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Risk of developing sleep disorders and psychologic comorbidity in children with inflammatory skin diseases—A population-based study



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Background: Inflammatory skin diseases such as atopic dermatitis (AD), psoriasis, and urticaria are associated with impaired mental health and sleep. In children the risk of developing these comorbidities is still poorly evaluated.

Methods: Retrospective data analysis of a US Collaborative Network including children of 55 health care providers was performed. Data from electronic health records of patients with a diagnosis of either AD, psoriasis, or urticaria, as well as a control cohort were retrieved in an anonymized batch format and propensity score matched.

Results: Children with psoriasis had a 3.2-fold higher risk of hypersomnia, 2.1-fold higher risk of sleep apnea, 1.8-fold higher risk of fatigue, and 1.9-fold higher risk of depression. Children with urticaria (acute or chronic) and AD had a 1.7-fold higher risk of sleep disorders, 1.6-fold higher risk of anxiety disorders, and 1.4-fold higher risk of insomnia. AD children had a 1.5-fold higher risk of anxiety disorders.

Limitations: Electronic health insurance data are not subject to random sampling of the general population and potential misdiagnosis is possible.

Conclusions: Children with inflammatory skin diseases were at a higher risk of sleep psychological disorders. Thus, regularly performed screenings and appropriate treatment initiation might potentially prevent mental and physical health consequences and secure improved life quality. (J Am Acad Dermatol 2025;92:1261-8.)

Key words: anxiety; atopic dermatitis; depression; pruritus; psoriasis; psychological burden; sleep apnea; sleep disorders; urticaria.

INTRODUCTION

The prevalence of inflammatory skin diseases in children ranges from approximately 0.1% in urticaria,^{1,2} to 2% in psoriasis,³⁻⁵ and up to 20% in atopic dermatitis (AD).⁶⁻⁸ Commonly observed

symptoms (ie, pruritus and pain), and psychosocial comorbidities such as sleep disorders (47%-80%)^{9,10} and psychological disorders in adults as well as in children lead to severely impaired quality of life.^{1,11-13}

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Sleep disorders can be subdivided into various forms. The most prevalent form is insomnia, characterized by problems falling asleep, staying asleep or waking up too early.¹⁴ Sleep apnea is a disruption of continuous breathing during sleep, due to a dysregulation of the central nervous system and/or airway obstruction. Consequently, increased proinflammatory signals and oxidative stress lead to various cardiovascular and psychological problems.¹⁵ Hypersomnia, opposed to the aforementioned sleep disturbances, is defined by excessive sleepiness due to factors such as sleep deprivation and can result from conditions, eg, insomnia or sleep apnea.¹⁶

Adults with psoriasis, urticaria, or AD have an increased risk of sleep apnea, with several causalities beside obesity, such as airway swelling or allergic rhinitis, being discussed.¹⁷ Furthermore, insomnia and fatigue are associated symptoms and mentioned in adult patients with psoriasis, urticaria, and AD, potentially caused by pruritus and pain.¹⁸⁻²⁰ However, data on hypersomnia are missing and little is known about the risk association between the development of various forms of these sleep and psychological disorders in early childhood.

Therefore, we aimed to retrospectively investigate the risk of developing psychosocial comorbidities, sleep disturbances, and common related symptoms in a pediatric population at the age of 5 to 17 years.

METHODS

Study design and data base

Analysis was performed as previously described.²¹⁻²³ Data from electronic health records were retrieved from the US Collaborative Network as part of the TriNetX, LLC network. The US Collaborative Network consisted, at the time of analysis, of 57 health care providers of which 55 health care providers responded. Individual cohorts were characterized by an index event, which was defined as the first diagnosis of either AD, psoriasis, (chronic or acute) urticaria or for the control group “fracture of upper end of radius” recorded by the respective ICD10 code according to the International Classification of Diseases 10th revision (ICD10). For the outcome analysis, predefined diagnoses were analyzed within 1825 days (5 years) after the index event. Data retrieval from electronic health records

was limited to a maximum of 20 years before the time of analysis.

