

REVIEW ARTICLE **OPEN ACCESS**

# Cosmeceuticals in the Pediatric Population Part I: A Review of Risks and Available Evidence

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## ABSTRACT

The rise in the use of cosmeceuticals among children and adolescents has created a new challenge for dermatologists, who are confronted with the task of advising young patients on the risks that these products can carry and the often questionable efficacy of these products. While some cosmeceuticals can be beneficial for this population when used correctly, such as broad-spectrum sunscreen or specific anti-acne agents, other products may not carry benefits for young skin and could even cause complications, particularly in young consumers who have skin conditions such as acne or atopic dermatitis. Many of the common ingredients in cosmeceutical products have had very limited (if any) studies conducted in pediatric populations, and much of the data regarding the efficacy claims and risks of these products must be inferred from studies in adult patients.

## 1 | Introduction

The use of cosmeceuticals, or products designed to provide aesthetic benefits to the skin without a prescription, has exploded among the pediatric population, causing concern within the dermatology community. Cosmeceuticals fall in between cosmetics and drugs in terms of regulation by the United States Food and Drug Administration (FDA). Drugs are intended to treat a condition by altering physiologic processes, while cosmetics simply alter appearance [1]. Cosmeceuticals, a combination of the two, often contain active ingredients considered to be drugs, while claiming to provide aesthetic benefits typical of cosmetics [1, 2]. While cosmeceuticals that contain active ingredients are subjected to FDA regulation, the presence of active ingredients does not guarantee efficacy as not all active ingredients have known benefits. Cosmeceuticals are sold without a prescription by keeping the concentration of active ingredients below a threshold set by the FDA. The safety and tolerability of many of these ingredients and the effects on pre-pubertal and pubertal skin is

largely unstudied, and therefore the full risks of these ingredients to young consumers cannot be fully known.

The rise of social media has dramatically changed the landscape of available health information, particularly when it comes to skincare for children and adolescents. A 2021 study of teenage acne vulgaris patients found that 75% consulted social media for advice related to the treatment of their acne [3]. An analysis of the most popular videos related to acne treatment on TikTok, Instagram Reels, and YouTube Shorts found that 67.2% were made by users with no dermatologic medical background [4]. Additionally, cosmeceuticals were recommended far more than prescription treatments [4]. Teen spending on cosmetic and cosmeceutical products increased by 8% over the past year; the global skincare industry was valued at \$146.7 billion in 2021 and is projected to reach a value of \$273.3 billion in 2031 [5]. There is a massive financial incentive for cosmeceutical companies to drive demand for their products, and adolescents and pre-teens have proven to be a key group to market toward.

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Despite the rapidly expanding use of cosmeceuticals in the pediatric population, very limited research has been conducted to study these products in children and adolescents. Therefore, much of the data regarding cosmeceuticals in this population must be extrapolated from research in the adult population, often with questionable and irreproducible data from studies conducted by the cosmetics industry. This review investigates the safety concerns, efficacy, and uses of the most common cosmeceutical categories in the pediatric population. The cosmeceuticals discussed in this review are among the most popular featured on social media, in general marketing campaigns, and encountered by pediatric dermatologists as assessed by informal survey.

## 1.1 | Moisturizers

Moisturizers encompass a broad group of products that aim to hydrate the skin by reducing transepidermal water loss [6, 7]. There are many different types of moisturizers that vary in terms of occlusivity, esthetic properties, and added ingredients targeting different skin concerns. While moisturizers are generally considered beneficial, many moisturizing products contain ingredients that are comedogenic, such as oleic acid, petrolatum, isopropyl esters, and some emulsifiers [7]. Popular moisturizers may include a variety of trending ingredients with variable levels of evidence behind the claims of their benefits. Some of these ingredients are discussed in Table 1.

A moisturizer can be useful to soothe skin irritation; however, adolescents with acne-prone skin should be directed toward noncomedogenic products [7]. The popular social media trend “slugging” involves applying occlusive or comedogenic products such as petrolatum to purportedly hydrate the skin, which can worsen acne lesions by trapping oil and dirt in the skin. These agents can also trap ingredients from other skincare products, potentially increasing their potency, leading to irritation [14].

