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Role of Diet in Dermatological Conditions

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Abstract

In recent years nutritional deficiency diseases have been reported in developed countries. Nutritional deficiencies can be due to inadequate intake, abnormal absorption or improper utilisation. Many nutrients are essential for life, an adequate amount of nutrients in the diet is necessary for providing energy, building and maintaining body organs and for various metabolic process. Skin disorders have long been associated with nutritional deficiencies. Nutrition is one of the most important parameters that are involved in modulating skin health and condition. Nutritional status plays an important role in maintenance of healthy skin. A variety of nutritive factors such as small peptides minerals, vitamins, macronutrients and micronutrients work together to maintain the barrier functions of skin in the face of everyday challenges. Changes in nutritional status that alters skin structure and function can also directly affect skin appearence. In general dermatological problems were diet plays a role are atopic eczema, urticaria, dermatitis herpetiformis, psoriasis, pityriasis, rubra pilaris, purpura, scurvy, refsumes disease, ichthyosis, vitiligo, hypo pigmentary conditions, acne, rosacea, kwashiorkor, marsmus, stomatitis, phrynoderma, pellagra, acro dermatitis enteropathica, homocysteinuria, hartnup disease, gout, porphyrias, xanthomas, hyper carotenemia and lycopenemia. Dietary changes or modification might help to prevent recurrences of many skin diseases.

Introduction

Many nutrients are essential for life, and an adequate amount of nutrients in the diet is necessary for providing energy, building and maintaining body organs, and for various metabolic processes [1].

Skin disorders have long been associated with nutritional deficiencies. Nutrition is one of the most important parameters that are involved in modulating skin health and condition [2].

In general dermatological problems where diet plays a role are atopic eczema, urticaria, dermatitis herpetiformis, psoriasis, pityriasis rubra pilaris, purpura, scurvy, Refsum's disease, ichthyosis (nutritional), vitiligo, hypoigmentary conditions, acne, rosacea, kwashiorkor, marasmus, stomatitis, phrynoderma, pellagra, acrodermatitis enteropathica, homocystinuria, Hartnup desease, gout, porphyrias, xanthomas, hypercarotenemia and lycopenemia [3].

Earlier nutritional deficiency diseases were assumed to be limited to the underdeveloped and developing countries. In recent years nutritional deficiency diseases have been reported in developed countries [4,5]. Nutritional deficiencies can be due to inadequate intake, abnormal absorption or improper utilization [1]. Nutritional status plays an important role in the maintenance of healthy skin [6-9]. Deficiencies of several vitamins, minerals, and fatty acids have clear cutaneous manifestations [10-13].

Many attempts have been made to improve skin health and beauty by changing or by supplementing the diet [14]. In 2001, Boelsma et al. [15] reviewed the effects of vitamins, carotenoids and fatty acids supplementation in optimizing skin condition and preventing skin diseases and concluded that nutritional factors show potential beneficial actions on the skin.

Macronutrients (carbohydrates, proteins, and lipids) and micronutrients (vitamins and nutritionally essential minerals) work together to maintain the barrier functions of skin in the face of everyday challenges. Changes in nutritional status that alter skin structure and function can also directly affect skin appearance [16].

Excessive inflammation of the skin is known to increase the requirements of specific nutrients like folic acid and protein [10,17].

Primary requirement for skin cells is glucose also provides carbohydrate backbones for modification of proteins (glycoproteins) and lipids (glycoplipids) that comprise the extracellular environment of the epidermis. Aberrant glucose handling drastically affects skin structure and appearance [18].

Much of the role of nutrition in skin health emphases on the effects of deficiency, since the structural components of the skin are supported by a variety of nutritive factors, such as small peptides, minerals, and vitamins, which serve as enzyme cofactors, activators, or inhibitors [9].

Many micronutrients were initially recognized for their impact on skin health. The effect of micronutrient supplementation on skin health is a relatively new field of study, as associations between diet and skin conditions are only now starting to emerge [19] (Table 1).

