Adverse effects of topical corticosteroid usage in children: A review

Abstract

This review explores the long-term effects of topical corticosteroid (TCS) use in children with atopic dermatitis, focusing on adverse outcomes associated with treatment lasting longer than one year. While TCS are the first-line therapy for managing eczema flares due to their powerful anti-inflammatory properties, their prolonged use in pediatric populations has raised concerns about both local effects (such as skin atrophy and perioral dermatitis) and systemic risks, including effects like hypothalamic-pituitary-adrenal axis suppression and growth delay [1, 2]. This review outlines the pharmacological mechanisms of TCS, current best practice treatment regimens, and age-specific considerations in pediatric care. Clinical data suggest intermittent or proactive use of low to moderate potency TCS can be safe in the short term, but evidence for long-term safety remains limited and inconsistent [3, 4]. This gap in research complicates decision-making for clinicians and caregivers, particularly when balancing disease control against potential harms. By synthesizing findings from clinical trials, systematic reviews, and observational studies, this paper aims to inform safer, more effective treatment strategies for children requiring long-term eczema management.

Keywords: topical corticosteroids, atopic dermatitis, pediatric, eczema, adverse effects

Introduction

Atopic dermatitis (also called eczema) affects approximately 72.4 million children globally and can persist into adolescence and adulthood [5]. Topical corticosteroids remain the cornerstone for managing acute flares due to their proven anti-inflammatory properties [6]. However, apprehension regarding their safety profile, particularly fears of adverse effects like skin atrophy and growth suppression, has led to underuse or inconsistent application by caregivers [7]. Various strategies have been recommended to limit steroid exposure while maintaining disease control, including reducing application frequency to once daily during flares and using TCS intermittently as a maintenance approach to prevent relapses [8]. Despite these efforts, much of the available evidence on TCS safety comes from short-term studies lasting only a few weeks, which limits understanding of adverse effects that develop over longer durations [8]. This review investigates the adverse effects children experience from using topical corticosteroids for more than one year to treat eczema, with the aim of clarifying the long-term safety profile of TCS in pediatric populations and identifying gaps in the current evidence base. Unlike existing systematic reviews such as Harvey et al. [3], which focus primarily on quantifying risk across study populations, this review synthesizes pharmacological, clinical, and caregiver-behavioral perspectives to provide a comprehensive framework for clinical decision-making in long-term pediatric TCS use.

Methods

This narrative review was conducted by searching PubMed, the Cochrane Library, and Embase databases using the search terms “topical corticosteroids,” “atopic dermatitis,” “eczema,” “pediatric,” “children,” “adverse effects,” “safety,” and “long-term” in various combinations. The search covered articles published between January 1995 and December 2024.

Inclusion criteria encompassed peer-reviewed original research articles, systematic reviews, meta-analyses, and clinical practice guidelines that reported on TCS adverse effects in pediatric populations (age 0–18 years). Case reports, editorials, and non-English-language publications were excluded. Reference lists of identified systematic reviews were also hand-searched to capture additional relevant studies. A total of 18 sources met the inclusion criteria and formed the evidence base for this review.

Literature Review

Pediatric Atopic Dermatitis

Atopic dermatitis is a chronic, inflammatory skin condition that affects approximately 15–30% of children worldwide, most commonly beginning in infancy or early childhood [9]. Clinically, it presents with intense pruritus (itching), dry skin, and skin lesions that often involve the cheeks, scalp, or extensor limbs in infants, and flexural areas (areas where the skin naturally folds) in older children [9]. The disease follows a relapsing–remitting course and is exacerbated by triggers such as allergens, infection, or seasonal changes [9]. In addition to chronic inflammation, atopic dermatitis is associated with epidermal barrier dysfunction, leading to increased transepidermal water loss and susceptibility to secondary infections [9]. Although many children experience improvement with age, up to 50% continue to have persistent or recurrent symptoms into adolescence or adulthood [9]. This chronicity is clinically significant because it means a substantial proportion of pediatric patients require long-term anti-inflammatory treatment, making the safety profile of maintenance therapies a central concern in clinical decision-making.

Mechanism of Action of Topical Corticosteroids

The mechanism of action of topical corticosteroids involves preventing inflammatory responses through methods such as vasoconstriction and inhibiting phospholipase A2 release [10]. Vasoconstriction is the process of narrowing blood vessels, which reduces the amount of inflammatory mediators that are delivered to a certain region, in this case, the upper dermis [10]. Inhibition of phospholipase A2 release is achieved by producing lipocartin, a protein that slows down both inflammation and skin cell growth [10]. This subsequently reduces the production of prostaglandins and leukotrienes [11]. Prostaglandins are local lipid mediators that promote inflammation, pain, fever, and vasodilation [11]. Leukotrienes are eicosanoid mediators produced by leukocytes that drive immune cell recruitment, vascular leakage, and smooth-muscle contraction [11]. Corticosteroids inhibit inflammatory transcription factors by binding to glucocorticoid receptors and recruiting histone deacetylase-2 (HDAC2) to suppress NF-κB and AP-1–driven genes, which normally increase inflammation [10].

