months to 12 months: PASI-75 increased from 75.6% to 85.3% (Figure 2a), PASI-90 increased from 58.8% to 76.5% (Figure 2b), and PASI-100 increased from 37.0% to 51.5% (Figure 2c).

Mean PASI was comparable for both subgroups and decreased from baseline to 12 months (Pso: 18.4 to 2.0; PsA: 16.0 to 3.2) (Figure 1a). Likewise, mean BSA was comparable for both subgroups and decreased from baseline to 12 months (Pso: 29.7 to 3.1; PsA: 29.6 to 3.2) (Figure 1b). PASI-75 achievement increased for the Pso subgroup from 3 months to 12 months (77.2% to

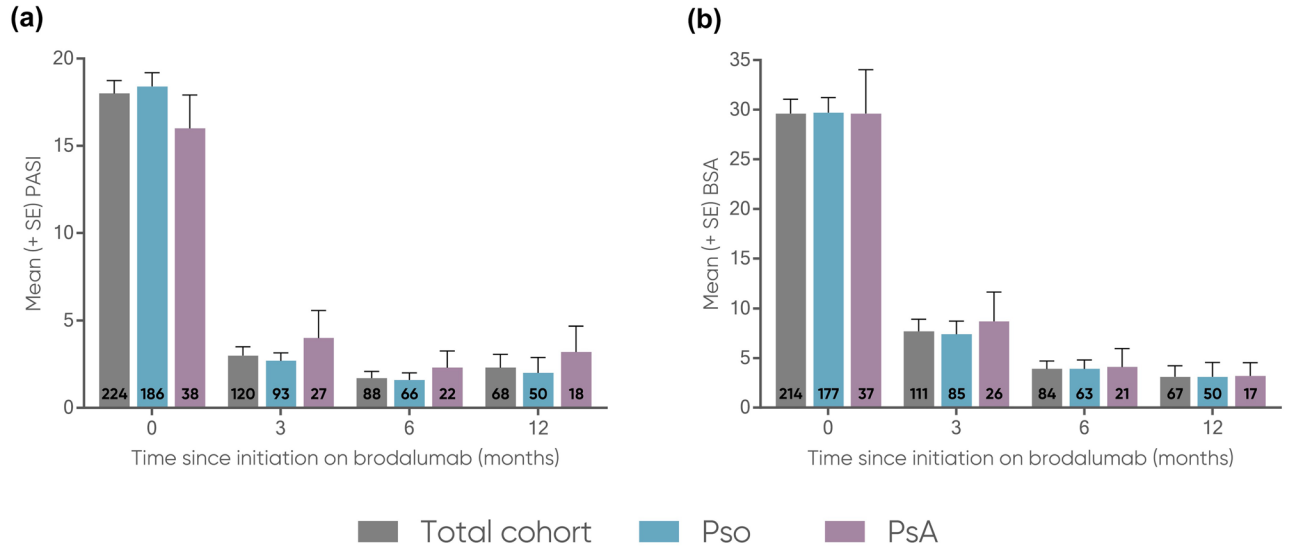

Figure 1. Mean (a) PASI (0-72) and (b) BSA (0-100) scores at 3, 6, and 12 months.
Error bars depict standard error. The number of patients at each time point are represented within each respective bar.
BSA, body surface area (range 0-100); PASI, Psoriasis Area and Severity Index (range 0-72); PsA, psoriatic arthritis; Pso, psoriasis; SE, standard error.

