



## PSORIASIS: ETIOPATHOGENESIS AND NUTRITIONAL THERAPY

<sup>1</sup>\*Dr. Sharique Ahmad, <sup>2</sup>Subuhi Anwar and <sup>3</sup>Dr. Akanksha Sharma

<sup>1</sup>Professor, Department of Pathology, Era's Lucknow Medical College and Hospital, Era University, Sarfarzganj Hardoi Road Lucknow U.P. -226003 India.

<sup>2</sup>Research Assistant, Department of Pathology, Era's Lucknow Medical College and Hospital, Era University, Sarfarzganj Hardoi Road Lucknow U.P. -226003 India.

<sup>3</sup>Junior Resident, Department of Pathology, Era's Lucknow Medical College and Hospital, Era University, Sarfarzganj Hardoi Road Lucknow U.P. -226003 India.

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\*Corresponding Author: Dr. Sharique Ahmad

Professor, Department of Pathology, Era's Lucknow Medical College and Hospital, Era University, Sarfarzganj Hardoi Road Lucknow U.P. -226003 India.

### ABSTRACT

Due to an excessive expansion of skin cells, psoriasis is a persistent autoimmune skin disorder that causes red, scaly areas on the skin. There are several types of psoriasis; plaque psoriasis is the most common type, affecting about 80% of the population. Some types of psoriasis, including guttate, inverse, pustular, and erythrodermic, have various signs and challenges. Genetic predispositions, comorbidities, and immunological profiles are among the distinct patient characteristics that the meta-analysis finds as influencing the variability in treatment outcomes after nutritional therapy. Additionally, it investigates how certain dietary elements, such as omega-3 fatty acids and vitamin D, affect particular nutrients, such as fish oil, antioxidants from fruits and vegetables, and anti-inflammatory compounds, as well as how dietary patterns, like Mediterranean, low-inflammatory, or gluten-free diets, affect how the disease and its response to treatment are modulated. These findings may help to lessen the severity of psoriasis and reduce inflammation. Psoriasis is a complex etiological chronic inflammatory skin disorder. In spite of the fact that topical corticosteroids, phototherapy, and systemic medications are frequently used to treat psoriasis, recent study suggests that dietary changes may be essential to symptom reduction. This study comprehensively analyzes the multidimensional link between etiopathogenesis, patient features, and treatment responses to nutritional therapies in psoriasis. A thorough search was carried out on PubMed, MEDLINE, Scopus, and other reliable databases to find pertinent research that had been published up until the analysis's date. An anti-inflammatory, In addition to taking regular medication, persons with psoriasis may benefit from a well-balanced diet high in fruits, vegetables, lean meats, and whole grains.

**KEYWORDS:** Nutrition, Stress, Inflammation, Obesity, Psoriasis, Diet, Autoimmunity, Etiopathogenesis.

### INTRODUCTION

In addition to providing defense against external stresses, the skin is an essential organ for cellular signaling and homeostasis maintenance.<sup>[1]</sup> The skin is a constant source of reactive oxygen species (ROSs), free radicals, and nitrogen species (RNSs), which include peroxy nitrite assaults, hydrogen peroxide, hydroxyl radicals, superoxide anion radicals, nitrogen monoxide, and hypochlorous acid. The cellular redox state may change to an oxidizing state when these species are produced in excess and antioxidant defense systems are not strong enough to prevent this, which can lead to inflammation and a disturbance of oxidative stress, OS, conception,

and redox homeostasis.<sup>[2]</sup> The cause of psoriasis, a prevalent chronic illness, is unknown. It can affect individuals at any age and has multiple hallmarks of autoimmunity along with strong hereditary ties to chronic inflammation.<sup>[3]</sup> Lifestyle factors that affect psoriasis include diet and physical activity (PA). According to estimates, this illness lowers life expectancy and affects 2% of the global population.<sup>[4]</sup> Psoriasis vulgaris accounts for about 90% of cases of psoriasis and is the most frequent form.<sup>[5]</sup> This kind of illness is characterized by distinct, itchy, erythematous skin lesions that are covered with silvery scales.<sup>[6]</sup> Hyperproliferation, inadequate differentiation of

