The Correlation of Dietary Pattern Mediated Intestinal Flora to Disease

Xinran Zhang *

Huankui Academy, Nanchang University, Nanchang, Jiangxi, 330031, China

* Corresponding Author Email: mengying@ldy.edu.rs

Abstract. At present, many popular diet patterns emerge in an endless stream, but the pros and cons of these diet patterns, the application time and the applicable population are worth studying, and blindly following the trend will often backfire. At present, many experts have studied the application mechanism of various dietary patterns, the impact on the gut flora, and the suitable population. Many dietary therapies have been applied in clinical practice, and there are also studies on probiotics combined with dietary pattern therapy with many people, and the effect is much higher than that of dietary pattern assisted therapy alone. But how to use dietary patterns to maintain the balance of gut flora and thus treat patients needs to be more deeply related. This paper analyzes the dietary therapy of the current popular diseases HUA\ gout and intestinal inflammation, and analyzes the advantages and disadvantages of the current popular dietary pattern and the suitable population for these two diseases. According to the intestinal flora, the mechanism of health regulation of different dietary patterns was analyzed, and the advanced therapy of probiotics combined with dietary patterns was analyzed, and the dietary patterns adapted to different populations were obtained. This paper makes the clinical and dietary cross-treatment of different diseases clearer and more intuitive, but the application time of different dietary patterns and the applicable environment and regulation of probiotics still need more in-depth research. Future studies could focus on the duration of different dietary patterns and the direction of side effects.

Keywords: Intestinal flora; dietary patterns; HUA; intestinal inflammation; obesity.

1. Introduction

Diet is vital to human life and health, and many food-borne diseases are currently key issues of social concern, such as cardiovascular and cerebrovascular diseases and diabetes. Therefore, many studies focus on the intrinsic connection between diet and human health. Through the tireless efforts of countless predecessors, an increasing number of dietary patterns have been presented to the public. There are numerous popular dietary patterns today, including the USDA Dietary Guidelines, vegetarianism, the Mediterranean Diet (MD), the Standard American Diet, the Paleo Diet, Low-Carbohydrate Diets (LCDs), the Ketogenic Diet (KD), and the Carnivorous Diet and so on.

A low-fat, high-carb diet is encouraged by the USDA Dietary Guidelines, which also call for consuming more vegetables, fruits, beans, whole grains, dairy products, and lean meats while reducing intake of sweets, trans fats, and saturated fats. Vegetarianism promotes a diet derived solely from plants, with some allowing for the inclusion of eggs and dairy products. It is advised that those following a vegetarian diet supplement their intake with vitamin B12, as this vitamin is only found in meat and eggs [1]. MD is characterized by olive oil and cheese, with a focus on high-quality carbohydrates from vegetables, fruits, and unrefined grains, complemented by a modest amount of seafood and protein from fish. The Standard American Diet is marked by a heavy reliance on processed, ready-to-eat foods, such as refined grains, processed meats, sugary beverages, fast food, sweets, and fried foods. The Paleo Diet embraces natural foods, including vegetables, fruits, meats, organ meats, eggs, nuts, and root vegetables, while avoiding grains, legumes, processed foods, sugar, dairy products, refined oils, alcohol, and coffee. LCDs encourage the consumption of natural whole foods, reduction in sugary foods, more fats and dietary fiber, and appropriate protein intake. This diet is often used for weight loss, and to prevent diabetes, insulin resistance, and inflammation. The KD is an even stricter low-carbohydrate approach, consuming less protein, and having plenty of dietary fats, typically including nuts, heavy cream, avocados, coconut oil, meats, eggs, and dairy products

[2]. In contrast to vegetarianism, the Carnivorous Diet supports animal-based foods such as meat, eggs, and dairy, excluding all vegetables, legumes, and grains. This diet is often chosen to alleviate allergic symptoms associated with plant-based diets, such as inflammation, fatigue, gas, and joint pain. However, are these dietary patterns all beneficial without any harm? The answer is clearly no. For example, the MD may not be appropriate for people who need to strictly restrict their caloric intake, even though it is high in dietary fiber, vitamins, minerals, and antioxidants that can help lower the risk of diabetes, cardiovascular disease, and some types of cancer. Foods high in salt may not be good for people with high blood pressure. The KD, too, is beneficial for rapid weight loss and improved metabolic health due to its high-fat, moderate protein, and very low-carbohydrate composition. However, it may lead to nutritional imbalances, deficiencies in vitamins and minerals, and could potentially increase the burden on the liver and kidneys with long-term adherence. The KD is well-suited for those needing quick weight reduction, as it restricts carbohydrate intake and accelerates fat burning.