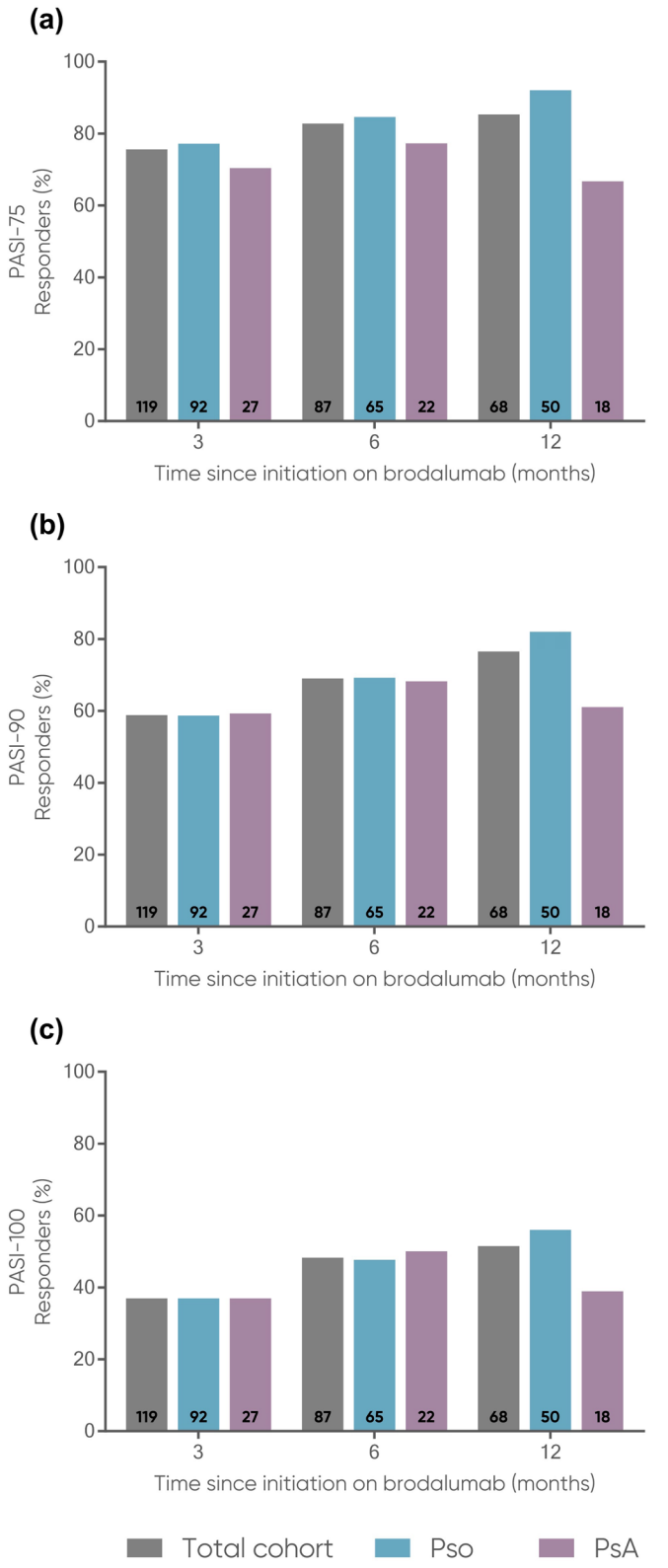

Figure 2. Proportions of patients achieving (a) PASI-75, (b) PASI-90, and (c) PASI-100 at 3, 6, and 12 months.
The number of patients at each time point are represented within each respective bar.
PASI, Psoriasis Area and Severity Index (range 0-72); PASI-75, at least 75% reduction from baseline PASI; PASI-90, at least 90% reduction from baseline PASI; PASI-100, 100% reduction from baseline PASI; PsA, psoriatic arthritis; Pso, psoriasis.

92.0%) and decreased for the PsA subgroup from 3 months to 12 months (70.4% to 66.7%) (Figure 2a). For both subgroups, PASI-90 and PASI-100 achievement increased from 3 months to 12 months. In the Pso subgroup, PASI-90 increased from 58.7% to 82.0% (Figure 2b) and PASI-100 increased from 37.0% to 56.0% (Figure 2c). In the PsA subgroup, PASI-90 increased from 59.3% to 61.1% (Figure 2b) and PASI-100 increased from 37.0% to 38.9% (Figure 2c). For the PsA subgroup, the largest effectiveness was observed at 6 months for PASI-75 (77.3%, $n = 17/22$), PASI-90 (68.2%, $n = 15/22$) and PASI-100 (50.0%, $n = 11/22$). The mean PsA severity using the VAS 0-10 decreased from 4.2 at baseline ($n = 37$) to 2.3 at 12 months ($n = 16$) (Figure 3a), while the mean number of swollen joints decreased from 7.2 at baseline ($n = 31$) to 7.1 at 12 months ($n = 14$), and the mean number of tender joints decreased from 8.6 ($n = 34$) to 5.5 ($n = 14$), respectively (Figure 3b).