In some cases, the corticosteroid-receptor complex can work without binding to DNA by interacting with other proteins in the cytoplasm [12]. As these drugs also reduce cell growth in the skin by increasing lipocartin, they prove especially helpful in dermatological conditions like eczema and psoriasis [12]. In deeper layers of the skin, corticosteroids reduce the activity of cells like fibroblasts, which helps limit scarring and skin thickening [12]. They also weaken the immune system’s response by stopping immune cells from maturing and multiplying [12]. In addition, they reduce the release of substances like cytokines that normally boost inflammation [12]. Altogether, these effects make topical corticosteroids useful for treating many skin diseases that involve inflammation and overactive immune responses [12].

Recommended Usage Timeline for Topical Corticosteroids

Topical corticosteroids are used in a multitude of strategies for treating dermatological conditions such as eczema, with varying degrees of effectiveness [13]. For children experiencing an atopic dermatitis flare, standard initial treatment typically involves once- or twice-daily application of a medium- to high-potency corticosteroid for up to four weeks, depending on disease severity and location [13]. If sufficient improvement is observed during this period, treatment can either be tapered in potency or frequency or discontinued entirely [13]. Clinical evidence also supports the finding that once-daily application is as effective as twice-daily use, even for medium- or high-potency corticosteroids during active flares, which can simplify regimens and improve adherence in pediatric populations [14]. Despite this evidence, twice-daily application persists in clinical practice, likely due to outdated prescribing conventions rather than therapeutic superiority [14]. If a child does not respond adequately to a high-potency corticosteroid within four weeks, treatment may be escalated to a super-high potency corticosteroid for up to two weeks, followed by a taper or switch to a lower potency agent for maintenance [13].

For maintenance therapy, proactive or intermittent strategies have shown clinical value in pediatric patients [4]. Proactive therapy refers to the application of a high-potency corticosteroid twice weekly to previously affected areas after remission [4]. In one 2019 to 2022 pediatric study involving 52 patients with eczema, patients maintained on proactive therapy had a relapse rate of 8.3% compared to 12.0% among those transitioned to daily lower-potency corticosteroids [4]. This finding suggests better itch control and potentially improved long-term disease suppression with proactive therapy [4]. Notably, the incidence of adverse events in this study was low with both strategies, and no significant changes were seen in cortisol or ACTH levels (which suggests the treatment did not interfere with the body’s natural hormone balance), supporting their safety

in children over short durations [4]. Proactive therapy has been associated with a lower risk of relapse compared to reactive or “rank-down” approaches [4]. However, the ANTICIPATE study was limited by its small sample size (n = 52), open-label design, and relatively short follow-up period, which restricts the generalizability of these findings to long-term maintenance therapy [4]. Notably, strategies such as wet wrap (moisturizing the affected area, then applying a damp cloth) therapies have shown mixed results in terms of both efficacy and safety, with evidence suggesting that improper use may increase the risk of adverse effects or infection, particularly in younger children [13]. As Frantz et al. emphasize, factors such as a child’s age, body surface area involved, and site of application must be carefully considered when determining treatment duration and potency, as pediatric skin absorbs corticosteroids more readily than adult skin [13].

Table 1. Summary of Key Studies on Adverse Effects of Topical Corticosteroids in Pediatric Atopic Dermatitis

Study	Design	N	TCS Potency	Duration	Key Adverse Effect Findings
Fisher (1995) [1]	Narrative review	N/A	All classes	Variable	Skin atrophy, striae, perioral dermatitis, HPA axis suppression; facial and intertriginous sites at highest risk
Stacey & McEleney (2021) [2]	Clinical review	N/A	All classes	Variable	Growth retardation, Cushing’s syndrome, glaucoma, cataracts; enhanced absorption in pediatric skin
Harvey et al. (2023) [3]	Systematic review	10 studies	Low–moderate	Up to 5 years	Minimal risk of growth abnormalities, skin atrophy, or adrenal insufficiency with intermittent low–moderate potency use
Kamiya et al. (2022) [4]	RCT (ANTICIPATE)	52	High	16 weeks	Relapse rate 8.3% (proactive) vs. 12.0% (rank-down); no significant cortisol/ACTH changes
Siegfried et al. (2016) [6]	Systematic review	6 trials	Low–high	12–40 weeks	No consistent evidence of skin atrophy or HPA suppression in controlled trials; data beyond 1 year lacking
Axon et al. (2021) [8]	Umbrella review	16 SRs	All classes	Variable	Low-quality evidence for most adverse effects; short study durations limit long-term conclusions

RCT = randomized controlled trial; SR = systematic review; HPA = hypothalamic-pituitary-adrenal; ACTH = adrenocorticotropic hormone; N/A = not applicable.

