



SKIN HEALTH



CYTOPLAN
NATURE MEETS SCIENCE

SKIN HEALTH

The British Skin Foundation estimates that 60% of the population experience skin conditions at some point in their lives, 20% of all children now have eczema and 70% of British people with skin conditions say it affects their confidence. For some, severe skin conditions can become quite debilitating and have a significant impact on wellness and self-esteem.

It may seem like just a shell we wear, but the skin is the largest organ in the body with many essential functions. These include:

Providing a barrier

Temperature control

Acting as a sensory organ

Absorption and excretion

Hormone (vitamin D) synthesis

The wellbeing of the skin can therefore have a marked effect on health in general and involves a constant flow of energy and nutrients.



While the skin can be affected by the external environment, many skin conditions are a manifestation of imbalances within other body systems. Therefore, when looking to support skin conditions, it is important to consider factors which support skin health (e.g. nutrition) as well as any underlying dysfunction (e.g. toxic overload). Although the skin is not the major player in the excretion of toxins or waste products, if the gut and/or liver are overloaded or under stress, extra pressure is then placed on the skin to assist with excretion. This can cause local irritation and inflammation which may present as a skin dysfunction. For this reason, other systems must always be considered when supporting skin health.

Acne -
up 95% of adolescents are affected. 20-35% develop moderate or severe acne¹

Eczema -
20% of children and 1-3% of adults are affected²

Rosacea -
occurs in around 5% of the population, with women more commonly affected than men³

Psoriasis -
occurs in around 3% of the population - although its incidence may be under-estimated as those with mild symptoms may not consult healthcare professionals⁴

It is thought that every year, nearly a quarter of the country consult their GP about a skin complaint⁵ with the most common reasons being skin infection and eczema.



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Underlying pathophysiology and diagnosis

Condition	Underlying pathophysiology	Diagnosis
<p>Acne vulgaris</p>	<ul style="list-style-type: none"> • Linked to an increase in sebum production which is affected by oestrogen, androgens and insulin • Inflammation and hyperkeratinisation contribute to blocked pores which secrete sebum allowing for bacterial overgrowth leading to localised infection and inflammation^{6,7} 	<ul style="list-style-type: none"> • Skin lesions such as comedones (a dilated hair follicle filled with skin debris, bacteria, and sebum, the primary sign of acne) in conjunction with risk factors including being between 12 to 24 years of age, genetic predisposition, greasy skin/increased sebum production or endocrine disorders
<p>Eczema</p>	<ul style="list-style-type: none"> • Also known as atopic dermatitis, this is a chronic inflammatory skin condition characterised by relapsing pruritic, dry and scaly lesions. Associated with atopy and potential allergy, and in response, excessive inflammation and impaired skin barrier function • Excess inflammation and atopic conditions, including eczema, are associated with gastrointestinal permeability and the presence of tissue-resident memory T cells^{8,9} • Filaggrin is a protein involved in skin barrier function. Recent studies revealed that up to 30% of patients with eczema have a genetic mutation in genes responsible for filaggrin production leading to skin barrier function abnormalities^{10,11} 	<ul style="list-style-type: none"> • Physical examination identifying presence of pruritus and xerosis (dry skin) - often at specific sites of skin; in addition to erythema, scaling, vesicles or papules

<p>Rosacea</p>	<ul style="list-style-type: none"> • A chronic inflammatory skin disorder that is not fully understood but involves the complex interplay of genetic factors, immune dysregulation, neurovascular dysregulation, presence of microorganisms and environmental factors¹² 	<ul style="list-style-type: none"> • Presence of flushing, erythema, papules and pustules in addition to risk factors including fair skin and reaction to extreme temperatures e.g. hot showers and sunlight • Facial skin thickening due to fibrosis and/or sebaceous glandular hyperplasia. Most commonly affects the nose, where it can impart a bulbous appearance¹³
<p>Psoriasis</p>	<ul style="list-style-type: none"> • A common, chronic inflammatory skin disease most often appearing in the form of well-demarcated, scaly plaques. The underlying pathogenesis involves inflammation, autoimmunity and epidermal hyperproliferation¹⁴ • Psoriasis is considered to be a Th2 dominant autoimmune condition however it is unclear whether it is a primary autoimmune disease or secondarily evolving autoimmunity as seen in other chronic inflammatory diseases 	<ul style="list-style-type: none"> • Physical examination, with observation of common symptoms including red patches of skin covered with thick, silvery scale, small scaling spots (commonly seen in children), dry and cracked skin that may bleed^{14,15} • In rare cases, a small sample of skin, called a biopsy, will be sent to the laboratory for examination under a microscope. This determines the exact type of psoriasis and rules out other skin disorders such as Seborrhoeic dermatitis, Lichen planus, Lichen simplex and Pityriasis rosea

What causes skin problems?