Vitamin A

Deficiency of vitamin A results in hyperkeratinization with reduced number of sebaceous glands and blockage of sweat glands [10].

Hypovitaminosis also affects the skin by causing xerosis, generalized hyperpigmentation, and sparse and fragile hair. Plugging of the follicular openings with spiny horns is one of the classic signs of vitamin A deficiency as in phrynoderma [20].

Retinol (Vitamin A), carotenoids (provitamin A) and retinoids (Vitamin A metabolites) are absorbed better with parallel intake

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Vitamins	Skin conditions
Vitamin A	Hyperkeratinization, sparse and fragile hair, phyrnoderma, herpes, wound healing,acne , photoaging
Vitamin C	Scurry
Vitamin B12	Hyperpigmentation, vitiligo, angular stomatitis, hair changes
Vitamin B3	Pellagra
Vitamin D	Photo damage
Vitamin E	Anti-inflammatory effects-erythema,edema. Wound healing, photodamage
Macronutrients	**Skin conditions**
Carbhohydrates, proteins	Galactosemia, Kwashiorkor (Protein malnutrition)
	Marasmic-Kwashiorkor
Fatty acids	Photoprotection, photoaging, wound healing, skin sensitivity
Minerals	**Skin conditions**
Zinc	Weeping dermatitis, secondary infections, excessive fragile hair and spars, alopecia, nail defects, acrodermatitis, poor wound healing.
Iron	Spoon shaped nails, hair loss, gloscitis with loss of papillae, angular chelitis and pruritis.

Table 1: List of Macronutrients and Micronutrients Related to their Skin Conditions.

of vegetable oils [21-26]. Vitamine A rich food items are useful in controlling the Pityriasis rubra pilaris [27]. Excess intake of vitamin A itself can lead to side effects including shedding of skin and hair loss [28]. Source of Vitamin A:Liver, heart, kidney, milk, codliver oils, fishliveroils, butter, eggs, carrots, cabbage, vegetables, green leaves, mangoes, potatoes tomatoes, spinach, papaya etc. [29].

Vitamin B12

Cutaneous appearances associated with vitamin B12 deficiency are skin hyperpigmentation, vitiligo, angular stomatitis, and hair changes. Malabsorption is the most common reason of vitamin B12 deficiency

Sources: Milk, liver, kidney, muscle, butter, chicken, fish, yeast, cheese, raw egg, white grains, green vegetable such as spinach, peanuts, fruits such as apple, orange etc. [29].

Vitamin B3

Classic pellagra is a nutritional disease considered deficiency of vitamin niacin.11 Other factors, such as, mycotoxins, excessive dietary leucine intake, estrogens and progesterone, chronic alcoholism, and various medications, might also lead to the development of pellagra [11,30,31]

Vitamin C

Scurvy is a deficiency disease of ascorbic acid manifested in the decreased production and increased fragility of collagen [1].

Sources: Guava, amla, green chilli, amaranth leaves, citrus fruits, green vegetables, potatoes, tomatoes, cheese, milk etc.29

Vitamin D

It can cause photodamage.

Sources: Fish liver oils e.g., cod liver oil, halibut liver oil etc. butter, milk, eggs, liver. In sub coetaneous tissue, 7 dihydrocholesterol is conveted to vitamin D by UV light [29].

Antioxidants

Antioxidants are effective in reducing free radical damage of collagen and elastin, the fibers that support the skin structure, and in preventing wrinkles and other signs of premature aging [32].

Supplementation with βcarotene33 and other carotenoids [33-35] such as dietary tomato paste containing lycopene [36] protects against UV light induced erythema in humans However, they are reported to exacerbate UV carcinogenesis under certain dietary conditions, by acting as prooxidants, at high oxygen pressure and under oxidative stress [37].

Selenium is an antioxidant mineral accountable for tissue elasticity. It also acts to avoid cell damage by free radicals. Associated skin signs contain hypopigmentation of the skin and hair and whitening of the nails [13]. It may play an important role in preventing skin cancer, as it can protect the skin from damage from excessive ultraviolet light.