Side Effects of Topical Corticosteroid Use in Children

Dermatological side effects

Topical corticosteroids, while highly effective in managing inflammatory skin conditions in children, are associated with a range of local and systemic adverse effects, particularly when used inappropriately, at high potency, or for prolonged periods of over six weeks or longer [1, 2]. Among pediatric patients, a commonly reported local side effect includes skin atrophy, which arises from corticosteroid-induced inhibition of fibroblast activity and reduced collagen synthesis [2]. Clinically, this appears as thinning of the skin, increased skin fragility, and the development of telangiectasias and purpura, especially in areas of chronic application such as the face, axillae, or groin [1, 2]. Striae distensae, or stretch marks, are also a notable side effect in children and can develop quickly, even with medium-potency corticosteroids used for as little as one to two weeks [1].

Of note, facial application of TCS in pediatric patients carries a higher risk of inducing perioral dermatitis, acneiform eruptions, and steroid-induced rosacea [1]. These reactions are believed to stem from rebound vasodilation and microbial proliferation, particularly of Demodex folliculorum mites and Propionibacterium acnes bacteria, following abrupt corticosteroid withdrawal [1]. In some pediatric cases, inflammatory rebound is significant enough to require systemic antibiotic treatment, such as tetracycline or erythromycin, although antibiotic use in children must be carefully considered given the risks of adverse drug reactions, disruption of the developing microbiome, and the broader concern of antibiotic resistance [1, 2].

Topical corticosteroids can also impair the skin's local immune response, reducing its ability to fight off infection [1]. This immunosuppression can mask or exacerbate fungal infections such as dermatophytosis, resulting in tinea incognito (an atypical clinical presentation of a common fungal infection made more severe by corticosteroid use) [1]. Furthermore, corticosteroid therapy may facilitate secondary bacterial or Candida yeast infections in the skin due to compromised local immunity [2].

In rare cases, children may develop allergic contact dermatitis in response to a corticosteroid molecule itself or to typical excipients (a vehicle substance for another drug) found in topical formulations, such as lanolin, parabens, or quaternium-15 [1]. These reactions usually present as chronic, erythematous, and papular eruptions, and they can be misinterpreted as worsening of the primary dermatologic condition [1]. Differentiating allergic reactions to TCS from irritant dermatitis or hypersensitivity to other ingredients in the drug's vehicle is critical [2].

Systemic side effects

Children are particularly vulnerable to systemic side effects of topical corticosteroids because of their relatively larger body surface area in relation to body weight, which increases their percutaneous absorption of this medication [1]. Systemic adverse effects in pediatric patients may include suppression of the hypothalamic-pituitary-adrenal axis, growth retardation, Cushing's syndrome, hyperglycemia, and hypertension [2]. Even relatively low doses of high-potency corticosteroids can cause significant systemic absorption in children, particularly when applied to thin-skinned areas like the eyelids, groin, or diaper region, or when occlusion (such as with diapers) is present [1]. In addition, ocular complications such as cataracts and glaucoma, though rare, have been reported in children following prolonged corticosteroid use near the eyes [2].

Long-term topical corticosteroid use in children

Although low-potency corticosteroids are generally better tolerated in pediatric populations, long-term treatment should be approached with caution [2]. Close monitoring is essential when topical corticosteroids are used in children, especially in infants or toddlers, due to their enhanced skin permeability and systemic susceptibility [2]. Careful selection of the appropriate potency, duration, and application site is necessary to avoid complications [2]. There is no strong evidence supporting the development of tachyphylaxis, or diminished therapeutic response, with continued corticosteroid use in children [2]. However, corticosteroid withdrawal (sometimes referred to as topical steroid addiction) can occur after extended use, particularly on the face or genital regions [2]. This corticosteroid withdrawal is characterized by erythema, burning, stinging, papules, and pustules following sudden discontinuation and represents rebound inflammation rather than loss of drug efficacy [2].

