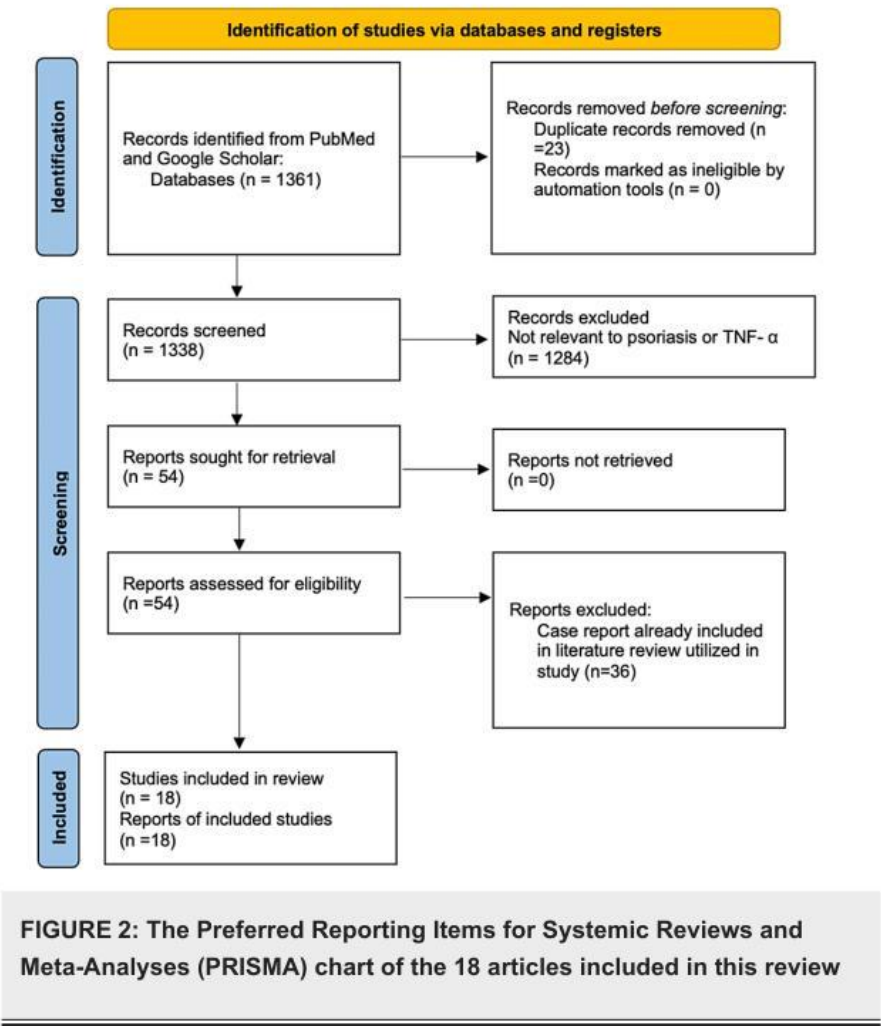


development of paradoxical psoriasis. There has been some suggestion that the presence of IL23R, FBXL19, CTLA4, SLC12A8, and TAP1 polymorphisms may be involved; however, the exact mechanism of action resulting in the development of lesions is still unclear [16].

Review

Methods

A systematic literature review was performed utilizing the PubMed and Google Scholar databases (1992-present). Search terms included "tumor necrosis factor-alpha inhibitor," "TNF- α ," and "paradoxical psoriasis" combined with the terms "psoriasis," "pathogenesis," and "treatment." After considering inclusion and exclusion criteria, 18 peer-reviewed publications were identified and utilized (Figure 2).



In addition, we performed an electronic literature search to identify case reports that documented the development of psoriatic lesions after beginning treatment with a TNF- α inhibitor. One hundred and six case reports were included in the final analysis. In each case, the patient's age, the disease being treated, the morphology of psoriasis lesions, and the treatment of lesions combined with the outcome were evaluated and summarized in Table 1.

