The Impact of Nutrition Factors to the Prevention and Treatment of Cancer

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Abstract: Background: People are beginning to realize the important role of nutrition in tumorigenesis, cancer prevention, treatment and cancer recurrence prevention. There have been many studies and conclusions about the effects of various nutrients on various cancers, but many of them have been controversial or inconsistent. Inconsistent results are common in scientific research. Given the impact of nutrition on cancer, it is difficult to get an accurate picture of the impact of each nutrient on cancer at three distinct stages. Methods: The literature search was conducted to find a variety of perspectives on the impact of nutrition on cancer. The aspects include listing the typical types of cancer and the nutritional factors that affect them, clinical risks of nutritional interventions, the effect of nutrition on a certain stage during cancer progression. Then, we appropriately cited and comprehensively elaborate the literature from different perspectives. Results: This review covers the entire process of cancer progression, including tumorigenesis, cancer prevention, cancer treatment and cancer recurrence prevention. Below are the implications, controversies and different results of individual nutrient for certain type of cancer. Conclusions: Diet and nutrition play important roles in tumorigenesis, cancer prevention, treatment and cancer recurrence prevention. Nutrition and some nutritional interventions not only can keep us healthy, but also improve the quality of life, ameliorate treatment outcomes, reduce the incidence of complications, and increase survival rate.

1. Introduction

Cancer is a complex disease that results from multiple factors. It is considered as one of the leading causes of fatality worldwide,[1,2] Even the overall death rate from cancer has increased significantly over time, particularly in the past century.[3] The importance of nutrition relates to a wide range of cancer incidence, outcome and remission of long-term comorbidities after treatment. Unfortunately, nutritional advices in oncology in the twentieth century still remain vague and often contradictory epidemiological studies. In the twenty-first century, many studies have reported that the incidence of various cancers is related to high-calorie diets and obesity. In fact, the incidence of obesity, including insulin resistance are independently considered to increase the risk of cancer. Besides, as which reported, malnutrition accompanied by inflammation can cause cancer patients to lose weight, which is a very common phenomenon in cancer patients. According to the reports, about 40 to 80 percent of the population will suffer from malnutrition during cancer.[23] Furthermore, malnutrition can affect the therapeutic results, delay wound healing, worsen muscle function and increase the risk of postoperative complications. It may also break the tolerability and responsiveness of the anti-tumour treatments, which may prolong patients' time spent in hospital, increase the risk of treatment interruption, and may reduce survival rates.[1-3]

On the other hand, the raising of prospect of an huge public-health and medical-care problem will be caused by the global burden of cancer.The conclusion that nutrition factor plays a major role in cancer is becoming more clear as researchers have been putting more and more efforts and attention to this field. Estimates from the American Institute for Cancer Research and the World Cancer Research Fund that between 30 and 40 percent of all cancers can be prevented through proper diet, physical activity, and maintenance of appropriate body weight. The evidence of consumption of fruits and vegetables on the prevention of cancer are very strong for some cancers, especially for cancers that occur in the gastrointestinal and respiratory tract[3-6].

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2. Nutrition Factors Impact the Prevention of Cancer.

The results of numerous studies have shown that all healthy lifestyle habits can reduce the incidence of cancer and death rate by ten to sixty percent. A recent meta-analysis of 31 studies reported significant reductions in cancer incidence, death rate, and all-cause death in patients who followed diets that ranged high in the Dietary Approaches to Stop Hypertension, the Alternative Healthy Eating Index, and the Healthy Eating Index. According to some studies analyzing macronutrient profiles and inaccuracies in collecting survey data and food frequency questionnaires, even though we can draw a conclusion from these data that healthy diets are related to a reduction in cancer incidence and mortality. However, the benefits of specific dietary interventions remain ambiguous[7-10].

(1) Obesity and diet fat: The connection between the particular type of fat, such as saturated, monounsaturated, or polyunsaturated and some types of cancer has not yet been determined. In the increase of the risk of cancer, the saturate fat is crucial. However, some dietary patterns can reduce the impacts of saturate fat, such as not make the meat as the focus of a meal or eat more beans, grans and vegetables[11]. Obesity is a well-recognized risk factor for adenocarcinoma, possibly due in part to reflux of gastric contents into the esophagus[12,13]. Overweight and obesity raise the risk of colorectal cancer Studies have shown that feeding mice an HFD led to an increase in the number and size of intestinal polyps, a type of precancerous mass. However, this effect may have nothing to do with the amount of fat in the diet and more to do with diet-induced obesity and inflammatory states. Being overweight and obese also increase the risk of liver cancer. Obesity increases the risk of pancreatic cancer by about 20%[14]. Obesity impacts breast tumorigenesis. Enlarged adipose depots grow into a chronic inflammation state, which raise the levels of adipokines and cytokines, leading to the growth of tumor. Obesity boosts the expression of aromatase, which allows fat cells to better convert androgens into estrogen, a known mitogen in breast cancer. In addition, increased local adipose depots in the obese breasts may supply a source of fatty acid reserves that tumors can be used as building blocks. Studies from mouse models adhesion that there is a connection between dietary fat and breast cancer development. The dietary fat is important for tumor progression rather than the resulting obesity. For lean women, obese women are three times more likely to develop endometrial cancer[11-22].

