STANISZEWSKA, Izabela. Health benefits of exercise and dietary interventions for patients with psoriasis – a literature review. Journal of Education, Health and Sport. 2024;73:51552. eISSN 2391-8306.
https://dx.doi.org/10.12775/JEHS.2024.73.51552
https://apcz.umk.pl/JEHS/article/view/51552

The journal has had 40 points in Minister of Science and Higher Education of Poland parametric evaluation. Annex to the announcement of the Minister of Education and Science of 05.01.2024 No. 32318. Has a Journal's Unique Identifier: 201159. Scientific disciplines assigned: Physical culture sciences (Field of medical and health sciences); Health Sciences (Field of medical and health sciences).
Punkty Ministerialne 40 punktów. Załącznik do komunikatu Ministra Nauki i Szkolnictwa Wyższego z dnia 05.01.2024 Lp. 32318. Posiada Unikatowy Identyfikator Czasopisma: 201159. Przypisane dyscypliny naukowe: Nauki o kulturze fizycznej (Dziedzina nauk medycznych i nauk o zdrowiu); Nauki o zdrowiu (Dziedzina nauk medycznych i nauk o zdrowiu).
The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 25.04.2024. Revised: 10.05.2024. Accepted: 22.05.2024. Published: 14.06.2024.

Health benefits of exercise and dietary interventions for patients with psoriasis – a literature review

Izabela Staniszewska
Medical University of Warsaw, Zwirki i Wigury 61, 02-091 Warszawa
staniszewskaiza28@gmail.com
https://orcid.org/0000-0002-1457-0675

Abstract

Introduction: Psoriasis is a prevalent chronic inflammatory systemic disease that can manifest in a variety of clinical manifestations. Psoriasis was thought to only affect the skin. Recent findings from dermatologic, rheumatologic, and cardiologic research indicate that it is a systemic disease, henceforth referred to as psoriatic disease.

Purpose of work: Collecting information on the benefits of physical activity and diet modifications in patients with psoriasis on aspects such as metabolic syndrome, cardiovascular risk, mental health, and general well-being.

Summary: Psoriasis is a disease that affects many areas of life. Physical activity improves the body weight, mental health, and cardiovascular risk of patients with psoriasis. Engaging in physical activity may reduce the probability of developing psoriasis and may also ameliorate its course. The Mediterranean diet, ketogenic diet, probiotics, and alcohol withdrawal may also alleviate the course of psoriasis. It is noteworthy to mention the potential limitations that may arise in the context of this disease, including embarrassment resulting from skin lesions and joint discomfort resulting from psoriatic arthritis. Sports training ought to be customized for each patient, taking into account their limitations and preferences.

Keywords: psoriasis, sport, physical activity, exercise, diet

Introduction

Psoriasis is a prevalent chronic inflammatory systemic disease that can manifest in a variety of clinical manifestations. Psoriasis was thought to only affect the skin. Recent findings from dermatologic, rheumatologic, and cardiologic research indicate that it is a systemic disease, henceforth referred to as psoriatic disease. The psoriatic disease causes inflammation in the skin, as well as psoriatic arthritis, hypertension, metabolic syndrome, depression, inflammatory bowel disease, or other cardiovascular diseases. Multiple comorbidities can be expected with the progressive aging of the population. It has a relapsing-remitting course. The primary risk factor for the onset of psoriatic disease is obesity, which also contributes to the occurrence of psoriatic arthritis. Stress, infection, and medication are the most common trigger factors (1-3).

Various types of innate and adaptive immune cells are involved in psoriasis. The interleukin (IL)-23/Th17 axis is crucial for the development of psoriasis (4). The evidence suggests that dendritic cells, Th17 cells, and keratinocytes are involved in the pathology of psoriasis. Dendritic cells make tumor necrosis alpha (TNF-α) and IL-23 to help T cells differentiate into Th17 cells, which make key psoriatic cytokines IL-17, IFN-γ, and IL-22. Their activity results in inflammation of the skin and activation and hyperproliferation of keratinocytes (5). The idea that the skin's microbiota plays a big part in causing psoriasis has

become important because scientists have noticed that the microbes in the skin are not as diverse. Another idea, called oxidative stress, says that the damage to cells the release of chemicals called reactive oxygen species, and a lack of antioxidants can cause psoriasis (6).