All skincare products, including cosmeceuticals of all categories, may contain known contactants that can provoke allergic contact dermatitis in the pediatric population. Examples of common, well-documented allergens that may be found in cosmeceuticals include fragrances, emollients (such as lanolin and propylene glycol), and preservative ingredients (such as formaldehyde and methylisothiazolinone) [15].

## 1.2 | Anti-Acne Agents

Acne vulgaris is one of the most common dermatologic concerns among the pediatric population, affecting over 80% of adolescents [7]. Acne-targeting cosmeceuticals may be beneficial for an acne-prone consumer. Acne can cause significant psychological distress, driving many pre-teens and teens to seek relief, which may involve following social media influencers and buying products touting dramatic benefits. It is important for dermatologists to be knowledgeable about cosmeceutical products targeting acne in order to understand what their patients may be

**TABLE 1** | Common ingredients in cosmeceutical moisturizers.

Ingredient	Description
Ceramides	<ul style="list-style-type: none"> <li>• Sphingolipids found naturally in the stratum corneum that function to uphold the skin barrier [8] <ul style="list-style-type: none"> <li>• Moisturizers with ceramides may be superior at improving damaged skin barriers [8]</li> <li>• In a study of patients 7–11 years old with mild acne, a skincare routine that included a noncomedogenic moisturizer with ceramides was found to be well-tolerated, safe, and highly rated by users [9]</li> </ul> </li> </ul>
Peptides	<ul style="list-style-type: none"> <li>• Small amino acid chains that exert downstream effects within skin cells [6] <ul style="list-style-type: none"> <li>• Peptide functions include: carrier, signal, and neurotransmitter [6]</li> </ul> </li> <li>• Unclear how the mechanism in vitro translates to in vivo use and if these peptides have clinically meaningful effects in the skin [2, 6]</li> <li>• Acetyl hexapeptide-8 (neurotransmitter peptide found in popular cosmeceutical products) acts by decreasing acetylcholine release at the neuromuscular junction in a mechanism similar to botulinum toxin [2, 6]</li> <li>• Studies have shown that almost no acetyl hexapeptide-8 is actually absorbed into the skin [10]</li> <li>• Palmitoyl pentapeptide (signal peptide in cosmeceutical products) is a fragment of procollagen I, a collagen precursor, which is supposed to increase collagen production [2, 6]</li> <li>• Absorption of palmitoyl pentapeptide in the skin is also poor, and more robust clinical data are needed to determine efficacy in vivo [11]</li> </ul>
Hyaluronic acid (HA)	<ul style="list-style-type: none"> <li>• A glycosaminoglycan found naturally in the extracellular matrix of skin cells [2]</li> <li>• HA present in the skin provides structure, helps retain moisture, and is involved in tissue repair [2] <ul style="list-style-type: none"> <li>• Snail mucin, a popular cosmeceutical product among teens, contains hyaluronic acid [12]</li> </ul> </li> <li>• Given that it is produced by the body, HA itself is unlikely to cause any sort of reaction in users</li> <li>• Depending on the molecular weight of the HA derivative used, penetration into the dermis is limited and may not persist for a meaningful length of time [13] <ul style="list-style-type: none"> <li>• Unclear if there is any added benefit of exogenous HA in young skin with plentiful HA</li> </ul> </li> </ul>

using aside from prescribed agents, and to optimally integrate prescription treatments into a regimen their patients will be compliant with and satisfied to use consistently. Common anti-acne agents and their possible benefits and associated risks can be found in Table 2.

### 1.3 | Sunscreen

Broad-spectrum sunscreen is the most effective cosmeceutical for skin cancer prevention and prevention of skin aging signs [1]. Sunscreen should be recommended to all children and adolescents [1]. Broad-spectrum sunscreen blocks both long-wave ultraviolet radiation (UVA), thought to be the primary contributor to photoaging, and short-wave ultraviolet radiation (UVB), considered to be the main contributor to sunburns and skin cancer [1]. The continuous use of broad-spectrum sunscreen has been shown in multiple studies to prevent and even reverse signs of photoaging in adults [29]. There are several types of broad-spectrum sunscreens including those with chemical blockers, mineral blockers, and those that are tinted to match skin tone. In the pediatric population, sunscreen serves a largely protective function in preventing acute sunburn and phototoxicity and thus the chronic effects that lead to photoaging and skin cancer [1]. While many dermatologists might be wary of the overuse of cosmeceutical products by children, the increased interest in sunscreen in this population that has resulted from the popularity of the cosmeceutical industry may help reduce skin cancer rates [1, 30].