Sugar: According to the studies of mouse models have indicated a bigger association between dietary sugar ingest and breast cancer. A recent NIH-AARP Study (N = 435, 674) found that added fructose was linked with the risk of small intestine cancer (HR = 2. 20, CI95 = 1. 16–4. 16). When there is a high glycemic load, the risk of cancer of gastric, upper aero digestive tract, endometrial, ovarian, colon or colorectal. However, people with different glucose disposal and insulin metabolism have different responses at the same glycemic load[23-32].

Alcohol: Alcohol enlarges the risk of squamous cell carcinoma and the risk of colorectal cancer. Alcohol is a major dietary risk factor associated with liver cancer, presumably on account of the development of cirrhosis and alcoholic Hepatitis. The risk of some cancer increases with alcohol consumption. The oral esophageal cancers are common in some areas that have high consumption of alcohol. The metabolites of alcohol and the alcohol-induced changes in levels of hormones may increase the risk of breast cancer, but the mechanism is still uncertain[33-37].

(4) Smoking: Smoking gain the risk of both types, with a huge influence for squamous cell carcinoma. Smoking grows the risk of colorectal cancer[36]. When the tobacco alcohol combined, the risk of oral and esophageal cancer is higher than their individuals.

(5)Vegetables and fruits: Modern nutrition research shows that eating vegetables and fruits can help people against the cancer as well as many other diseases. According to the Block's review about studies of 200 vegetables and fruits, fruits and vegetables were found to have a significant protective effect in 128 of 156 cases studies with relative risk.

Vegetarians do not eat meat or fish, and generally intake more fruit and vegetables than non-vegetarians, and the combined risk of all cancer sites might be slightly lower for vegetarians and vegans than for non-vegetarians, but the results for individual cancers are inconclusive. The risk of stomach and lung cancer perhaps is decreased by a large number of intake of vitamin C content

from fruits and vegetables. Also, the carotenoid, vitamin C and Se intake are considered to decrease the risk of lung cancer[4]. However, according to the strong protective effects(relative risk (RR) ¼ 0·77; 95 % CI 0·67, 0·87) and the dose-response relationship showed by fruits instead of vegetables(RR ¼ 0·88; 95 % CI 0·78, 1·0), we can get the conclusion that fruits have the main impact. On account of high consumption of dietary fiber, folate, calcium, and selenium, the rates of colorectal cancer decrease[38-42] The best way to obtain fiber is from fruits, vegetables and whole grains[13].

(6) Salt: Consumption of foods preserved with salt has been linked with the cancers of the oral cavity and pharynx[43]. The stomach cancer can be caused by the salt itself or by carcinogens extracted from nitrites in multiple preserved foods. Evidence from case-control studies suggests that high intakes of traditionally preserved salted foods, especially meats and pickles, and with salt per se increase the risk of stomach cancer[26].

(7) Coffee and tea: Some studies have shown a negative association between coffee drinking and risk of liver cancer[10]. Prospective studies conducted in Japan also showed an inverse association between stomach cancer risk and green tea consumption in women (mostly non-smokers), perhaps related to polyphenols[44].

(8)Exercise: According to some epidemiologic studies, the change in hormone levels by exercising can decrease the risk of breast and prostate cancer[45-46], the movement through the bowel that was stimulated by exercise can reduce the risk of colon cancer[13]. Exercise can help people maintain body weight in the recommended range[47] (the recommended range of weight is changed with the different height of people) and then reduce the risk for chronic disease and cancer.

