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The Integrated Impact of Metabolic, Dietary, Environmental, and Psychological Factors on Psoriasis – An Interdisciplinary Perspective on an Inflammatory Skin Disease

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Abstract:

Introduction, purpose: Psoriasis is a chronic, non-infectious skin disease. It is estimated that approximately 2–3% of the global population is affected by this condition. Its prevalence varies geographically — higher rates are observed in Europe and North America, while lower rates are noted in Asia and Africa. The development of psoriasis is influenced by genetic predisposition, immune system dysfunction, as well as environmental factors. Psoriasis is not only a dermatological issue characterized by excessive keratinocyte proliferation, but also a systemic inflammatory disease that impacts the patient's psycho-emotional well-being and carries an increased risk of numerous complications.

Materials and methods: A literature review was conducted using the PubMed database to analyze the impact of patients' lifestyle on the course of psoriasis and the development of complications associated with this condition.

Basic results: A holistic approach to patient care, which takes into account the various factors influencing the course of the disease and identifies areas of life that can be modified to enhance the overall health of the patient, is of significant importance in the pathogenesis of psoriasis.

Conclusions: Although topical and systemic medications remain the cornerstone of psoriasis treatment, lifestyle modifications and health-promoting behaviors can contribute to a milder disease course, reduce the frequency of relapses, and lower the risk of comorbidities.

Keywords: Psoriasis; Inflammation; Diet; Obesity; Omega-3; Polyphenols

1. Psoriasis as a systemic disease

Psoriasis is a long-lasting, systemic inflammatory condition that impacts millions of individuals around the globe [1]. It is characterized by increased keratinocyte proliferation and dysregulation of the immune system. In the development of psoriasis, various cells are involved, such as Langerhans cells, keratinocytes, endothelial cells, and monocytes. Among these, T lymphocytes—particularly T-helper 1 (Th1) cells—play a crucial role in amplifying the inflammatory response and are considered the primary initiators of the disease [2]. The pathogenic mechanism of psoriasis centers around the excessive production of cytokines associated with Th1, Th2, and Th17 lymphocytes. Key cytokines involved include interleukin IL-23, IL-17, TNF-α, and IL-22, all of which play a central role in disease progression by promoting keratinocyte hyperproliferation [3,4].

It is crucial to consider the multidimensional effects of psoriasis, which include physical, psychological, and emotional aspects. Physicians caring for patients with psoriasis should take into account various factors, aiming to improve not only the patients' skin condition but also their overall quality of life [1]. Psoriasis can affect key areas of life, influencing the decisions made by patients and reflecting the long-term consequences of the disease. Particularly in cases of early-onset psoriasis, a comprehensive treatment approach is necessary to minimize psychosocial consequences [5].

A broad perspective on the patient with psoriasis, not only from the viewpoint of skin disease but also considering the impact of stress, including low self-esteem and negative social perception, can significantly improve the quality of life of patients [6]. Promoting a healthy lifestyle through patient education remains an extremely important approach in clinical practice [7]. Many lifestyle factors, such as smoking, alcohol consumption, a diet high in fats, and lack of physical activity, are closely related to overall health and also play a role in the initiation and progression of psoriasis [8].

2. The relationship between psoriasis and metabolic syndrome

Available epidemiological data unequivocally confirm the existence of an association between psoriasis and metabolic diseases, such as obesity, hypertension, diabetes, dyslipidemia, and non-alcoholic fatty liver disease [9]. Obesity is linked to more severe skin lesions in psoriasis and a poorer response to treatment [10]. Patients receiving systemic treatment for psoriasis are more likely to have a tendency toward overweight and obesity. Excess body weight not only correlates with psoriasis severity but also elevates cardiovascular risk. A proper response to biologic treatment with fixed doses is less frequently observed in patients with higher body weight, particularly those weighing over 100 kg. Higher body weight and BMI (Body Mass Index) are associated with a poorer response to biologic treatment and a shorter remission period [11].

Patients with moderate to severe psoriasis tend to lead a more sedentary lifestyle compared to the general population and face barriers to engaging in physical activity due to their condition. Physical exercises of moderate and high intensity serve as an independent protective factor. The use of this weight loss strategy may improve the course of the disease, particularly in overweight patients. Expert panels agree that physical activity can be a beneficial adjunct to psoriasis treatment in overweight patients [12].