Discussion

The long-term use of topical corticosteroids in pediatric patients with eczema presents a complex clinical picture that demands careful risk-benefit analysis. While TCS remains the gold standard for controlling inflammatory flares due to its potent anti-inflammatory and immunosuppressive mechanisms, extended use raises concerns about both local and systemic adverse effects in children [6]. Long-term TCS use, especially high-potency agents applied to large body surface areas or thin-skinned regions, has been linked to hypothalamic-pituitary-adrenal (HPA) axis suppression, growth retardation, and, in severe cases, Cushingoid features [1]. HPA axis suppression and growth retardation interfere with a child's normal physical development, while Cushingoid features cause both physiological and psychological distress [1].

This raises a central clinical question: do these risks outweigh the morbidity of the condition being treated? In cases of severe eczema, where the disease significantly affects quality of life, sleep, and school attendance, the benefits of effective treatment are likely to outweigh the risks [3]. A 2023 systematic review by Harvey et al. found that intermittent use of low- to moderate-potency TCS over long periods (up to 5 years) carried minimal risk of growth abnormalities, skin atrophy, or adrenal insufficiency [3]. This suggests that in severe or poorly controlled cases, the disease burden of eczema surpasses the risk of long-term TCS treatment. However, for milder cases, the potential harm of long-term TCS use does not justify aggressive treatment, particularly given the limited evidence base for extended use [1]. Although once-daily or intermittent application regimens reduce adverse risk profiles, these findings stem predominantly from trials lasting only weeks to months [1]. Evidence regarding cumulative effects beyond one year remains limited. As Harvey et al. highlight, significant knowledge gaps persist, particularly for mid-to-high potency regimens and outcomes beyond 5 years [3]. This scarcity of long-term data stems from ethical constraints in prolonged pediatric trials, challenges with funding and participant retention, heterogeneity of TCS formulations, and inconsistency in adverse effect reporting [3]. Consequently, clinicians often make long-term treatment decisions without definitive data, underscoring the need for individualized care plans informed by the best available evidence.

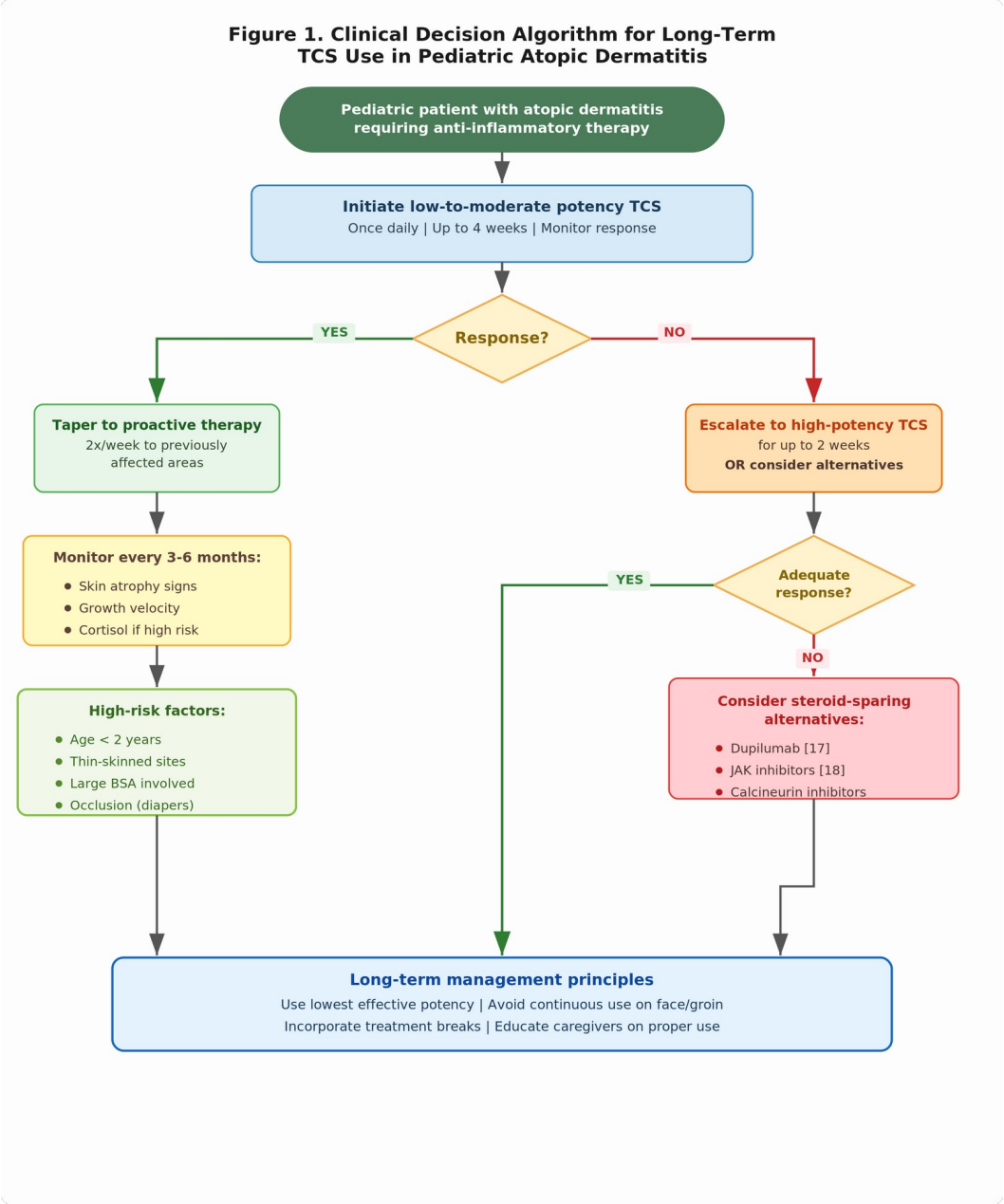
Importantly, recent studies on proactive TCS strategies, such as twice-weekly application to previously affected areas, have demonstrated reduced relapse rates and a favorable short-term safety profile, with no significant alterations in cortisol or ACTH levels (a hormone that releases cortisol) [4]. However, these findings cannot be extrapolated to extended use over several years, as no comprehensive long-term safety profile exists for proactive TCS regimens. Pediatric