### 1.4 | Cleansers

Cleansers are designed to remove sweat, microorganisms, excess sebum, and debris from the surface of the skin [6]. Cleansers often contain surfactants that emulsify and remove these aggregates from the skin, including soaps [7]. While the term “soap” is often used interchangeably with “cleanser”, in this context “soap” refers to anionic surfactants used in some facial cleansers that can be helpful for those with oily skin, but can be too harsh for sensitive skin [7, 31]. Nonionic surfactants found in nonsoap cleansers are generally more mild and less damaging to the stratum corneum, and are preferred for sensitive skin [7, 31].

While cleansing is generally beneficial, over-cleansing can cause damage to the skin barrier, leading to irritation and an imbalance of the skin microbiome that can worsen acne [7]. Additionally, individuals with allergies or sensitivities to fragrances or harsher surfactants that are found in some facial cleansers may present with irritant contact dermatitis [32]. It is important to mitigate these risks in children and adolescents by recommending a mild cleanser, usually containing an amphoteric (acts as both acid and base) surfactant in the pH range of 4–6 to match the skin's natural acidity [6, 7].

Toners are astringents that are meant to provide additional cleansing benefits to the skin, usually after cleaning the face with a cleanser that is washed off [6, 31]. These may contain alcohol for oily skin or propylene glycol for more sensitive skin [6]. Toners do not confer much additional cleansing benefit if

an appropriate facial cleanser is used, and they can be overly drying [6]. Some toners contain anti-acne or anti-aging ingredients such as salicylic acid or glycolic acid; these toners may also result in dryness and carry the same risks and potential benefits as discussed in the section on anti-acne agents [6]. Additional details about common cleanser categories are listed in Table 3.

### 1.5 | Skin-Lightening Agents

Skin-lightening agents, sometimes called “skin-brightening agents,” aim to treat hyperpigmentation in the skin. Postinflammatory hyperpigmentation (PIH) is a common concern that results from a deposition of melanin in the dermis that occurs after inflammation in the skin, such as from acne or eczema [34]. PIH is more prevalent in people with darker skin tones who have more melanin in their skin at baseline [34]. PIH causes significant distress, with patients and families often reporting more concern regarding the discoloration than for the primary dermatosis. The failure of health care providers to recognize and address this concern may contribute to health care disparities in this population. Likewise, PIH is frequently used as a marketing tool by manufacturers of skin care products whether or not products contain ingredients having activity against hyperpigmentation. Skin-lightening agents also have the potential to be misused in an attempt to achieve a lighter overall complexion, a topic which will be discussed in greater detail in Part II of this review.

#### 1.5.1 | Hydroquinone

Hydroquinone is a phenol that inhibits the conversion of tyrosine to melanin in the skin [34]. Formulations of up to 2% can be found in OTC products. While hydroquinone has been proven to be efficacious in treating hyperpigmentation, even 2% hydroquinone used for a prolonged duration carries the risk of inducing exogenous ochronosis, a condition of excess pigment deposition resulting in unintended additive hyperpigmentation [35, 36]. Although prescription-strength hydroquinone has been approved for use in patients 12 years and older, it is not recommended that young consumers attempt to treat PIH with hydroquinone without the oversight of a dermatologist.

#### 1.5.2 | Kojic Acid

Kojic acid also inhibits the conversion of tyrosine to melanin in the skin [2, 35]. Unlike hydroquinone, kojic acid does not carry additional risks of dyspigmentation from long-term use [2]. However, kojic acid can cause contact dermatitis, so it should be used cautiously in those with sensitive skin [2, 35, 37]. Studies on the use of kojic acid in the pediatric population are lacking.

