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# *The Link Between Diet and Gout and the Role of Dietary Intervention in Its Management*

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***Abstract:*** Gout across different ethnic and geographical groups. Also, the research into the interactions between dietary elements and their association with metabolism in vivo must be further developed. This paper examined the pathogenesis and impact of dietary structure on gout (using the Guangdong region of China as an example), and the role of food and metabolic factors. The study also explored dietary recommendations for different stages of the disease and comprehensive treatment options. There are still many questions. Future studies could focus on, as a common inflammatory disease, is closely linked to purine metabolism disorders and excretion problems. It is a worldwide problem. It is not only associated with joint pain but also a number of comorbidities that can seriously affect the quality of life for patients and increase the burden on social healthcare. There are still some gaps in current research. For example, there is a lack of comprehensive studies that examine the effects of dietary composition on the relationship between gout and diet in different regions and races and investigate the interactions and metabolism associations of dietary ingredients to open new avenues for prevention and treatment.

***Keywords:*** gout, dietary intervention, treatment

## 1. Introduction

Gout, which is the most common form of inflammatory arthritis and is caused by purine metabolism problems, is closely linked to impaired excretion. When serum uric levels continue to increase, sodium urate is deposited in joints and other tissues. This leads to recurrent acute inflammation and uric-acid nephropathy. Around 41 million people suffer from asthma worldwide. According to the National Health and Nutrition Examination Survey 2015-2016 (NHANES), 3,9% (9.2) of U.S. adult sufferers have gout. Patients often experience severe joint pain when gout attacks. Gout has also been linked to obesity, high blood-pressure, chronic kidney disease and erectile disorder. Gout is not only a serious condition that affects patients' quality of life, but it also has a significant impact on the health of society and families. Obesity (1014%) and cardiovascular disease (1014%) are associated with an increased risk of mortality and morbidity [1].

However, there are no studies examining prospective associations between vegetarian diets and gout risk. Although the relationship between gout and individual foods or nutrients has been investigated, research on the effect of overall dietary patterns (the combined effects of a variety of foods) on the risk of gout has been limited to a single study that found a negative association between gout and the Dietary Approaches to Stop Hypertension (DASH) [2]. This study, however, was only conducted on men and did no analyse whether the association between gout and diet was dependent

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on uric/hyperuricemia. Patients with gout are more likely to have metabolic syndrome, and hyperuricaemia asymptomatic is more common among patients with metabolic syndrome. Diet is a key factor in gout, and other chronic diseases that are associated with gout. It has been hypothesized that dietary purine intake contributes to an increase in uric acid, which has a negative impact on hyperuricemia and the development of gout. There has been a great deal of interest in the potential effects dietary interventions can have on gout. This is due to the importance of dietary and metabolism factors in many common comorbidities of patients with gout. This review will focus on the relationship between diet and gout, and the role that dietary interventions can play in its management.

## 2. Pathogenesis of gout

The pathogenesis for gout includes uric-acid imbalance, uric-acid crystal deposition, chronic gout, and kidney damage. Increased uric acid is produced when the body's purine metabolic process is abnormal or when red meat, seafood, and other foods high in purine are consumed excessively. It is easy to form urate crystals if the blood uric level is high for a prolonged period of time (>6.8mg/dL) [3]. Sodium Urate Crystals are deposited mainly in soft tissues, such as the joints, synovium and cartilage. Sodium urate crystals are recognized by the immune system as a foreign substance, which activates inflammatory substances such as NLRP3 as well as pro-inflammatory factors like IL-1b [4]. Uric acid crystals are also deposited in the interstitium and renal tubules, triggering inflammation, and contributing to fibrosis. This leads to the decline in renal function. Uric acid crystals can also cause kidney stones, which can lead to renal colic or urinary obstruction.

### 2.1. Dietary structure in Guangdong

There are five main dietary structures in the world, namely the Western diet, the Mediterranean diet, the Oriental diet, the vegetarian diet and the traditional diet. The dietary structure of the Guangdong region belongs to the category of Oriental Diet, as a typical representative of the dietary culture of southern China, it combines the unique cultural connotation and geographical environment factors of the Lingnan region. The Guangdong diet takes rice as its staple food, pays great attention to the diversity of ingredients, emphasizes the original flavor of the ingredients, and has a variety of cooking techniques. Soup culture and dim sum culture flourish here, fully demonstrating the Cantonese people's persistent pursuit of health, deliciousness and the importance of quality of life. Purine metabolism pathway includes several aspects, including synthesis from the beginning, catabolism and rescue mechanism.