Genetics

As with many diseases, the skin conditions mentioned are not directly heritable. However, there can be familial tendencies, suggesting that genes which increase susceptibility to certain risk factors, such as increased inflammation, can play a role in the pathogenesis. For example, studies have shown that if one parent has acne then one in four of the children will; if both parents have acne, three of four children will develop it.¹⁶

Inflammation

All skin conditions discussed possess inflammatory characteristics. Inflammation drives damage, redness and irritation to localised areas and so drivers of inflammation should be investigated, including: gastrointestinal permeability, hyperactivation of the HPA axis, food intolerances and microbiome imbalances.¹⁷⁻¹⁹

- **Acne** – in acne, inflammation is partially secondary to bacterial overgrowth, but recent studies have demonstrated that inflammation also plays an independent role in the development of the condition.^{20,21}
- **Eczema** – skin barrier dysfunction has been considered to be the first step in the development of eczema, however, it is also now evident that immune dysregulation, including the activation of type 2 immune responses, results in impairment of the epidermal barrier.⁷² As the most common chronic inflammatory skin condition, eczema is associated with an increase in IgE antibodies as well as T-cell and other inflammatory markers.^{9,22,26}
- **Rosacea** - is an inflammatory condition and is associated with upregulation of macrophages and IL-1 and TNF α .²³⁻²⁵ Mast cell numbers have been shown to increase in the skin of rosacea patients, and their proteases not only recruit other immune cells, which amplify the inflammatory response, but also cause vasodilation and angiogenesis, and may therefore be key mediators in the development of inflammation in the condition.⁸⁹
- **Psoriasis** - studies show the signalling pathways of nuclear factor- κ B (NF- κ B), interferon- γ and interleukin (IL)-23, as well as antigen presentation, are activated in patients with psoriasis and are associated with inflammation. Studies also show activation of tumour necrosis factor- α , IL-23 or IL-17, suggesting significant inflammatory characteristics.¹⁴

Leaky gut

Disruption of the tight junctions between intestinal epithelial cells leads to hyperpermeability (leaky gut) and is implicated in the pathogenesis of several acute and chronic conditions, some of which are likely to have their origin during infancy (eczema is a common condition in infancy). Incomplete protein digestion, gut dysbiosis, stress and other factors can contribute to leaky gut. In turn, leaky gut contributes to both inflammation and allergy due to increased permeability allowing larger molecules to cross the digestive lining and trigger an altered immune response.²⁷

- **Acne** - when the intestinal barrier is disrupted, gut microbiota and their metabolites quickly enter the bloodstream, accumulate in the skin, and disturb the skin equilibrium.²⁸
- **Eczema** - it is proposed that permeability of the small intestine may be increased in eczema patients. Eczema often occurs in infancy, and the premature infant is particularly vulnerable to protein antigens that penetrate the intestinal barrier, which may promote the development of allergies, especially in genetically predisposed infants.²⁹ The overgrowth of *Candida albicans* has also been implicated as a causative factor in the pathophysiology of eczema, and other disturbances in the intestinal microbiome could be a risk factor for further development.⁸
- **Rosacea** – zonulin is a protein known to increase intestinal permeability, and a recent study demonstrated that serum zonulin levels were higher in individuals with rosacea when compared to healthy controls – suggesting a role for an impaired intestinal barrier system in the development of rosacea.³⁰ The presence of *Helicobacter pylori* is also strongly associated with rosacea, and an infection of this bacteria has been linked with increased mucosal permeability of the stomach and intestine.^{31,8}
- **Psoriasis** - poor protein digestion due to reduced stomach acid or digestive enzymes increases amino acids and polypeptides in the bowel where gut flora convert them into toxic substances known as polyamines. High polyamines are associated with psoriasis and a reduction in urinary and skin polyamines has shown improvements to symptoms of psoriasis.^{19,32} Psoriasis is considered to be an autoimmune condition and it is known that leaky gut is a significant driver in the pathogenesis of autoimmunity.^{22,33}