#### 1.5.3 | Other Agents

Retinoids, topical niacinamide, azelaic acid, and vitamin C all have some degree of skin-lightening effects that have been observed in clinical studies [37–41]. The cautions and

**TABLE 2** | Common anti-acne agents in cosmeceuticals.

Agent	Description
Salicylic acid	<ul style="list-style-type: none"> <li>An exfoliating agent that removes plugs from clogged follicles and reduces sebum production [2, 6]</li> <li>It is an effective treatment of acne vulgaris in formulations up to 2%, the approved over-the-counter (OTC) concentration [6]</li> <li>At the low concentrations found in OTC cosmeceuticals, there is little risk of adverse effects, though it may be irritating for individuals with sensitive skin [6]</li> </ul>
Glycolic acid	<ul style="list-style-type: none"> <li>An alpha-hydroxy acid often found in toners that can act as an exfoliant in a similar manner to salicylic acid to prevent pore occlusion that can lead to acne development [6, 16]</li> <li>Can cause irritation at higher concentrations, although this risk is reduced in lower concentrations typical of OTC products [16] <ul style="list-style-type: none"> <li>Some data suggests that glycolic acid can increase photosensitivity and risk of UV damage [16]</li> </ul> </li> </ul>
Benzoyl peroxide (BPO)	<ul style="list-style-type: none"> <li>A first-line topical therapy for acne and is approved at concentrations up to 10% in OTC cosmeceuticals [6]</li> <li>Generates free oxygen radicals that kill <i>Cutibacterium acnes</i> in the skin, a mechanism which does not allow for drug resistance [17]</li> <li>Adverse reactions including scaling, erythema, and irritant dermatitis are relatively common and may deter individuals from continuing treatment before they receive full benefit [17] <ul style="list-style-type: none"> <li>BPO has been the subject of controversy since a 2024 study by pharmaceutical quality assurance agency Valisure found that BPO products have the potential to form benzene, a known carcinogen, when stored at warm temperatures for a prolonged period [18]. This concern may be mitigated if BPO products are stored at room temperature. Various studies on benzene formation in benzoyl peroxide conducted since the original Valisure study show mixed findings and this is still an area of active investigation [19–22].</li> </ul> </li> </ul>
Topical vitamin A derivatives (retinoids)	<ul style="list-style-type: none"> <li>Act by influencing cellular differentiation, stimulating epidermal cell turnover, and preventing collagen degradation [2]</li> <li>Approved by the FDA as safe and effective in adolescents for the treatment of acne, so OTC versions can likely be assumed safe in this population</li> <li>Adapalene is an OTC synthetic retinoid approved for the treatment of acne vulgaris and has been found in some studies to be even more effective than prescription tretinoin [2, 23]</li> <li>Other less potent retinoids, especially natural (nonsynthetic) retinoids such as retinol and retinyl esters, are inactive precursors of retinoic acid and have little evidence suggesting efficacy [24]</li> <li>While OTC retinoids are less likely to cause irritation than prescription retinoids, people with sensitive skin may experience irritation and photosensitivity [2]</li> </ul>
Azelaic acid	<ul style="list-style-type: none"> <li>Has both antibacterial and comedolytic properties [17] <ul style="list-style-type: none"> <li>Available in OTC formulations at up to 10% concentration [17].</li> </ul> </li> <li>Can be useful in conjunction with other anti-acne agents and for people with more sensitive skin [17]</li> <li>FDA approved in a 20% prescription form for patients 12 and older, thus suggesting safety of the OTC versions in the adolescent population [25]</li> </ul>
Hypochlorous acid	<ul style="list-style-type: none"> <li>Has been used in burn and wound care for many years, but has recently gained popularity as a topical spray marketed to adolescents as a product that can be sprayed on throughout the day to prevent acne <ul style="list-style-type: none"> <li>The most common OTC concentration of hypochlorous acid is 0.015%</li> </ul> </li> <li>Hypochlorous acid has been found to have antimicrobial and anti-inflammatory properties and may be effective in reducing the concentration of <i>Cutibacterium acnes</i> on the skin [26]</li> <li>No major adverse effects have been reported in the use of topical hypochlorous acid, although it has the potential to cause irritation and contact dermatitis [26]</li> <li>While further research is needed to better establish efficacy, the limited literature available suggests that it is a safe product for adolescents who can tolerate it [26]</li> </ul>
Hydrocolloid patches	<ul style="list-style-type: none"> <li>Acne patches or “pimple patches” are typically small, hydrocolloid dressings that are placed on top of an active acne lesion and are marketed with the promise of quickly improving the appearance of the lesion</li> <li>Hydrocolloid itself is not an active ingredient; it is widely used in wound dressings and is unlikely to cause an adverse reaction [27] <ul style="list-style-type: none"> <li>For patients prone to popping pimples or touching their acne, hydrocolloid patches could help prevent manipulation</li> </ul> </li> <li>A small, randomized trial of 41 teens and young adults found that hydrocolloid patches improved the size and appearance of acne lesions as compared with the control group [28]</li> <li>Some acne patches have added ingredients that could potentially be irritating and lead to contact dermatitis</li> </ul>

