Moisturizer Allergy

Diagnosis and Management

by Matthew J. Zirwas, MD, and Sarah A. Stechschulte

Abstract

Background: Moisturizers are used by patients with dry skin conditions as well as those with healthy skin to enhance and preserve the smoothness of the skin and to interrupt the dry-skin cycle. Moisturizers are generally considered safe, although skin reactions, such as allergic contact dermatitis from topical preparations may occur. Cosmetic products including moisturizers are among the main culprits of allergic contact dermatitis.

Methods: Utilizing a recently published database of all moisturizers available at Walgreens Pharmacies (Chicago, Illinois), which listed each product's allergens from the North American Contact Dermatitis Group (NACDG) screening panel, we evaluated the number of moisturizers containing each allergen.

Results: Of the 276 moisturizers accounted for in the database, 68 percent contained fragrance making it the most common allergen found in these moisturizers. Parabens were discovered in 62 percent of moisturizers, followed by Vitamin E in 55 percent of products. Essential oils and biologic additives were found in 45 percent of products, followed by benzyl alcohol in 24 percent of moisturizers. Propylene glycol was found in 20 percent of moisturizers, followed by formaldehyde releasers in 20 percent of products. Iodopropynyl butylcarbamate was discovered in 16 percent of products, followed by lanolin in 10 percent of moisturizers. Methylisothiazolinone/methylchlorois othiazolinone was found in six percent of available products.

Conclusions: Many ingredients of moisturizers have the potential to cause irritant and allergic contact dermatitis; therefore, it is necessary for clinicians to be aware of such potential allergens in order to manage and advise their patients accordingly.

Introduction

Moisturizers are used by people all over the world, with one study reporting that 75 percent of the young population uses them daily.[1] Moisturizers are used by patients with dry skin conditions as well as those with healthy skin to enhance and preserve the smoothness of the skin and to interrupt the dry-skin cycle. This is accomplished by improving the skin's hydration through modifying the chemical and physical nature of the dry stratum corneum.[2] When a moisturizer is applied to the skin, the surface appears smoother and softer due to the filling of spaces between partially desquamated skin flakes.[3] Additionally, an immediate hydrating effect can be achieved through water penetration into the skin. Humectants, such as sodium salts of pyrrolidone carboxylic acid, sodium lactate, glycerine, panthenol, and urea, attract and hold water in the stratum corneum, influence the elasticity of the stratum corneum, and may assist in maintaining lipids in a liquid crystalline state. Also, alpha-hydroxy acids are added to enhance skin elasticity. Additionally, lipids in the moisturizers may improve skin hydration by occluding water loss into the external environment.[2]

Moisturizers are generally considered safe, although skin reactions from topical preparations may occur. Sensory reactions or subjective sensations, such as burning or stinging, immediately following application have been reported.[2] Irritation, sweat retention, occlusive folliculitis, allergic contact dermatitis (ACD), contact urticaria, and photo contact dermatitis have all been found in individuals due to moisturizer use.[4] Individuals with impaired barrier function, such as atopic dermatitis, are especially at risk for adverse reactions.[5] Exposure of mildly irritating preparations to sensitive areas may also cause

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dermatitis. For example, facial skin has been found to be more sensitive to moisturizers than other parts of the body potentially due to a less efficient barrier, a decreased number of stratum corneum layers, and the larger follicular pores.[4]

Although some moisturizers may strengthen skin barrier function, some may also weaken it. Differences in moisturizer lipid content and the natural moisturizing factors, such as urea, are thought to account for such differences. This has been recognized through susceptibility to irritants and changes in transepidermal water loss (TEWL). A study evaluating the short-term use of two different moisturizers on normal skin found that the moisturizer containing high lipid content caused a statistically significant irritant response when compared with the moisturizer with a moderate-to-low lipid content.[6] Furthermore, water, the primary constituent in most moisturizers, may contribute to dryness and increased TEWL since prolonged contact with water disrupts the stratum corneum's intercellular lipid lamellae structure.[7]

Cosmetic products are among the main culprits of ACD. In a study of 531 patients patch tested with their own cosmetics over a two-year period, skin care products were discovered to be the main causes of both irritant and allergic reactions.[1] Various components of moisturizers eliciting ACD have been reported. Patch testing may be necessary to determine which agent is responsible for the condition, since moisturizers commonly contain preservatives, fragrances, emulsifiers, and plant extracts among other ingredients. Treatment following a positive patch test is aimed at allergen avoidance, though this may be difficult for individuals who wish to continue using moisturizers due to the prevalence of common allergens used in these products. We strove to assess the potentially allergenic constituents in moisturizers that are widely available to the general public. This information may help clinicians determine the possibility of allergen exposure due to the ingredients of their patient's moisturizers.