Retrospective electronic health record data retrieval was performed in an anonymized and protected form via TriNetX, LLC in accordance with Health Insurance Probability and Accountability Act of 1996 compliance and with privacy and security protection of health care

data according to US federal law and individuals health care providers. All data are deidentified as defined by Health Insurance Probability and Accountability Act of 1996 Privacy Rule and usage of data does not involve collection, use, or transmittal of individually identifiable data. Subsequently, no institutional review board approval had to be obtained from the local ethics committee.

CAPSULE SUMMARY

- Children with inflammatory skin diseases suffer from sleep and psychological disorders, however the risk of association for developing such comorbidities is still poorly understood.
- Screening for certain sleep and psychological disorders in children could help prevent negative health consequences and decreased quality early on in life.

Study population and outcome analysis

At the time of analysis, the US Collaborative Network contained longitudinal medical records from approximately 98 million health-insured individuals. Four cohorts for retrospective data analysis were defined by ICD10 codes, while limiting age at index to 5 to 17 years. The following ICD10 codes were used for each cohort: AD, L20; psoriasis, L40; urticaria, L50; and controls, S52.1 (“fracture of upper end of radius”). For each cohort, patients with a diagnosis of the 3 other respective diagnoses, as well as other diagnoses with known impact on outcome events, were excluded (Supplementary Table I, available via Mendeley at <https://data.mendeley.com/datasets/8tbnp4hr3y/1>). Additional analyses were performed by only including either female or male patients. Following, propensity score matching of each cohort for comparison was performed. Matching criteria consisted of age at index, race (White; 2106-3 and Black or African American; 2054-5), ethnicity (not Hispanic or Latino; 2186-5), sex (female; F) and the 3 diagnoses overweight and obesity (E66), family history of mental and behavioral disorders (Z81), and family history of intellectual disabilities (Z81.0) (Supplementary Table II, available via Mendeley at <https://data.mendeley.com/datasets/8tbnp4hr3y/1>).

Outcome analysis was performed by determining hazard ratios (HRs) of outcome events for individual comparison of either L20, L40, or L50 cohorts to S52.1 cohort. Outcome events analyzed for consisted of diagnoses of depression, fatigue, sleep disturbance

Abbreviations used:

AD:	atopic dermatitis
HR:	hazard ratio
ICD10:	International Classification of Diseases 10th revision

unspecified, sleep apnea, insomnia, and also pruritus and pain because of its known prevalence in all 3 skin diseases, based on ICD10 codes (Supplementary Table III, available via Mendeley at <https://data.mendeley.com/datasets/8tbnp4hr3y/1>).

Statistical analysis

Univariate Cox proportional hazard regression was used for calculation of HRs within a time frame of 5 years after initial diagnosis, with additional exclusion of patients having the particular outcome event before the index event. Patients were censored after the last record available in TriNetX. To determine differences between distribution of each comparable groups, a log-rank test was performed. Pairwise log-rank comparison was run for each disease. Two-tailed p values $< .05$ were considered statistically significant.

RESULTS

Before matching, children with AD displayed a mean age of 9.9 years (SD 3.4 years), whereas children with psoriasis were slightly older (11.7 years, SD 3.7 years), and the mean age for first diagnosis of urticaria was 10.1 years (SD 3.9 years). Although no differences regarding sex (~55% female) and not Hispanic or Latino (~60%) were found across the 3 groups, 37.4% of children with AD were White, compared with 67.9% with psoriasis and 55.5% with urticaria. Furthermore, the proportion of Black or African American children was 30.9% for AD, 9% for psoriasis, and 15.6% for urticaria (Table I, Supplementary Tables IV and V, available via Mendeley at <https://data.mendeley.com/datasets/8tbnp4hr3y/1>). Propensity score matching resulted in 79,673 matched children with AD, 28,365 with psoriasis, and 82,452 with urticaria (Table I, Supplementary Tables IV and V, available via Mendeley at <https://data.mendeley.com/datasets/8tbnp4hr3y/1>).