**TABLE 3** | Common types of cosmeceutical cleansers.

Cleanser type	Description
Medicated cleansers	<ul style="list-style-type: none"> <li>• Contain additives to treat specific concerns, commonly acne</li> <li>• Salicylic acid and benzoyl peroxide are both common additive ingredients</li> </ul>
Natural or traditional cleansers	<ul style="list-style-type: none"> <li>• Often derived from nut oils or tallow and contain anionic surfactants, which tend to be particularly irritating [31]</li> <li>• Anionic surfactants can damage the skin barrier, cause follicular plugging, and raise the skin's pH, leading to an increase in bacterial growth [7]</li> </ul>
Toners	<ul style="list-style-type: none"> <li>• Astringents that are applied after or instead of a cleanser and dissolve debris on the skin [6, 31] <ul style="list-style-type: none"> <li>• Not necessary if a cleanser adequately removes aggregates from the skin [6, 31]</li> </ul> </li> </ul>
Scrubbing cleansers	<ul style="list-style-type: none"> <li>• Contain particulates that mechanically exfoliate the skin [6]</li> <li>• May be excessively abrasive, leading to inflammation and irritation <ul style="list-style-type: none"> <li>• Banned in some states, the particulates have been found to accumulate in wastewater and have raised environmental concerns [33]</li> </ul> </li> </ul>

uncertainties regarding use of these ingredients by the pediatric population are the same as discussed previously and in the following section.

#### 1.5.4 | Sunscreen

Sunscreen is essential to treating hyperpigmentation and should be encouraged as a first-line intervention for PIH [34, 35]. Broad spectrum sunscreens (especially tinted sunscreens) prevent further hyperpigmentation and optimize the fading of existing hyperpigmentation [34, 35].

### 1.6 | Anti-Aging Agents

The intent of many cosmeceutical products is to slow or reverse signs of aging such as dyspigmentation, fine lines, and wrinkles. While the “anti-aging” claims of products are heavily used as a marketing tactic, this supposed benefit makes little sense for pediatric consumers who have yet to accumulate signs of skin aging. Additionally, the studies that exist even in the adult population are generally not robust randomized control trials and the endpoints are often not clinically meaningful or appreciable. It is important to be aware of the uses and risks of these ingredients as they are widely incorporated into all types of cosmeceutical products.

#### 1.6.1 | Topical Vitamin A Derivatives

Active retinoic acid, a vitamin A derivative, has anti-aging activity through inhibition of collagen degradation and stimulation of collagen synthesis and cell growth and differentiation [2, 6]. Unlike prescription forms of retinoic acid, many of the retinoids found in cosmeceuticals (especially retinol and retinyl esters) are inactive and there is insufficient data to assume clinical efficacy [1, 2, 6, 24]. Retinoids can cause irritation and photosensitivity [2, 24].