epidermal keratinocytes, and reduced keratinocyte apoptosis linked to inflammatory infiltration of the dermis and epidermis are characteristics of psoriatic lesions. Psoriasis, however, is not just a skin condition. It is regarded as a systemic disease in contemporary medicine. Metabolic problems, including atherogenic dyslipidemia, insulin resistance, hypertension, elevated body mass index (BMI), obesity, and cardiovascular illnesses, are intimately associated with the condition.<sup>[5]</sup> It can also impact the joints (psoriatic arthritis). NAFLD, uveitis, osteoporosis, and other conditions have also been connected to psoriasis like celiac disease, inflammatory bowel disease (IBD), and depressive disorders, according to recent findings.<sup>[7]</sup> Psoriasis is therefore no longer frequently referred to as a dermatological condition. Therefore, part of providing holistic treatment for patients with psoriasis is educating them how to employ a nutritious diet and regular, the development of the aforementioned disorders can be prevented by moderate physical activity (PA).<sup>[4]</sup> Understanding the human genome's sequence had a significant impact on how the biological sciences developed. Not only has genomics advanced significantly in recent years, However, other disciplines that combine the Molecular biology research on food and nutrition has also flourished, with fields such as nutrigenomics, which examines how nutrients affect the expression of genes, levels of proteins, and epigenetic processes in the genome, and nutrigenetics, which emphasizes genetically based variations in the metabolic reaction to specific meal ingredients.<sup>[8]</sup>

### Psoriasis Types

Psoriasis comes in five different forms. Multiple psoriasis types can occur simultaneously and over the course of a lifetime.

#### 1) Guttate

Papules are small, round, elevated, occasionally scaly lesions that are indicative of guttate psoriasis. Papules, which are frequently seen on the arms, legs, and torso, are a result of skin inflammation. But, you might get papules on your scalp, ears, and face. Psoriasis with a guttate often appears overnight. It could begin following an illness like strep throat. A streptococcal bacterial infection is the cause of strep throat.

#### 2) Pustular Psoriasis

Pustules are painful, pus-filled, white or yellow bumps that are associated with reddened, discolored, or inflammatory skin. These are signs of pustular psoriasis. Pustule pus is not communicable; rather, it is the result of inflammation. Pustular psoriasis can occur in people who have plaque psoriasis or other forms of psoriasis.

#### ○ *GPP, or generalized pustular psoriasis, affects a large portion of body*

GPP can strike without warning, spread swiftly, and frequently be accompanied by fever, chills, intense itching, irregular heartbeat, exhaustion, and muscle weakness.

**Plantar palm** When symptoms appear on the palms of the hands and/or soles of the feet, it is called pustular psoriasis. This kind frequently affects the sides of the heels and the base of the thumbs.

○ **Acrodermatitis continua of Hallopeau (ACH)** is a condition in which the nail tips of the fingers and/or toes are the only areas affected by symptoms. This kind is extremely uncommon and could appear following a skin injury or infection.

#### 3) Plaque Psoriasis

Plaques caused by psoriasis manifest as elevated, scaly, and inflammatory areas of skin that can also cause pain and itching. Plaques usually show up as raised, red patches on Caucasian skin that are covered in a silvery white accumulation of scale or dead skin cells.

#### 4) Inverse psoriasis

Inverse psoriasis, also called intertriginous psoriasis, manifests as purple-colored, brown, or darker-than-normal lesions in body folds on skin of color. It manifests as bright red lesions in body folds on Caucasian skin. It might seem glossy and silky.

#### 5) Psoriasis erythrodermica

Nearly the whole body is frequently affected by erythrodermic psoriasis, which can be fatal. The normal fluid balance and temperature of your body are disturbed by erythrodermic psoriasis. Shivering fits and edema, a swelling caused by fluid retention—in certain body areas, like the ankles or feet, could result from this. Additionally, you might be more susceptible to heart failure, pneumonia, and infections.<sup>[9]</sup>

#### A meta-analysis of etiopathogenesis patients and therapeutic response to nutritional therapy

Psoriasis is a multifactorial inflammatory disease that is immune-mediated and persistent. The etiopathogenesis of psoriasis remains unclear despite a plethora of research. It is unclear and complicated. The development and severity of this dermatosis are influenced to variable degrees by the previously described causes (immunological, genetic, and environmental). It's also important to note the link between psoriasis and other illnesses.