Sources of selenium include wheat germ, seafood such as tuna and salmon, garlic, Brazil nuts, eggs, brown rice, and whole wheat bread [1].

Fatty Acids

Numerous studies have revealed that clinical imbalances of specific essential fatty acids are associated with a variety of skin problems. Hence dry, itchy, scaly skin is a hallmark sign of fatty acid deficiency [38].

Omega-6 fatty acids are believed to persuade more pro-inflammatory mediators and have been related with the development of inflammatory acne [39,40]. On the other hand, intake of high levels of omega-3 fatty acids is linked with declines in inflammatory factors [41]. In addition there are epidemiological studies that demonstrate that increasing the intake of omega-3 fatty acids through a diet rich in fish and seafood results in lower rates of inflammatory disease [42]. There are also studies claiming that sebum production is increased by the consumption of dietary fat or carbohydrate [43] and that variations in carbohydrates could also affect sebum composition [44,45].

Minerals Deficiency

Cutaneous manifestations of zinc deficiency are weeping dermatitis, secondary infection, poor wound healing, excessively fragile hair and sparse or no scalp and pubic hair [1]. Dermatitis, alopecia, and nail defects are also associated with zinc deficiency [11].

Zinc deficiency is accompanying with delayed wound healing. Lim et al, have hypothesized the association of dietary zinc in activating the nuclear factor kappa B (NFκB), expression of proinflammatory cytokines (interleukin1b and tumor necrosis factora), and in neutrophil infiltration during the early stage of cutaneous wound healing [46]. Turmeric, red pepper, cloves, ginger, cumin, anise, fennel, basil, rosemary, garlic, and pomegranate, can block NFKB activation of inflammatory cytokines [47].

Acrodermatitis enteropathica develops in a zinc deficient patient and a combined nutritional deficiency of zinc, EFAs, albumin and amino acids may result in acrodermatitis enteropathica [48].

The activities of lysyl oxidases that initiate the crosslinking of collagen and elastin decline with copper deficiency [49].

Chronic iron deficiency has resulted in spoon shaped nails (koilonychia), hair loss, glossitis with loss of papillae, angular cheilitis, and pruritus.11 Iron found in Liver, eggs, meat, dark and green vegetables, lentis, potatoes, soybeans, chick peas, black beans, spinach, etc. [29,50].

Carotenemia

Carotenemia is caused by too much intake of carotene rich food

such as oranges and carrots.50 Carotene is present in carrots. Hence excess eating of carrots has to be avoided [3].

Kwashiorkor

Kwashiorkor is the edematous form of protein energy malnutrition. Evidence has been linking aflatoxins, free oxygen radicals, leukotrienes; zinc deficiency, and essential fatty acid deficiency [4]. In the 1970s, Vasantha et al. [6] demonstrated that kwashiorkor, a severe protein/calorie deficiency, was related with skin biochemical changes in children [51].

Sources of protein Peas, beans, poultry, cereals, lentils, milk, cheese, eggs, meat, wet and dry fishes, pulses, and nuts [29].

Pemiphugus

The role of thioland tannin rich foods in exacerbating pemphigus have been reviewed by Tur E and Brenner S [52]. Substances such as thiols, thiocyanates, phenols and tannins can precipitate the pemphigus in a genetically predisposed individual [53].

Foodstuffs covering tannins include a wide variety of vegetables (cassava, eggplant), fruits (mango, cashew apple, guarana, raspberry, cherry, cranberry, blackberry, avocado, banana, apple, peach, grape and pear), nuts(betel nut, kola nut, walnut, cashew, peanut, pistachio), beverages (coffee, tea, cocoa, beer, wine, soft drinks), spices (ginger, ginseng, garlic, red chillies, asofoetida, coriander, cumin, black pepper, ajwain) and food additives [52].