Children with chronic inflammatory skin diseases display sleep impairment

First, the impact of each skin disease on sleep was analyzed. Risk of overall sleep disorders were equally significant increased across the diseases (AD: HR, 1.70, 95% CI, 1.592-1.813, $p = .0001$; psoriasis: HR, 1.71, 95%

CI, 1.536-1.893, $p = .0001$; and urticaria: HR, 1.73, 95% CI, 1.618-1.814, $p = .0001$) (Table II). For improved granular understanding sleep disorders were further divided into sleep apnea, insomnia, and hypersomnia. Risk of developing sleep apnea was increased across all diseases and highest in children with psoriasis (HR, 2.10, 95% CI, 1.662-2.659, $p = .0001$), followed by children with AD (HR, 1.82, 95% CI, 1.592-2.068, $p = .0001$) and urticaria (HR, 1.69, 95% CI, 1.480-1.928, $p = .0001$). Although patients with urticaria and AD displayed increased risk of insomnia (urticaria: HR, 1.40, 95% CI, 1.237-1.582, $p = .0001$; AD: HR, 1.30, 95% CI, 1.144-1.465, $p = .0001$), no significant risk difference was noted in patients with psoriasis ($p = .129$). Hypersomnia displayed increased risk in all 3 diseases (psoriasis: HR, 3.22, 95% CI, 2.431-4.273, $p = .0001$; urticaria: HR, 1.93, 95% CI, 1.611-2.319, $p = .0001$; and AD: HR, 1.46, 95% CI, 1.199-1.776, $p = .0001$) (Table II).

Risk of depression and anxiety are increased across AD, psoriasis, and urticaria

Next, risk of development of psychological diseases was analyzed. Here, all patient groups displayed increased risk of depression and anxiety. Patients with psoriasis displayed the highest risk of depression (HR, 1.92, 95% CI, 1.692-2.177, $p = .0001$), whereas patients with urticaria displayed the highest risk of anxiety (HR, 1.62, 95% CI, 1.529-1.715, $p = .0001$) (Supplementary Tables VI and VII, available via Mendeley at <https://data.mendeley.com/datasets/8tbnp4hr3y/1>).

Increased risk of fatigue is found already early in psoriatic patients

To better understand the impact on malaise, fatigue, and pain individual HRs were determined. Risk of fatigue was increased across all groups, however, patients with psoriasis displayed the highest HRs (HR, 1.84, 95% CI, 1.686-1.998, $p = .0001$), followed by urticaria (HR, 1.74, 95% CI, 1.647-1.838, $p = .0001$) and AD (HR, 1.34, 95% CI, 1.269-1.424, $p = .0001$). Furthermore, patients with psoriasis also had a higher risk of development of unspecified weakness (HR, 1.35, 95% CI, 1.211-1.501, $p = .0001$), which contrary was decreased in AD (HR, 0.77, 95% CI, 0.711-0.833, $p = .0001$) (Table II). Urticaria children had the highest incidence of pain as compared with the other groups (Fig 1, Supplementary Figs 1 to 3, Supplementary Tables IV to VI, available via Mendeley at <https://data.mendeley.com/datasets/8tbnp4hr3y/1>). Interestingly, risk of pruritus was equally significant increased across all groups (AD: HR, 3.22, 95% CI, 2.928-3.492, $p = .0001$; psoriasis: HR, 3.20, 95% CI, 2.786-3.712, $p = .0001$; and urticaria: HR, 3.01, 95% CI, 2.756-3.286, $p = .0001$) (Table II).