3.3. Patient-reported outcomes

Mean DLQI decreased from baseline to 12 months in the total cohort and across the subgroups (total: 12.5 to 1.4; Pso: 12.7 to 1.1; PsA: 11.4 to 2.2) (Figure 4a). Mean PBI of approximately 3 was maintained from 3 months (total: 3.0; Pso: 3.1, PsA: 2.7) to 12 months (total: 3.1; Pso: 3.2; PsA: 2.7) (Figure 4b). DLQI 0/1 achievement increased from baseline to 12 months in the total cohort and across the subgroups (total: 5.5% to 81.2%; Pso: 3.8% to 82.7%; PsA: 13.5% to 76.5%) (Figure 4c). Achievement of PBI ≥1 increased from 3 months (total: 95.5%; Pso: 97.7%; PsA: 88.5%) to 12 months (total: 98.4%; Pso: 100.0%; PsA: 94.1%) (Figure 4d). PBI ≥3 achievement increased overall from 3 months (total: 58.9%; Pso: 64.0%; PsA: 42.3%) to 12 months (total: 63.5%; Pso: 67.4%; PsA: 52.9%) (Figure 4d). For the PsA subgroup, the largest decrease in mean DLQI (1.8, $n = 22$), mean increase in PBI (3.2, $n = 20$), PBI ≥1 achievement (100.0%, $n = 20/20$), and PBI ≥3 achievement (65.0%, $n = 13/20$) was observed at 6 months, and largest achievement of DLQI 0/1 occurred at 3 months (80.0%, $n = 20/25$).

3.4. Reasons for discontinuation and 12 month drug survival

3.4.1. Treatment discontinuation

Within the whole observational period, 18.1% (41/227) of total patients discontinued treatment (Pso: 18.0%, $n = 34/189$; PsA: 18.4%, $n = 7/38$). The average time on brodalumab to discontinuation (cases with a reported stop) in months was 8.3 for the total cohort, 8.0 for the Pso subgroup, and 9.7 for the PsA subgroup. Patients with PsA showed a numerically longer median time to discontinuation (Pso: 5.8 vs PsA: 9.1 months) and narrower time range to discontinuation compared to patients with Pso (Pso: 1.2 to 34.5 months vs PsA: 1.9 to 25.5 months) (Table 2).

The primary reason for discontinuation was lack or loss of effectiveness (total: 47.7%; Pso: 41.7%; PsA: 75.0%). The second most common reason for discontinuation were AEs (total: 27.3%; Pso: 30.6%; PsA: 12.5%). Skin clearance was reported twice (both instances in the Pso subgroup) as the reason for treatment discontinuation (Table 3).