Skin microbiome

Human skin is a complex barrier organ with a symbiotic relationship between microbial communities. One can imagine the skin as a melting pot of different microenvironments, constantly shifting with influences from the outside world and the host immune system. The skin presents a physical barrier to harmful agents while establishing a unique innate immune system to regulate resident microbial communities. In contrast to other epithelial surfaces, such as the gut, which maintain physical separation from microbes through establishment of a mucous layer, the skin provides a large surface area for close communication with microbes.³⁴

This mutualistic relationship leads to a well-controlled but delicate equilibrium of the microbiota, which is mandatory for healthy skin. The skin regulates a sophisticated set of innate antimicrobial products that include antimicrobial peptides and proteins, lipids, a pH barrier, and free radical production to control the surface microbial community.³⁵ For example, healthy skin barrier function is necessary for the commensal bacteria *Staphylococcus epidermis* to inhibit the growth of pathogenic *Staphylococcus aureus*, which is normally observed in chronic inflammatory skin conditions, and maintain homeostasis of the microbial inhabitants of the skin. The commensal bacteria secrete antimicrobial agents which work in tandem with our immune system to kill pathogens and prevent biofilm formation and colonisation of pathogenic bacteria.^{36,37}

However, the skin is constantly exposed to various endogenous and exogenous factors which potentially impact this balanced system, thereby creating pathophysiologically relevant situations. These imbalances could thereby ultimately lead to the development of a range of inflammatory skin conditions.^{18,38}

- **Acne** – research has shown that acne is associated with the overgrowth of the specific bacterial strain *Propionibacterium acnes*. This bacterium is found naturally on the skin and can become opportunistic and therefore overgrow when conditions are out of balance.⁸⁸

However, further research has questioned the belief that *P.acnes* is necessarily a causal factor in the development of acne. Instead, it highlights the delicate equilibrium between the skin microflora and *P.acnes* phylotypes becoming imbalanced, thereby causing a loss of microbial diversity. It is this loss of diversity that is considered a significant causal factor for inflammatory skin diseases. Perhaps a more appropriate explanation for *P.acnes*' part in acne is its role in the inflammatory response coupled with the cutaneous microbiota and innate immune cells excessive response from keratocytes of the follicle glands, and the increase in sebum production.³⁹

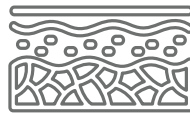
- **Eczema** – high levels of *s.aureus* are often found on the skin of people with eczema, and the density of this pathogenic bacteria tends to increase with the clinical severity – whereas it is rarely found on healthy skin.⁴⁰ Metagenomic sequencing has shown that eczema patients are usually colonised with a single strain of *s.aureus* during a severe flare, while microbiome composition reverted to more normal diverse communities during recovery.³⁵
- **Rosacea** – an overgrowth of commensal skin organisms is one of the proposed pathophysiologies for rosacea. Several microorganisms including *Demodex folliculorum*, *Bacillus oleronius*, *Staphylococcus epidermidis*, and *Cutibacterium acnes* have been found in high amounts on the skin of rosacea patients, and demonstrate a potential role in rosacea's pathogenesis, through their abnormal activation of the innate immune system and triggering of inflammation.⁴¹
- **Psoriasis** – significant skin dysbiosis has been observed among patients with psoriasis, with a decrease in richness and diversity reported in lesional samples when compared to control. Psoriatic lesions have also presented raised levels of fungal species such as *Malassezia* which can increase the production of the pro-inflammatory cytokines such as TNF- α , IL-1, IL-6, and IL-8 in the skin and stimulate keratinocyte proliferation.

As mentioned, it is an inflammatory condition and psoriatic flares, and the management of such episodes are dependent on the integrity of the skin barrier and immune system response. These are tightly controlled by the resident microflora so when an overabundance of microorganisms such as fungal flora (*Candida albicans*) and the bacterial flora (*Corynebacterium sp.*), as seen in psoriasis, then this can be compromised leading to an inflammatory response.^{42,}

43,44

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Hormone imbalances

The skin is significantly affected by many hormones; androgens (particularly testosterone), oestrogens and insulin stimulate sebum production and keratinisation, which encourages blocked pores and bacterial overgrowth within the pore. Stress hormones, including cortisol associated with adrenal dysfunction, play a role by contributing to inflammation and disrupting the signalling of other hormones.

Endocrine disrupting chemicals (EDCs) are exogenous chemicals found in the environment that interfere with hormone function. They are commonly found in some metals, many industrial chemicals, natural and synthetic hormones, pesticides, fungicides, herbicides, pharmaceutical drugs and even personal care products. Due to the ubiquitous exposure to EDCs and their ability to alter key hormone functions, they have been proposed to be relevant to the development of certain skin conditions.⁴⁵ EDCs put a burden on the liver and digestive system in order to detoxify and excrete these chemicals, and extra pressure is then placed on the skin to assist with excretion. This can cause local irritation and inflammation which may present as a skin dysfunction.