Topical corticosteroids constitute a fundamental component of the treatment of psoriasis. However, prolonged administration may result in stria and cutaneous atrophy, as well as systemic adverse effects such as topical steroid withdrawal (7). Oral systemic nonbiologic therapies for psoriasis patients include oral acitretin, methotrexate, cyclosporine, apremilast, tofacitinib, and deucravacitinib (8). At present, a diverse array of biological treatments are accessible for moderate to severe psoriasis, encompassing inhibitors, IL12/23 inhibitors, IL17 inhibitors, and IL23 inhibitors (3, 9).

As a persistent condition, psoriasis frequently impacts the physical, psychological, and social status of the patient, thereby influencing their experience of illness and requirements. It is imperative to emphasize the combined physical, psychological, and social consequences of psoriasis and its attendant care requirements. Assist and guide patients with their coping strategies with high-quality therapeutic interventions, provide information about psoriasis, monitor, and follow up regularly over time, and get feedback to inform further treatment and care (10). Physical activity and enhancing the physical fitness of patients with psoriasis also play a significant role in this care. Smoking, obesity, metabolic syndrome, hypertension, dyslipidemia, diabetes, and decreased physical activity are associated with psoriasis, which increases cardiovascular risk (11). What is more, vigorous physical activity is correlated with a decreased likelihood of the occurrence of psoriasis (12). On the other hand, metabolic syndrome is associated with an increased risk of developing psoriasis (13). Regular physical activity has the potential to have a beneficial impact on the natural course of the disease, positively influencing not only the severity but also the frequency of metabolic comorbidities (14, 15).

Physical activity and cardiovascular risk

Patients suffering from psoriasis do not engage in adequate physical activity as recommended for cardiovascular health, which may contribute to the elevated risk of cardiovascular disease and metabolic syndrome observed in this patient group (16). The overall capacity to perform exertion exercise is referred to as cardiorespiratory fitness. Individuals with

psoriasis may have lower cardiovascular fitness, and these variations may not be explained by self-reported disease severity or physical activity. Those reporting high life impairment or body surface area had significantly lower cardiorespiratory fitness (17). Low cardiorespiratory fitness at an early age is associated with an increased risk of incident psoriasis and psoriatic arthritis in men (18). Furthermore, patients with psoriasis are at a higher risk of atrial fibrillation and should therefore be closely monitored for this condition (19).

Different life zones of psoriasis patients can benefit from exercise. Sheppard et al. developed an exercise program for patients with psoriasis. A 10-week intervention consisting of two group walking sessions per week each of 1 hour duration was implemented. The exercise program was designed to remove barriers to exercise for those with psoriasis. Regular physical activity may possess significant health advantages for individuals with psoriasis, including reduced cardiovascular risk and enhanced psychosocial functioning (20). It is possible that both psychological and physiological reasons are involved. Lack of physical activity may contribute to the elevated risk of cardiovascular disease in individuals with psoriasis, as well as the inherent dangers associated with systemic inflammation and psoriasis-associated co-morbidities. Because of its beneficial effects on systemic inflammation and cardiometabolic comorbidities associated with psoriasis, physical activity should be encouraged in all psoriasis patients (21).

Physical activity and body weight

Obesity increases the risk of cardiovascular disease in patients with psoriasis and can make adipocytes and immune cells produce proinflammatory adipocytokine. Schwartz et al. found that 66.9% of German psoriasis patients were overweight or obese, compared to approximately 50% of the German general population. The proportion of affected body surface area, cardiovascular risk factors, and cardiovascular event frequency increased with an increase in BMI. Overweight participants had more severe psoriasis and impaired engagement in weight loss diets and physical activity (22). As measured by waist circumference, central adiposity is associated with a higher risk of developing psoriasis (23). Patients who self-report psoriasis are less likely to exercise in order to lose weight (24). Furthermore, psoriasis has the potential to be a prediabetic condition. Patients with psoriasis displayed a higher degree of insulin resistance in comparison to healthy control subjects (25). Poor dietary and physical activity routines may

be contributing factors to overweight and metabolic syndrome in individuals with psoriasis (26). The implementation of a healthy lifestyle resulted in the reduction of body fat, enhancement of body fat distributions, enhancement of resting metabolic rate, and enhancement of pulmonary functions (27).

