

Review

Diet in hidradenitis suppurativa: a review of published and lay literature

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Introduction

Hidradenitis suppurativa (HS), also known as acne inversa, is a chronic, inflammatory skin disease that causes recurrent abscesses and sinus tract formation in inverse areas: commonly in the axillae, groin, buttocks, and inframammary folds. It has been noted to affect approximately 0.05–4% of the global population and is more common in women than in men.^{1,2} The large difference in current prevalence estimates is thought to be because of lack of recognition of HS and the average 7-year delay to diagnosis.^{3,4} Despite its debilitating characteristics, the exact etiology and pathogenesis are unknown. For patients with HS, dietary modifications are often a topic of conversation, but there is a paucity of data on this subject because of the challenging nature of conducting nutritional studies. Not only it is difficult to design a truly blinded, placebo-controlled dietary trial, it is difficult to request patients to implement dietary restrictions that discontinue a major portion of their normal dietary intake. It is also challenging for patients to adhere to such strict guidelines for a significant period of time. Nonetheless, clinicians and patients recognize the potential role that restrictive dietary management may play in controlling or improving HS. Herein, we review existing published and lay literature regarding diet and HS.

Abstract

Hidradenitis suppurativa (HS) is a chronic, recurring, inflammatory skin disorder resulting in skin abscesses and sinus tracts of the skin folds. Hidradenitis suppurativa remains a disease with limited treatment options. Management of disease activity with dietary modification has been of considerable interest to the HS patient community. Limited evidence exists to support dietary changes for treatment of HS. Strategies such as eliminating dairy products, limiting simple carbohydrate and sugar intake, and avoiding nightshades (Solanaceae) and foods containing brewer's yeast have been reported to be helpful in some patients. Several supplements have also been touted as beneficial. Herein, we review the existing dietary recommendations in both peer-reviewed and lay literature in an attempt to consolidate and evaluate existing information, while stimulating further inquiry into the role of diet in HS. Although dietary modifications are often of considerable interest to HS patients, there is a paucity of data regarding diet as it relates to HS. It is unclear whether diet may prove to be of value in limiting the severity of HS. Further research is needed to determine the potential benefits of these dietary changes.

Materials and methods

In our analysis of the current available data, we performed an extensive literature search via PubMed and in the lay literature (i.e. Google searches, HS support groups, social media forums) using the search terms: "hidradenitis suppurativa" OR "acne inversa," OR "verneuil's disease," AND one or the following search terms: "diet" OR "dietary restriction," OR "dairy" OR "supplements" OR "vitamin d" OR "glycemic load." No date range was applied. A total count of 20 unique search results were identified via PubMed, 12 of which were relevant and directly related to the topic and subsequently retained for this analysis. Those excluded were either not specific to HS or not related to diet. We did not include duplicates of already-included studies in our total count. We did not include any articles in a foreign language. From 14,500 to 486,000 search results were found via Google depending on the different search term combinations. We reviewed the most frequently occurring results within the first five search engine result pages that were directly related to the topic and included information we deemed most relevant to our discussion regarding HS and diet.

Obesity and metabolic syndrome

Higher rates of obesity and metabolic syndrome have been reported in HS patients, with a direct association of disease severity with increased body mass index (BMI).⁵⁻⁷ Mechanisms by which obesity promotes HS disease activity include mechanical friction and follicular occlusion, along with systemic low grade inflammation of the obese body.⁸ Thus, diets that promote weight loss have been observed to reduce disease flares in HS patients.^{1,8,9} For example, consumption of high fiber foods may contribute to satiety, reduce intake of unhealthy foods, and lead to weight reduction. A retrospective study by Kroman *et al.*¹⁰ involving questionnaires distributed to patients who had undergone bariatric surgery 2 years prior found that $\geq 15\%$ weight reduction was associated with a significant reduction in HS disease severity. Other studies have demonstrated that weight reduction after bariatric surgery resulted in decreased severity of HS as well.^{11,12}