- **Acne** – research has shown a complex interplay between growth hormone, adrenal hormones (such as cortisol), insulin like growth factors (IGF-1) and insulin, contributing to the pathogenesis of acne.^{46,47}

EDCs have various effects on endogenous hormone pathways, particularly those of hormones relevant to the pathogenesis of acne: an increase in androgens, a decrease in oestrogens, which can be protective in acne, and elevated cortisol, which can enhance sebum production.⁴⁵

- **Rosacea** – in a survey conducted by the National Rosacea Society, emotional stress was reported as one of the most common rosacea triggers, affecting 79% of respondents. Emotional stress activates the hypothalamic-pituitary-adrenal (HPA) axis to increase cortisol release, which activates inflammatory pathways and impairs the skin barrier function.⁴⁸ Potential therapies for rosacea are meditation and yoga, both of which can act on the HPA axis to reduce cortisol levels and can be supportive for emotional stress reduction.⁴⁹
- **Psoriasis** - the HPA axis plays a crucial role in systemic hormonal regulation and homeostasis and research has indicated that HPA dysfunction may be present in psoriasis. Physiological responses to stress include increased sympathetic activity, over-activation of the HPA axis, and the release of pro-inflammatory cytokines; these can, in turn, perpetuate and aggravate psoriasis.⁵⁰

Oxidative stress

Oxidative stress can lead to adrenal dysfunction and inflammation, however direct oxidation of the skin has the potential to cause significant damage. The skin, being the largest and outermost organ, acts as a physical, chemical and immunological barrier against environmental factors. Human skin is exposed not only to natural environmental factors but also to pollutants of anthropic origin, including air pollutants such as diesel exhaust fumes, ultraviolet rays, food, xenobiotics, drugs, and cosmetics, all of which promote the production of reactive oxygen species (ROS). Whenever a prolonged and repetitive exposure to environmental stressors exceeds the skin's normal defensive potential, there is a disturbance in the skin barrier function, potentially leading to the development of various skin diseases.^{51,52}

- **Acne** – a high level of the ROS superoxide has been observed in acne, as well reduced activity of superoxide dismutase (SOD), the only antioxidant that can eliminate superoxide in humans. Squalene, a lipid localized in the sebaceous glands, captures superoxide and suppresses the peroxidation of other proteins and lipids in skin; therefore, the oxidation of squalene can exacerbate acne vulgaris.⁵²
- **Eczema** – the presence of oxidative stress, its increase in eczema exacerbation and a decreased antioxidant capability have all been observed in eczema patients.⁵³ Other factors are also part of the complex interplay of oxidative stress: skin microbes can induce oxidative stress and alterations in the cutaneous microbiota are associated with eczema. Inflammation could be mediated, at least in part, by ROS released by monocytes activated by *Staphylococcus aureus*, which is notoriously increased on the skin of eczema patients.⁵⁴
- **Rosacea** – oxidative stress contributes to the development of rosacea through the activation of neutrophils that produce ROS and the oxidative modification of proteins and lipids by ROS. Higher total oxidant capacity and lower levels of antioxidant action is present in rosacea patients.^{55,56}
- **Psoriasis** - an important point in the pathogenesis of the condition seems to be related to dysfunction in the antioxidant system, with increased production of ROS. As mentioned, TNF α leads to the formation of ROS in human keratinocytes, which in turn leads to the formation of further cytokines – and this relationship is likely to be important in the pathogenesis of psoriasis and other skin conditions. Moreover, antioxidant delivery for the treatment of psoriasis has shown positive effects.⁵⁷

Filaggrin

Filaggrin is a crucial epidermal protein that is important for the formation of differentiated keratinocytes. It is also involved in the generation of intracellular metabolites which contribute to stratum corneum (the outermost layer of the skin), hydration and pH. The levels of filaggrin and its degradation products are influenced not only by the filaggrin genotype but also by inflammation and exogenous stressors. Although genetics are involved, filaggrin deficiency is observed in patients with atopic dermatitis regardless of filaggrin mutation status, suggesting that the absence of filaggrin is a key factor in the pathogenesis of this skin condition.⁵⁸

Other factors which can affect skin health are:

- **Diabetes**
- **Injury**
- **Infection**
- **Sun damage**
- **Menopause**
- **Thyroid issues**



NHS treatments^{59,17}

Condition	NHS treatment
Eczema	<ul style="list-style-type: none">• Emollients (moisturisers) - used every day to stop the skin from becoming dry• Topical corticosteroids, pimecrolimus or tacrolimus – creams and ointments used to reduce swelling and redness during flare-ups• Antihistamines for severe itching• Bandages or special body suits to allow the body to heal underneath
Psoriasis	<ul style="list-style-type: none">• Anti-inflammatory or immune suppressant drugs• Topical corticosteroids or emollients• Phototherapy
Acne	<ul style="list-style-type: none">• Topical retinoids, topical antibiotics, oral antibiotics, azelaic acid• Combined oral contraceptive pill (women)• Isotretinoin tablets
Rosacea	<ul style="list-style-type: none">• Topical anti-inflammatories• Antibiotics• Anti-anxiety medications, beta-blockers, isotretinoin

Dietary recommendations

Although there are a variety of conditions associated with skin health, they all have inflammation and digestive disturbance at their core. The dietary recommendations below aim to address these:

- **Balance blood sugar levels** by avoiding sugar, refined grains and processed foods. Ensure that starchy carbohydrates are consumed in small to moderate amounts only (and wholegrain), while also consuming adequate protein and healthy fat with every meal.
- **Increase dietary fibre** as it is closely associated with anti-inflammatory activity in the body through its beneficial action on the microbiota.
- **Reduce or avoid gluten** containing grains. Gluten can increase inflammation and permeability of the digestive lining creating leaky gut and can therefore be a trigger for inflammation and autoimmune conditions.
- **Reduce sugar and refined carbohydrates.** Glucose is the primary fuel for skin cells, but high levels can advance skin ageing. Advanced glycation end products (AGEs) develop when a glucose molecule binds to collagen in the skin, accelerating ageing, poor elasticity, and deeper wrinkles.⁶⁰ Elevated glucose levels can also contribute to inflammation.
- **Reduce foods high in omega-6** e.g. farmed meats, dairy products and vegetable oils (such as sunflower and corn oils). These are high in the inflammatory omega-6 fatty acids arachidonic acid and linoleic acid (precursor to arachidonic acid). Arachidonic acid can be converted to the pro-inflammatory prostaglandin PGE2.
- **Increase sources of omega-3** and/or a supplement containing EPA/DHA. EPA is found in oily fish or it can be supplemented; alpha linolenic acid is found in flax seeds, chia seeds and dark leafy green vegetables and can be converted to EPA in the body. EPA is converted into anti-inflammatory prostaglandins. The ratio of omega-6 to 3 is very important and the majority of people are consuming too high a ratio of omega-6 to 3 and therefore are often producing excess amounts of pro-inflammatory prostaglandins. On the other hand, the omega-6 fatty acid gamma linolenic acid (GLA), found in evening primrose oil, borage oil and spirulina is a precursor to anti-inflammatory prostaglandins and therefore is useful for inflammatory skin conditions.

- **Consume six to eight portions of vegetables per day** including dark leafy greens high in anti-inflammatory phytonutrients and antioxidants.
- **Yellow and orange vegetables are high in beta-carotene**, the precursor to vitamin A; a major fat-soluble antioxidant and epithelial tissue support agent.^{61,62}
- **Curcumin** (found in turmeric) has been shown to inhibit Cox-2 enzymes which produce inflammatory prostaglandins.^{63,64} Other culinary herbs that possess anti-inflammatory properties include saffron⁶⁵ and ginger.⁶⁶
- **Vitamin E** has been shown to suppress inflammatory markers (IL-6, TNF α and NO) and down-regulate the transcription factor NF-kB. Sources of vitamin E include avocados, almonds, green vegetables and olives.
- **Choosing organic produce** will reduce exposure to environmental toxins such as pesticides.



Specific nutritional support

Vitamins

Vitamin A

Vitamin A acts as a hormone-like growth factor to support epithelial cell production and so is involved in maintaining the structural integrity of the skin. Retinols (active form of vitamin A) have been shown to reduce sebum production and hyperkeratinisation⁶²

Deficiencies in Vitamin A have been linked to an increased susceptibility to skin infection and inflammation⁶⁷

Vitamin B5 (pantothenic acid)

Pantothenic acid is essential for maintaining keratinocyte proliferation and differentiation

Vitamin C

Major antioxidant which reduces free radicals and oxidative stress to help prevent and protect from damage. In addition, vitamin C is responsible for the recycling of vitamin E and glutathione, both major antioxidants. Vitamin C also supports collagen and elastin production; important for maintaining the structural integrity of the skin.

