Dietary Inflammatory Index and Hyperuricemia

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Dietary Inflammatory Index (DII) scores have been consistently associated with several chronic diseases.

dietary inflammatory index hyperuricemia diet risks

1. Introduction

Hyperuricemia is defined as an increased concentration of uric acid in the blood and occurs due to urate overproduction or because of impaired urate excretion through the kidney and gastrointestinal tract [1][2]. It is considered to be a precursor of gout and associated with other complications such as hypertension [3], chronic kidney disease [4][5], diabetes [6], myocardial congestion and stroke [7]. The prevalence of gout and hyperuricemia is increasing globally and has emerged as a major public health concern in recent years. According to previous studies, the prevalence of hyperuricemia is about 11–17% in the Western population [8] and approximately 5.5% to 23.6% in the Chinese population [9].

Although risk factors for hyperuricemia have not been fully determined, recent studies have shown that chronic inflammation is correlated with hyperuricemia [10][11]. Hyperuricemia is involved in the initiation and progression of inflammation through a complex mechanism. Kidney injury, as the main cause of uric acid excretion disorder, is linked to pro-inflammatory cytokines and markers of inflammation [12]. Some nutrients can also alleviate hyperuricemia nephropathy by reducing the level of inflammation [13].

Diet is one of the main modulators of subclinical inflammation and is associated with hyperuricemia [14][15][16]. Previous research suggests a direct association between specific dietary components (or dietary patterns) and inflammation [17][18]. For instance, red and processed meat, high-fat dairy products and refined grains are pro-inflammatory and are associated with increased levels of high-sensitivity C-reactive protein, interleukin-6 and fibrinogen [17][19][20]. Meanwhile, whole grains, fruit and green vegetables are associated with low levels of inflammatory markers [21]. Previous studies also found that anti-inflammation diets and low inflammatory potential diets were associated with low risks of non-commutable diseases such as obesity, type 2 diabetes mellitus and cardiovascular disease [22].

The Dietary Inflammatory Index (DII) was developed in 2009 and updated in 2014 [23][24], and aims to specifically measure dietary inflammation potential. It is composed of 45 food parameters based on the balance of pro and anti-inflammatory properties of its components. A higher DII score represents a pro-inflammatory diet, whereas a

lower DII score represents an anti-inflammatory diet. DII scores are standardized to global dietary intakes, allowing their use across different cultures and dietary patterns.

2. Data Collection and Samples

Researchers used data from the China Health and Nutrition Survey (CHNS), an ongoing open cohort of more than 30,000 subjects from 15 provinces and municipal cities, designed to reflect the nutritional and health status of the Chinese population. The first round of the CHNS started in 1989, and a total of 10 surveys have been carried out so far. Biomarker data were collected in the 2009 survey. Details of the CHNS have been described previously [25]. In this study, the data from the 2009 survey were used.

According to the conclusion of previous relevant studies [8][26], current study included nutrition status and general demographic information. Personal dietary data was collected by a 3-day 24 h meal review, and general demographic information was collected by a face to face interview questionnaire. Of the 18,805 participants in 2009, researchers identified 9549 subjects with serum uric acid index and dietary data. After excluding participants who were pregnant, or for whom there was incomplete information, 7880 adult subjects were finally included in the study.

The CHNS was approved by the Institutional Review Board of the University of North Carolina at Chapel Hill, and the National Institute for Nutrition and Health (NINH, former National Institute of Nutrition and Food Safety) at the Chinese Center for Disease Control and Prevention (CCDC), and all participants gave written informed consent.

3. Current Discussion

In this cross-sectional analysis, researchers observed that a higher DII score, which is indicative of a pro-inflammatory diet, was associated with a higher risk of hyperuricemia. These findings remained true after adjustments were made for a range of confounding factors. Researchers also found positive associations between higher intakes of proteins, fats and alcohol with uric acid.

Previous studies have examined the relationship between dietary inflammation and hyperuricemia. A Korean study suggested that women in the highest DII score group had a higher risk of hyperuricemia than those in the lowest group [26], which is comparable to the findings of current study. However, researchers found that this association was true for both male and female subjects. Current study showed that compared to the highest DII score, all of the female subjects in other groups and male subjects in the lowest and second-lowest groups had lower risks of hyperuricemia. This indicates a strong relationship between dietary inflammatory potential and hyperuricemia in the Chinese population. This may be due to the dietary gap between men and women in the two countries. Traditional Korean diets contain more seafood and ferment foods, while the traditional Chinese diet contains more cereals and livestock meat [27]. Furthermore, the risk of hyperuricemia in female subjects with less dietary inflammatory potential is lower than that in male subjects, suggesting that the association between dietary inflammation and hyperuricemia seems to be stronger in female individuals.