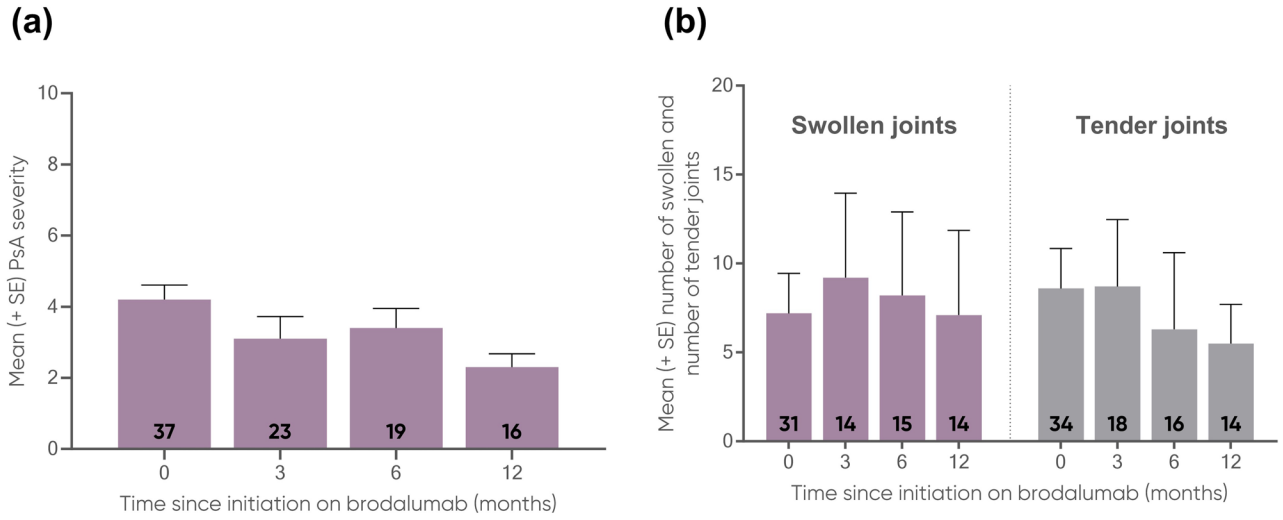

Figure 3. Mean (a) PsA severity (VAS 0-10) and (b) number of swollen (0-74) and number of tender (0-76) joints in PsA patients at 0, 3, 6, and 12 months.
Error bars depict standard error. The number of patients at each time point are represented within each respective bar.
PsA, psoriatic arthritis; SE, standard error; VAS, Visual Analogue Scale.