In addition, chronic inflammation and hyperinsulinism associated with obesity leads to hyperandrogenism. Metformin improves glucose utilization via a decrease in glucose production and an increase in both peripheral glucose uptake and insulin sensitivity. This reduces the level of circulating insulin and decreases androgen receptor sensitivity. As a result, the reactive hyperinsulinemia from ingestion of simple carbohydrates or milk is diminished.^{1,13,14} In an open label study with metformin in patients with HS, 76% of 25 patients with HS improved, with significant average reductions of 12.7 in Sartorius scores, which calculate severity and extent of disease by counting involved regions, nodules, and sinus tracts. Seven patients had 50% reduction or better. A decrease in the number of monthly lost work days (from 1.5 to 0.4) was also observed. Dermatology Life Quality Index (DLQI), a tool used to measure the impact of skin diseases on quality of life, showed significant average reduction in scores by 7.6 points in 16 patients. Remarkably, 48% achieved significant decreases in their disease severity.⁹

Dairy and glycemic load

A “Western” diet includes two typical features which have been implicated in the initial obstruction of the follicular duct in HS: dairy and highly refined simple carbohydrates.¹⁵ Dairy products have long been suspected as a possible contributor to acne severity, and similarly have been named as a possible contributor to HS. Dairy products include three different factors: casein, whey, and natural androgens and their precursors, along with numerous growth factors.^{15,16} These factors contribute to follicular ductal blockade – inducing overexpression of cytokeratins, hyperproliferation of keratinocytes, and hypercornification of the follicular wall – and thereafter causing subsequent leakage and rupture of the already genetically susceptible follicular pilosebaceous unit that causes the clinical presentation of HS.¹⁵⁻¹⁷ Hormones, in particular androgens, are thought to activate HS.^{1,17} Casein increases levels of insulin-like growth factor 1 (IGF-1), whereas whey increases

insulin levels. Hyperinsulinemia and high levels of IGF-1 also target the androgen receptor, making it increasingly accessible to androgens from many endogenous and exogenous sources.^{9,15,17}

A low glycemic diet can also benefit HS patients, as diet-induced insulin elevation by highly refined simple carbohydrates similarly predisposes patients to accessible androgen receptors.^{13,15} In addition to healthier food choices, the elimination of sugary drinks, such as sodas and juices, is an important factor for patients to take into consideration when attempting a low glycemic load diet as well. A link between high glycemic foods and worsening acne has been proposed, with biologic factors like insulin and insulin-like growth factor thought to augment androgen-mediated sebum production, one of the proximate causes of acne.¹⁸⁻²¹ The phosphoinositol 3/kinase/Akt/FoxO1 pathway, triggered by a high carbohydrate diet, dairy, nicotine use, and stress, may play a role in both acne and HS.^{1,21}

Based on the mechanisms above, a zero dairy, low glycemic load diet has been reported to show improvement of HS. In a personal “dairy-free series” by Danby, 83% of 47 patients who were placed on a dairy-free diet without glycemic load restriction had various degrees of improvement of their HS. No patient experienced worsening of the disease compared to the control population not on a dairy-free diet.¹⁵ Although Danby reported impressive results, he did not define “various degrees of improvement.” His study did not utilize formal, validated assessment methods and may have been subject to recall and non-response bias.

Wheat and brewer’s yeast

Wheat and brewer’s yeast have been implicated as possible inducers of inflammation in some patients, exacerbating HS symptoms. Brewer’s yeast is an ingredient in bakery products such as bread, pizza dough, pastries, and cakes which helps them rise. It is also used to produce beer, wine, and cheese. It is composed mainly of a single cell fungus called *Saccharomyces cerevisiae* which causes the production of fermentation alcohol and carbon dioxide.²² Anti-*Saccharomyces cerevisiae* antibodies (ASCAs) are considered specific for Crohn’s disease but have also been identified at high levels in patients with other autoimmune conditions such as systemic lupus erythematosus, antiphospholipid syndrome, rheumatoid arthritis, and type I diabetes mellitus.²³ Restricting wheat and brewer’s yeast has shown HS disease stabilization in a small research study. This study enrolled 12 patients who tested positive for anti-*Saccharomyces cerevisiae* antigen IgG, indicating alimentary intolerance. These patients were put on a brewer’s yeast-free diet for 12 months after undergoing surgical excision of lesions and followed monthly. Results showed immediate stability of clinical symptoms with skin lesions regressing over the 12-month time period as well as an increase in reported quality of life for patients.²² As soon as patients either accidentally or voluntarily ingested beer or foods containing wheat or brewer’s yeast, recurrence was reported to have occurred. The small sample size and lack of a control group of patients negative for the

Saccharomyces antigen limit the generalizability of the study. It is unclear whether a brewer's yeast-free diet will be beneficial for HS patients who are not predisposed to wheat intolerance.