endocrinologic monitoring is rarely incorporated into long-term dermatologic studies, and subclinical suppression of adrenal function likely goes undetected without targeted testing [2]. There is limited empirical support for the development of tachyphylaxis in children; however, prolonged use is associated with rebound flares upon abrupt cessation, particularly in sensitive areas [2]. This “topical steroid withdrawal syndrome” or “steroid addiction” has been reported as distressing for both patients and caregivers and can lead to mistrust in medical guidance, contributing to TCS underuse or non-adherence [7]. Despite these risks, it is essential to acknowledge that poorly controlled eczema also carries significant burdens, such as chronic itching and increased susceptibility to infections [15, 16]. Therefore, the decision to continue TCS treatment beyond one year for maintenance must balance potential long-term adverse effects against the morbidity of uncontrolled disease [15, 16]. Clinical judgment, individualized treatment plans, and regular monitoring are vital to optimizing both safety and efficacy.

The emergence of steroid-sparing alternatives has also reshaped the long-term management landscape for pediatric atopic dermatitis. Dupilumab, a monoclonal antibody targeting interleukin-4 and interleukin-13, has demonstrated significant efficacy in children as young as 6 months in a phase 3 randomized controlled trial, with a favorable safety profile that avoids the cutaneous and endocrine adverse effects associated with TCS [17]. Similarly, Janus kinase (JAK) inhibitors, including topical ruxolitinib and oral agents such as abrocitinib and upadacitinib, have shown promise as targeted therapies that modulate specific inflammatory pathways without the broad immunosuppressive and atrophogenic effects of corticosteroids [18]. While these newer agents carry their own safety considerations and long-term data remain limited, their availability provides clinicians with important alternatives for children who require

sustained anti-inflammatory therapy, particularly those at high risk for TCS-related adverse effects or those who have not responded adequately to conventional treatment.

Figure 1. Clinical Decision Algorithm for Long-Term TCS Use in Pediatric Atopic Dermatitis



Conclusion

Topical corticosteroids are indispensable in the management of pediatric eczema, offering rapid and effective control of inflammation. However, long-term use beyond one year, especially when involving high-potency agents or sensitive application sites, increases the risk of both local and systemic side effects in children. While proactive and intermittent TCS regimens appear to reduce relapse rates and minimize some risks, current evidence is largely based on short-term studies and does not adequately address long-term safety concerns.

Given children's heightened vulnerability to adverse effects due to their thinner skin and greater body surface area-to-weight ratio, a cautious and tailored approach to long-term TCS use is warranted. Strategies might include avoiding continuous application to high-risk areas, incorporating regular treatment breaks, and considering non-steroidal alternatives when appropriate. Further longitudinal studies are urgently needed to better understand the cumulative impact of TCS over multiple years and to develop evidence-based guidelines for extended use in pediatric populations.

Ultimately, improving caregiver education, providing consistent follow-up, and integrating emerging steroid-sparing therapies such as dupilumab and JAK inhibitors into treatment algorithms (Figure 1) will enhance adherence, reduce misuse, and ensure that children with atopic dermatitis receive effective, individualized treatment without compromising long-term safety.

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