Although many dietary patterns have been studied and applied, the relationship between human gut microbes and diseases and the internal mechanism need to be further explored. Based on the application of diet patterns such as Mediterranean diet and vegetarian diet and their suitable populations, and combined with recent research progress, this paper will further analyze the influence of different diet patterns on the control of uric acid level and IBD incidence in patients with hyperuricemia (HUA)\ gout, providing dialectical ideas for future research.

2. Effects of Intestinal Flora on Uric Acid Levels under Different Dietary Patterns

With the rapid economic development and the improvement of living standards, the number of sub-healthy people is on the rise, which can be attributed to the prevalence of internal illness (the sudden increase in competitive pressure), irregular rhythm and unhealthy eating patterns. The incidence of HUA and gout is also increasing year by year, the number of people remains high, and young people have become a new trend of HUA and gout. Dietary management is an important adjunct therapy for patients with HUA and gout. However, the use of dietary patterns is a double-edged sword. Many studies have shown that foods with high protein, high fructose and high purine are the promoters of HUA. In other words, the correct use of dietary patterns is also an important tool to reduce the incidence of HUA and gout. In recent years, people have been searching for the main mediators between diet and disease, and gut flora has been proven to be a major mediator. The nutrients in certain foods will favor certain gut flora, and over time, these gut florae will become the dominant population in the gut, and the rest of the gut flora will be gradually depleted. In addition, the body's metabolic response to different nutrients in the diet is also influenced by a variety of gut flora, and these effects will over time have a response to health and disease. Therefore, it can be said that diet can mediate the intestinal flora to affect the occurrence of a range of diseases. In fact, the intestinal flora of patients with many diseases will show significant characteristics, for example, the diversity and richness of intestinal flora in patients with HUA\ gout will decrease [3]. The imbalance of purine metabolism in the body will promote the increase of uric acid in the blood, thus inducing the occurrence of diseases. This is due to the increase of inflammatory factor producing bacteria and opportunistic pathogens in the intestinal flora of HUA\ gout patients, such as Bacteroides faecalis, Escherichia coli, Shigella, etc. [3]. Different dietary patterns are a good way to control uric acid levels. It may change the growth and community dynamics of different microbial species. It is known that dietary pattern has long-term selection pressure on intestinal flora, so from the perspective of dietary patterns, the effects of intestinal flora on uric acid levels under several different dietary patterns of low purine diet, Western diet and Mediterranean diet were introduced in detail.

2.1. Low Purine Dietary Pattern

The end product of purines is uric acid, and lowering purine intake has long been considered a good way to control uric acid levels. In people without gout, intake of purine-rich foods is associated with elevated serum uric acid and risk of sudden gout. The low purine diet pattern that restricts protein intake can theoretically control the incidence to a certain extent, but the side effects of a diet for a long time are not negligible. For example, in order to balance the energy supply, the body will often make up for the protein energy gap through the intake of excessive carbohydrates and fats. But behind it, which may be invisible, is the consumption of more processed foods and trans fatty acids, which is also beneficial for lowering uric acid.

2.2. Western Eating Patterns

The high-fat dietary pattern leads to the release of pro-inflammatory cytokines, the number or even disappearance of bifidobacteriaceae, which can produce SCFAs to reduce inflammatory factors such as LPS, and the decrease of butyrate, which can change the number and distribution of uric acid transporters [4], which are not conducive to the transport and excretion of uric acid and the decrease of uric acid level.

2.3. The Mediterranean Diet

The influence and mechanism of different dietary patterns is shown in table 1, studies have shown that the higher the score of the Mediterranean diet, the less susceptible to HUA [5]. The Mediterranean diet has both sides. Rich in MAC and polyphenols, significantly increasing the number of bifidobacteria in the gut [6] and promoting SCFAs production with anti-inflammatory and immunomodulatory properties [7] are undoubtedly the benign aspects of the Mediterranean diet. On the other hand, unsaturated fatty acids that can up-regulate inflammation [6], excess MUFA that reduces lactobacillus abundance, and ethanol accumulation can significantly increase the rate of purine biosynthesis [8]. Therefore, the shortcomings of the Mediterranean dietary pattern cannot be ignored. In future studies, more in-depth research can be introduced to explore the two sides of this dietary pattern.