Various supplements

Turmeric

Multiple online sources tout the potential benefits of supplements for HS. In the lay literature, including various online HS discussion threads, there have been claims that oral and topical turmeric as well as probiotics have helped relieve symptoms in HS patients.^{24–26} Turmeric is a natural plant root with the principal curcuminoid curcumin, which has been shown to function as an antioxidant and anti-inflammatory.²⁷ One recent clinical study showed beneficial effect of curcumin consumption on metabolic syndrome, skin diseases, malignancy, gut inflammation, arthritis, fatty liver disease, depression, and premenstrual syndrome.²⁸ Studies have also shown curcumin to have immune-regulatory activity, modulating various immune cells like T-lymphocyte subsets, macrophages, dendritic cells, B-lymphocytes, and natural killer cells, and anti-cancer effects.²⁹ Curcumin protects against inflammation by modulating pro-inflammatory cytokines and related signaling pathways. This downregulation of cytokines by turmeric may play a role in relieving the inflammation in HS.

Omega-3 fatty acids and vitamin D

Omega-3 fatty acids are also thought to play a role in the reduction of inflammation and have been discussed in the lay literature to have possible utility in HS.³⁰ Vitamin D supplementation may be considered, as vitamin D deficiency has been observed in HS patients. In a small, low-power study by Guillet *et al.*³¹ in 2015, HS was found to be associated with vitamin D deficiency with all 22 HS patients exhibiting vitamin D deficiency and 36% of these patients exhibiting severe vitamin D deficiency which correlated with disease severity. Although the percentage of control subjects with vitamin D deficiency was also high, the severity was less than that of HS patients. Although this correlation has been observed, vitamin D deficiency is thought to be a result of chronic inflammation rather than a causative factor for HS.³² No formal studies have been conducted to validate the benefits of turmeric or omega-3 fatty acids in HS.

Zinc

Zinc has been reported as an anti-inflammatory and anti-androgenic measure in acne and HS via inhibition of both isoenzymes of 5 α -reductase. A multicenter, prospective, case-control study by Poveda *et al.*³³ analyzed serum zinc levels in 122 moderate to severe HS patients compared to 122 control patients. Low serum zinc levels were found to be more prevalent in HS patients, with associations found with Hurley stage III, DLQI \geq 9, affected sites \geq 3, genital location, and perineal location of lesions. Additionally, zinc gluconate can be used as a second-

line treatment for mild to moderate inflammatory acne with improvement seen at 30 and 60 mg/day.^{13,14} As a result, the utility of zinc in HS has been explored in a single open study. Brocard *et al.*³⁴ enrolled 22 Hurley stage I or stage II patients on 90 mg/day of zinc gluconate; 14 patients with HS showed partial remission, and eight experienced complete remission of their HS over a period of 24 months. When the doses were diminished, recurrence occurred. Eighteen percent of these patients experienced mild digestive symptoms such as diarrhea, esophagitis, nausea, and abdominal distension. This study did not include a control group and did not account for variations in concomitant treatments. Another small study by Dréno treated 12 patients with stage 1–2 HS with 90 mg/day of zinc gluconate. Immunohistochemical analysis of lesional and non-lesional skin biopsies occurred at baseline and at 3 months which showed significantly decreased expression of all innate immunity markers studied (except IL-10) in both lesional and nonlesional skin, with lesional skin showing significantly stronger downregulation of all innate markers (except tumor necrosis factor) compared to normal skin. Three months of zinc treatment in these HS patients caused a significant increase in the expression of all innate markers.³⁵ As the side effects are minimal, zinc gluconate may be considered for adjuvant treatment of mild to moderate HS.