Table I. Characteristics before and after matching of patients with atopic dermatitis and healthy controls

ICD10CM	Diagnosis	Before matching			After matching		
		Atopic dermatitis N = 248,682	Radius fracture N = 83,917	Standard difference	Atopic dermatitis N = 79,673	Radius fracture N = 79,673	Standard difference
A1	Age (y) at index	9.1, SD 3.7 (240,266)	9.9, SD 3.4 (82,590)	0.247	9.9, SD 3.4 (79,673)	9.8, SD 3.3 (79,673)	0.016
2106-3	White	89,973 (37.4%)	54,996 (66.6%)	<.001	52,075 (65.4%)	52,079 (65.4%)	<0.001
F	Female	132,432 (55.1%)	33,827 (41.0%)	<.001	34,517 (43.3%)	33,827 (42.5%)	0.017
2186-5	Not Hispanic or Latino	152,744 (63.6%)	47,526 (57.5%)	<.001	45,736 (57.4%)	46,148 (57.9%)	0.010
2054-5	Black or African American	74,193 (30.9%)	7481 (9.1%)	<.001	7483 (9.4%)	7481 (9.4%)	<0.001
E66	Overweight and obesity	16,276 (6.8%)	1446 (1.8%)	<.001	1454 (1.8%)	1446 (1.8%)	0.001
Z81	Family history of mental and behavioral disorders	1586 (0.7%)	256 (0.3%)	<.001	235 (0.3%)	256 (0.3%)	0.005
Z81.0	Family history of intellectual disabilities	87 (<0.1%)	10 (<0.1%)	.001	10 (<0.1%)	10 (0.1%)	<0.001

CM, Clinical modification; ICD, International Classification of Disease.

Gender specific differences across insomnia, depression, anxiety, and pain

When comparing gender differences, girls were at a higher risk of developing insomnia, depression, fatigue, and pain, with the most significant being depression, where girls with AD had a 2.1-fold higher risk (95% CI, 1.928-2.279, *p* = .0001) than boys (Table III). Similar, girls with urticaria displayed increased risk of depression (HR, 2.04, 95% CI, 1.878-2.215, *p* = .0001), which was less in girls with psoriasis (HR, 1.30, 95% CI, 1.128-1.5, *p* = .0001). Regarding anxiety disorders, girls with urticaria had the highest HR (HR, 2.07, 95% CI, 1.889-2.266, *p* = .0001), followed by girls with AD (HR, 1.98, 95% CI, 1.811-2.173, *p* = .0001) and girls with psoriasis (HR, 1.94, 95% CI, 1.551-2.421, *p* = .0001) (Table III). Girls were also more likely to develop sleep disorders, insomnia, as well as pruritus and pain (Supplementary Tables VII to IX, available via Mendeley at <https://data.mendeley.com/datasets/8tbnp4hr3y/1>). No significant gender differences were seen for sleep apnea.

DISCUSSION

Inflammatory skin diseases in children and adults are associated with symptoms such as itch, pain, psychological disorders, sleep disturbances, and fatigue.^{10,24-26} In this study, it was found that diseased children had a higher risk of developing psychological comorbidities or sleep disorders. Among sleep disorders, sleep apnea had the highest overall incidence. Although children with psoriasis were more likely to develop hypersomnia, sleep apnea, and fatigue, children with urticaria were more likely to develop insomnia.

According to the literature, sleep apnea affects 1% to 5% of children and is a serious condition with various psychosocial and systemic consequences, such as cardiovascular diseases.²⁷ Adults with psoriasis are known to have a higher prevalence of sleep apnea,²⁸ whereas associations in children with inflammatory skin diseases are unclear. In addition to a possible association with obesity and, especially in children, hyperplasia of the tonsils and adenoids, other causal mechanisms have been discussed, such as airway swelling in urticaria and allergic rhinitis in AD.¹⁷ In line with our findings, previous data showed a high prevalence of sleep disturbance in AD.⁶⁻⁸ Regarding observed gender specific differences on sleep disturbances a Swedish study found that girls with AD suffer more often from sleep disturbances than boys, which is in line with our findings.²⁹ This implicates that gender differences already exist early on in life. Recent studies suggest