Numerous non-communicable diseases are influenced by chronic inflammation and elevated oxidative stress. An increasing amount of research suggests that certain nutrients in food might stimulate the immune system and cause an overabundance of cytokines that promote inflammation. As macronutrients, fatty acids play a

major role in immunomodulation; Carotenoids and polyphenols are among the most advantageous n-3 polyunsaturated fatty acids and appear to be the most promising antioxidants. In general, dietary regimens like the gluten-free and Mediterranean diets, as well as the use of supplements, may help psoriasis respond better to treatment and progress naturally. However, there is a dearth of knowledge about more intricate dietary regimens, like targeted macro- and micronutrient replacement, very low-carb, or ketogenic.

### External Risk factors

#### ➤ Mechanical stress

The Koebner phenomenon is the appearance of skin lesions in unaffected areas following various injuries in psoriasis patients.<sup>[10]</sup> There have been reports that UVB rays, radiotherapy, and even mild skin irritation can cause new psoriasis lesions.<sup>[11]</sup> Under the correct conditions, the Koebner phenomenon can occur, especially in cases of cutaneous damage with epidermal involvement. It is believed that increased blood flow to the papillary dermis promotes the entry of mediators implicated in the pathogenesis of psoriasis.<sup>[12]</sup> Early activities that take place before T lymphocyte epidermotropism in a growing psoriasis lesion after cutaneous trauma include keratinocyte proliferation and NGF up-regulation in basal keratinocytes.<sup>[13]</sup> NGF production is increased in psoriasis patients' keratinocytes. According to this study, NGF is involved in the pathophysiology of psoriasis and that its receptor system's regulatory function is functionally active in the early stages of psoriasis lesions developing.<sup>[14]</sup> It's interesting to note that in psoriasis patients' non-lesioned skin, skin-resident pathogenic T cells may initiate and maintain psoriasis lesions.<sup>[15]</sup> When psoriasis resolves, TRM cells, a subset of T cells that first entered the skin during an active illness, are still present there. These cells can produce cytokines that are important in the pathophysiology of psoriasis and create a site-specific disease memory.<sup>[16]</sup> These findings imply that TRM cells play a major role in both the Koebner phenomenon's lesions and the recurrent psoriasis lesions.

#### ➤ Sun Exposure and Air Pollution

The skin of humans has been significantly impacted by the rise in air pollution over time. Numerous air pollutants lead to oxidative stress in the skin, such as ultraviolet radiation, polycyclic aromatic hydrocarbons, oxides, particulate pollution, ozone, volatile organic compounds, and heavy metals.<sup>[17]</sup> Cadmium is one of the air contaminants that affect how psoriasis develops. Patients with severe psoriasis had higher blood cadmium levels than the overall population.<sup>[18]</sup> Robust HLA correlations, an abruptly abnormal clinical reaction to broadband UVA resulting in erythema and/or scaling plaques, a notable female predominance, and a very short mean age of psoriasis beginning were all present in photosensitive psoriasis patients.<sup>[19]</sup> Histological examination revealed characteristics of a phenotypically

unique subset of psoriasis. For a specific population, exposure to UV radiation can cause psoriasis.

#### ➤ Drugs

The onset and aggravation of psoriasis linked to specific drugs is known as drug-related psoriasis. Sometimes the psoriasis flare-up goes away even after the suspected medication is stopped. Furthermore, there might not be much of a difference in the histopathological and clinical findings between drug-related psoriasis and psoriasis.<sup>[20]</sup> Plaque, palmoplantar, nail, scalp, pustular, and erythrodermic psoriasis are among the common manifestations of drug-related psoriasis.<sup>[21]</sup> Drug-related psoriasis histopathological findings are almost always identical to those of conventional psoriasis. But remember that they are not the most important signs, and they are just a handful that suggest a drug-related reason for psoriasis.<sup>[22]</sup> Lithium,  $\beta$ -blockers, imiquimod, interferons, terbinafine, tetracycline, nonsteroidal anti-inflammatory drugs, fibrate medicines, and anti-malarial drugs are among the most often used medications.<sup>[21,23,24]</sup>