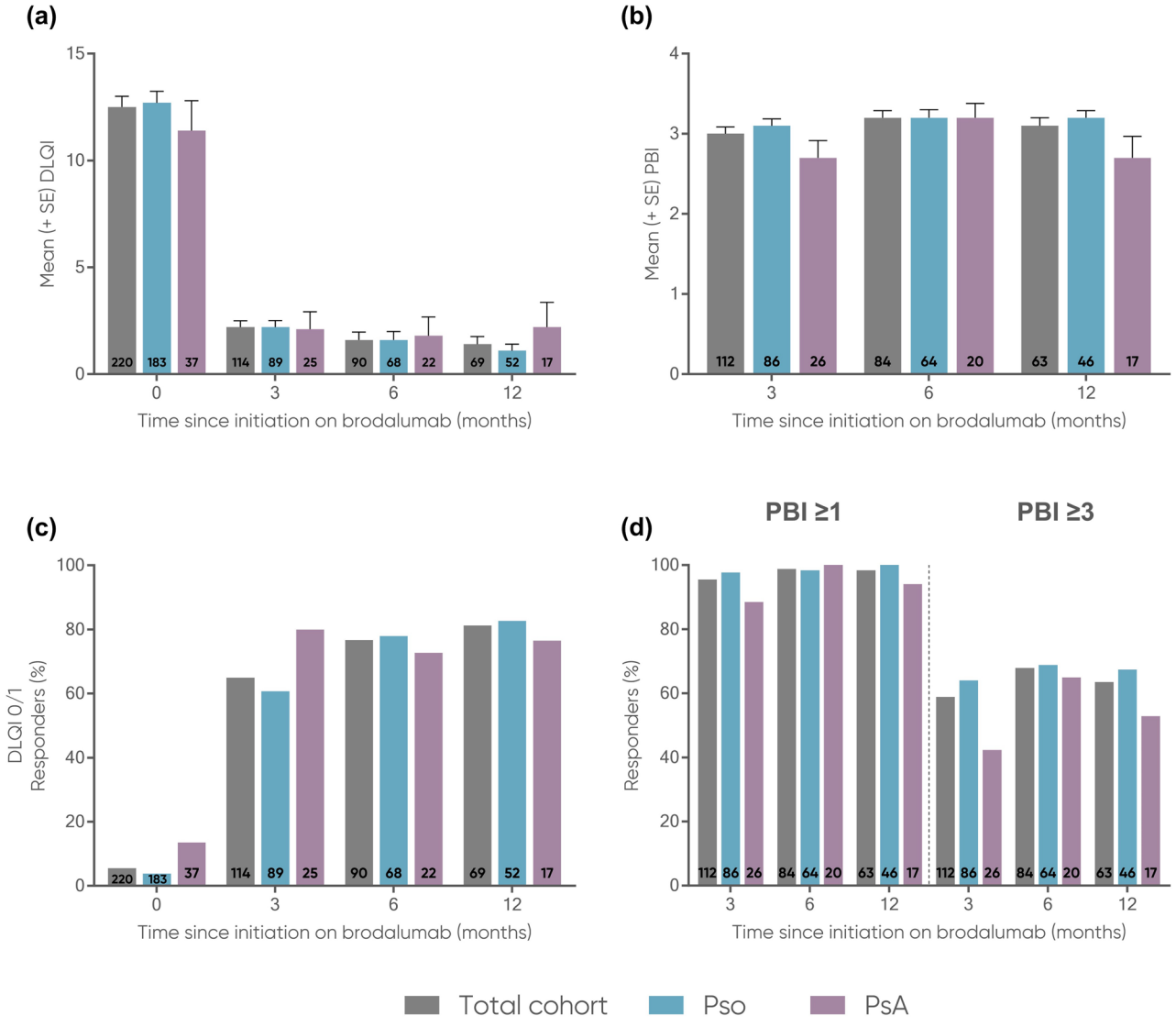

Figure 4. Mean (a) DLQI (0-30) and (b) PBI (0-4) and proportions of patients achieving (c) DLQI 0/1, (d) PBI ≥1 and PBI ≥3 at 0, 3, 6, and 12 months.
The number of patients at each time point are represented within each respective bar. For mean DLQI and PBI, error bars depict standard error.
DLQI, Dermatology Life Quality Index; PBI, Patient Benefit Index; PsA, psoriatic arthritis; Pso, psoriasis; SE, standard error.

Table 2. Time to discontinuation (for cases with reported stop).

		n	Min	Max	Mean	Median	SD
Total ($n=227$)	time to discontinuation [months]	41	1.2	34.5	8.3	5.8	6.9
Pso ($n=189$)	time to discontinuation [months]	34	1.2	34.5	8.0	5.8	6.6
PsA ($n=38$)	time to discontinuation [months]	7	1.9	25.5	9.7	9.1	8.5

n, number of patients in analysis set; PsA, psoriatic arthritis; Pso, psoriasis, SD, standard deviation.

Table 3. Reasons for discontinuation of brodalumab.

	Total ($n=227$)		Pso ($n=189$)		PsA ($n=38$)	
Reason*	n	%	n	%	n	%
Stop due to adverse events	12	27.3	11	30.6	1	12.5
Stop due to onset of contraindication	3	6.8	3	8.3	0	0
Stop due to skin clearance	2	4.5	2	5.6	0	0
Stop due to lack or loss of effectiveness	21	47.7	15	41.7	6	75.0
Stop due to other reason	1	2.3	1	2.8	0	0
Stop due to unknown reason	5	11.4	4	11.1	1	12.5
Total reported reasons	44	100.0	36	100.0	8	100.0

*Multiple reasons possible. PsA, psoriatic arthritis; Pso, psoriasis.

3.4.2. Adverse events leading to discontinuation

Further examination of the AEs reported showed that 55.0% (11/20) of the events were non severe and mostly involved the skin and subcutaneous tissue (4 non severe, 2 severe events in 3 cases). The single observed AE in the PsA subgroup was non severe erythema, accompanied by rash and pruritus of the skin beginning at Day 74 after treatment initiation (Table 4). Four of seven serious AEs (57.1%) involved severe infections, including bacterial arthritis (80 days after treatment start; with causality rated as related to treatment) in connection with palmoplantar pustulosis and pyoderma gangrenosum (35 days after treatment start; with causality rated as related to treatment), infective episcleritis (4 days after treatment start; with causality rated as possibly related to treatment), herpes zoster meningitis and ophthalmic herpes infections (350 days after treatment start; with causality rated as possibly related to treatment). Lastly, a joint operation due to pre-existing osteoarthritis issues occurred 285 days after treatment start, but causality to treatment was rated as improbable (Table 4).

3.4.3. Drug survival

For the total cohort, the mean drug survival rate decreased across the 1-year period of analysis from 96.6% after 3 months, to 86.4% after 6 months, and 76.2% after 12 months. As the drug survival rate remained ≥50% after 12 months, the median survival time was not estimable. There was no statistically significant difference in the estimated mean 12 months survival time (mean time until discontinuation) between the subgroups (Pso: 10.6 months vs PsA: 10.8 months; $p \leq 0.54$). Mean 12 months drug survival rates decreased to 97.3%, 85.8%, and 74.9% for the Pso subgroup, and 92.9%, 89.1%, and 83.2% for the PsA subgroup (Table 5, Figure 5). Of note, the restriction of longer treatment times to 12.01 months resulted in the observation period being censored for 85.9% (195/227) patients of the total cohort (Pso: 85.2%, $n=161/189$; PsA: 89.5%, $n=34/38$).