In summary, studies have shown that vitamin C:⁶⁸

- Reduces skin damage and ageing
- Promotes collagen formation
- Scavenges free radicals and reduces oxidative stress
- Plays a role in keratinocyte differentiation
- Has a beneficial effect on wound healing

Vitamin D

There is a synergistic relationship between vitamin D and skin cells. Vitamin D is responsible for adequate differentiation of epithelial cells and skin cells are the site of endogenous production of vitamin D from sunlight. Vitamin D is also recognised to be involved in the cutaneous production of antimicrobial peptides in keratinocytes, which help to protect against invading microorganisms⁶⁹

Vitamin E	<p>Vitamin E is the major fat-soluble antioxidant important for neutralising free radicals in the skin. Vitamin E can also absorb UV rays and therefore enhance skin protection. It has also been demonstrated to have anti-inflammatory properties.</p> <p>Vitamin E deficient diets are associated with acne, eczema and psoriasis⁷⁰</p>
Biotin	<p>An important co-enzyme and essential nutrient in the maintenance of normal skin. Biotin deficiency has been shown to enhance the inflammatory response of dendritic cells</p>
Nicotinamide (B3)	<p>This form of B3 has been shown to inhibit lysosomal enzymes, vasoactive amines and activity of <i>P. acnes</i> when applied topically. This has proved to be effective, with fewer side effects, than some medical interventions for inflammatory acne</p>

Minerals

Zinc	<p>The skin has the third highest abundance of zinc in the body, which is required for active proliferation and differentiation of epidermal keratinocytes. Several disorders, with accompanying skin manifestations, are caused by mutations or dysregulation in zinc transporters. Zinc is also involved in protection against oxidative stress. Zinc deficiency is associated with eczema and poor wound healing^{71,72}</p>
Selenium	<p>An important antioxidant which is abundant in the skin. Selenium protects keratinocyte stem cells (KSCs) against senescence. Studies have suggested that selenium may be useful against skin ageing⁷³</p>
Iodine	<p>Essential for thyroid hormone production. Reduced thyroid function is associated with a decline in skin quality, skin thinning and dryness</p>

Silica	Key component of collagen, therefore essential for healthy skin formation, repair and maintaining elasticity
Copper	Essential for the formation of melanin, involved in pigmentation. Copper contributes to the maintenance of normal connective tissues and protection from oxidative stress
Sulphur - MSM	Required for the production of collagen and elastin, both of which are important for the maintenance of normal skin

Flavonoids and carotenoids

Bilberry (anthocyanins)	Studies show that anthocyanins increase levels of collagen, elastin and hyaluronic acid within the skin, therefore they may support its structural integrity and ability to retain water
Cocoa flavanols	Dietary flavanols from cocoa contribute to endogenous photoprotection, improve dermal blood circulation and affect cosmetically relevant skin density and hydration ⁷⁴
Lutein	Human studies have demonstrated that lutein and zeaxanthin are present in the skin, and studies have provided evidence of significant efficacy against light-induced skin damage, especially the ultraviolet wavelengths ⁷⁵
Lycopene	Research indicates that lycopene is protective against UVA and UVB radiation damage to the skin, and reduces oxidative stress in the skin ⁷⁶
Astaxanthin	Possesses anti-inflammatory and antioxidant capabilities and has been shown to be protective for inflammatory skin conditions as well as inhibiting age-related skin deterioration ⁷⁷

Other nutrients

Curcumin

The most useful aspect of curcumin for skin health is that it acts to reduce inflammation by acting on several different targets including:

- Cyclooxygenase 2
- Lipoxygenase 5
- Interleukin 1
- Interleukin 6
- Tumour necrosis factor alpha

Curcumin protects skin cells against UVB induced cytotoxicity, therefore preventing skin damage.⁷⁸ Curcumin is also a polyphenol, with prebiotic activity and thus supports a healthy microbiota

Omega-3

The omega-3 fatty acid EPA produces anti-inflammatory prostaglandins and so is very useful as an anti-inflammatory molecule. Both EPA and DHA may support the integrity and repair of the skin through their structural and functional roles in cellular membranes⁷⁹

Omega-6

Omega-6 oils such as evening primrose or borage oil are sources of gamma linoleic acid (GLA). Studies have shown that this specific form of omega-6 supports skin barrier function. A combination of GLA and omega-3 fatty acids shows the highest potential for improving the symptoms of inflammatory skin conditions including acne, eczema and psoriasis⁸⁰