#### 2.1.1. Component-food-metabolism specific effects on gout production

Purine metabolism includes several aspects including synthesis at the beginning, catabolism, and rescue mechanism. Purine metabolism is activated by the following pathways: depletion endogenous adenosine Triphosphate (ATP), due to ischemia or depletion exogenous ATP, due to alcohol or fructose ingestion; second, cell regeneration; and third, consumption purine-containing food. In Guangdong people consume foods high in purine, such as red meat and seafood. Adenine and Guanine are the two main components of nucleotides. Nucleotidase is used to dephosphorylate and deamidate adenosine monophosphate (AMP) to produce inosine. Nucleotidase dephosphorylates guanosine to form guanosine. Purine nucleosides (PNP) converts isosine and guanine into hypoxanthine. Xanthine oxidase (XOD), a enzyme that produces superoxide, uses hypoxanthine to produce superoxide. This superoxide then undergoes further oxidation to form uric acid by XOD. Guanine is deamidated by guanine-oxidase to form xanthine. This is then oxidized to produce uric acid. The majority of uric acid in the body is a salt called "urate". When the level of urate in your

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blood exceeds a certain amount (6.6 mg/dL), it begins to crystallize into monosodium. The immune system will recognize the sodium as a foreign substance, and trigger an immunological response.

Gout is caused by abnormal uric-acid metabolism. The microbiome is a community of bacteria and microorganisms that reside in the intestine and contain enzymes and proteins. This microbiome accounts for approximately one-third of total uric-acid elimination. Functional microbiome research has shown that gut-associated microbiota such as Lactobacillus and Pseudomonas members, and Enterobacteriaceae degrade uric acids by uricase enzymes and allantoinase to allantoin and urea. The uric acid pathway is depleted among gout patients' gut microbiota compared to healthy individuals [5,6].

#### 2.1.2. Impact of other dietary factors on gout

In 2004, a 12-year research showed that an increase in milk consumption was associated with reduced risk of gout. (OR: 0,56, 95%CI: 0,42 - 0.74) Later investigations revealed that this negative correlation was only for low-fat milk and specific reference intakes (240mL/day). This study also found that low-fat milk yogurt can reduce the risk of gout. This finding was also confirmed by a second study that included 2,076 Scottish participants. Skim milk and low-calorie yoghurt were found to reduce the risk of gout. Whole milk did not have this protective effect [5]. The ways in which increased milk intake lowers the risk of gout are diverse. Previous research suggests that casein, whey protein, and vitamin D in milk might be implicated. This study presents a new perspective, suggesting that BCAAs in milk may contribute to its protective effect against gout.

### 2.2. Dietary interventions in the acute onset of gout

The typical symptom of acute gout onset, known as a gouty attack or acute gouty arthritis, is sudden and severe pain. The pain often occurs at night or early in the morning without warning, reaching its peak within a few hours. The most commonly affected joint is the big toe, specifically the first metatarsophalangeal joint. However, other joints such as the ankles, knees, wrists, and fingers can also be affected. During an attack, the affected joints exhibit significant redness and swelling, feel hot and painful to the touch, and experience severe movement restrictions. In severe cases, walking or bearing weight may become difficult. If left untreated, an acute attack typically lasts from a few days to two weeks, after which symptoms gradually subside and resolve [6]. The American Dietetic Association Nutrition Care Manual recommends the following

During an acute attack:

1) Consume 8 to 16 cups of fluid/day, at least half as water.
2) Abstain from alcohol (should be discussed with physician).
3) Limit animal foods.
4) Eat a moderate amount of protein. Recommended sources: low-fat or nonfat dairy, tofu, eggs, and nut butters.
5) Limit meat, fish, and poultry to 4 to 6 oz/day [7].

#### 2.2.1. Dietary interventions in gout remission

Gout remission is the stage in the course of gout when symptoms temporarily disappear or lessen. Gout is divided into acute attack and remission phases. The remission phase refers to the stage when the acute inflammation subsides and the joint pain and redness disappear. Although there are no symptoms in this period, hyperuricemia persists, and uric acid crystals may be deposited in the joints or tissues, laying the groundwork for the next attack. The three main diets associated with hyperuricemia and gout are the DASH, the Mediterranean diet, and the low purine diet [8]. The focus of this discussion is the DASH diet, a dietary pattern that promotes the consumption of fruits, nuts,

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legumes, vegetables, grains, and low-fat dairy products while limiting the intake of sodium, sugar-sweetened beverages, red meat, and processed meats. The DASH model includes several components that are considered potentially protective against head and neck cancer (HNC), such as fruits and grains, while reducing the intake of harmful ingredients like red and processed meats [9].