Table II. Risk and hazard ratios of analyzed outcomes in patients with and without atopic dermatitis after initial diagnosis

Definition	Atopic dermatitis			Radius fracture			Hazard ratio	95% CI	P value (log-rank test)
	No. of eligible participants	No. of outcomes	Risk, %	No. of eligible participants	No. of outcomes	Risk, %			
Anxiety disorder, unspecified	77,778	3007	0.039	78,664	1840	0.023	1.539	1.452-1.631	.0001
Depression, unspecified	79,181	1050	0.013	79,438	695	0.009	1.422	1.292-1.566	.0001
Generalized anxiety disorder	79,155	951	0.012	79,366	707	0.009	1.257	1.14-1.385	.0001
Hypersomnia	79,507	257	0.003	79,598	163	0.002	1.46	1.199-1.776	.0001
Hypersomnia, unspecified	79,523	225	0.003	79,608	147	0.002	1.415	1.149-1.742	.001
Insomnia	79,188	605	0.008	79,413	434	0.005	1.295	1.144-1.465	.0001
Insomnia, unspecified	79,216	559	0.007	79,421	420	0.005	1.235	1.088-1.402	.001
Malaise and fatigue	76,402	3132	0.041	78,269	2393	0.031	1.242	1.177-1.31	.0001
Other fatigue	76,852	2790	0.036	78,490	1962	0.025	1.344	1.269-1.424	.0001
Other sleep disorders	79,106	275	0.003	79,249	259	0.003	0.964	0.813-1.142	.672
Pain, unspecified	75,714	2303	0.030	77,173	2746	0.036	0.786	0.743-0.831	.0001
Pruritus	75,226	2128	0.028	79,160	645	0.008	3.198	2.928-3.492	.0001
Sleep apnea	77,633	1062	0.014	78,551	543	0.007	1.791	1.615-1.986	.0001
Sleep apnea, unspecified	78,478	674	0.009	79,035	339	0.004	1.815	1.592-2.068	.0001
Sleep disorders	75,536	2551	0.034	77,739	1420	0.018	1.699	1.592-1.813	.0001
Sleep disorders not due to a substance or known physiological condition	79,256	322	0.004	79,443	197	0.002	1.493	1.251-1.783	.0001
Weakness	78,302	1129	0.014	78,759	1356	0.017	0.769	0.711-0.833	.0001

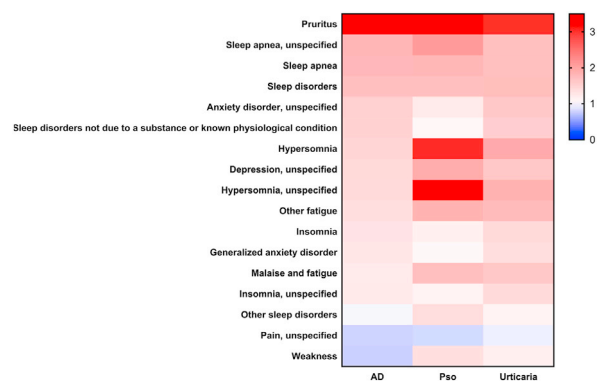


Fig 1. Heatmap showing risk of association of development of the selected comorbidity (*y-axis*) dependent on the respective skin disease (*x-axis*) with high risk of association of development (red) and low risk (blue). AD, Atopic dermatitis; Pso, psoriasis.

that inflammation itself may cause sleep apnea, and that sleep apnea causes an increase in oxidative stress and thus proinflammatory signals.³⁰⁻³² Although the cohort was matched for obesity and overweight in order to rule out confounders, other confounding variables and differences between groups such as the comorbidities mentioned above, might exist.