Reference (year)	Primary Disease	Patients Age/Sex	TNF- α Inhibitor	Duration of Treatment	Family/Personal Hx of Psoriasis	Morphology of Lesion	Treatment	Outcome
Jarrett et al., 2003 [17]	RA	60/F	Infliximab	6 weeks	Not Specified	Palmoplantar Pustular Psoriasis	Discontinuation + Oral Prednisolone	Resolution
Thurber et al., 2004 [18]	UC	36/M	Infliximab	24 weeks	No	PS and Palmoplantar PS	Topical Corticosteroids, UV-B	Resolution
Verea et al., 2004 [19]	CD	46/F	Infliximab	6-8 weeks	No	Psoriatic Dermatitis	Discontinuation + Topical	Resolution

							Steroids	
Beuthein et al., 2004 [20]	RA	63/F	Adalimumab	6 weeks	No	Papulopustular Exanthema	Discontinuation	Resolution
Dereure et al., 2004 [21]	RA	47/F	Infliximab	2 months	No	Psoriasis	Topical Corticosteroids + Salicylic Acid	Partial Resolution
	RA	55/F	Infliximab	3 months	No	Psoriasis	Topical corticosteroids + Vitamin D + UV-B	Partial Resolution
Habel et al., 2004 [22]	AS	32/M	Infliximab	8 weeks	No	Psoriasis	Discontinuation + Topical Corticosteroid	Partial Resolution
	AS	27/F	Infliximab	10 months	No	Palmoplantar Psoriasis	Discontinuation + Systemic Corticosteroid	Partial Resolution
	AS	25/M	Etanercept	7 months	Family History	Palmoplantar Psoriasis	Discontinuation + Topicals	Partial Resolution
Sfikakis et al., 2005 [23]	AS	33/F	Infliximab	9 months	No	Psoriasis and Palmoplantar Psoriasis	Switched to Etanercept	Partial Resolution
	RA	65/F	Adalimumab	8 months	No	Psoriasis	Topical Corticosteroids	Resolution
	Behçet's Disease	49/M	Infliximab	6 months	No	Psoriasis and Palmoplantar Psoriasis	Topical Corticosteroids	Slight Improvement
	Behçet's Disease	43/M	Infliximab	6 months	No	Psoriasis and Palmoplantar Psoriasis	Topical Corticosteroids	Resolution
	RA	48/F	Etanercept	6 months	No	Psoriasis and Palmoplantar Psoriasis	Discontinuation + Topical Corticosteroids	Partial Resolution
Grinblat and Scheinberg [24]	RA	37/F	Infliximab	7-9 infusions	No	Psoriasis	Acitretin	Not Tolerated
Michaelson et al., 2005 [25]	RA	62/F	Infliximab	8 weeks	Personal History	Psoriasis	Topical Corticosteroid	Resolution
	RA	50/F	Infliximab	8 weeks	No	Psoriasis	Discontinuation	Resolution
Starmans-Kool et al., 2005 [26]	AS/CD	41/M	Infliximab	4 infusions	Not Specified	Pustular Psoriasis	Topical Clobetasol + Restarted Infliximab Months Later	Resolution
	RA	62/F	Infliximab	5 infusions	Not Specified	Pustular Palmoplantar Psoriasis	Topical Clobetasol + Sulfasalazine + Restart Infliximab 1 Month Later	Resolution
Peramiquel et al., 2005 [27]	CD	29/F	Infliximab	9 infusions	No	Intertriginous PS	Topical Corticosteroid PUVA	Partial Resolution
Zamitski et al., 2005 [28]	RA	50/F	Adalimumab	3 months	Not Specified	Palmoplantar Pustulosis	Topical Corticosteroids	Improvement
Kary et al., 2005 [29]	RA	69/F	Etanercept	1 month	Personal History	Palmoplantar Psoriasis	Discontinuation	Resolution
	RA	65/F	Adalimumab	4 days	No	Pustulosis Psoriasis Vulgaris	Discontinuation	Resolution
	RA	38/M	Infliximab	3 months	Family History	Psoriasis Vulgaris	Changed to Etanercept	Improvement + Reappearance of Lesions After 6 Weeks
	RA	67/F	Adalimumab	5 months	Family History	Psoriasis Pustulosa	Discontinuation	No Improvement
	RA	49/F	Infliximab	8 months	Personal History	Psoriasis Pustulosa	Topical Corticosteroid	Improvement
	RA	49/F	Etanercept	1 month	Personal History	Psoriasis Vulgaris	Methotrexate Added + Topical Corticosteroid	Not Specified
	RA	63/F	Etanercept	2 months	No	Psoriasis Vulgaris	No Treatment	Stable
	RA	40/F	Adalimumab	11 months	No	Psoriasis Vulgaris	Discontinuation + Cyclosporin Started, Then Switched to Infliximab	No Improvement
	UC	32/F	Infliximab	2 months	No	Palmoplantar Pustulosis	Topical Corticosteroid	Partial Resolution
Adams et al., 2006 [30]								