Chinese herbal medicine

Chinese herbal medicine is also an avenue some patients pursue, along with treatments such as acupuncture.²⁵ Lay literature and blog posts online claim various herbal Chinese mixtures, sometimes in addition to acupuncture and dietary restrictions, are beneficial in improving HS. Electroacupuncture, when performed around an HS lesion, has also been described to cause rapid regression of HS lesions or cause lesions to drain and heal more quickly. In acupuncture, this technique is called “surrounding the dragon.”^{36,37} Many times, patients combine treatment modalities in order to optimize results.

Other supplements

The dietary supplement Levigon[®] (composed of myo-inositol, folic acid, and liposomal magnesium) has been reported to improve disease activity in HS. In an Italian study by Donnarumma, 20 HS patients with Hurley score I–II, impaired glucose metabolism, and BMI between 25 and 29.9 were treated with topical clindamycin gel 1%, systemic antibiotic therapy with oral clindamycin 300 mg twice daily and oral rifampin 600 mg daily for 6 weeks, and a normocaloric diet.³⁸ They were equally randomized to receive Levigon[®] versus not receiving the dietary supplement. The Levigon[®] website reports multiple benefits of the supplement ingredients: the insulin-mimetic properties of myo-inositol which may improve insulin resistance; improved GI tract absorbance and decreased insulin resistance and inflammation because of folic acid; and improvement of fasting glucose and insulin sensitivity as a result of liposomal magnesium. After 6 months, the patients on supplementation showed increased efficacy of concomitant therapies, along

with an improved metabolic profile when compared to those not receiving supplementation. Sartorius scores were reduced on average from 38.3 ± 7.75 to 27.3 ± 13.53 ($P < 0.04$), while the control group not receiving the dietary supplement exhibited a reduction in Sartorius score from 38.4 ± 7.88 to 31.1 ± 8.02 ($P = 0.55$). Homeostasis Model Assessment of Insulin Resistance (HOMA-IR), a tool used to measure insulin resistance and beta-cell function, also exhibited a statistically significant reduction from 2.43 ± 0.35 to 2.1 ± 0.31 ($P < 0.01$) whereas the control group did not show significant reduction.³⁸ The study was limited by its open label design, small sample size, inclusion of only overweight patients (none met obese criteria), and inclusion of only mild to moderate HS (Hurley scores of I–II). It was also funded by the makers of Levigon[®]. The results of this study must be cautiously considered in light of its limitations; however, the potential role of metabolic profile in HS is again highlighted here.

Diets that purport to impact the skin-gut axis

Several diseases that affect the gut also manifest in the skin and vice versa. Both a balance in the gut and skin microbiota are important in maintaining homeostasis. Cumulative evidence has shown that there is a bidirectional connection between the gut and skin, with many studies linking gastrointestinal health to skin homeostasis and allostasis.^{39,40} Some have proposed this skin-gut axis to exist in HS as well, implicating a “leaky gut” and the GI microbiome in problems of the skin, suggesting that if disruption of the gut microbiome and immune milieu occur, it could induce the pathogenic pathway of an inflammatory pilosebaceous disorder such as HS. An association of HS with inflammatory bowel disease, especially Crohn’s disease, raises the question of whether a Crohn’s specific diet could help control HS.^{16,41} One proposed diet is the paleo diet – a gluten-free, dairy-free, grain-free, legume-free, night-shade free diet – thought to promote gut microbiome diversity and prevent opportunistic bacterial overgrowth. Nightshades, which include potatoes, tomatoes, eggplant, paprika, and peppers, are eliminated in this diet. They are thought to increase intestinal permeability via components like glycoalkaloids, alpha tomatine, and capsaicin. Patients may choose to employ a nightshade-free diet exclusively or may also choose to eliminate alcohol or caffeine.⁴² A similar, but more restrictive, diet is the autoimmune protocol (AIP) diet, which has been suggested in the lay literature for control of HS flares.⁴³ In addition to the typical paleo diet restrictions, the autoimmune protocol focuses on meat and vegetable intake and includes limitations to gum, eggs, nuts, seeds, and artificial sweeteners. No studies have been conducted to formally evaluate the benefits of these diets.