To the best of our knowledge, our presented data is the first on hypersomnia in children with

inflammatory skin diseases. The highest incidence rate of hypersomnia was seen in the psoriasis cohort. As hypersomnia is also a common consequence of sleep apnea and fatigue,¹⁶ this could explain the coprevalence in children with psoriasis. The proinflammatory burden could also result in hypersomnia and fatigue¹⁸ and possibly even sleep apnea. Moreover, as other studies have shown, hypersomnia, is associated with psychiatric disorders,³³ as is psoriasis in this cohort.

Psoriasis is known to be associated with an increased risk of fatigue in adults,^{34,35} but data in children are scarce.³⁶ AD in children was shown to be associated with increased fatigue,¹⁰ which is in line with the here in described increased risk of the development of fatigue.

In accordance with previous studies, our presented data show that girls are at a higher risk of psychiatric comorbidities as compared with boys.³⁷ Similar results were also observed in children with urticaria.¹

Mental disorders such as depression and anxiety are known to be present in children with chronic inflammatory skin diseases, with girls being particularly affected.^{26,38-40} In this cohort, an increased risk of developing psychiatric comorbidities was also found, with children with psoriasis particularly affected and at risk of depression. Sleep disturbances

Table III. Risk and hazard ratios of analyzed outcomes in female patients with atopic dermatitis as compared with male patients

Definition	Atopic dermatitis female			Atopic dermatitis male			Hazard ratio	95% CI	P value (log-rank test)
	No. of eligible participants	No. of outcomes	Risk, %	No. of eligible participants	No. of outcomes	Risk, %			
Depression, unspecified	108,104	1731	0.016	108,340	801	0.007	2.096	1.928-2.279	.0001
Other fatigue	105,399	3700	0.035	105,480	2717	0.026	1.33	1.266-1.398	.0001
Sleep disorders not due to a substance or known physiological condition	108,285	506	0.005	108,184	422	0.004	1.164	1.023-1.324	.021
Sleep disorders	102,639	3977	0.039	101,799	3653	0.036	1.05	1.004-1.099	.032
Sleep apnea	105,740	1909	0.018	104,866	2048	0.020	0.9	0.846-0.958	.001
Insomnia	108,202	819	0.008	108,256	641	0.006	1.241	1.119-1.376	.0001
Insomnia, unspecified	108,238	754	0.007	108,299	594	0.005	1.233	1.107-1.373	.0001
Sleep apnea, unspecified	107,026	1202	0.011	106,525	1257	0.012	0.928	0.857-1.004	.062
Pruritus	102,206	3163	0.031	102,561	2594	0.025	1.198	1.138-1.262	.0001
Pain, unspecified	104,044	2752	0.026	103,995	2384	0.023	1.123	1.063-1.187	.0001
Generalized anxiety disorder	108,172	1404	0.013	108,425	688	0.006	1.984	1.811-2.173	.0001
Anxiety disorder, unspecified	106,378	4296	0.040	107,110	2360	0.022	1.79	1.702-1.882	.0001
Other sleep disorders	107,983	441	0.004	107,847	426	0.004	1.007	0.881-1.15	.922
Hypersomnia, unspecified	108,669	283	0.003	108,639	264	0.002	1.036	0.876-1.225	.678
Hypersomnia	108,642	331	0.003	108,604	323	0.003	0.991	0.85-1.155	.909
Malaise and fatigue	104,844	4160	0.040	104,932	3095	0.029	1.314	1.254-1.376	.0001
Weakness	107,269	1377	0.013	107,265	1030	0.010	1.302	1.201-1.412	.0001

in turn are also known to be associated with depression.⁴¹

Pain and pruritus are known to be present to varying degrees in all of the skin diseases evaluated in this study and may serve as internal control. The results suggest that pruritus in children is as important in psoriasis as in AD and urticaria, and that pain is more important in urticaria than commonly recognized.^{42,43} Moreover, both symptoms can be possible explanations for sleep disturbances.⁴⁴

In summary, the results of this study confirm and expand upon previous studies that found associations between sleep disturbances and inflammatory skin diseases and show that the disease burden is far more complex than previously recognized.^{24,45} Moreover, for the first time, disease-specific differences in terms of sleep disturbances and comorbidity in children with psoriasis, urticaria, and AD are highlighted, with increased pruritus in all groups, increased risk of sleep apnea, hypersomnia, and fatigue in psoriasis, and insomnia in AD and urticaria. Children in particular have a significant need for screenings of these comorbidities, which should be implemented in routine care. Untreated sleep disorders can not only cause cardiovascular and psychological disorders, but also possibly result in reduced school performance, underachievement, and overall reduced quality of life.