Methods

We used a recently published database of all the moisturizers available at Walgreens Pharmacies (Chicago, Illinois), which listed each product's allergens from the North American Contact Dermatitis Group (NACDG) screening panel.[8] The data had been gathered by a dermatologist with expert knowledge in ACD. Employing this database, we entered each moisturizer with its corresponding allergens into a Microsoft Excel (Seattle, Washington) spreadsheet. We then evaluated the number of moisturizers containing each allergen.

Results

Two hundred seventy-six moisturizers were accounted for in the database. Of the 276 moisturizers, 187 (68%) contained fragrance, making it the most common allergen found in these moisturizers (Table 1). Of the products that did not contain fragrance, 43 (16%) contained fragrance-related potential allergens-benzyl alcohol or essential oils and biologic additives. Therefore, only 46 (17%) were absolutely fragrance free and definitely safe for individuals with fragrance allergy, while 230 (83%) of 276 moisturizers contained at least one ingredient to which a fragrance-allergic patient could react.

The second most common allergens were parabens, commonly used preservatives, found in 170 (62%) of the 276 products. Vitamin E, the third most common allergen found in 151 (55%) of the 276 moisturizers, is commonly added for its potential antioxidant properties. Essential oils and biologic additives, added for their fragrance, were the fourth most common allergens and were found in 123 (45%) of 276 products. Benzyl alcohol, a common fragrance and preservative, was the fifth most common allergen discovered in 65 (24%) of 276 moisturizers.

Propylene glycol, a humectant and preservative, was found in 56 (20%) of 276 products, making it the sixth most common allergen. Formaldehyde releasers, used as preservatives, were grouped together and were the seventh most common allergens, discovered in 55 (20%) of 276 products. Iodopropynyl butylcarbamate, a preservative, was the eighth most common allergen found in 45 (16%) of 276 products. Lanolin, a component of moisturizer used to soothe the skin, was the ninth most common allergen and was identified in 27 (10%) of 276 products. Methylisothiazolinone/methylchloroisothiazolinone (MCI/MI) is another preservative and was the 10th most common allergen in moisturizers, found in 17 (6%) of 276 available products.

See Table 1 for a summary of the 10 most common allergens in moisturizers.

Discussion

The most prevalent allergen identified in our analysis of moisturizers in the Walgreens database was fragrance, identified in 67.7 percent of moisturizers. When fragrance-related allergens are also considered, the proportion of moisturizers containing either fragrance or a fragrance-related allergen increases to 83 percent.

Table 1. Common allergens found in 276 moisturizers

ALLERGEN	NUMBER OF PRODUCTS CONTAINING ALLERGEN	PERCENT OF PRODUCTS CONTAINING ALLERGEN
Fragrance	187/276	67.7%
Parabens	170/276	61.6%
Vitamin E	151/276	54.7%
Essential oils and biological additives	123/276	44.6%
Benzyl alcohol	65/276	23.6%
Propylene glycol	56/276	20.3%
Formaldehyde-releasing preservatives	55/276	19.9%
Iodopropynyl butylcarbamate	45/276	16.3%
Lanolin	27/276	9.8%
Kathon CG	17/276	6.2%

Fragrances are ingredients added to a product to add a pleasurable odor. More than 100 fragrance ingredients have been identified as allergens.[9] The prevalence of contact allergy to fragrances has been reported to be between 5 percent and 12.8 percent.[10] Fragrance has been identified as a major sensitizer in topically applied products and the most common cause of ACD from personal care products.[11] ACD of the face and body due to the fragrance contained in moisturizers has been previously reported.[12,13]