Researchers found that there was a difference in diet between the hyperuricemia and the non-hyperuricemia groups in the Chinese population. The hyperuricemia group had a lower average energy intake and higher energy-adjusted protein and fats. This finding is contrary to previous studies, which have suggested that weight-loss diets may lower serum urate [28]. These data must be interpreted with caution, since weight-loss diets not only have lower calorie intake but also have different proportions of foods and macronutrients. Meanwhile, in the DII calculation, there was no differentiation between plant-sourced proteins and animal-sourced proteins. A higher intake of protein and fat may also suggest a higher intake of animal food, which is thought to be associated with hyperuricemia [29]. Researchers also found that alcohol intake in the hyperuricemia group was higher than the non-hyperuricemia group, which was consistent with other studies. In current study, alcohol intake (1.91 g/d) was much lower than the global daily mean intake in the DII data set (13.98 g/d). Alcohol was considered as an anti-inflammatory parameter in DII calculations, but it is important to note that the abuse of alcohol can seriously damage health.

Dietary factors can affect the development of hyperuricemia and the severity of the symptoms, as well as the inflammatory response. Vitamin C and vitamin E reduce serum uric acid levels through their antioxidant activity [30][31]. Flavonoids reduced uric acid levels, suppressed ROS and protected from kidney damage in several animal studies [32][33]. Inflammation may raise blood uric acid through several potential mechanisms, and oxidative stress is considered to play a crucial role in the inflammatory response. The kidneys play a major role in UA homeostasis, as more than 70% of urate excretion is renal [34]. Chronic inflammation is one of the main mechanisms of renal inter-tubule injury and may ultimately affect the excretion of uric acid [35][36]. Researchers found that a diet's inflammatory potential can influence hyperuricemia risk, yet further studies are still required to confirm the potential mechanisms and to reveal other possible mechanisms underlying the association between diet, inflammation and uric acid. Current results found that there is the possibility of reducing hyperuricemia and gout through dietary patterns. Given that patients with hyperuricemia and gout often prefer non-pharmacological approaches such as dietary management [37], the adoption of changing the patient's dietary pattern or dietary guidance will be important considerations.

It is noteworthy that some foods might exert both beneficial and detrimental effects on uric acid levels at the same time. Legumes, for instance, are rich in purine and soybean isoflavones [38]. Previous studies on legumes showed inconsistent evidence of the relationship between legumes and hyperuricemia [16][39]. These plant compounds are often considered as anti-inflammatory factors in the calculation of DII scores, resulting in lower outcomes, but purines in these foods may influence the ultimate effect on hyperuricemia. The effect of purines in food on hyperuricemia was not considered in current study, and further research into this subject is needed.

Strengths of this study include the accuracy of dietary intake data and population-based design. The data were obtained from the CHNS, covering 15 provinces or municipalities, which is more representative of the Chinese residents. The CHNS used a 3-day 24 h meal review to collect diet data, and nutrients in foods were calculated by the CFCTSD and subsequently determined and compiled by the CCDC.

There are some limitations of this study. Firstly, this was a cross-sectional study that cannot account for temporality. Besides this, information about self-aware hyperuricemia or gout history was not available through the questionnaire or interview in the CHNS, and subjects diagnosed with gout or hyperuricemia might change their diet pattern. Therefore, the causality of diet and hyperuricemia cannot be established. Secondly, hyperuricemia was defined by a single blood test of the study population in the CHNS, and the diagnosis in the guideline required two determinations of serum uric acid levels at different times. Therefore, the results of serum uric acid may not represent the true situation. Finally, Researchers included only 28 indicators that were used to calculate the DII, because some of the parameters had insufficient information due to objective conditions. This may have narrowed the effective range of the DII score. Although evidence suggested that the predictive ability was not affected when fewer parameters were used to calculate the DII scores [40], the possibility of affecting the relationship between the DII score and hyperuricemia, due to the lack of parameters, cannot be completely ruled out.

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