Dermatitis Herpetiformis

It is a well-known gluten intolerance disease and is controlled by a glutenfree diet. A gluten free diet (GFD) is the mainstay of treatment in celiac disease [54].

After following 133 DH patients who consumed a GFD, Garioch et al. [55] reported that the related advantages are the need for medication is reduced or abolished, there is resolution of enteropathy, a general feeling of wellbeing and protective effect against development of lymphoma. Patients with DH often have malabsorption. A GFD improves absorption of essential nutrients and prevents alimentary deficiencies of iron, vitamin B12 and folate [54].

Food stuffs having gluten, and hence to be avoided, are wheat, rye, oats and barley. Rice, corn and potatoes are safe for ingesting. Iodine containing food (fish, kelp, iodized salt and vitamin) may be avoided in patients who do not respond to a GFD, as iodides worsen DH by local chemotaxis and stimulating neutrophil migration [56].

Psoriasis

A low-calorie and low-protein diet has been recommended in the treatment of psoriasis [1]. Psoriasis is an inflammatory condition that appears to be aggravated by an inflammatory diet. An inflammatory diet may consist of a food allergen or a diet with imbalanced ω6 and ω3 fatty acids [57].

Many psoriatic patients show increased sensitivity to gluten and their symptoms improve on a glutenfree diet [58]. A vegetarian based diet may put an individual at a risk of eating high amounts of vegetable oils and soy products, and low amounts of fish, which can tip the balance toward a proinflammatory state [1].

Low serum calcium and zinc during pregnancy is known to cause pustular psoriasis. Supplementations of food containing calcium and zinc have been suggested in such situations [3]. Iodide can precipitate pustular psoriasis. Seafood and iodized salt are rich sources of iodine [59,60].

PUFA intake in Psoriasis

Daily intake (170 g) of oily fish60 EPA/DHA 1.8 g/day or fish oil (10 capsules three times a day) supplementation [61] parenteral infusion of EPA and DHA 4.2 g/day useful in acute guttate psoriasis [62]. Combined ω3 and ω6 fatty acid supplementation (rationale: low concentration of PUFA in membrane phospholipids, increased saturated fatty acids and decreased ω6 fatty acid in psoriatic arthritis, high doses of linoleic acid suppressing LTB 4 production) [63].

The consumption of fresh fruits and vegetables, such as carrots and tomatoes, may be beneficial in psoriasis because of their high content of carotenoids, flavonoids and vitamin C [64]. A sufficient status of antioxidants (e.g., vitamin C, vitamin E, bcaroteneand selenium) may be helpful to prevent an imbalance of oxidative stress and antioxidant defence in psoriasis [65].

Alcohol stimulates histamine release and may thereby worsen skin lesions [66]. The intake of alcohol is associated with a concomitant increase in the intake of fatty foods and reduced consumption of fresh vegetables and fruits. Hence, alcohol intake should be restricted in psoriasis.

Acne

American Academy of Dermatology published recommendations 3 in 2007 suggesting that caloric restriction has no benefit in the management of acne and that there is insufficient suggestion to link the consumption of certain “food enemies” to acne.4 On the other hand, recent studies have suggested a rather close relationship between diet and acne [67,68].

Bulkley’s 1887 book [69] discussed the subject and up until the 1950s, in America, restrictions on various foods, most often dairy products, were presented in dermatology textbooks as part of acne therapy [70].

A positive association was made between dairy products (particularly skim milk) and acne [71-73]. A high glycemic load diet, processed cheese, a high-fat diet, and iodine play a role in the exacerbation of acne in Koreans [74]. Ludwig [75] and Liu and co-workers [76] found that chronic ingesting of high glycemic load carbohydrates may cause long-term hyperinsulinemia and insulin resistance. Insulin influences circulating concentrations of free insulin like growth factor I (IGF-1) and insulin like growth factor binding protein 3 (IGFBP-3), which in turn directly regulate keratinocyte proliferation and apoptosis [77].