Sea Buckthorn Oil

Sea buckthorn contains a unique mix of fatty acids, including a higher presence of omega-7 than any other plant. This mix ensures multidirectional effects in different layers of the epidermis. It has shown therapeutic effects in several different skin conditions.⁸¹

Omega-7 is a primary component of cell membranes that make up mucous membranes, therefore keeping the natural structure of the skin hydrated and healthy by promoting tissue regeneration and reducing inflammation

<p>Marine Collagen</p>	<p>Collagen is the primary component in human skin. One study found that after just 12 weeks of supplementing with marine collagen, women saw a 35% reduction in wrinkles, and improved elasticity, hydration, radiance and firmness when compared to placebo⁸²</p> <p>Marine collagen is also emerging as a supportive nutrient for wound healing⁸³</p>
<p>Probiotics</p>	<p>Live bacterial supplements have been shown to have a positive effect on the human microbiome by:</p> <ul style="list-style-type: none"> • Inhibiting pathogenic adhesion • Increasing tight junction expression and initiating barrier function • Reducing local inflammation <p>Studies have shown that regulating the gut microbiome has a positive effect on the skin microbiome which is essential for structural integrity. It has also been shown to be impaired in atopic dermatitis. Supporting gastrointestinal integrity is important for reducing systemic inflammation and hyperactivation of the immune which contributes both to inflammatory and atopic conditions</p>
<p>Prebiotics (fructo-oligosaccharides (FOS), inulin, polyphenols and flavonoids)</p>	<p>Prebiotics have been shown to support the growth of desirable bacteria within the colon and inhibit the growth of pathogenic organisms. They are also associated with improved integrity of the gastrointestinal lining and are therefore supportive of inflammatory and atopic conditions.</p> <p>Prebiotics were also shown to be effective in selectively increasing the abundance of <i>Bifidobacteria</i> and <i>Lactobacilli</i> in both pregnant women and formula-fed infants. In fact, FOS has been identified as a potential therapy for infants with atopic dermatitis⁸⁴</p>
<p>NAC</p>	<p>As an antioxidant, NAC strongly suppresses the Th2-mediated IL-4 response and mildly suppresses the secretion of IL-5 and INF-γ, it is useful for the treatment of Th2-related diseases, such as atopic dermatitis⁵²</p>

Lifestyle recommendations^{85,86}

Smoking

Smoking causes many physiological and pathological adverse effects and has been directly linked to numerous inflammatory skin conditions. Smoking has been linked to an increased risk of developing psoriasis, and increases the risk of *S. aureus* infection in patients with atopic dermatitis. Studies have found that people who smoke, and those who are exposed to second-hand smoke, have reduced amounts of vitamin C and other antioxidants in their bodies.⁹⁰

Alcohol

Alcohol contributes to skin inflammation, leading to epidermal thickening, production of inflammatory cytokines from keratinocytes, and local proliferation of lymphocytes in the skin, thus acting as an exacerbating factor in psoriasis. Vascular permeability is upregulated by alcohol intake, which contributes to the development of skin inflammation. Excessive alcohol intake also depletes the body of B vitamins and minerals such as zinc and magnesium.

Sleep

Sleep disturbance has been identified as a possible risk factor for inflammatory skin diseases. Studies have revealed a relationship between shift work, and the disturbance to the circadian rhythm, leading to a higher risk of psoriasis. Poor sleep is also a huge nutrient steal and research suggests we tend to make poor food choices after a bad night's sleep.

Obesity

Obesity is known to exacerbate inflammation and is closely linked with inflammatory skin conditions. Dysfunction of lymphatic vessels reduces their clearance function and can prolong an inflammatory state. Obesity can cause changes to skin barrier function, and there is a statistically significant correlation between body mass index and psoriasis.

Cosmetics

The use of aggressive skin care regimens and inappropriate cosmetics may cause acne flare-ups. These products modify the skin barrier and the skin microbiota balance especially in the sebaceous area, thus activating the innate immunity and triggering inflammation. Natural and organic skincare should be used where possible.

Pollution

Pollution exerts a harmful effect on the skin by increasing oxidative stress. In acne, the skin lipid film on the surface of the *stratum corneum* is altered through an increase in oxidised squalene and a decrease in linoleic acid. Studies have also demonstrated relationship between exposure to environmental pollutants and increased sebum levels and a higher number of inflammatory and non-inflammatory acne lesions. Pollutants will also place an extra burden on the liver for detoxification.