#### ➤ Vaccination

Psoriasis patients are more susceptible to infection, primarily as a result of immunosuppressive or immunomodulatory medication treatments. Consequently, immunization is advised to avoid certain infections.<sup>[25]</sup> But immunization frequently causes and aggravates psoriasis. Several studies have demonstrated a correlation between influenza vaccination and psoriasis exacerbation.<sup>[26,27]</sup> Moreover, receiving an influenza vaccination can result in psoriasis.<sup>[28]</sup> To prevent tuberculosis, *Mycobacterium bovis*, a live attenuated strain, is used in the Bacillus Calmette-Guerin (BCG) vaccine.<sup>[29]</sup> Psoriasis may appear after being vaccinated with BCG.<sup>[30]</sup> A retrospective study discovered that psoriasis more frequently developed after adenovirus vaccination.<sup>[31]</sup> Other vaccinations, such as the pneumococcal polysaccharide and tetanus-diphtheria vaccines, may also cause psoriasis.<sup>[32,33]</sup> Immunizations are not a cause of psoriasis; rather, they are effective treatments for those who already have psoriasis.

#### ➤ Infection

It is well known that streptococcal infection and psoriasis are related.<sup>[34]</sup> Guttate psoriasis is the most prevalent type of psoriasis, which develops following a streptococcal infection. The symptoms can recur even though they are self-limiting when the streptococcal infection returns. As a result, tonsillectomy might be a viable course of treatment for individuals with resistant psoriasis linked to tonsillitis episodes.<sup>[35]</sup> Psoriasis development is also linked to *Staphylococcus aureus* (*S. aureus*). Approximately 60% of psoriasis patients have been shown to have *S. aureus* colonization in their lesions, compared to 5% to 30% of people with normal, healthy skin.<sup>[36]</sup> A lipophilic yeast called *malassezia* is present on the skin and other body surfaces and may exacerbate psoriasis.<sup>[37]</sup> Another well-known risk factor for psoriasis is the human immunodeficiency virus (HIV).<sup>[38]</sup>

### ➤ Lifestyle

Alcohol and smoking have both been linked to psoriasis.<sup>[39]</sup> Furthermore, there is a strong correlation between smoking and pustular lesions in psoriasis.<sup>[40]</sup> A correlation was observed between the number of pack-years or years of smoking and an elevated risk of psoriasis.<sup>[41]</sup> Another study discovered a favorable association between the frequency of psoriasis and the quantity and duration of smoking. It appears that consuming alcohol raises the possibility of getting psoriasis.<sup>[42]</sup>

### Components of Intrinsic Risk factors

#### ➤ Obesity

Psoriasis patients frequently have metabolic syndrome<sup>[43]</sup>, and obesity is closely linked to the development and aggravation of psoriasis.<sup>[44,45]</sup> Obesity is substantially more common in<sup>[39,46]</sup> and poses a greater risk to<sup>[47]</sup> patients with psoriasis. Additionally, a sizable prospective cohort study revealed a favorable correlation between psoriasis and body mass index (BMI).<sup>[48]</sup> When it comes to identifying adiposity, BMI has strong specificity but low sensitivity because it is unable to detect half of the population that has excess body fat.<sup>[49,50]</sup> Nonetheless, other researches have demonstrated a significant correlation between psoriasis and waist circumference, suggesting that waist circumference represents a more precise indicator of body fat.<sup>[45,51,52]</sup> Increased white adipose tissue is referred to as obesity, and this tissue secretes a number of mediators that are involved in the pathophysiology of psoriasis and cause a low-grade inflammatory state.<sup>[53,54]</sup> It seems that losing weight helps with psoriasis symptoms.<sup>[55]</sup>