Metabolic syndrome and erectile dysfunction frequently occur in individuals suffering from chronic plaque psoriasis. A study was conducted involving 60 obese men with plaque psoriasis, mild to moderate erectile dysfunction, and metabolic syndrome. The aim of the

study was to implement a 12-week lifestyle modification program (low-calorie diet: a three-meal daily plan with the following proportions: 20–30% fats, 10–15% proteins, and 55–65% carbohydrates, along with moderate-intensity treadmill walking for 40 minutes three times a week). The results showed significant improvements in erectile function within the lifestyle modification group, as well as improvements in blood pressure, fasting blood glucose levels, HDL levels, triglyceride levels, PASI (Psoriasis Area and Severity Index), and waist circumference compared to the control group [13].

A cohort study conducted in Thailand analyzing the impact of elevated HbA1c levels on psoriasis flare-ups demonstrated that hyperglycemia was associated with exacerbations of psoriasis in patients with severe disease and coexisting type 2 diabetes or impaired fasting glucose. The study found that in the group of patients with severe psoriasis, an HbA1c $\geq$ 7% may be an independent prognostic factor for disease flare-ups. However, in the group of patients with mild psoriasis, no significant associations were found between the analyzed variable and disease exacerbations. Regular monitoring of diabetes may be necessary for all psoriasis patients, and tight glycemic control may aid in the management of severe forms of the disease [14].

As previously mentioned, patients with psoriasis tend to develop metabolic syndrome, which accelerates the progression of psoriasis. A study aimed at determining the impact of leptin on keratinocyte insulin sensitivity measured leptin levels in the serum and skin lesions of psoriasis patients, and assessed insulin sensitivity changes in a cell line culture. Patients with metabolic syndrome had higher leptin levels in both serum and skin lesions compared to those without the syndrome. It has been observed that serum leptin levels correlate with psoriasis activity — the higher the leptin level, the smaller the decrease in the PASI score. Leptin induces insulin resistance, which leads to abnormal keratinocyte differentiation. This may be an important therapeutic target in the treatment of psoriasis [15].

3. From the stomach to the skin

Diet can influence immune system function, contributing to an imbalance in gut microbiota and the initiation of inflammatory processes [16]. Diet has a significant impact on both the development and the course of psoriasis. [17]. The Western diet, marked by excessive saturated fats abd insufficient omega-3 intake, has been linked to immune dysfunction and inflammation [18].Various studies have proven that products high in sugar or gluten, as well as alcohol and dairy—classified as pro-inflammatory foods—can trigger the exacerbation of skin lesions in psoriasis. Modifying dietary habits can play an important role in alleviating the course of the disease [19].

It has been proven that the mediterranean, gluten-free, or low-calorie diets have a positive correlation with disease control in adult patients with psoriasis, when combined with appropriate pharmacotherapy. In children suffering from psoriasis, following these dietary models may have a significant impact on the course of therapy [17]. The mediterranean diet, rich in vegetables and fruits, is considered one of the most well-documented and safest ways to support the immune system [18]. It is rich in plant-based foods with antioxidant and anti-inflammatory properties, such as whole grains, extra virgin olive oil, vegetables, legumes, fruits, and nuts, which help reduce the clinical severity of psoriasis. It also aids in weight management and positively affects metabolic and cardiovascular risk factors, which are closely linked to the disease. Nutritional education plays an extremely important role in the treatment of skin diseases and represents a crucial non-pharmacological treatment option that can impact patient prognosis [20].

A study conducted in Croatia involved 28 volunteers with histopathologically confirmed chronic plaque psoriasis and a PASI ≥ 5 at the start of the study, investigating the impact of a reduced salt intake diet over a period of 2 weeks on skin microvascular reactivity. It was demonstrated that a short-term low-salt diet was associated with a significant improvement in endothelial-dependent vascular reactivity among psoriasis patients after just two weeks of following the low-salt diet. Moreover, this effect was more pronounced in women and participants with a shorter disease duration, in patients with normotension, normolipemia, and no central obesity. A longer disease course is associated with greater endothelial dysfunction of blood vessels [21].