Strength and limitations

The strength of this work is the large sample size with more than 190,000 children matched to a control group. So far, there is a lack of data showing the risk of association for developing different comorbidities in children with inflammatory skin diseases.

This study has some limitations that need to be addressed: Health insurance data are not subject to random sampling of the general population and potential misdiagnosis is possible. However, the database used offers the advantage that patients could be included in the current study regardless of disease stage or even accessibility. The lack of clinical information, such as severity grading and disease duration, might have an impact on development of comorbidities, which is not reflected here.

Outlook

Our findings might be of particular interest for physicians to improve patient monitoring and early screening and treatment to potentially prevent onset of these comorbidities, thereby positively influencing the development into adulthood of children with inflammatory skin diseases. By raising awareness and enabling early detection and treatment, it is possible to avoid additional loss of quality of life and reduce disease burden.

Conflicts of interest

Dr Mann has received grants or contracts from Novartis and Almirall; is a consultant for Almirall Hermal and Apogee; has received payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing, or educational events from UNEV, AbbVie, Pfizer, Novartis, and L'Oreal; and has received support for attending meetings and/or travel from AbbVie, Pfizer, Lilly, Almirall, L'Oreal, Takeda, and Novartis. Dr Wollenberg is a consultant for AbbVie, Aileens, Almirall, AMGEN, Beiersdorf, Eli Lilly, Galderma, GlaxoSmithKline, Hexal, Jansen, LEO Pharma, L'Oreal, Medimmune, MSD, Novartis, Pfizer, Pierre Fabre, Regeneron Pharmaceuticals, Inc, and Sanofi; is an investigator for Abbvie, Almirall, Anacor Pharmaceuticals, Eli Lilly, Galapagos, Galderma, Glenmark, LEO Pharma, Medimmune, Novartis, Pfizer, Regeneron Pharmaceuticals, Inc, Sanofi, and UCB; and has received research grants from Pierre Fabre. Dr Ständer has received honoraria for speaking or consulting from AbbVie, Bristol Myers Squibb, Janssen-Cilag, and UCB. Dr Thaçi has received honoraria or fees for serving on advisory boards, as a speaker, and as a consultant from AbbVie, Amgen, Almirall, Beiersdorf, Bristol Myers Squibb, Boehringer Ingelheim, Galapagos, Leo Pharma, Merck Sharp & Dohme, MorphoSys, Lilly, Novartis, Janssen-Cilag, Pfizer, Regeneron, Sanofi, Hexal, Sun Pharmaceuticals, and UCB; and received grants from Leo Pharma and Novartis. Dr Staubach has received grants or contracts from Novartis and Almirall; is a consultant for Abbvie, Allergika, Almirall Hermal, Amgen, Beiersdorf, Biocryst, BMS, Boehringer Ingelheim, Celgene, CSL Behring, Eli Lilly, Falk, Galderma, Hexal, Janssen, Klinge, Klosterfrau, LEO Pharma, LETI Pharma, L'Oreal, Novartis, Octapharma, Pfizer, Pflüger, Pharming, Regeneron, Shire, Takeda, Sanofi-Genzyme, and UCB Pharma; holds a leadership or fiduciary role in the Society of Dermopharmazie, which is unrelated to the current work, and is paid or unpaid. Dr Zirpel has received support for attending meetings and/or travel from Pfizer, UCB Pharma, Almirall, Janssen, and TriNetX.

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