#### ➤ Diabetes Mellitus

Ethnic origin and lifestyle factors generally have an impact on the prevalence of diabetes mellitus. However, despite differences in patient populations, ethnic backgrounds, and baseline therapy, the prevalence of DM may be comparable. Psoriasis and diabetes mellitus were linked, according to a meta-analysis.<sup>[56]</sup> Type 1 and type 2 DM are the two categories into which DM is divided. Type 2 diabetes is far more common in those with psoriasis. Whatever the severity of the condition, psoriasis is a marker for an increased risk of type 2 diabetes. The order in which type 2 diabetes and psoriasis manifest themselves is unknown.<sup>[57]</sup> Unlike type 2 diabetes, which is a lifelong condition marked by elevated blood sugar levels, type 1 diabetes is defined by insufficient insulin production since the  $\beta$ -cells in the pancreas that produce insulin are destroyed by an autoimmune process.<sup>[58]</sup>

#### ➤ Dyslipidemia

In a previous study involving 70 psoriasis patients, in 62.85% of the subjects, dyslipidemia was discovered.<sup>[59]</sup> The two most common problems were low levels of high-density lipoprotein (HDL) and hypertriglyceridemia alone (39%). Dyslipidemia is another side effect of oral

systemic psoriasis treatments.<sup>[60]</sup> Retinoid are the most potent agents that induce dyslipidaemia. They simultaneously lower HDL cholesterol while increasing triglycerides, low-density lipoprotein cholesterol, total cholesterol, and very-low-density lipoprotein cholesterol.<sup>[61,62]</sup> Cyclosporine use may potentially result in dyslipidaemia.<sup>[63]</sup>

#### ➤ Hypertension

Patients with psoriasis had higher incidence and prevalence of hypertension, according to a meta-analysis. Seven out of fourteen cases of higher incidence of hypertension were linked to severe psoriasis.<sup>[64]</sup> Hypertension appears to be more severe in psoriasis patients.<sup>[65]</sup> Hypertension was present in 26% of psoriasis patients, and it was more common in this patient population than in the general population, according to a multicentre non interventional observational study that included 2210 psoriasis patients.<sup>[66]</sup>

#### ➤ Mental Stress

Mental stress is a state of tension and pressure brought on by internal perceptions that give rise to anxiety or other unfavorable feelings. Many psoriasis patients and doctors agree that mental stress aggravates psoriasis, as it is widely recognized as a well-established trigger of the disease. Psoriasis and mental stress have a complicated relationship, even if the Dermatology Life Quality Index scales show that psoriasis causes more distress than other conditions. A prior systematic analysis comprising 39 studies and 32,537 patients found that 46% of patients believed stress was a factor in their illness and 54% recalled stressful events from the past.<sup>[67]</sup> However, there was insufficient data to support the theory that the previous stress had a major part in the onset and exacerbation of psoriasis.

### Psoriasis and Hereditary Factors

Thus far, research has indicated that the genes encoding the HLA-T allele HLA-C  $\times$  06 were most strongly associated with the risk of acquiring psoriasis.<sup>[68]</sup> According to research, psoriasis develops as a result of epigenetic modifications such histone modification, promoter methylation, the overexpression of long non-coding microRNA (miRNA, miR). Circulating miRNAs in blood can affect a patient's diagnosis, prognosis, and responsiveness to treatment. Several microRNAs, including miR-21, miR-31, miR-146a, and miR-155 are inhibited has been demonstrated to have a major therapeutic impact on psoriasis by lowering inflammation. Certain substances that are ingested by the body possess these properties.<sup>[69]</sup>

### Nutritional systems and dietary patterns for the treatment of psoriasis

Studies have demonstrated the effectiveness of low-energy and vegetarian diets, weight loss plans using dietary modifications, and gluten-free diets. Mediterranean diets, and extremely low-calorie diets low in carbohydrates are all beneficial in helping to treat