Matthews et al., 2006 [31]	CD	19/M	Infliximab	17 months	No	Palmoplantar Pustulosis	Topical Corticosteroid	Partial Resolution
	AS	49/F	Infliximab	8 months	No	Pustular Psoriasis	Increasing Methotrexate Dose	Resolution
	PsA	68/F	Infliximab	Not Specified	Personal History	Intertriginous Psoriasis	Topical Treatment	Resolution
	RA	54/F	Adalimumab	10 months	No	Psoriasis	No Treatment	Resolution
Gonriz et al., 2007 [32]	RA	55/M	Adalimumab	20 months	No	Palmoplantar Psoriasis	Discontinuation + Adalimumab	Significant improvement
	AS	32/M	Infliximab	5 months	No	Plantar Psoriasis	Topical Corticosteroids	Partial Resolution
	PS	52/M	Etanercept	2 months	Personal History	Psoriasis	Topical Corticosteroids	Improvement
	PS	42/F	Etanercept	15 days	Personal History	Psoriasis	Cyclosporine	Remission
	PS	54/F	Etanercept	1 month	Personal History	Psoriasis	Topical Corticosteroids	Improvement
	PS	40/M	Etanercept	14 months	Personal History	Psoriasis	Topical Corticosteroids	Improvement
	PS	58/F	Etanercept	3 months	Personal History	Psoriasis	Topical Corticosteroids	Improvement
	PS	56/M	Etanercept	18 months	Personal History	Psoriasis	Topical Corticosteroids	Improvement
Sari et al., 2006 [33]	RA	30/F	Etanercept	2 months	No	Psoriasis	Discontinuation + Corticosteroid	Resolution
Pirard et al., 2006 [34]	CD	19/F	Infliximab	3 years	Family History	Psoriasis	Topical Corticosteroids	Improved
	RA	47/F	Infliximab	5th infusion	No	Psoriasis	Topical Corticosteroids	Resolution
	AS	29/F	Infliximab	9th infusion	No	Palmoplantar Psoriasis	Topical Corticosteroids	Improved
Volpe et al., 2006 [35]	RA	70/F	Infliximab	9th infusion	No	Psoriasis	Discontinuation + Calcipotriene Ointment	Resolution
	AS	50/M	Infliximab	4 months	No	Psoriasis	Calcipotriene Ointment	Improvement
Gonzalez-Lopez et al., 2006 [36]	CD	39/M	Infliximab	1 month	No	Palmoplantar Psoriasis	Discontinuation + Corticosteroid	Resolution
Aslanidis et al., 2007 [37]	RA	64/F	Adalimumab	18 months	Not Specified	Plaque Psoriasis	Topical Agents	Resolution
	RA	62/F	Adalimumab		Not Specified	Plantar Pustulosis	Topical Agents	Resolution
	AS	24/F	Infliximab	8 months	Not Specified	Palmar Pustulosis	Cyclosporine	Improvement
	RA	29/F	Infliximab	24 months	Not Specified	Plaque Psoriasis	-	Improvement
	SpA	57/M	Infliximab	3 months	Not Specified	Guttate Psoriasis	Topical Agents	Resolution
	RA	76/F	Infliximab	18 months	Not Specified	Plaque Psoriasis	Topical Agents	Resolution
	RA	63/M	Infliximab	14 months	Not Specified	Palmar Pustulosis/Guttate Psoriasis	Cyclosporine	Improvement
Roux et al., 2007 [38]	Behcet's Disease	60/M	Infliximab	1.5 months	Not Specified	Palmoplantar Pustulosis	Discontinuation	Resolution
	AS	57/M	Infliximab	3 months	Not Specified	Palmoplantar Pustulosis	Topical Agents/Cyclosporine	Improvement
	RA	47/M	Infliximab	26 months	Not Specified	Plaque Psoriasis	Topical Agents	Improvement
	RA	60/M	Infliximab	4 months	Not Specified	Palmar Pustulosis	-	Stable
	AS	37/M	Infliximab	42 months	Not Specified	Guttate Psoriasis	-	Resolution
	RA	42/F	Infliximab	30 months	None	Palmoplantar Pustulosis	None	Resolution
	RA	32/F	Infliximab	7 months	None	Palmoplaris Pustulosis	Discontinuation, Etanercept	Resolution
Severs et al., 2007 [39]	UC	40/F	Infliximab	10 months	Family History	Plaque Psoriasis	Discontinuation + UVB therapy	Improvement
	CD	38/M	Infliximab	42 months	None	Plaque Psoriasis	UVB Therapy	Improvement
	CD	21/M	Infliximab	4 months	None	Pustular Psoriasis	Topical Corticosteroids	Improvement
Ubriana and Van								