Clement et al., in their studies have shown a positive association between the intake of skim milk and acne [78] Robyn N Smith et al., have recommended that nutrition-related lifestyle factors may play a role in the pathogenesis of acne [67]. The role of chocolate and other dietary factors in acne development has also been reported [79].

In the 1969 experiment by Fulton and co-workers 65 subjects (14 adolescent boys, 16 adolescent girls, and 35 young adult male prisoners) consumed either a 112-g bittersweet chocolate bar enriched with chocolate liquor and cocoa butter or a 112-g control bar without chocolate liquor and cocoa butter once a day for 4 weeks in a single blind crossover design with a 3-week washout period. Authors concluded “ingestion of high amounts of chocolate did not materially affect the course of acne vulgaris or the output or composition of sebum [80].”

Herpes

Herpes is a viral infection of the skin. A study suggested that a mix of nutrients, such as those found in fruits and vegetables, act together to sustain immune health, rather than individual dietary intakes of vitamins A, B6, C, and E, and of folic acid, zinc, and iron [81].

Scleroderma

It is an autoimmune disease of the connective tissue, characterized by fibrosis and thickening of various tissues. Avoidance of high-fiber diet is advised to patients with scleroderma.82Improvement in the skin of scleroderma on vitamin E supplementation has been reported [82,83].

Atopic Dermatitis

Foods such as chocolate, cheese, coffee, yogurt, and some Japanese foods such as glutinous rice cake, soy sauce, and fermented soybeans are stated to play an important role in unpredictable, uneven aggravation of skin lesions in patients with atopic dermatitis [84].

Arguments in favor of the role of diet in AD include the fact that some foods provoke AD, an elimination diet can heal AD, diet manipulation can prevent allergy in newborns at risk for atopy, presence of specific serum immunoglobulin (Ig) E for food allergens [85].

Food allergy plays a role in 20% of children under the age of 4 years with AD. A direct effect on eczema is observed in four of 10 children with AD and proven food allergy [86]. Ninety percent of food allergy is caused by six foods such as wheat, milk, soy, fish, eggs and peanut [87].

A recent Cochrane review of nine randomized controlled trials of food allergy in patients with AD showed that there seems to be no benefit of an egg and milk free diet in unselected participants with atopic eczema [88].

Treatment of AD can be supported by supplementation of 'probiotic' intestinal bacteria [89]. A probiotic is currently defined as a live microbial food supplement with a recognized beneficial effect on human health [90]. However, a recent cochrane Intervention Review suggests that probiotics are not an effective treatment for eczema and may, in fact, carry a small risk of adverse events such as infections and bowel ischemia [91].

Cow's milk containing penicillin spores, chocolates, food additives, citrus fruits, fish, shell fish, cheese, eggs, meat, nuts, alcohol, caffeine, tomatoes and wheat are known to aggravate atopic dermatitis [6].

Urticaria

Adverse reactions to food are a frequently discussed cause of urticaria. In acute urticaria, 63% of patients suspect food as the eliciting factor [3]. Penicillin can cause urticaria after food ingestion when present in beef, frozen meats and soft drinks, in penicillin sensitive individuals [92]. Food additives producing urticaria due to tartrazine dye has been reported [93]. Food additives most commonly concerned are azo-dyes, tartrazine, amaranth, sunset yellow and carmosine.

Allergic Contact Dermatitis

Approximately 30-50% of individuals who are allergic to natural rubber latex show a related hypersensitivity to some plant derived foods, especially freshly consumed fruits. This association of latex allergy and allergy to plant derived foods is called latex fruit [85].

The oral intake of nickel can induce systemic contact dermatitis in nickel sensitive individuals. A flare up of recurrent vesicular hand eczema is the most common clinical manifestation of systemic nickel contact dermatitis [94].

Certain foods are usually high in nickel content, such as cocoa and chocolate, soya beans, oatmeal, nuts and almonds, and fresh and dried legumes [95]. Food items most usually mentioned by patients as producing aggravation of dermatitis due to balsam of Peru are wine, candy, chocolate, cinnamon, curry, citrus fruit, tomatoes and flavorings. Avoidance of these food stuffs would constitute a low balsam diet and may alleviate contact dermatitis to balsam of Peru [96,97]. Nickel, cobalt and chromium allergies frequently coexist and patients sometimes respond to dietary restrictions of all three metals [98].