psoriasis when combined with the right nutrition. These diets typically contain a large amount of fruits and vegetables; as a result, the patient receives less energy but also receives an abundance of vitamins, minerals, and other substances that are good for their health.<sup>[70]</sup> Fresh fruits and vegetables, legumes, seeds, olive oil, fish, and low levels of animal fats and simple carbohydrates characterize the Mediterranean diet. Studies show that inflammatory illnesses, such as psoriasis, respond well to the Mediterranean diet.<sup>[71]</sup> Numerous studies have demonstrated that individual Mediterranean diet staples like fruit, vegetables, whole grains, and sea fish are linked to a reduction in CRP, the most widely used indicator of inflammation.<sup>[42,72]</sup> On the other hand, elevated CRP levels were indicative of meal-induced inflammation immediately following the consumption of high-energy, low-nutrient, and processed foods.<sup>[74]</sup> For those who have psoriasis, Another possibility is the ketogenic diet. The main characteristic of this diet plan is a reduction in the quantity of carbs taken in food and a corresponding rise in the quantity of fat and protein served. A change in metabolism towards ketone bodies, where fat is mostly broken down into ketones as an energy source, is brought about by the ketogenic diet from a biochemical standpoint. Following this, there is a rise in blood ketones and a fall in blood glucose levels. Research indicates that in individuals with psoriasis, a low-calorie ketogenic diet lowered levels of pro-inflammatory cytokines (IL-2 and IL-1 $\beta$ ). Additionally, the PASI index (Psoriasis Area and Severity Index, Psoriasis Severity Assessment Scale) decreased.<sup>[75,76]</sup>

The distinct role of Th-1 and Th-17 cell activation in inducing inflammation is implicated in the etiology of psoriasis. Interleukins (IL-1, IL-6, IL-23, IL-22, IL-17, and IL-33), tumor necrosis factor-alpha (TNF- $\alpha$ ), and interferon-gamma (IFN- $\gamma$ ) are among the inflammatory cytokines that are produced more frequently as a result of this. However, diet may be able to control inflammation because it contains antioxidant and anti-inflammatory components.<sup>[77]</sup> A unique function of lipids is to regulate inflammation. Red meat and butter are two foods high in saturated fats (SFAs), which raise interleukins' concentration and aid in the onset of inflammation.<sup>[78]</sup> Similarly, too much n-6 unsaturated fatty acids, which are present in refined vegetable oils and margarine, for example, can also cause inflammation. Nuts, seafood, and Mono- and polyunsaturated fatty acids (PUFAs) are abundant in diets derived from plants, which are linked to positive health effects.<sup>[79]</sup> These essential macromolecules are classified into two main groups: omega-6 (linoleic acid, arachidonic acid (AA), and n-6), and omega-3 (eicosapentaenoic acid (EPA) and  $\alpha$ -linoleic acid), as well as docosahexaenoic acid, n-3. Both PUFAs must be obtained through diet, as the human body is unable to produce them. Vegetable oils such as corn oil, sunflower oil, soy bean oil, cotton seeds, cereals, and corn are high in n-6 polyunsaturated fatty acids (PUFAs); n-3 PUFAs are abundant in