Voorhees et al., 2007 [40]	RA	65/F	Infliximab	8 weeks	No	Palmoplantar Psoriasis	Discontinuation + Corticosteroid	Resolution After 6 Months
	RA	41/F	Etanercept	26 months	No	Palmoplantar Pustular Psoriasis	Topical Corticosteroids + Topical Calcipotriene	Resolution
	Psoriatic Arthritis	59/F	Infliximab	12 months	Personal History	Psoriasis	Topical Corticosteroids + Topical Calcipotriene	Partial Resolution
	RA	53/F	Etanercept	17 months	Personal History	Psoriasis	Topical Corticosteroids + Topical Calcipotriene	Partial Resolution
	RA	66/F	Etanercept	4 months	No	Psoriasis	Topical Corticosteroids + Topical Calcipotriene	Resolution
	AS	51/M	Etanercept	12 months	No	Psoriasis	Topical Corticosteroids + Topical Calcipotriene	Partial Resolution
	RA	48/F	Etanercept	3 months	No	Pustular Psoriasis	Topical Corticosteroids + Topical Calcipotriene	Partial Resolution
	Juvenile RA	19/F	Adalimumab	3 months	Family History	Palmoplantar Psoriasis	Topical Corticosteroids + Topical Calcipotriene	Partial Resolution
De Gannes et al., 2007 [4]	RA	41/F	Infliximab	2 months	No	Palmoplantar Psoriasis	Topical Corticosteroids + Topical Calcipotriene	Resolution
	RA	52/F	Infliximab	24 months	No	Psoriasis	Topical Corticosteroids + Topical Calcipotriene	Partial resolution
	RA	78/F	Infliximab	2 months	No	Palmoplantar Psoriasis	Topical Corticosteroids + Topical Calcipotriene	Resolution
	RA	57/M	Adalimumab	62 months	No	Psoriasis	Topical Corticosteroids + Topical Calcipotriene	Partial resolution
	RA	50/M	Infliximab	12 months	No	Palmoplantar Psoriasis	Topical Corticosteroids + Topical Calcipotriene	Resolution
	RA	55/F	Adalimumab	36 months	No	Palmoplantar Psoriasis	Topical Corticosteroids + Topical Calcipotriene	Resolution
	RA	49/M	Adalimumab	5 months	No	Pustular Psoriasis	Topical Corticosteroids + Topical Calcipotriene	Resolution
	RA	37/F	Etanercept	24 months	No	Psoriasis	Topical Corticosteroids + Topical Calcipotriene	Partial Resolution
Wollina et al., 2008 [41]	AS	24/F	Infliximab	8 weeks	Not specified	Pustular Psoriasis	Discontinuation + UVB Therapy and Etanercept	Resolution
	CD	22/M	Infliximab	6 weeks	None	Pustular Exanthema	Discontinuation + Prednisolone	Resolution
	Pustular Psoriasis	21/M	Adalimumab	2 weeks	Not specified	Pustular Psoriasis	Discontinuation + Topical Steroids	Resolution
	SAPHO	52/F	Adalimumab	4 weeks	None	Pustular Palmoplantar Psoriasis	Discontinuation + Retinoid Acitretin and PUVA	Resolution
	RA	59/F	Adalimumab	7 months	None	Pustular Psoriasis	Discontinuation + Methotrexate, etanercept, and UVB	Resolution
	AS	52/M	Infliximab	2 years	Family History	Psoriatic Arthritis	Discontinuation + Topical Steroids	Resolution
Manni & Barachini, 2009 [42]	CD	30/F	Infliximab	15 weeks	None	Palmoplantar Pustular Psoriasis	Discontinuation, Corticosteroids, Cyclosporine	Resolution
Nakagomi et al., 2009 [43]	RA	69/F	Infliximab	21 months	Not Specified	Palmoplantar Pustulosis	Discontinuation + Clobetasol and Cyclosporin	Resolution
Bruzzese & Pepe, 2019 [44]	CD	29/M	Infliximab	6 weeks	None	Palmoplantar Pustular Psoriasis	Discontinuation + Corticosteroid	Resolution
						Spongiotic Psoriasiform		