A 20-week dietetic intervention, coupled with an increase in physical activity, resulted in a reduction in the severity of psoriasis in systemically treated overweight or obese patients with active psoriasis. Naldi et al. examined a cohort of 303 overweight or obese individuals with moderate-to-severe chronic plaque psoriasis who failed to achieve clearance after four weeks of continuous systemic treatment. Patients were randomly assigned to receive either a 20-week quantitative and qualitative dietary plan incorporating physical exercise for weight loss, or a simple informative counseling session at baseline regarding the efficacy of weight loss in the clinical management of psoriatic disease. The analysis of the Psoriasis Area and Severity Index (PASI) from baseline to week 20 indicated a median reduction of 48% in the dietary intervention group and 25.5% in the information-only group. There was a significant difference in the PASI score reduction between the study groups, and the weight-loss goal was reached by 29.8% of patients in the dietary intervention group, compared to 14.5% in the information-only group (28). Weight loss for patients with psoriasis has long-lasting positive effects on the severity of the psoriasis (29).

Physical activity and musculoskeletal effects

It is possible that very strenuous physical activity will cause joint pain and tenderness in patients with psoriasis and psoriatic arthritis (30). Particularly in professional athletes who are subject to a greater training load (31). In the context of leisure sports activity, the impact of low to moderate biomechanical stress on entheses in patients with psoriasis and psoriatic arthritis seems to be well tolerated by psoriatic patients without causing an increase in tenderness, pain, or ultrasound-proven inflammation (30). However, the impact of psoriasis on leisure activities is considerable. Patients with psoriasis tend to reduce or give up leisure-time activities because of their condition (32).

Patients with psoriasis without psoriatic arthritis also experience fatigue and musculoskeletal pain. Psoriatic patients without psoriatic arthritis can benefit from a 16-week

aerobic training program at moderate intensity. It significantly improves scores on the illness therapy fatigue scale (FACIT-Fatigue), the health assessment questionnaire disability index (HAQ-DI), and the visual analog scale (VAS) without increasing markers of muscle damage. It also improves fat mass percentage, lipid profile, and maximal oxygen consumption (33).

Physical activity and general well-being

Psoriasis has a negative impact on quality of life (34). Most negative impacts of psoriasis on health-related quality of life are reported as limitations on clothing, sleep disorders, and depression/anxiety, and with psoriatic arthritis, as limitations on clothing, sports/leisure, or daily routine and sleeping disorders (35). Disease severity, single status, working status, sports activities, nail dystrophy, exposed area involvement, itching, disturbed sleep, stress, and infection are general factors associated with impact on health-related quality of life (34). The degree of disease severity is a significant predictor of the severe impact of psoriasis on health-related quality of life (34). Sleeping disorders and depression are prevalent conditions that should not be overlooked (35). The optimal treatment of psoriasis patients requires a comprehensive approach that incorporates psychological aspects (34).

Additionally, psoriasis has a significant secondary impact on the lives of family members and partners. Most of them said that the way their relative or partner was treated made them have to spend extra time doing housework. They elucidated psychological pressures that encompassed anxiety, distress, and apprehension regarding the patient's future, as well as social disruption resulting from a lack of social confidence, either due to embarrassment or the time required for care duties. Limitations to holiday plans, sports, and leisure activities, and evenings out were described by them. They expressed limitations on their daily activities, such as shopping, work, and time with other family members, and felt that their close relationships had deteriorated (36). It is important to bear in mind that individuals with psoriasis are also subjected to financial expenses arising from their treatment, which have a significant impact on their household budgets (37).

Many patients have social and emotional problems, even though they can get modern treatment. 50% of patients expressed their belief that psoriasis had hindered their sexual relationships. 11% of them stated that they would refrain from having children if their offspring

were to develop the disease. The majority of people with psoriasis avoided common social activities, such as swimming and sports (38).

Patients with psoriasis, particularly severe psoriasis, usually undertook less physical activity than persons who had never been diagnosed with psoriasis. Clinicians ought to encourage patients with psoriasis, particularly those with more severe disease, to engage in more physical activity. The psychological and physical obstacles to their patients' physical activity should be identified and addressed by them (39). Psoriasis has a significant impact on many aspects of the patient's daily life. The role of sport in improving quality of life seems relevant, even if it is underestimated (40).