canola/rapeseed oil, chia oil, flaxseed oil, and perilla oil. It is acknowledged that seafood and fish, particularly marine fish, are the primary providers of n-3 PUFAs.<sup>[80]</sup> Polyunsaturated fatty acids (PUFAs) with n-3 and n-6 chain lengths are essential components of cell membranes and signaling molecules that regulate blood pressure and metabolic processes, additionally impacting the expression of genes. These substances are vital for brain development and function, and they also have a significant impact on immunity and inflammation. The pathophysiology of numerous diseases may be connected to their levels.<sup>[81]</sup> Due to their competition for the same metabolic enzymes, n-3 and n-6 polyunsaturated fatty acids have the potential to change energy homeostasis and promote inflammation when they are biotransformed into prostaglandins, thromboxane, and leukotrienes.<sup>[80]</sup> The AA/EPA PUFA and n-6/n-3 ratios are helpful markers that can provide vital information about health, disease risk, and dietary needs.<sup>[80,82]</sup> According to reports, the best daily intake for managing and preventing chronic illnesses is 1.1–1.6 g of n-3 and n-6/n-3 PUFA ratios between 4/1 and 7.5/1.<sup>[81]</sup> Additionally, simple sugars may make psoriasis more inflammatory.<sup>[83,84]</sup> It is most likely connected to a diet high in carbohydrates and concurrent anthropometric changes, such as an increase in waist circumference and body weight, which increase the risk of developing diseases like obesity and cardiovascular disease. Reducing inflammation and the glycemic index (GI) were found to be related.<sup>[85]</sup> Studies have shown that dietary treatments for psoriasis can lower postprandial insulinemia and glycaemia, which may help delay the emergence of various inflammatory disorders linked to contemporary society. Psoriasis sufferers must consume anti-inflammatory and antioxidant foods and supplements, consisting of dietary fibres, vitamins A, E, and C, omega-3 acids, certain polyphenols, and oligo-elements (zinc, copper, manganese, and selenium).<sup>[86, 87]</sup> Omega-3 polyunsaturated fatty acids found in fish oil, as well as fruits and vegetables, vitamin D, and probiotic supplements are the most often mentioned dietary elements that help patients' conditions.<sup>[88]</sup> Vitamin D has a complex effect on the skin.<sup>[87]</sup> Calcitriol, more formally known as 1,25-dihydroxycholecalciferol, is the active form of vitamin D. Together with its receptor, it controls apoptosis, which maintains the dermal immune system's equilibrium, and the differentiation and proliferation of keratinocytes. Moreover 25(OH)2 D and its analogs reduce the increased degree of psoriasis in psoriatic skin. There is proof that 25(OH)2 D inhibits keratinocyte proliferation. Reduced levels of involucrin and loricrin, lost granularity in keratohyalin, and disruption of epidermal differentiation due to insufficient or decreased 1,25(OH)2 D all contribute to hyperplasia in the foundational layer. For most people, there is a positive relationship between serum vitamin D deficiency and the degree and duration of psoriasis.<sup>[78,88]</sup> Another area of interest for investigation is the involvement of gut microbiota in inflammatory skin diseases.<sup>[88,89]</sup> Probiotics and prebiotics are crucial parts of a well-balanced diet

for people with psoriasis.<sup>[90]</sup> Both the skin's and the gut's microbiota are crucial to the pathophysiology and treatment response of the illness. Studies validate a robust and reciprocal relationship between the gut and skin, associating intestinal well-being with skin homeostasis and equilibrium. In inflammatory bowel disease (IBD), for example, psoriasis is identified in 7–11% of patients suggesting a strong correlation with gastroenteritis.<sup>[91]</sup> It is established that the etiopathogenesis of both diseases may involve immune pathways, certain environmental and genetic factors, and both. Among other things, the pathophysiology of IBD and the development of psoriasis are significantly influenced by Th17 cells and their cytokines.<sup>[92]</sup>

## DISCUSSION

The course of psoriasis may be significantly influenced by diet and lifestyle choices. According to what is currently known, avoiding alcohol and smoking can help prevent both psychosocial stress and the aggravation of diseases. Exercise plays a primary role in managing psoriasis and its related conditions, while losing weight can improve psoriasis and increase the effectiveness of systemic treatments. Without a doubt, a healthy diet that combines calorie restriction with the preference for foods with high antioxidant content should also form the foundation of a healthy lifestyle.

A gluten-free diet may be beneficial in treating psoriasis, according to certain research findings. Reports from the present, however, refute the theory that this kind of diet is helpful when treating psoriasis. Anti-gliadin antibodies, specifically IgA and IgG, are frequently elevated in certain psoriasis patients. It might imply celiac disease co-occurring. Consequently, only those with verified gluten intolerance should follow a gluten-free diet.<sup>[80,93,94,95]</sup> Patients suffering from psoriasis are also advised to have a vegetarian diet, which is high in fruits, vegetables, nuts, legume seeds, and various grains and groats.<sup>[80]</sup> Consuming eggs and dairy products is also allowed, depending on the vegetarian diet option. This diet is low in cholesterol and saturated fats because it doesn't include meat. It is crucial for controlling uric acid levels, reducing CRP and triacylglycerol's in blood serum, and preventing cardiovascular illnesses. Furthermore, patients with a vegetarian diet have a lower chance of being overweight. A decrease in arachidonic acid, The advantages of a vegetarian diet are linked to a polyunsaturated fatty acid and its byproducts, particularly leukotriene LTB<sub>4</sub>, which are engaged in oxidative metabolism. These compounds have a pro-inflammatory action and increase the synthesis of IL-1 $\beta$  and tissue susceptibility to the cytokine. Additionally, patients on a vegetarian diet exhibit lower levels of IgE expression, reduced intestinal microbiota expression of genes associated with inflammation and greater levels of adipokines that are anti-inflammatory as opposed to pro-inflammatory.<sup>[95,96]</sup>