4. Discussion

These data reflect, to our knowledge, the largest real-world population analysis of the effectiveness and safety of brodalumab in patients with moderate-to-severe psoriasis. Mean PASI and BSA values indicated that patients receiving brodalumab had moderate-to-severe psoriasis with a high impact on their health-related QoL at baseline. Clinician-assessed outcomes and PROs indicated a rapid response to brodalumab treatment within the first 3 months, which was maintained up to 12 months. Although patients in the PsA subgroup showed slightly worse mean PASI and BSA decline, these differences were not statistically significant at all time points. These real-world data are aligned with long-term efficacy data from clinical trials (35) and real-world effectiveness data from Italy (22) and Greece (24, 25). Moreover, the data presented here are similar to a recent *post hoc* analysis of the phase 3 AMAGINE-2 and AMAGINE-3 trials which showed a comparable degree of brodalumab effectiveness and impact on QoL through 52 weeks in patients with moderate-to-severe psoriasis with and without concomitant PsA (36).

Approximately one-third of patients (Pso: 30.2% vs PsA: 39.5%) had received another biologic therapy prior to brodalumab. Since previous work suggests treatment efficacy is less likely to improve for subsequently offered biologics (37), it is possible that response rates would be lower in a population with a higher proportion of biologic-experienced patients. However, an analysis of the phase 3 AMAGINE-2 and −3 trials demonstrated that rates of skin clearance with brodalumab were similar in biologic-naïve and biologic-experienced patients (38), which aligns with these data, demonstrating that brodalumab is also effective in moderate-to-severe psoriasis patients who did not respond to a previous anti-IL-17 therapy, a finding which may better inform clinical decisions regarding when to modify biologics treatment.

As drug survival is a marker for treatment sustainability in chronic diseases such as psoriasis (39), an overall one-year drug survival rate of approximately 75% and a mean time to discontinuation of 8.2 months indicates high sustainability. In the first 12 months of treatment, there was no difference in average drug survival rate and time between the Pso and PsA subgroups. In both subgroups, the primary reason for treatment discontinuation was a reported lack or loss of effectiveness and the majority of reported AEs were non severe.

The analysis performed was limited by several factors related to its observational and non-interventional design. A lower degree of internal validity is expected in non-interventional studies (compared to clinical trials) as well as a potential for selection bias. These analyses were performed while the registry is ongoing; therefore, the results are interim and all analyses are limited by completeness of the data itself. There is likely only a limited number of patients able to be included at each

Table 4. Adverse events as reason for discontinuation.

Pseudo ID	Severity	MedDRA SOC	MedDRA PT	Days to event	Result	Causality	Comment
1	unknown	unknown	unknown	–	unknown	unknown	Not determinable by query
2	unknown	unknown	unknown	–	unknown	unknown	Not determinable by query
3	non severe	Psychiatric disorders	Listless	154	not yet recovered	possibly related	
	non severe	Metabolism and nutrition disorders	Decreased appetite	154	not yet recovered	possibly related	
4	non severe	Reproductive system and breast disorders	Orchitis noninfective	73	recovered	possibly related	
5	non severe	Musculo-skeletal and connective tissue disorders	Musculo-skeletal discomfort	115	recovered	probably related	
6	non severe	Psychiatric disorders	Depression	50	not yet recovered	possibly related	
7	non severe	Nervous system disorders	Headache	43	not yet recovered	probably related	
	non severe	Skin and subcutaneous tissue disorders	Pruritus	57	recovered	related	
8	non severe	Gastrointestinal disorders	Diarrhoea	140	not yet recovered	probably related	
9	non severe	Skin and subcutaneous tissue disorders	Erythema	74	not yet recovered	probably related	PsA
	non severe	Skin and subcutaneous tissue disorders	Pruritus	74	not yet recovered	probably related	PsA
	non severe	Skin and subcutaneous tissue disorders	Rash	74	not yet recovered	probably related	PsA
10	severe	Surgical and medical procedures	Knee arthroplasty	285	recovered	improbable	
11	severe	Skin and subcutaneous tissue disorders	Pyoderma gangrenosum	35	not recovered	related	
	severe	Skin and subcutaneous tissue disorders	Palmoplantar pustulosis	35	not recovered	related	
	severe	Infections and infestations	Arthritis bacterial	80	not recovered	related	
12	severe	Infections and infestations	Herpes zoster meningitis	350	recovered	possibly related	First treatment period
	severe	Infections and infestations	Ophthalmic herpes zoster	350	recovered	possibly related	First treatment period
	severe	Infections and infestations	Infective episcleritis	4	recovered	possibly related	Second treatment period