Patch testing for fragrance allergy uses fragrance mix and balsam of Peru. Although these were previously reported to identify 80 percent of those allergic to fragrance, they may only identify 60 to 70 percent of patients with fragrance allergy due to the evolving nature of fragrance use in the cosmetic industry. Therefore, it may be beneficial to use additional allergens or the patient's own product when patch testing.[8] For example, fragrance mix II, containing six additional fragrance allergens, was found to identify 30 percent additional fragrance-sensitive patients missed using only the traditional fragrance mix.[14] After having a positive patch test reaction to fragrance, it may be difficult to elicit which moisturizers do not contain the particular allergen since manufacturers are not mandated to list their fragrance formulas.[8] Because fragrance allergy is an increasing problem, the European Cosmetics Directive recently introduced the mandatory labeling of 26 fragrance ingredients if the concentration in the product surpasses either 0.001% in leave-on products or 0.01% in rinse-off products.[15]

Parabens, such as butyl paraben, methy paraben, propyl paraben, and ethyl paraben, were the second most common allergen, found in 61.6 percent of the moisturizers analyzed. They are commonly used in foods and personal care products as chemical preservatives given their bacteriocidal and fungicidal properties. Parabens are capable of permeating through and accumulating in the skin. An *in-vitro* study found that 60 percent of methyl paraben can be found on the skin after eight hours of contact.[16] This increased paraben contact may potentially lead to an increased risk for paraben sensitization. Another study found that parabens are found in 99 percent of leave-on products and 77 percent of rinse-off cosmetics.[17] Despite expansive use of parabens, the incidence of allergy to them is lower than many other preservatives. However, paraben allergy may be becoming more common, as it was reported in the 2003–2004 NACDG data to be at least 1.12 times more common than in previous years.[18] It is important to note that using paraben-containing topical medicaments on damaged skin can be a cause of sensitization and elicit paraben allergy.[19] The "Paraben Paradox" refers to this reaction occurring only on inflamed skin in paraben-sensitive individuals, while these patients are able to tolerate paraben on noninflamed skin.[20,21]

Vitamin E, also known as tocopherol, was found in 51.7 percent of moisturizers analyzed. It is commonly added to moisturizers to inhibit oxidation by reacting with free radicals, thereby stopping a chain reaction. It potentially also acts as a moisturizer itself through its skin-hydrating effects.[3] While ACD due to vitamin E is relatively rare, possibly due to its low concentration in cosmetic products, case reports and case series of contact allergy to vitamin E in personal care products have been reported.[22,23] Among these cases, several individuals developed widespread dermatitis despite local application.[24] An outbreak of approximately 1,000 cases of allergic papular and follicular contact dermatitis occurred in 1992 due to alpha-tocopherol linoleate in a cosmetic line, although the reaction was believed to be caused by oxidation products of the allergen rather than the allergen itself.[25] Therefore, it may be of value to patch test patients with suspected vitamin-E allergy to the derivatives of the vitamin rather than the compound itself. Additionally, repeated open application testing and patch testing with individual components of cosmetic creams and the actual products has been useful in establishing a diagnosis of ACD.[26]

Essential oils and biologic additives were the fourth most common allergens in the moisturizers and were found in 44.6 percent of products. They are the highly concentrated, volatile, aromatic substances extracted from various trees and plants that are used for their fragrant and antimicrobial properties.[27] Multiple cases of hand and body ACD have been reported due to lotions and creams containing essential oils. For example, a study of more than 2,000 patch-tested individuals found that tea tree oil, the most common essential oil allergen, elicited a positive reaction in 1.8 percent of these patients.[28] There are many components to essential oils, and the ingredients may vary by batch, heat, season, moisture, and light, which is why it is difficult to standardize these allergens.[29] Although there are many essential oils, only the most prevalent ones known to cause contact dermatitis, such as ylang ylang, tea tree oil, compositae mix, propolis, and colophony, are included in most patch-testing trays.[8] While this may represent a good screening tool, extended patch testing is necessary in patients suspected for sensitization since not all affected patients are positive to fragrance mix I, and most individuals react positively only to some of the essential oils they use.[30] Since multiple sensitizations have been reported in essential-oil-sensitive patients, avoiding a single oil may not prevent further ACD episodes. Additionally, benzyl alcohol is a component of certain essential oils. Therefore, patients with known reactions to benzyl alcohol may potentially react to essential oils.