Probiotic supplementation was found to inhibit cytokines that promote inflammation in the IL-23/IL-17 cytokine axis, including TNF-alpha and IL-6 related to psoriasis reports from human and mouse models state. Researchers also mention the involvement of additional food ingredients that may prevent psoriasis from developing. Cyclic tols, or sugar alcohols, are one example of this.<sup>[97]</sup> Because of their immunomodulatory qualities, Certain ones, such as myo-inositol, D-chiro-inositol, and D-pinitol, can be used to treat psoriasis. Additionally, there are hints that the antioxidant flavonoid genistein, which is present in soybeans among other foods, positively lowers psoriasis-related inflammation.<sup>[98]</sup>

According to another study, genistein treatment decreased skin lesions in the histological image in psoriasis-affected mice. Nonetheless, the administration of genistein modified the way specific genes were expressed in psoriatic skin lesions, thereby halting the progression of the illness.<sup>[99]</sup> Scholars also emphasize how important it is to treat psoriasis with diet, with a concentration on the trace element selenium. Part of the cellular antioxidant defense mechanism, selenium is located inside the active center of glutathione peroxidase. Nuclear factor kappa-B (Nf- $\kappa$ B) is deactivated and ROS are reduced by this element, and it is associated to inflammation, IL-6, and TNF- $\alpha$  production pathways involved in redox signalling.<sup>[100]</sup> Selenium levels in serum are often low in psoriasis patients. However, due to the paucity of data supporting selenium's therapeutic efficacy, there are no compelling arguments in favor of further supplementation. Scientists have recently developed an interest in the gut microbiome. There is evidence that some psoriasis patients also report the existence of lesions that they refer to as "triggers," which exacerbate their psoriasis. The most commonly mentioned triggers include processed meals, dairy products, meat, nightshade vegetables (potatoes, eggplants, and peppers), white sugar, and alcohol. These food elements have negative effects because they can change the gut microbiome's makeup, aggravate the gut's epithelium, and compromise the immune system. The gut microbiome becomes dysbiotic due to dietary simple carbohydrates, which favors pathogenic bacterial species and raises the levels of inflammatory cytokines. On the other hand, fruits and vegetables that are high in fiber complex carbohydrates affect the gut microbiota in the opposite way. They are able to lessen swelling. Therefore, an increase in mitogen-dependent lymphocyte proliferation and an elevation of cytokines that promote inflammation are responsible for alcohol's harmful effects on psoriasis. Fruits and vegetables are rich in carotenoids, flavonoids, vitamins, and minerals, which are antioxidants. It has been demonstrated that these antioxidants and the synthesis of TNF-alpha, IL-6, and C-reactive protein (CRP) are inversely correlated. However, take heed of the previously listed restrictions to this food group, as they may cause harm to the digestive lining and release alkaloids. They have been

shown to negatively impact animal intestines in a mouse model and exacerbate inflammatory bowel disease, which is a prevalent comorbidity in psoriasis patients.<sup>[101,102]</sup>

## CONCLUSION

An inflammatory immune-mediated condition, psoriasis is linked to numerous other long-term illnesses and physiological dysfunctions. Patients with psoriasis should take more PA according to WHO recommendations and follow a personalized, healthy anti-inflammatory diet. A team of experts would need to work together to implement this strategy, with trained nutritionists being key players. The most recent scientific findings suggest that psoriasis sufferers ought to follow a customized diet. New nutritional guidelines can be implemented thanks to the ongoing advancements in nutrigenomics, which will probably enhance the lives of psoriatic patients.

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