MedDRA, Medical Dictionary for Regulatory Activities; PsA, psoriatic arthritis; PT, preferred term; SOC, system organ class.

Table 5. Drug survival rate.

	Total cohort ($n = 227$)		Pso ($n = 189$)		PsA ($n = 38$)	
Month	Drug survival rate (%)	Patients remaining at risk	Drug survival rate (%)	Patients remaining at risk	Drug survival rate (%)	Patients remaining at risk
3	96.6	162	97.3	136	92.9	26
6	86.4	111	85.8	93	89.1	24
12	76.2	71	74.9	58	83.2	13

n, number of patients in analysis set; PsA, psoriatic arthritis; Pso, psoriasis.

assessed time point in a long-term analysis, a limitation which may increase the possibility that small differences and rare events could be missed. Moreover, the 12-month follow-up time was shorter when compared to two real-world brodalumab data studies from Greece (24, 25), which had follow-up time of 24 months. Lastly, future studies should aim to directly compare data from other current biologics within the same registry.

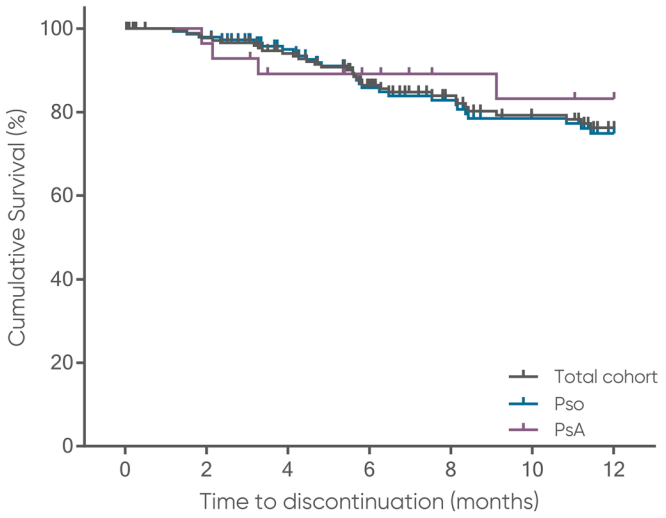

Figure 5. Time on brodalumab over 12 months.
Tick marks on connecting lines represent incidences/time points of censoring (i.e. last time of observation, not treatment stop).
PsA, psoriatic arthritis; Pso, psoriasis.

The analysis and data presented also demonstrates the strength of real-world data collection in patient registries. The protocol-driven data collection of relevant disease and treatment characteristics over a long time-period across a defined geographical region/health care system enables detailed analysis and generalizable data on course of disease, treatment effectiveness, safety, pathways as well as patient benefit, cost of illness and many more relevant dimensions of health care. The evidence generated is an enrichment of scientific medical knowledge useful for medical decisions and thus directly translates into routine health care.

Overall, brodalumab demonstrated rapid and sustained effectiveness and was well-tolerated over 12 months of treatment in German patients with moderate-to-severe psoriasis and psoriatic arthritis in a real-world setting.

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Ethical approval

Patients gave written informed consent on registry participation and approval from the local ethics committee was obtained to conduct the PsoBest registry.

Disclosure statement

Lisa Schaeffer, Christina Sorbe, and Stephan Jeff Rustenbach are employees at the University Medical Center Hamburg-Eppendorf (UKE) and report no conflicts of interest.

Nesrine Ben-Anaya has served as consultant and/or paid speaker of the following companies: AbbVie, Almirall, Incyte, Novartis, UCB, Pfizer.

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Data availability statement

The data that support the findings of this study are available from the corresponding author, Nesrine Ben-Anaya upon reasonable request.

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