3. Nutrition Factors Impact the Treatment of Cancer

3.1 Diet:

The insufficient and inadequate diet play big roles in the cause of malnutrition. In order to maintain balanced intake, the first step is to do screening and assessment to detect the nutritional disturbance and abnormal conditions. Also, there is energy and substrate requirements for patients. The recommended intake of protein, vitamins and minerals, (There is a strict range for the ratio of energy from fat to energy)[48]

Dietary fat and obesity

A high-fat diet prevents host catabolism during cachexia, primarily by reducing tumor growth. It can inhibit tumor growth and the body weight loss. Excessive nitrogen catabolism can prevent cachexia.Despite the positive results, the feasibility of the ketogenic diets in patients with cancer cachexia need further research and exploration.For Polyunsaturated Fatty Acids, fish oil is effective on inducing weight gain and tumor growth rate and reverse food intake[49-52].

In addition to fish oil, shark liver oil is a common dietary supplement rich in n-3 lcPUFAs. Shark liver oil promotes weight gain, reduces tumor weight and maintains blood metabolic parameters. Various metabolic factors, such as obesity and hyperinsulinemia, gain the risk of death in men with prostate cancer. A long-term survival analysis of prediagnostic body mass index, plasma C-peptide concentration, and prostate cancer-specific mortality among men with prostate cancer. Prostate cancer development has been linked to total fat, saturated fat, and polyunsaturated fats (PUFAs) in several large cohorts[53-66] .

Dietary protein

Cancer cachexia affects not only fat tissue, but also skeletal muscle atrophy and weakness. Adequate dietary protein supply is a prerequisite for maintaining or increasing skeletal muscle mass. (The given intake range of protein by ESPEN guidelines is 1-1. 5g/kg/day) but some necessary evidence is still lacking[67]. Branched-chain amino acids (BCAAS) have been hypothesized to have a therapeutic effect on skeletal muscle wasting and weakness. Isoleucine, valine, leucine, Glutamine, β-Hydroxy-β-Methyl butyrate, Glycine, Arginine have different degrees on treatment and alleviation for cancer cachexia.

For the patients that are in different physical situations, we should develop the most appropriate treatment plan.

For Those cancer patients who are able to eat but not malnourished or at risk of malnutrition are recommended to increase oral intake. And suggested not to use dietary provisions that restrict energy intake. The process of increasing food intake needed to be processed gradually and slowly and the doctors can adjust the amount according to the physical conditions of patient at any time[68].

① Dietary sugar

Dietary sugar may likewise worsen disease progression in stage III CRC patients and increase the number of tumor in Apc-mutated mice[69-70].

3.2 Exercise:

Generally, cancer patients have low level of physical activity. However, the level of physical activity in patients should be increased or maintained. Physical activity is well-tolerated and safe at different stage of cancer. Patients can get benefits physically and mentally if they take appropriate daily exercise.

4. Conclusions

Studying the effects of nutrition on health is difficult. We have summarized that there are some definite links between nutrition and cancer, but future research may reveal more significant risk factors either specific food ingredients or broader diet patterns. A large number of studies have shown that the occurrence, development, treatment and recurrence of cancer are closely related to lifestyle and diet. Judging from the current research, in the existing articles, a lot of nutrition or diet factors, including some extra intake and exercise were included in the study. But the research and results on some nutrition are the most extensive and in-depth, including the obesity, dietary fat, fruits, vegetables and dietary sugar. Also, dietary fat and sugar intake have different requirements at different stages during cancer progression, and they even have completely opposite influences, good or bad, at different stages of cancer. Nutritional intervention has obvious positive therapeutic effect and auxiliary effects. In a lot of uncertainty, there are some relatively convincing evidence: red meat and salt with colorectal cancer, alcohol with cancers of the gastrointestinal, β-carotene with the lung cancer of smokers[71]. Foods that provide bioactive substances can act individually or synergistically, such as cell cycle, DNA repair, apoptosis, proliferation, hormone regulation[72].For the treatment and the recovery of cancer patients, the metabolic and nutritional alternations can make impacts on malnutrition, sarcopenia, cachexia[73-74] treatment outcomes, risk of post-operative complications, hospital stay, survival[75-76] and the quality of life[77]. However, because of the challenge in the clinical practice[78-93], it is crucial to make a multidisciplinary strategy to increase the quality of care for cancer patients. In summary, our findings come from many prospective cohorts support the hypothesis that nutrients and diet factors are associated with the incidence and treatment of various types of cancer.[84-88]uccessful implementation of cancer prevention requires a multi-level strategy. Nutrition is one of the few common and modifiable cancer risk factors, so it is a key part of prevention strategy and policy. However, despite the development of nutrition guidelines for cancer prevention and the proven benefits of following these guidelines, few people participate in the prevention behaviors. These results are not conclusive in themselves, but these promising findings should stimulate further research to clarify the potential benefits of nutritional supplements.[89]

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