Benzyl alcohol was the fifth most common allergen, identified in 23.6 percent of moisturizers. It is frequently used for its fragrance, preservative qualities, antibacterial and antifungal nature, and its antipruritic capabilities.[26] Benzyl alcohol is considered a relatively rare contact allergen, although it may induce urticarial, immediate, and systemic reactions. The majority of reported reactions have been a consequence of repetitive topical medication and moisturizer use.[8] Contact allergy due to benzyl alcohol has also been reported from hair dye, occupational exposure, injectable medication, and anesthetic spray. Because benzyl alcohol is a component of balsam of Peru, it is important to avoid fragrance when sensitive to benzyl alcohol. Additionally, a case of eyelid dermatitis has been reported due to the benzyl alcohol component of pimecrolimus cream in a patient sensitive to balsam of Peru and benzoic acid.[31]

Propylene glycol was the sixth most common allergen and found in 20.3 percent of moisturizers. It is added to moisturizers as a humectant to prevent the escape of water or moisture from the skin. It also works as a solvent to mix relatively insoluble ingredients and acts as a preservative.[8] Of 1,494 patch-tested individuals who had a scattered generalized distribution of dermatitis, six percent were found to be sensitized to propylene glycol.[32] This allergen may cause adverse skin reactions at concentrations as low as 10 percent under occlusive conditions in normal individuals, and at concentrations as low as two percent in individuals with dermatitis.[3] Additionally, repeated applications of high-concentration propylene glycol (greater than 20%), may not be recommended on large body areas in children with skin barrier function due to reports of poisoning after high-concentration topical treatments.[3] Furthermore, propylene glycol contained in moisturizers is known to increase the cutaneous penetration of applied medicaments. In severe and widespread dermatitis, this has been reported to lead to high levels of hydrocortisone absorption, causing an increase in systemic cortisol levels.[33]

Because propylene glycol is a strong irritant, false positives with patch testing can occur, and true allergic prevalence to the allergen is unknown. Positive reactions to propylene glycol have been reported to range from 0.1 to 3.8 percent.[33] One study determined that propylene glycol exhibits very low sensitization potential, concluding that the risk for

sensitization on uncompromised skin seems to be very low.[34] Although many cosmetic ingredients are related to propylene glycol, little is known about their cross-reactions with propylene glycol.

Formaldehyde-releasing preservatives include quaternium-15, diazolidinyl urea, DMDM hydantoin, imidazolidinyl urea, bronopol, and tris nitro. Grouped together, they were found to be the seventh most common allergens, discovered in 19.9 percent of products. They are frequently used as preservatives, disinfectants, and for production of commercial construction material such as plywood. Formaldehyde, an irritant, allergen, and potential carcinogen, has been reported to be the second most common cause of cosmetic-associated contact dermatitis and many people are sensitized to the allergen.[35] Therefore, formaldehyde-releasing preservatives have replaced formaldehyde in order to decrease sensitization and to lower the concentration of formaldehyde used.[8] In a chart review of 210 patch-tested patients, 9.5 percent were allergic to formaldehyde-releasing preservatives.[36] In addition, between 1998 and 2000, the NACDG found that reactions to individual formaldehyde releasers in skin care products ranged between 1.9 percent and nine percent.[13] It is unclear whether a person who reacts to patch testing to one formaldehyde-releasing preservative should avoid the others in the group that were negative on patch testing, although if a patient is also allergic to formaldehyde, it is likely to be of benefit to avoid the entire group.[8] Also of note, ingestion of foods containing aspartame may elicit a reaction in highly sensitized individuals due to aspartame breakdown into formaldehyde.

Iodopropynyl butylcarbamate (IPBC) was the eighth most common allergen found in 16.3 percent of moisturizers. It is often used as a preservative in lotions and personal care products due to its effectiveness at preventing fungal growth in topical products.[8] It is also a biocide, a biologically reactive chemical with expected allergenic and irritant potential, which was first used for wood preservation.[37] From the years 1996 to 2001, the Food and Drug Administration reported IPBC to be the preservative with the fastest growth in use in cosmetics.[38] The maximum level for safe use in leave-on and rinse-off products has been set at 0.1 percent by international authorities.[39] Furthermore, an irritant label must be placed on all products containing concentrations greater than 0.01%, although cosmetic products are allowed to have 10 times this concentration without labeling. Observing for IPBC allergy is important since the frequency of contact allergy may rise with the increasing availability of IPBC-containing cosmetic products. IPBC can lead to sensitization after extensive and prolonged exposure, but only a few cases of ACD have been reported from its use in cosmetics even with its extensive use.[40]