Fixed Drug Eruption

Artificial flavors, colors and preservatives in foods as well as dyes in medications can rarely be culprits in classic fixed drug eruptions [99,100].

Homocystinuria

A low methionine diet is mandatory. Forbidden foods contain milk and milk products, meat and fish, wheat, maize, rice, pulses, legumes, nuts and dried fruits. Fruits and vegetables may be consumed in moderate amounts. Foods that need not be controlled are sago, arrowroot, corn flour, custard, sugars, fats, tea and coffee [101].

Galactosemia

Dietary elimination of galactose and lactose is necessary throughout childhood. Nutritionally satisfactory galactose/lactosefree milk should be used during infancy. In later childhood, occasional lactose free milk and calcium and vitamin supplements may suffice [101].

Vitiligo

Childhood Vitiligo has been related to malnutrition and intake of junk food [102]. Food containing antioxidants like citrus fruits, carrots and tomatoes (Vit A), sour yoghurt, sour pickles etc. is contraindicated in patients with vitiligo [3]. The simultaneous consumption of milk and fish is also discouraged.

It has been found, however, that oral supplementation with antioxidants containing alfa-lipoic acid and vitamin B12 before and during NB-UVB broadband UVB significantly improves the clinical effectiveness of phototherapy [103,104].

Rosacea

Consumption of coffee, tea, other hot drinks, tobacco, alcoholic beverages, and spicy foods is known to precipitate rosacea [10] hence it should be avoided [105].

Refsum's Disease

Vegetables and fruits rich in phytanic acid are contraindicated [106].

Phytanic acid is almost exclusively of exogenous origin and dietary restriction reduces plasma and tissue levels Fish, beef, lamb and dairy products should be avoided. The average daily intake of phytanic acid is 50-100 mg/day, which should ideally be reduced to 10-20 mg/day [85].

Nutritional Ichthyosis

Topical application of sunflower or safflower oil and systemic supplementation of fish, which are rich in linoleic acid (essential fatty acids), are useful [107].

Phrynoderma

Green leafy vegetables, carrots, tomatoes, milk, eggs, fish (containing essential fatty acids), soyabean, and sunflower oil are useful [3,108].

Xanthomas

Xanthelasmas may be associated with hyperlipidemia108.In addition to specific therapy with lipid-lowering agents, patients need lifestyle modifications, in which foods containing high concentrations of cholesterol, such as fat, eggs, meat and dairy products are to be avoided [109,110].

Gout

Patients with gout is the avoidance of foods with a high purine content, such as organ meat (liver, kidney), selected fish and shellfish, meat and yeast extract brewer, baker's yeast, pulses, certain vegetables (spinach, asparagus) and fermented milk products. Studies have observed an increased risk of gout among those who consumed large quantities of meat, seafood and alcohol. Although limited by confounding variables; low-fat dairy products, ascorbic acid and wine consumption appear to be protective for the development of gout [111].

Porphyrias

High-fibre diet of natural vegetable/fruit products with a daily caloric content of 1676 kJ/day has been assessed for porphyria cutanea tarda and is found to be useful. In addition, patients with porphyria may use from dietary supplementation of carotene-containing foods, such as carrots and green leafy vegetables.

Conclusion

Relation between diet and dermatological conditions is well established. Dietary changes or modification might help to prevent recurrences of many skin diseases. Diet which we are presented in this paper show indication that there is link between nutrition and skin condition. Evidence from literature review as well as published works show that appropriate nutritional supplementation is beneficial in the prevention of the harmful effect of UV exposure, in the management of skin aging and of reactive skin, as well as for limiting hair loss. Altogether, the data show that a balanced diet represents a globalized approach for improving skin health.

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