Table 1. The influence and mechanism of different dietary patterns on uric acid level.

Dietary pattern	Food source	Food feature	Effects on intestinal flora	Mechanism of influence on uric acid level	Effects on uric acid levels	Document
Low purine diet	Grains, eggs and milk, most vegetables and fruits, and a few aquatic products	Reduce purine intake		By reducing purine intake	Drop	[9]
Western diet	Lots of animal fat	Saturated fatty acids rich	Proteus genus increased; Prevotella, extreme halophile, Archaea and Lactobacillus decreased, and bifidobacteriaceae disappeared	By promoting inflammatory factors	Rise	[10]
	Lots of animal meat	Protein rich	Bifidobacterium, Rothella and eubacterium rectum were reduced			[11]
Mediterranean diet	Plant food	MAC rich	Bacteroides, Bifidobacterium and ruminococcus increased; enterobacteria	By reducing xanthine oxidase activity and reducing inflammatory factors	Drop	[12]
		Polyphenols rich	Bifidobacterium and Lactobacillus increased, while clostridium, Enterobacter and salmonella decreased			[13]

	Large quantities of aquatic and animal meat	Adequate amount of aquatic -n-3 fatty acid is abundant	Bifidobacterium increased, enterobacterium decreased	By lowering inflammatory factors	Drop	[14]
		Adequate amount of aquatic -n-6 fatty acid is abundant	Bifidobacteria decreased and enterobacteria increased	By promoting inflammatory factors	Rise	[15]
		Moderate amount of aquatic - animal protein (meat) abundant	Bifidobacterium, Rothella and eubacterium rectum were reduced	By promoting inflammatory factors	Rise	[11]
	Olive oil	MUFA in moderation	Bifidobacterium and lactobacillus increased	By lowering inflammatory factors	Drop	[16]
		Excess MUFA	Increased clostridium; lactobacilosis	By promoting inflammatory factors	Rise	[17]
	Red wine in moderation	Flavones	Clostridium praxis and bifidobacterium increased	By lowering inflammatory factors	Drop	[13]
		Ethanol		Lactic acid impedes renal excretion; purinosis	Rise	[18]

3. Effects of Intestinal Flora on Controling the Incidence of Intestinal Inflammation under Different Dietary Patterns

In addition to HUA\ gout, IBD is also one of the most common diseases nowadays. The proportion of microorganisms in the gut maintains a stable balance of intestinal microecology. The imbalance of intestinal microecology, that is, the reduction of intestinal microbial diversity and structural destruction, has been confirmed to be associated with diseases such as obesity, diabetes and IBD. The correct diet pattern is also one of the important auxiliary treatment methods to control the incidence of IBD, and the selection of diet patterns is an important part of the treatment of patients. Therefore, from the perspective of dietary patterns, dietary strategies for IBD patients such as total enteral nutrition, plant-based diet, Western diet and specific carbohydrate diet (SCD) were introduced in detail.

3.1. Total Enteral Nutrition

Exclusive enteral nutrition (EEN) is the use of a liquid nutritional formula as the sole dietary intake for 6 to 10 weeks. Total enteral nutrition is superior to corticosteroids in alleviating Crohn's disease in children. Studies have shown that there is no difference between the two in inducing remission of Crohn's disease in children, and EEN has the advantage of achieving mucosal healing. But today, the treatment of IBD and other diseases, more than the use of a combination of multiple dietary patterns to ease the disease. EEN persistence is poor, and the mechanism is not well understood, so EEN is not recommended as the only continuous therapy.

3.2. A Plant-based Diet

A plant-based diet (PBD) also has two sides to its effects on the human body. A long-term plant-based diet may lead to a series of side effects such as insufficient protein intake, micronutrient deficiency, and induced overeating. Conversely, a plant-based diet high in polyphenols and dietary fiber can boost intestinal resistance by diversifying the bacteria in the gut. Furthermore, enhancing the quantity of advantageous bacteria like bifidobacterium, lactobacillus, and faecalis might yield advantageous microbial metabolites while preventing the growth of bacteria linked to pathogens [19].

3.3. Western Diet

A Western diet rich in saturated fat, red meat, refined sugars, and processed foods is an unbalanced diet that is not suitable for patients with IBD and may lead to ecological imbalance, leaky intestines, and chronic inflammatory responses. The incidence of IBD will increase with the intake of red meat, and intestinal microbes will also ferment to produce harmful metabolites such as hydrogen sulfide due to a high-protein diet, resulting in impaired intestinal shielding function and immune response. The Western diet may disrupt the regulation of the inflammatory response of the intestinal mucosa, and the additives in it as pro-inflammatory foods may also affect the intestinal flora and promote the occurrence of colitis and metabolic syndrome [1].