Dietary interventions in psoriasis

Diet may influence the course of psoriasis. The research shows that psoriasis is connected to other health problems like obesity, high blood pressure, diabetes, high cholesterol, and liver disease. A healthy diet implementation has a great impact on obesity, non-alcoholic fatty liver disease/hepatic steatosis, and diabetes associated with psoriasis (41). What's more, non-adherence to general national dietary guidelines increases the risk of prevalent psoriasis (42).

Patients who practice intermittent fasting or follow ketogenic or Mediterranean diets have been shown to have positive effects on inflammatory conditions, such as psoriasis, atopic dermatitis, hidradenitis suppurativa, and acne (43). The utilization of the Mediterranean and ketogenic diet in patients with psoriatic arthritis and psoriasis results in weight reduction, reduced body mass index (BMI), reduced waist circumference, reduced total fat mass, and reduced visceral fat. The ketogenic diet also resulted in a decrease in the severity of disease symptoms as measured by the PASI and Disease Activity Index of Psoriatic Arthritis Scale (DAPSA), as well as a decrease in the blood concentration of IL-6, IL-17, and IL-23 (44). Patients with severe psoriasis were less likely to adhere to the Mediterranean diet. Nonetheless, the Mediterranean diet has the potential to impede the progression of psoriasis (45). Additionally, a healthy diet and exercise regimen can also improve erectile dysfunction associated with psoriasis (46). Dietary intervention in psoriatic arthritis demonstrates the greatest evidence of benefit for weight loss among obese patients (47). A non-pharmacological,

holistic approach may enhance the quality of life for individuals with psoriatic arthritis, incorporating dietary adjustments, adequate sleep duration, and physical activity (48).

The detrimental impact of an imbalanced diet, alcohol abuse, and smoking on the progression of psoriasis vulgaris can be observed (49). The analysis revealed that with each additional gram of daily alcohol intake, the odds of developing psoriasis increased by 4%. This association was more prominent in the group drinking more than 45 g of alcohol per day (50). Furthermore, there is an increasing number of reports about the intestinal microbiota and its impact on the progression of various diseases. The possible role of probiotics in psoriasis is emphasized, and probiotic supplementation may be helpful to treat psoriasis (51). Present evidence regarding the role of the gut microbiome and metabolites in psoriasis and their potential implications for diagnosis and treatment is currently and constantly being developed (52). A gluten-free diet may lessen the severity of psoriasis in people with gluten intolerance or the presence of gluten-specific antibodies. There is no evidence that micronutrient supplements (i.e., selenium, vitamin D, vitamin B12) have a beneficial effect on patients with normal serum levels (53).

Patients with psoriasis need to understand how their diet affects their symptoms and make changes to their diet. The literature offers limited guidance to individuals suffering from psoriasis, focusing on shedding pounds and afflicting coexisting conditions. Understanding diet modification and larger, controlled trials are needed to establish dietary strategies for psoriasis management (54-56).

Conclusions

Engaging in physical activity may reduce the probability of developing psoriasis and may also ameliorate its course. Physical activity improves the body weight, mental health, and cardiovascular risk of patients with psoriasis. It is noteworthy to mention the potential limitations that may arise in the context of this disease, including embarrassment resulting from skin lesions and joint discomfort resulting from psoriatic arthritis. Sports training ought to be customized for each patient, taking into account their limitations and preferences. The Mediterranean diet, probiotics, and alcohol withdrawal may also alleviate the course of psoriasis.

DISCLOSURE

Authors'contribution:

Conceptualization: Izabela Staniszewska
Methodology: Izabela Staniszewska
Software: Izabela Staniszewska
Check: Izabela Staniszewska
FormalAnalysis: Izabela Staniszewska
Investigation: Izabela Staniszewska
Resources: Izabela Staniszewska
Data Curation: Izabela Staniszewska
Writing-Rough Preparation: Izabela Staniszewska
Writing-Reviewand Editing: Izabela Staniszewska
Visualization: Izabela Staniszewska
Supervision: Izabela Staniszewska
Project Administration: Izabela Staniszewska
Author have read and agreed with the published version of the manuscript.

Funding Statement: The Study Did Not Receive Special Funding.
Institutional Review Board Statement: Not Applicable.
Informed Consent Statement: Not Applicable.
Data Availability Statement: Not Applicable.
Conflict Of Interest: The authors declare no conflict of interest.