The elimination diet

Desperate patients often opt for a complete elimination diet, especially when specific dietary restrictions fail. These vary

Table 1 Evidence levels of published literature and lay recommendations regarding diet in HS

Published literature Level 3–5: Moderate-to-low quality evidence	Lay recommendations Level 5: Low quality evidence
Elimination methods: <ul style="list-style-type: none"> • Dairy products: casein, whey, natural androgens • High glycemic load: increased insulin and IGF-1 • Wheat and brewer’s yeast Therapies: <ul style="list-style-type: none"> • Curcumin • Vitamin D • Zinc • Levigon[®] 	Elimination methods: <ul style="list-style-type: none"> • Paleo diet • Nightshade free diet • AIP diet • Elimination diet • Alcohol • Caffeine Therapies: <ul style="list-style-type: none"> • Omega-3 • Chinese herbal medicine • Acupuncture/electro-acupuncture

Evidence Levels (high-to-low quality) – Level 1: Randomized controlled trials. Level 2: Prospective comparative studies. Level 3: Case-control studies, retrospective cohort studies. Level 4: Uncontrolled cohort studies, case series. Level 5: Expert opinions, case reports, personal observations.

in scope and specifics, but the idea is to eliminate all possible dietary triggers for a set number of days to months and then slowly re-introduce each new component of diet, all the while keeping track of the foods the patient is ingesting and whether or not their HS symptoms flare or recur afterwards.⁴⁴

Conclusion

Hidradenitis suppurativa remains a frustrating and discouraging disease for patients and clinicians who are desperate for a cure. With this review, we hope to stimulate further discussion and interest in an area of dermatology research that is lacking. Observational dietary studies are difficult to design and conduct to avoid biases, as patients typically should be kept on their existing treatments, thus potentially introducing confounding variables. In addition, adherence to strict dietary restrictions is challenging. Zero dairy intake, low glycemic load diet, and weight loss may be beneficial as adjuvant therapy in HS. However, at present, inquiry into the role of diet and metabolic control in the prevention and treatment of HS remains largely speculative (see Table 1). It is unclear whether diet may prove to be of value in limiting the severity of HS. Thus, there is potential for increasing the understanding of dietary impact on the pathophysiology of HS, whether through larger, randomized, controlled prospective trials or through evaluation of the molecular impact of dietary changes and supplements.

Questions (answers provided after references)

- 1 Which of the following are true for HS?
 - a Also known as acne inversa
 - b Characterized by abscesses and sinus tract formation
 - c More common in men than in women
 - d Commonly occurs in the axillae, groin, buttock, inframammary folds
- 2 True or false: in general, the higher a patient's BMI, the more severe their HS.
- 3 True or false: liposomal magnesium may cause improvement in fasting glucose and insulin sensitivity.
- 4 Published literature has shown improvement of HS with all of the following except:
 - a Use of metformin
 - b Weight loss
 - c Acupuncture
 - d Low glycemic diet
- 5 True or false: A plethora of studies have been performed to evaluate the benefits of dietary modification in HS.
- 6 Low zinc levels have been found to be more prevalent in HS patients with what stage of disease?
 - a Hurley stage I
 - b Hurley stage II
 - c Hurley stage III
- 7 What else has been observed to be deficient in HS patients?
 - a Vitamin A
 - b Vitamin D
 - c Folic acid
 - d Vitamin E
- 8 Nightshades include:
 - a Potatoes
 - b Tomatoes
 - c Eggplant
 - d Avocado
- 9 Elimination studies of the following have shown some improvement in HS patients except:
 - a Shellfish
 - b Simple carbohydrates
 - c Dairy
 - d Brewer's yeast
- 10 The ductal blockade contributing to HS can be exacerbated by all of the following except:
 - a Whey
 - b Caffeine
 - c Casein
 - d Androgens

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Answers

- 1 a, b, d
 2 True
 3 True
 4 c
 5 False
 6 c
 7 b
 8 a, b, c
 9 a
 10 b