Bioactive compounds from flavonoid, terpenoid, omega-3 fatty acid, and alkaloid classes derived from natural sources have anti-inflammatory and antioxidant properties in psoriasis. They have fewer side effects compared to many psoriasis treatments, and due to their immunomodulatory and antiFoxidant properties, they may provide beneficial effects for patients, especially when used alongside conventional treatment methods. Ongoing research in this area is crucial to ensure their safety in long-term use, develop new treatment strategies that may better improve patients' quality of life [22].

An analysis of studies evaluating the effectiveness of omega-3 fatty acids in the treatment of psoriasis showed a significant decrease in PASI scores in patients receiving omega-3 supplementation compared to those who did not use it. Higher doses of omega-3 supplementation were associated with more significant relief of key psoriasis symptoms, such as erythema, pruritus, and scaling [23]. Another review of studies found that fish oil and omega-3 fatty acids may be more effective as adjunctive therapies rather than as standalone treatments [24].

Polyphenols are a large and diverse group of natural chemical compounds found in various fruits, vegetables, and herbs. They are characterized by strong antioxidant and anti-inflammatory properties and provide benefits in the prevention and support of treatment for various diseases, including skin conditions such as psoriasis. A diet rich in polyphenol-containing foods is exemplified by the Mediterranean diet [25]. Curcumin, a polyphenol found in turmeric, has been shown to be effective in reducing the thickness of psoriatic lesions and decreasing the expression of inflammatory markers in the skin in animal studies [26]. Gallic acid is a phenolic compound found in fruits, red wine, and green tea. In vitro studies involving this polyphenol have shown its direct effect on pro-inflammatory cytokines involved in the development of psoriasis. It exhibits anti-inflammatory, antioxidant, anticancer, and antibacterial properties [27].

Resveratrol, which also belongs to the group of polyphenols, can be found in red grapes and wine. It blocks cytokines such as TNF-α, IL-17, IL-6, and IL-1β, which leads to the inhibition of T cell differentiation. Resveratrol has been shown to have anti-inflammatory, antioxidant, and anti-aging properties. In some animal and human studies, this compound reduced and alleviated the progression of autoimmune diseases such as rheumatoid arthritis, systemic lupus erythematosus, psoriasis, inflammatory bowel disease, and type 1 diabetes [28].

4. The Impact of Substances of Abuse on Psoriasis

Tea is one of the most commonly consumed beverages worldwide, with a long tradition of use in treating skin diseases due to its anti-inflammatory properties and high safety profile. A study conducted in China evaluated the anti-psoriatic effects of extracts from black, green, and white tea. A total of 88 chemical compounds were isolated from these tea extracts, mainly phenols and organic acids. The use of tea extracts alleviated skin damage, lowered the levels of inflammatory cytokines IL-17 and TNF-α, effectively neutralized reactive oxygen species (ROS), and nitric oxide. The study confirmed the inhibitory effect of tea extracts on psoriasis, suggesting that the proper tea could be an adjunct factor in treating skin inflammatory conditions [29].

Drinking coffee is also a beneficial dietary habit that supports human health. It significantly affects the immune system and metabolism, including the reduction of inflammatory factors and the decrease in the frequency of aging T lymphocytes. Positive effects can be observed both in individuals who regularly consume coffee over a long period and in new coffee drinkers [30].

A cross-sectional observational study conducted on patients with psoriasis, who had not previously received treatment, assessed the impact of coffee on the clinical severity of

psoriasis. The clinical severity of psoriasis was evaluated using the PASI (Psoriasis Area and Severity Index). The study analyzed whether the patient drank coffee (consumers vs non-consumers) and the number of cups consumed per day (ranging from 0 to 4 servings daily). Patients who drank coffee had a lower PASI score compared to those who did not consume it. The lowest PASI score was associated with the consumption of 3 cups of coffee per day, which was also the most commonly reported daily amount (34.8%). In contrast, the highest PASI score was observed in individuals who drank ≥ 4 cups of coffee per day [31].

A Danish study showed an increased risk of psoriasis in individuals with high alcohol consumption. Compared to those with moderate and low alcohol intake, individuals with high alcohol consumption were older, more often male, more likely to be smokers, had a higher average BMI, and a greater prevalence of diabetes and hypertension. In a study involving over 100,000 individuals from the general Danish population, a 30% increase in the risk of psoriasis was found in people consuming >224 g of alcohol per week, compared to those consuming 1-112 g of alcohol per week in observational analyses [32].