Lanolin was the ninth most common allergen and was identified in 9.8 percent of moisturizers. It is commonly added to moisturize and soothe the skin. Lanolin easily absorbs through the skin and facilitates the absorption of medicinal chemicals when used as an ointment. In addition, lanolin may be used in lubricants, rust-preventative coatings, shoe polish, and other commercial products. Between 1998 and 2000, the NACDG discovered that 2.4 percent of their patients were allergic to lanolin alcohol.[13] Although lanolin alcohol is believed to be the main sensitizer, lanolin is derived from the fleece of sheep and comprises hundreds of different chemicals, making it difficult to isolate the contact allergens. Additionally, lanolin-sensitive patients may tolerate one product containing lanolin but not another.[13] Furthermore, the true prevalence of positive reactions is unknown since reactions are often not reproducible and false positives and negatives commonly occur.[41] Therefore, patch testing with the patient's own product may be of value. Patch testing for lanolin allergy is done with either wool alcohol or a mixture of lanolin alcohol and mineral alcohol (containing wool alcohol from the hydrolysis of wool fat). Of note, occasional cross reactants to lanolin include fatty alcohols such as stearyl and cetyl alcohol.[8]

Similar to paraben sensitivity, reactions to lanolin more frequently occur on compromised skin, yet lanolin is generally safe when added to cosmetics extensively used in the population on noncompromised skin. Furthermore, patients sensitized to lanolin as a result of topical therapeutic agents may tolerate lanolin-containing cosmetics.[41] Case studies have been published demonstrating that some patients who patch test positive to lanolin are able to tolerate lanolin-containing cosmetics when used on normal skin.[40]

Methylisothiazolinone/methylchloroisothiazolinone (MCI/MI) is the tenth most common allergen in moisturizers, found in 6.2 percent of available products. It is frequently used as a preservative in cosmetic applications, body care products, and industrial products such as paint, and is highly efficacious at low concentrations. It is documented to be a more common allergen in Europe than in the United States, although the reason for this difference is unclear.[8] A theory for this discrepancy is that MCI/MI in the United States is used more

Table 2. Moisturizers of low allergenic potential
Aveeno Eczema Care Moisturizing Cream
CeraVe Moisturizing Lotion
Curel Fragrance Free Lotion
Doak Acid Mantle Cream
Elta Facial Moisturizer & Facial Block SPF 30
Eucerin Plus Intensive Repair Hand Crème
Eucerin Redness Relief Soothing Moisture Lotion SPF 15
Neutrogena Body Oil—Fragrance Free
Neutrogena Norwegian Formula Hand Cream—Fragrance Free

frequently in wash-off products, which may be tolerated by sensitized individuals.[8] Contact allergy to MCI/MI affects 1 to 3 percent of patch-tested individuals in European centers.[41] Sensitization appears to be most common in those with facial and hand dermatitis and in women, although frequency among men is increasing.[42] In a study of 119 patients suffering from cosmetic-related contact dermatitis, MCI/MI was determined to be the most important cosmetic allergen reacting in 27.7 percent of these patients.[43] Additionally, studies of lymph-node assays used to determine the likelihood of potential contact allergens have confirmed MCI/MI as a potent contact allergen.[41]

Conclusion

Moisturizers are extensively used personal care products, although many of the ingredients have the potential to cause irritant and ACD. Therefore, it is necessary for clinicians to be aware of such potential allergens in order to manage and advise their patients accordingly. Our search of the Walgreens database found the most common allergens in moisturizers to be fragrances, parabens, vitamin E, essential oils and biologic additives, benzyl alcohol, propylene glycol, formaldehyde-releasing preservatives, iodopropynyl butylcarbamate, lanolin, and MCI/MI. Since a number of these allergens are not present on the Thin-layer Rapid Use Epicutaneous (TRUE) Test, patch testing with expanded panels and with the patient's own products by an expert in contact dermatitis may be necessary to determine to which of these ingredients a patient is sensitized.

When expanded testing is not available or is delayed, it may be useful to empirically recommend products with the lowest potential for inducing ACD. In this setting, plain petroleum jelly can be recommended. If a cream or lotion is desired, there are no widely available products that are free of all NACDG allergens. In this setting, the authors recommend one of several products that only contain parabens as potential allergens, given the discussion noted previously regarding low allergenic potential of parabens. A list of these products can be found in Table 2.

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CLINICAL CONTACT DERMATOLOGY