One study looked at the effects of a DASH diet on the uric acid level in gout sufferers. In this crossover randomized controlled pilot trial, 43 adults with severe gout were randomly allocated to either receive dietitian-directed grocery (DDG) of self-directed grocery (SDG), both modeled after the DASH Diet. Participants then crossed over to the other group without a washout. The DDG group experienced a 0.55mg/dL drop in serum uric levels, whereas the SDG group did not show any change. In the second phase, the results were reversed. The serum uric levels decreased by 0.48mg/dL for the SDG group, but only by 0.05mg/dL for the DDG group. Overall, no significant differences within-person were observed between the periods. This may be due to residual effects from the lack a washout time.

To date, no published studies have evaluated the effect of the DASH diet on gout flares or gout stones. Given the slight reduction in serum uric acid levels observed with the DASH diet in non-gout patients and the limited data available for gout patients, it remains unclear whether the DASH diet alone would have a meaningful impact on clinically relevant outcomes in gout. The American Dietetic Association Nutrition Care Manual recommends the following

In remission:

1) Drink 8 to 16 glasses of fluids a day, at least half as much as water.

2) stop drinking alcohol

3) follow the Dietary Guidelines for Americans' balanced diet plan. Eat animal foods to the extent allowed. Continue to eat moderate amounts of protein.

4) Maintain ideal body weight. Avoid fasting or high-protein diets to lose weight [7].

### 2.2.2. Integration of dietary interventions with other therapeutic approaches

A multifaceted approach is required to successfully manage gout. This includes flare treatment, long-term ULT (ultrasound therapy), patient education, disease monitoring, and comorbidity control. Colchicine, NSAIDs and corticosteroids are first-line anti-inflammatory treatments for gouty episodes. In practice, the treatment choice is usually based on the patient's comorbidities as well as the likelihood of drug interaction. IL-1 inhibitors are effective for those who cannot use these treatments. The Society of Rheumatology Professionals suggests that long-term ULT be used to prevent attacks and achieve a sustained decrease in serum urate of 0.36mmol/L (6mg/dL). ULTs are currently available in the form of xanthine-oxidase inhibiters, uric acid excreting agents, and recombinant Uricase. During the early stages of uric-acid reduction, gouty attacks can increase. Anti-inflammatory prophylaxis is recommended with low-doses of colchicine, NSAIDs or prednisolone [10].

## 3. Conclusion

This article centers on the association between diet and gout and the role of dietary intervention in gout management. In terms of the pathogenesis of gout, when the human body has abnormal purine metabolism or consumes too much high-purine food, uric acid production increases, and high levels of uric acid in the blood are prone to form sodium urate crystals, which are deposited in the joints, kidneys and other tissues, triggering inflammation and tissue damage. Dietary structures such as the Oriental diet in the Guangdong region activate purine metabolic pathways, contributing to uric acid production. In studies on the effect of diet on gout, increased intake of dairy products has been found to be associated with a reduced risk of gout, possibly involving casein, whey protein, vitamin D and

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branched-chain amino acids in milk. The American Dietetic Association's Nutritional Care Manual gives dietary recommendations during different stages of gout, such as acute attacks and remission. In acute exacerbation, adequate water intake, abstinence from alcohol, and restriction of animal food and high purine food intake should be ensured; in remission, the same should be done by ensuring water intake, abstinence from alcohol, following a balanced diet program, and maintaining an ideal body weight. In addition, it is also described that gout management requires a combination of medication, patient education, and other multifaceted measures in addition to dietary control.

This study clarifies the close association between diet and gout and provides an important basis for gout prevention and management. The actionable and potentially effective nature of dietary interventions as part of gout management provides clinicians and patients with specific directions for dietary guidance. Although the relationship between diet and gout has been studied in various aspects in this paper, there are still some unanalyzed elements. For example, the study on the influence of differences in dietary structure on gout in different regions and ethnic groups is not comprehensive enough. The paper focuses solely on the dietary structure of Guangdong as an example and does not address the impact of diet on gout in other representative regions. Additionally, the relationship between diet and gout among different ethnic groups with varying genetic backgrounds and lifestyles has not been fully considered. Future research could expand the scope of the study by conducting large-scale epidemiological surveys across different regions and ethnic groups to explore the relationship between various dietary patterns and gout in greater depth.

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