Bibliography

1. Mrowietz U, Lauffer F, Sondermann W, Gerdes S, Sewerin P. Psoriasis as a Systemic Disease. Dtsch Arztebl Int. 2024(Forthcoming).
2. Seidel P, Magnolo N. [Treatment of psoriasis vulgaris : Therapy strategies for optimal patient-centered care]. Dermatologie (Heidelb). 2024;75(5):417-27.
3. Mateu-Arrom L, Puig L. Choosing the right biologic treatment for moderate-to-severe plaque psoriasis: the impact of comorbidities. Expert Rev Clin Pharmacol. 2024;17(4):363-79.
4. Potestio L, Martora F, Lauletta G, Vallone Y, Battista T, Megna M. The Role of Interleukin 23/17 Axis in Psoriasis Management: A Comprehensive Review of Clinical Trials. Clin Cosmet Investig Dermatol. 2024;17:829-42.
5. Sieminska I, Pieniawska M, Grzywa TM. The Immunology of Psoriasis-Current Concepts in Pathogenesis. Clin Rev Allergy Immunol. 2024.
6. Hernandez-Nicols BF, Robledo-Pulido JJ, Alvarado-Navarro A. Etiopathogenesis of Psoriasis: Integration of Proposed Theories. Immunol Invest. 2024;53(3):348-415.
7. Lo A, Greenzaid JD, Gantz HY, Chodri K, Feldman SR. Clinical pharmacokinetics and pharmacodynamics of topical non-biological therapies for psoriasis patients. Expert Opin Drug Metab Toxicol. 2024;20(4):235-48.
8. Eichinger JM, Shan DM, Greenzaid JD, Anakwenze L, Feldman SR. Clinical pharmacokinetics and pharmacodynamics of oral systemic nonbiologic therapies for psoriasis patients. Expert Opin Drug Metab Toxicol. 2024;20(4):249-62.
9. Thomas SE, Barenbrug L, Hannink G, Seyger MMB, de Jong E, van den Reek J. Drug Survival of IL-17 and IL-23 Inhibitors for Psoriasis: A Systematic Review and Meta-Analysis. Drugs. 2024.
10. Ou M, Xue Y, Qin Y, Zhang X. Experience and caring needs of patients with psoriasis: A qualitative meta-synthesis. J Clin Nurs. 2024.
11. Potestio L, Tommasino N, Lauletta G, Martora F, Megna M. Psoriasis and Molecular Target Therapies: Evidence of Efficacy in Preventing Cardiovascular Comorbidities. Dermatol Ther (Heidelb). 2024;14(4):841-52.

12. Frankel HC, Han J, Li T, Qureshi AA. The association between physical activity and the risk of incident psoriasis. Arch Dermatol. 2012;148(8):918-24.
13. Kim HN, Han K, Park YG, Lee JH. Metabolic syndrome is associated with an increased risk of psoriasis: A nationwide population-based study. Metabolism. 2019;99:19-24.
14. Balato N, Megna M, Palmisano F, Patruno C, Napolitano M, Scalvenzi M, Ayala F. Psoriasis and sport: a new ally? J Eur Acad Dermatol Venereol. 2015;29(3):515-20.
15. Megna M, Lobasso A, Napolitano M, Rossi FW, Balato A, Matucci-Cerinic C, et al. Soccer helps in controlling the development of psoriasis in Italian second league players. J Eur Acad Dermatol Venereol. 2017;31(4):e212-e4.
16. Auker L, Cordingley L, Griffiths CEM, Young HS. Physical activity is important for cardiovascular health and cardiorespiratory fitness in patients with psoriasis. Clin Exp Dermatol. 2022;47(2):289-96.
17. Wilson PB. Cardiorespiratory Fitness Among Individuals With Psoriasis in the General Population. J Phys Act Health. 2016;13(7):771-5.
18. Laskowski M, Schiöler L, Gustafsson H, Wennberg AM, Åberg M, Torén K. Cardiorespiratory fitness in late adolescence and long-term risk of psoriasis and psoriatic arthritis among Swedish men. PLoS One. 2021;16(1):e0243348.
19. Jain H, Odat RM, Goyal A, Jain J, Dey D, Ahmed M, et al. Association between psoriasis and atrial fibrillation: A Systematic review and meta-analysis. Curr Probl Cardiol. 2024;49(6):102538.
20. Sheppard R, Gan WK, Onambele-Pearson GL, Young HS. Developing an aerobic exercise intervention for patients with psoriasis to support lifestyle behaviour change and improve health outcomes. Clin Exp Dermatol. 2023;48(1):5-11.
21. Torres T, Alexandre JM, Mendonça D, Vasconcelos C, Silva BM, Selores M. Levels of physical activity in patients with severe psoriasis: a cross-sectional questionnaire study. Am J Clin Dermatol. 2014;15(2):129-35.
22. Schwarz PEH, Pinter A, Melzer N, Barteczek P, Reinhardt M. ERAPSO: Revealing the High Burden of Obesity in German Psoriasis Patients. Dermatol Ther (Heidelb). 2019;9(3):579-87.
23. Ferguson LD, Brown R, Celis-Morales C, Welsh P, Lyall DM, Pell JP, et al. Association of central adiposity with psoriasis, psoriatic arthritis and rheumatoid arthritis: a cross-sectional study of the UK Biobank. Rheumatology (Oxford). 2019;58(12):2137-42.