3.4. A Specific Carbohydrate Diet

A specific carbohydrate diet (SCD) is a diet in which only foods containing simple sugars are selected from carbohydrates, excluding complex carbohydrates and disaccharides [1]. By avoiding the intake of indigestible components such as complex carbohydrates and disaccharides, ecological disorders, intestinal barrier destruction and inflammatory responses are all suppressed to some extent [19]. Happily, the SCD diet has also shown significant efficacy in clinical studies, alleviating disease symptoms, reducing inflammatory responses, and improving gut microbes.

3.5. Effect and Application of Probiotics on Intestinal Flora

In the above part, this paper introduces that dietary pattern can affect human health by affecting intestinal flora, so it can be seen that regulating intestinal flora is very important for human beings. Now, relying solely on dietary patterns for adjuvant treatment is slightly weak, and probiotics combined with dietary patterns for collaborative treatment of human diseases has become a new situation. Probiotics are living microorganisms that have a beneficial effect on host health. At present, there are many probiotics used in China, mainly bifidobacterium, Lactobacillus, Clostridium butyricum, Saccharomyces burlae, Enterococcus, Bacillus licheniformis and Bacillus cereus. Today, many probiotics combined with dietary patterns for the corresponding diseases have become a major clinical treatment plan. For example, for the human disease that is of great concern to the world today - obesity, many obese patients with long-term high-fat diet patterns make many experts helpless. Obese patients, not only face the psychological trauma of receiving criticism from others, but more seriously, obesity will bring many complications, such as cardiovascular and cerebrovascular diseases, diabetes and so on. In the treatment of obese patients, it is not only difficult to help patients reduce blood sugar and lipids, but also more difficult to change the unhealthy eating pattern that patients have been accustomed to. If you directly force obese patients to eat a normal diet, it can cause emotional damage to patients, even depression, and it is difficult to stick to. After its origin, the long-term high-sugar and high-fat diet has long destroyed the balance of the patient's intestinal flora, and it is difficult to achieve the expected goal by relying on the dietary pattern alone. Probiotics can regulate intestinal flora and maintain the balance of intestinal flora in the intestine. Therefore, the treatment of probiotics combined with dietary patterns has become a hot topic for many experts and doctors. Probiotics combined with a low-GI, low-carb diet is one treatment for patients with obesity. Low GI diet refers to the intake of available carbohydrates and GI≤55 with dietary therapy [20] to reduce the fasting blood glucose level and 2 h postprandial blood glucose level of subjects. After a long-term study, it was found that probiotics combined with diet mode treatment greatly accelerated the repair of intestinal flora and the treatment of obese patients. After the intervention of probiotics combined with low-GI and low-carb diet therapy, the BMI and body fat percentage of patients in the observation group were lower than those in the control group, and muscle percentage was higher than that in the control group. However, some researchers doubt that some probiotics will also harm the intestinal flora under certain conditions and break the intestinal balance, so the treatment plan for probiotics combined with diet patterns and the contraindications of taking probiotics need to be further studied.

4. Conclusion

In conclusion, this paper analyzes the dietary therapy of the current popular diseases HUA\ gout and intestinal inflammation and analyzes the pros and cons of the current popular dietary pattern and the applicable population for these two diseases. According to intestinal flora, the mechanism of different dietary patterns on health regulation was analyzed. The analysis of the above contents provides a reference for patients to adopt what diet pattern to assist treatment, and also provides a healthy diet plan for ordinary people. The advancements of probiotics combined with dietary patterns were also analyzed. It is also a reflection that each dietary pattern has its own advantages and disadvantages and is suitable for a unique group of people, blindly following the trend may only hurt themselves. Moreover, it also teaches us not to look at the problem from a one-sided perspective, but to look at the problem from a dialectical point of view and analyze the problem from multiple angles. However, there are still many unanalyzed questions in this paper, such as how long a dietary pattern can be used as an adjuvant therapy and its side effects. The research on probiotics is still short and shallow, and probiotics combined with diet therapy is still a new show and needs long-term in-depth development. It is expected that future studies will be inspired by this to find effective dietary therapies suitable for different populations and conducive to long-term adherence.

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