Cigarette smoking can increase the likelihood of developing psoriasis and also reduce the effectiveness of treatment, particularly in the case of biologic therapies [7].

5. The Role of the Gut Microbiome in Psoriasis

Studies have demonstrated that the gut microbiota, which plays a pivotal role in maintaining the immunological homeostasis of the body, is closely associated with the onset, development, and progression of psoriasis. In individuals with psoriasis, significant alterations have been observed in both the abundance and diversity of the gut microbiota. Gut dysbiosis in patients with psoriasis involves alterations in microbiota composition, a decrease in the synthesis of short-chain fatty acids (SCFAs), and a changed Firmicutes to Bacteroidetes (F/B) ratio. Furthermore, the gut microbiota of psoriasis patients undergoes changes in response to systemic treatment or biologic therapies, suggesting that gut microbiota may serve as a potential biomarker for treatment response and therapeutic efficacy. Additionally, oral administration of probiotics and prebiotics, as well as fecal microbiota transplantation, have shown potential therapeutic benefits for patients with psoriasis [33].

Several randomized controlled trials have assessed the impact of various probiotics, including species of Lactobacillus and Bifidobacterium, compared to control groups. Improvements in the Psoriasis Area and Severity Index (PASI) scores and reductions in inflammatory markers, such as C-reactive protein (CRP), IL-6, and TNF-α, were observed in patients [34]. Most clinical studies have demonstrated beneficial outcomes regarding the efficacy of probiotic supplements in the treatment of psoriasis. These include improvements in PASI scores,

decreased levels of pro-inflammatory cytokines, and enhanced quality of life for patients, which supports a bidirectional relationship between psoriasis and the gut microbiome [35].

In one study, a patient diagnosed with plaque psoriasis and irritable bowel syndrome (IBS) underwent two fecal microbiota transplantation (FMT) procedures via endoscopy and colonoscopy. Following the intervention, improvements were observed in the body surface area affected by lesions, the Psoriasis Area and Severity Index (PASI), the Dermatology Life Quality Index (DLQI), gastrointestinal symptoms, and serum TNF-α levels [36].

6. The impact of environmental factors

An interesting observational study was conducted to assess the psychosocial impact of climatotherapy — a treatment method involving the temporary relocation of patients to a warmer region with a high ultraviolet (UV) radiation index. The study included thirty-four patients (median age 24 years) who underwent a 3-week therapeutic program in Spain (Gran Canaria). Participants completed questionnaires evaluating the psychosocial aspects of the disease. Climatotherapy was associated with a significant reduction in scores on the Hospital Anxiety and Depression Scale (HADS), Perceived Stress Scale (PSS-10), Psoriasis Quality of Life Questionnaire (PSQ), EuroQol Visual Analogue Scale (EQ-VAS), Dermatology Life Quality Index (DLQI), and pruritus intensity at the end of treatment and three months post-intervention, compared to baseline values. Climatotherapy not only impacts psoriasis severity and itch intensity but also positively affects patients' mental well-being by improving symptoms of anxiety, depression, perceived stigmatization, stress, quality of life, and self-rated general health [37].

It has been suggested that improved air quality may also play a significant role in the prevention of autoimmune diseases, including psoriasis [38]. Supporting evidence comes from a prospective study conducted in the United Kingdom, which assessed the long-term exposure to various air pollutants. This exposure was positively associated with an increased risk of developing psoriasis, particularly among individuals with a high genetic predisposition to the disease. It is essential to pay greater attention to air pollution levels and take effective measures to reduce them in order to enhance psoriasis prevention. Participants exposed to the highest levels of air pollution had a 5% to 29% greater risk of developing psoriasis. Among patients with a high genetic risk who were also exposed to elevated levels of air pollutants, the risk increased by 63% to 136%. Both air pollution and genetic factors showed an additive effect, in which higher levels of each contributed to a greater likelihood of disease onset [39].