24. Wilson PB. Prevalence of weight loss attempts and behaviors used by individuals with psoriasis in the United States population. J Dermatolog Treat. 2017;28(6):515-9.
25. Gyldenløve M, Storgaard H, Holst JJ, Vilsbøll T, Knop FK, Skov L. Patients with psoriasis are insulin resistant. J Am Acad Dermatol. 2015;72(4):599-605.
26. Ahdout J, Kotlerman J, Elashoff D, Kim J, Chiu MW. Modifiable lifestyle factors associated with metabolic syndrome in patients with psoriasis. Clin Exp Dermatol. 2012;37(5):477-83.
27. Demirel R, Genc A, Ucok K, Kacar SD, Ozuguz P, Toktas M, et al. Do patients with mild to moderate psoriasis really have a sedentary lifestyle? Int J Dermatol. 2013;52(9):1129-34.
28. Naldi L, Conti A, Cazzaniga S, Patrizi A, Pazzaglia M, Lanzoni A, et al. Diet and physical exercise in psoriasis: a randomized controlled trial. Br J Dermatol. 2014;170(3):634-42.
29. Jensen P, Christensen R, Zachariae C, Geiker NR, Schaadt BK, Stender S, et al. Long-term effects of weight reduction on the severity of psoriasis in a cohort derived from a randomized trial: a prospective observational follow-up study. Am J Clin Nutr. 2016;104(2):259-65.
30. Fagni F, Mutlu MY, Temiz SA, Minopoulou I, Krieter M, Schett G, et al. Tolerability of low to moderate biomechanical stress during leisure sport activity in patients with psoriasis and psoriatic arthritis. RMD Open. 2023;9(4).
31. Brophy RH, MacKenzie CR, Gamradt SC, Barnes RP, Rodeo SA, Warren RF. The diagnosis and management of psoriatic arthritis in a professional football player presenting with a knee effusion: a case report. Clin J Sport Med. 2008;18(4):369-71.
32. Leino M, Mustonen A, Mattila K, Koulu L, Tuominen R. Perceived impact of psoriasis on leisure-time activities. Eur J Dermatol. 2014;24(2):224-8.
33. Diaz AJ, Rosety MA, Armario JC, Bandez MJ, Garcia-Gomez N, Sanchez-Sanchez E, et al. Regular Exercise Improved Fatigue and Musculoskeletal Pain in Young Adult Psoriatic Patients without Psoriatic Arthritis. Nutrients. 2023;15(21).
34. Nyunt WW, Low WY, Ismail R, Sockalingam S, Min AK. Determinants of health-related quality of life in psoriasis patients in Malaysia. Asia Pac J Public Health. 2015;27(2):Np662-73.
35. Duvetorp A, Østergaard M, Skov L, Seifert O, Tveit KS, Danielsen K, Iversen L. Quality of life and contact with healthcare systems among patients with psoriasis and psoriatic arthritis: results from the NORdic PAtient survey of Psoriasis and Psoriatic arthritis (NORPAPP). Arch Dermatol Res. 2019;311(5):351-60.
36. Eghlileb AM, Davies EE, Finlay AY. Psoriasis has a major secondary impact on the lives of family members and partners. Br J Dermatol. 2007;156(6):1245-50.