Andrew et al., 2010 [45]	Sarcoidosis	58/M	Infliximab	2 years	None	Dermatitis	Topical Corticosteroids	Improvement
Oh et al., 2010 [46]	AS	53/M	Etanercept	3 years 7 months	Not Specified	Psoriasis	Discontinuation	Improvement
Pyrpasopoulou et al., 2010 [47]	AS	53/M	Infliximab	14 weeks	None	Palmoplantar pustulosis	Cyclosporine + Etanercept	Resolution
Rallis et al., 2010 [48]	PsA	-	Adalimumab	6 months	Not Specified	Palmoplantar Pustular Psoriasis	-	-
Tresh et al., 2012 [49]	Behçet's Disease	55/F	Infliximab	6 weeks	None	Palmoplantar Pustular Psoriasis	Superficial Radiotherapy	Improvement
Kawashima et al., 2013 [50]	CD	22/M	Infliximab	8 weeks	Not Specified	Palmoplantar Pustulosis	Discontinuation + Topical Corticosteroids	Improvement
Broge et al., 2013 [51]	CD	17/F	Infliximab	24 weeks 8 weeks 6 weeks	None	Plaque Psoriasis, Psoriasis Vulgaris, Plaque Psoriasis	Discontinuation + Adalimumab	Resolution
	CD	14/M	Infliximab	8 weeks	None	Psoriasis Vulgaris	Discontinuation + Prednisone and Adalimumab	Resolution
	CD	13/M	Infliximab	6 weeks	None	Plaque Psoriasis	Discontinuation + Topical Corticosteroids, UVB, and methotrexate	Resolution
Peinado, 2015 [52]	CD	32/F	Infliximab	10 years	Not Specified	Scalp Psoriasis	Discontinuation, Corticosteroids, Methotrexate, Vitamin D	Resolution
Gulec et al., 2020 [53]	AS	33/F	Adalimumab	3 months	None	Pustular Psoriasis	Discontinuation, Etanercept, Methotrexate and Cyclosporine	Resolution
	AS	43/F	Infliximab	3 years	None	Palmoplantar Pustular Psoriasis	Topical Corticosteroids	Improvement
	PsA	56/F	Infliximab	7 years	Personal History	PsA	Discontinuation + Secukinumab	Resolution
Irkin et al., 2021 [54]	AS	33/M	Adalimumab	10 years	Not Specified	Palmoplantar, Onycholysis of the Nail, PS of Legs and Back	Discontinuation, Started IL-17 Inhibitor Secukinumab	Significant Regression of Rashes Persistence of Onycholysis
Kanelleas et al., 2022 [55]	HS	4 pts (2M/2F)	Adalimumab	5 months	50% Had a Family History	Plaque Psoriasis	-	-

TABLE 1: Collective data of 106 patients who developed paradoxical psoriasis after TNF-α inhibitor treatment

RA: rheumatoid arthritis; UC: ulcerative colitis; CD: Crohn's disease; AS: ankylosing spondylitis; SPA: spondyloarthritis; SAPHO: synovitis acne hyperostosis osteitis; PsA: psoriatic arthritis; HS: hidradenitis suppurativa; UVB: ultraviolet B

Results

We identified 40 articles with 106 cases of new-onset TNF-α inhibitor-induced psoriasis (Table 1). Table 2 summarizes the patient demographics.