#### 1.6.2 | Topical Vitamin C Derivatives

Vitamin C, or L-ascorbic acid in its active form, acts as an antioxidant in the skin [2, 6]. Vitamin C theoretically protects from UVB damage and reduces thymine dimer formation, a cause of skin cancer [2, 6]. Additionally, vitamin C in the skin promotes collagen production and has anti-inflammatory properties [2]. However, topical L-ascorbic acid is unstable and is poorly absorbed in the skin, limiting its efficacy in vivo [40]. Cosmeceutical products may also contain other vitamin C derivatives that are theoretically converted to L-ascorbic acid in the skin, although further research on these derivatives is necessary [40]. Very little research has been conducted on the use of topical vitamin C in the pediatric population and many of the trials of topical vitamin C in adults have significant study bias and lack clinical evidence of efficacy [40]. Some people may experience skin irritation at higher concentrations of vitamin C; those with sensitive skin or eczema should be instructed to use products with a lower concentration (less than 10%) [2].

#### 1.6.3 | Topical Vitamin E Derivatives

Vitamin E is an antioxidant found naturally in the stratum corneum of the skin and may play a role in photoprotection [6, 42]. Some studies have suggested that topical vitamin E used in conjunction with topical vitamin C may have a synergistic antioxidant and photoprotective effect [42]. However, there is a lack of robust clinical trials on topical vitamin E in vivo in both the pediatric and adult populations, and the few adult studies of topical vitamin E alone that exist are ill-equipped to provide convincing clinical evidence [43]. In fact, a small study of vitamin E used to treat scars found that it was actually associated with a worse-appearing scar and induced contact dermatitis in a third of patients [44]. While topical vitamin E is a common ingredient in many cosmeceutical products, there have been case reports of contact dermatitis, urticaria and other eruptions after use of topical cosmeceutical vitamin E preparations [42].

#### 1.6.4 | Topical Niacinamide

Niacinamide is a coenzyme in the production pathways of collagen, ceramides, elastin and keratin, all of which help maintain the skin's natural elasticity [2]. It is involved in the

production of adenosine triphosphate (ATP) and repairing damaged DNA, thus it is marketed in cosmeceuticals to repair photodamage [2]. At concentrations less than 5%, topical niacinamide is well-tolerated, although people with especially sensitive skin may experience irritation [2]. In studies with rats, high doses of systemic niacinamide caused epigenetic and metabolic alterations [41]. There are very little data on topical niacinamide use in children and adult studies of topical niacinamide efficacy are limited to small trials with limited diversity, subjective endpoints, or confounded by inclusion of other agents [45, 46].

### 1.6.5 | Hyaluronic Acid

Topical hyaluronic acid (HA) has been shown in a limited number of trials to decrease fine lines in older patients [47]. For children and adolescents, who have not yet experienced a decrease in the skin's natural production of HA, the reduction in aging signs is less relevant and the benefits of HA-containing products are likely limited to moisturization [2].

### 1.6.6 | Snail Mucin

Snail mucin contains a high concentration of hyaluronic acid and has antimicrobial properties [12]. Small initial studies of topically applied snail mucin showed possible benefits of hydration, reduction of fine lines, and improvement in skin elasticity and acne, but further research is required to support the findings from these limited studies [12]. Other claims including antioxidant properties, stimulation of collagen production, cancer suppression, scarring and hyperpigmentation reduction have been studied in vitro only, highlighting the need for more robust data [12]. Snail mucin may trigger allergic reactions due to molecular mimicry of a protein in dust mites, and individuals with shellfish allergies may have cross-reacting sensitivity [12].

## 2 | Conclusion

Despite the widespread and growing use of cosmeceuticals in the pediatric population, very little testing has been conducted to determine the safety and efficacy of these products specifically for younger skin. This limits the ability of both consumers and dermatologists to evaluate the risks associated with these products as well as the validity of the products' marketing claims for children and adolescents. It is important for dermatologists to recommend evidence-based ingredients to their patients where possible, while also working to preserve and optimize the patient-provider relationship. Being open to discussing cosmeceutical products with patients, providing reasonable recommendations where appropriate, and not belittling or demeaning a patient's desire for a skin care regimen may improve the patient experience as well as a patient's trust in their provider. Young consumers receive an onslaught of marketing from skincare brands and social media influencers trying to convince them that they need elaborate regimens; dermatologists can work to balance this with advice to keep skincare routines simple and effective.

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The authors have nothing to report.

### Conflicts of Interest

The authors declare no conflicts of interest.

### Data Availability Statement

Data sharing are not applicable to this article as no new data were created or analyzed in this study.

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