37. Jenner N, Campbell J, Plunkett A, Marks R. Cost of psoriasis: a study on the morbidity and financial effects of having psoriasis in Australia. Australas J Dermatol. 2002;43(4):255-61.
38. Ramsay B, O'Reagan M. A survey of the social and psychological effects of psoriasis. Br J Dermatol. 1988;118(2):195-201.
39. Do YK, Lakhani N, Malhotra R, Halstater B, Theng C, Østbye T. Association between psoriasis and leisure-time physical activity: findings from the National Health and Nutrition Examination Survey. J Dermatol. 2015;42(2):148-53.
40. Custurone P, Macca L, Bertino L, Di Mauro D, Trimarchi F, Vaccaro M, Borgia F. Mutual Influence of Psoriasis and Sport. Medicina (Kaunas). 2021;57(2).
41. Bellinato F, Maurelli M, Geat D, Girolomoni G, Gisondi P. Managing the Patient with Psoriasis and Metabolic Comorbidities. Am J Clin Dermatol. 2024.
42. Näslund-Koch C, Kjeldsen EW, Vedel-Krogh S, Bojesen SE, Skov L. Adherence to general national dietary guidelines and risk of psoriasis: results from a general population study of 105,332 individuals. Clin Exp Dermatol. 2024.
43. Mansilla-Polo M, Piquero-Casals J, Morgado-Carrasco D. [Translated article] Popular Diets and Skin Effects: A Narrative Review. Actas Dermosifiliogr. 2024;115(4):T374-t86.
44. Lambadiari V, Katsimbri P, Kountouri A, Korakas E, Papathanasi A, Maratou E, et al. The Effect of a Ketogenic Diet versus Mediterranean Diet on Clinical and Biochemical Markers of Inflammation in Patients with Obesity and Psoriatic Arthritis: A Randomized Crossover Trial. Int J Mol Sci. 2024;25(5).
45. Phan C, Touvier M, Kesse-Guyot E, Adjibade M, Hercberg S, Wolkenstein P, et al. Association Between Mediterranean Anti-inflammatory Dietary Profile and Severity of Psoriasis: Results From the NutriNet-Santé Cohort. JAMA Dermatol. 2018;154(9):1017-24.
46. Ismail AMA, Hamed DE. Erectile dysfunction and metabolic syndrome components in obese men with psoriasis: response to a 12-week randomized controlled lifestyle modification program (exercise with diet restriction). Ir J Med Sci. 2024;193(1):523-9.
47. Maharaj AB, Eder L, Ogdie A. The impact of dietary interventions in psoriatic arthritis. Curr Opin Rheumatol. 2023;35(6):414-22.
48. Lubrano E, Scriffignano S, de Vlam K, Ronga M, Perrotta FM, Lories R. Triple jump for the optimal management of psoriatic arthritis: diet, sleep and exercise - a review. RMD Open. 2023;9(3).
49. Michalski P, Palazzo-Michalska V, Michalska-Bańkowska A, Bańkowski M, Grabarek BO. Impact of Alcohol Consumption, Smoking, and Diet on the Severity of Plaque Psoriasis: A

Comprehensive Assessment using Clinical Scales and Quality of Life Measures. Med Sci Monit. 2023;29:e941255.
50. Choi J, Han I, Min J, Yun J, Kim BS, Shin K, et al. Dose-response analysis between alcohol consumption and psoriasis: A systematic review and meta-analysis. J Dtsch Dermatol Ges. 2024;22(5):641-52.
51. Wei K, Liao X, Yang T, He X, Yang D, Lai L, et al. Efficacy of probiotic supplementation in the treatment of psoriasis-A systematic review and meta-analysis. J Cosmet Dermatol. 2024.
52. Zhu Q, Wu K, Yang Q, Meng B, Niu Y, Zhao F. Advances in psoriasis and gut microorganisms with co-metabolites. Front Microbiol. 2023;14:1192543.
53. Näslund-Koch C, Bennike NH, Skov L. [Not Available]. Ugeskr Laeger. 2023;185(47).
54. Hawkins P, Earl K, Tektonidis TG, Fallaize R. The role of diet in the management of psoriasis: a scoping review. Nutr Res Rev. 2023:1-35.
55. Cintoni M, Palombaro M, Maramao FS, Raoul P, Egidi G, Leonardi E, et al. Metabolic Disorders and Psoriasis: Exploring the Role of Nutritional Interventions. Nutrients. 2023;15(18).
56. Constantin C, Surcel M, Munteanu A, Neagu M. Insights into Nutritional Strategies in Psoriasis. Nutrients. 2023;15(16).