Sun exposure

Sun exposure to ultraviolet radiation (UVR) has been reported to cause hyperplasia of the sebaceous gland, thickening of the *stratum corneum*, increase in sebum secretion and in the number of comedones. UVR triggers the release of antimicrobial peptides, activates the innate immune system and ultimately suppresses the adaptive cellular immune response. As a consequence, skin microbiota may be altered, and *P. acnes* may over colonise the skin causing flares of acne.

Excessive exposure to UVR carries profound health risks to the skin, including atrophy, pigmentary changes, wrinkling and malignancy.

Psychological stress

Psychological stress arises when people are under mental, physical or emotional pressure, and the skin is both an immediate stress perceiver and a target of stress responses. Multiple inflammatory skin conditions including psoriasis, acne and eczema can be triggered or aggravated by stress.⁸⁷ The effects of stress can also have a detrimental effect on micronutrient concentrations: adequate nutrients such as vitamin C, B vitamins and magnesium are needed to support and sustain the body in times of stress and so can become rapidly depleted.



Relevant Cytoplan products

CoQ10 Multi

A comprehensive multivitamin and mineral with additional CoQ10 and beta glucan. Designed to optimise levels of all micronutrients. Contains 40µg of vitamin D3, 205mg of vitamin C, 14mg of zinc and 150µg of selenium.

Alternative products: Foundation Formula 1, Women's Wholefood Multi, Wholefood Multi

Cherry C

200mg of vitamin C from acerola cherry with naturally occurring bioflavonoids.

Alternative products: Organic Vitamin C, Food State Vitamin C

Mixed Tocopherols/Tocotrienols

Natural vitamin E containing all tocopherols and tocotrienols.

Alternative product: Vitamin E

Vitamin A

1 capsule provides 5000IU of vitamin A (retinol palmitate) which is suitable for vegans.

CytoProtect® Hair, Skin and Nails

A nutrient complex designed to support all aspects of hair, skin and nail health.

Includes beta carotene, pantothenic acid, biotin, silica, vitamin C, iodine, zinc, copper, selenium, MSM, pine bark extract and additionally bilberry, cocoa flavanols, astaxanthin, lutein, lycopene and beta glucan 1-3, 1-6. Recommended to be taken alongside a comprehensive multivitamin and mineral.

MSM

An organic form of sulphur. High levels of sulphur are found in muscles, skin and bones, as well as concentrated amounts in the hair and nails.

Acidophilus Plus

Providing 3.5 billion live bacteria with 9 strains and 35mg of fructo-oligosaccharides (FOS).

Alternative products: Fos-A-Dophilus, Women's Biotic, Vegan Biotic

PreBio Restore

A unique prebiotic supplement which provides a blend of mixed prebiotic fibres to help contribute to a diverse microbiome.

Krill Oil

Omega-3 supplement in phospholipid form, containing astaxanthin.

Alternative products: Vegan Omega 3, Omega Protect + CoQ10, Omega Balance

Sea Buckthorn Oil

One of the richest sources of omega-7 fatty acids. Acts as main constituent of cellular membranes, keeping the natural structure of the skin and membranes hydrated and healthy.

Cell-Active Curcumin Plus

Contains 95% curcuminoids with gingerols to support anti-inflammatory pathways. Includes Longvida® optimised curcumin, an innovative, more bioavailable form of curcumin. Longvida® is scientifically proven to be up to 285 times more bioavailable than standard curcumin.

Alternative products: Organic Turmeric

Marine Collagen

A unique, bioactive collagen peptide formulation to support the health of all connective tissue including the skin.

CytoProtect® Liver

A botanical formula comprising milk thistle, dandelion, turmeric, schisandra, burdock and artichoke.

Alternative products: Organic Milk Thistle, Organic Turmeric

NAC

A highly stable and bioavailable form of the amino acid cysteine.

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About Cytoplan

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Combining nature with science, we pioneered Wholefood & Food State supplements to create our market-leading supplement range. Our products are grounded in science, proven by results and designed to improve health, safely and effectively.

We are an independent British company, wholly owned by a charitable foundation and invest widely in health and nutritional projects across the UK and address issues such as community wellbeing and mental health. Every product purchased is helping us to help others.

Trusted by our practitioners and customers alike, we offer sound information about supplements and health to encourage self-empowerment and growth, helping customers to make their own informed decisions on their approach to nutrition and wellbeing.



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