A study conducted in the United Kingdom showed a positive linear relationship between water hardness and the risk of developing psoriasis. The polygenic risk score also indicated a

synergistic effect between exposure to hard water and genetic predisposition to the development of psoriasis. The impact of hard water on psoriasis was more pronounced in individuals with low polygenic risk, women, older adults, non-obese individuals, those with high socioeconomic status, or without dyslipidemia. Residential water hardness was identified as a significant risk factor for the occurrence of psoriasis in adults. Long-term strategies aimed at reducing exposure to hard water may contribute to lowering the prevalence of psoriasis [40].

7. The Psychological Aspects of Psoriasis

Psoriasis is classified among dermatological conditions in which psychophysiological factors play a major role. It is also considered a dermatosis that can either be a potential source of emotional disturbances or act as a trigger for the development of secondary psychiatric disorders [6].

Epidemiological studies show a correlation between psoriasis and mental health dysfunction. Due to their appearance, psoriasis lesions often contribute to social exclusion, emotional distress, and mental health problems such as anxiety and depression. Growing importance is being attributed to the shared pathogenesis of psoriasis and depression. The need to monitor patients with psoriasis for coexisting mental health disorders is increasing, regardless of the severity of skin lesions [41].

Depression and anxiety may lead to poorer adherence to treatment regimens, reduced therapeutic efficacy, and an increased overall disease burden [42]. A systematic review and meta-analysis investigating the correlation between psoriasis and anxiety disorders revealed varying prevalence rates depending on the specific type of anxiety disorder: 15% for social phobia, 11% - generalized anxiety disorder, and 9% - unspecified anxiety disorder. Additionally, a high prevalence of anxiety symptoms—34%—was observed among individuals with psoriasis [43].

A study aimed to determine whether individuals with psoriasis and atopic dermatitis (AD) experience greater difficulties in emotion recognition, attentional and memory processes, and whether they employ different stress-coping strategies compared to healthy individuals. The results demonstrated that patients with psoriasis scored higher on the alexithymia scale, indicating greater difficulty in identifying and verbalizing emotions. They were also less likely to select the correct stimulus and were able to remember shorter sequences in memory tasks. Patients with more severe skin lesions were less likely to use humor as a strategy to relieve stress [44].

A study conducted in the United States showed that children with psoriasis had a 3.2-fold increased risk of hypersomnia, a 2.1-fold increased risk of sleep apnea, a 1.8-fold increased risk of fatigue, and a 1.9-fold increased risk of depression. These findings indicate that children with inflammatory skin diseases are at a higher risk of experiencing sleep-related mental health disorders compared to their peers [45].

In adults with psoriasis, an increased risk of dementia has been observed. In England, researchers compared the risk of developing dementia in individuals with and without psoriasis among adults aged ≥40 years, matched for age, sex, and primary care practice. It was found that psoriasis was associated with a slightly increased risk of developing dementia. The long-term risk of all-cause dementia (excluding Alzheimer's disease) was slightly higher in patients with psoriasis. The risk appeared to increase over time following the diagnosis of psoriasis and was more pronounced in individuals with severe psoriasis compared to those with mild to moderate disease [46].

8. Conclusion

Regular screening in patients suffering from psoriasis is of great importance. Initiating treatment at an early stage of the disease may potentially prevent adverse health outcomes and contribute to an improved quality of life [45]. Management of metabolic comorbidities may not only enhance patients' overall health status but also positively influence psoriasis-related outcomes [10].

Physicians should be aware of the role of an anti-inflammatory diet as a complement to pharmacological treatment in inflammatory diseases with an immunological basis [16]. Undoubtedly, nutrition can serve as an additional therapeutic tool in the management of psoriasis. Further research into dietary patterns is essential to enable the tailoring of an appropriate diet model to the individual patient, providing both physicians and patients with safe, feasible, and personalized alternative methods for alleviating disease symptoms [18]. The combination of proper nutritional education and personalized dietary recommendations in holistic patient care can improve treatment outcomes and support long-term disease management [20].

Feelings of shame, inferiority, and stigmatization are common among these patients and may be more pronounced in women, especially when the disease affects intimate areas [1].

This highlights the need for preventive mental health screenings. Appropriate treatment should target both inflammation and mental health simultaneously [42].

If necessary, patients should be referred for consultation with a mental health specialist, and appropriate treatment should be initiated [43]. Patients with psoriasis require a holistic

approach; in addition to dermatological treatment, psychological, psychotherapeutic support, and possibly psychiatric treatment are recommended [44].

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