

Impact of Dietary Factors on Gut Microbiota Composition and Colorectal Cancer Risk: A Systematic Review and Meta-analysis

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Abstract

Colorectal cancer is a significant global health burden, and emerging evidence suggests that the composition of the gut microbiota is intricately linked to CRC risk. Diet plays a crucial role in shaping the gut microbiota, yet the specific dietary factors influencing CRC risk through modulation of microbial communities remain to be fully elucidated. This systematic review and meta-analysis aimed to investigate the impact of dietary factors on gut microbiota composition and CRC risk. A comprehensive search of electronic databases was conducted, and studies meeting inclusion criteria were selected for data extraction and analysis. The meta-analysis revealed significant associations between certain dietary components, including fiber, fat, red meat, and fermented foods, and alterations in gut microbiota composition. Furthermore, these dietary factors were found to be associated with CRC risk through their effects on the gut microbiota. This review provides valuable insights into the complex interplay between diet, gut microbiota, and CRC risk and highlights the importance of dietary interventions in CRC prevention.

Keywords: Colorectal cancer • Escherichia coli • Microbiota

Introduction

Colorectal cancer is the third most common cancer worldwide and a leading cause of cancer-related mortality. While genetic and environmental factors contribute to CRC development, accumulating evidence suggests that the gut microbiota plays a crucial role in colorectal carcinogenesis. Diet is a major determinant of gut microbiota composition, and dietary patterns rich in fiber, fruits, and vegetables have been associated with a reduced risk of CRC, whereas diets high in red and processed meats are linked to an increased risk. However, the specific dietary factors influencing gut microbiota composition and CRC risk remain to be fully elucidated. This systematic review and meta-analysis aim to synthesize the current evidence on the impact of dietary factors on gut microbiota composition and CRC risk.

The systematic review and meta-analysis provide valuable insights into the relationship between dietary factors, gut microbiota composition, and colorectal cancer risk. The findings highlight the complex interplay among diet, the gut microbiota, and CRC development, shedding light on potential avenues for CRC prevention and management. The meta-analysis revealed that dietary components such as fiber, fat, red meat, and fermented foods have significant effects on gut microbiota composition. High fiber intake was associated with increased abundance of beneficial bacteria like Bifidobacterium and Lactobacillus, while high fat intake correlated with a decrease in these taxa. On the other hand, consumption of red and processed meats was linked to an increase in potentially harmful bacteria such as Fusobacterium and pathogenic strains of Escherichia coli. These findings emphasize the importance of dietary choices in shaping the microbial ecosystem within the gut [1-3].

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Literature Review

The observed alterations in gut microbiota composition due to dietary factors are closely linked to CRC risk. Beneficial bacteria promoted by high fiber intake have been associated with reduced inflammation, improved gut barrier function, and enhanced production of short-chain fatty acids, which have anti-inflammatory and anticancer properties. Conversely, the proliferation of harmful bacteria associated with high-fat and red meat diets may contribute to intestinal inflammation, epithelial damage, and carcinogenesis. Fermented foods rich in probiotics have shown potential in reducing CRC risk by modulating the gut microbiota towards a more beneficial profile.

These findings underscore the importance of dietary interventions in CRC prevention and management. Promoting a diet rich in fiber, fruits, and vegetables, and low in saturated fat and red meat, may help maintain a healthy gut microbiota composition and reduce CRC risk. Furthermore, incorporating fermented foods containing probiotics into the diet could provide additional benefits for CRC prevention. Dietary interventions aimed at modulating the gut microbiota, such as prebiotic and probiotic supplementation, may represent promising strategies for CRC prevention and adjunctive therapy.

Discussion

Future research should focus on elucidating the mechanisms underlying the interaction between diet, gut microbiota, and CRC development. Longitudinal studies are needed to better understand the causal relationship between dietary factors, gut microbiota composition, and CRC risk. Additionally, randomized controlled trials investigating the effects of dietary interventions on gut microbiota and CRC outcomes are warranted. Further exploration of novel dietary interventions, such as personalized nutrition approaches and microbiota-targeted therapies, holds promise for optimizing CRC prevention and management strategies. A systematic search of PubMed, Embase, and Web of Science databases was conducted to identify relevant studies published. Studies investigating the association between dietary factors, gut microbiota composition, and CRC risk were included. Data on dietary intake, gut microbiota composition (assessed through 16S rRNA sequencing or metagenomic analysis), and CRC risk were extracted. Meta-analyses were performed to assess the association between dietary factors and specific microbial taxa or CRC risk.

A total of studies were included in the systematic review, comprising both observational and interventional studies. Meta-analysis of observational studies revealed that high dietary fiber intake was associated with increased abundance of beneficial bacteria such as *Bifidobacterium* and *Lactobacillus*, while high intake of saturated fat was associated with a decrease in these taxa. Moreover, consumption of red and processed meats was positively correlated with the abundance of potentially harmful bacteria such as *Fusobacterium* and certain pathogenic strains of *Escherichia coli* [4,5]. Interventional studies demonstrated that dietary interventions, such as supplementation with prebiotics or probiotics, could modulate gut microbiota composition and reduce CRC risk.

The findings of this systematic review and meta-analysis highlight the intricate relationship between dietary factors, gut microbiota composition, and CRC risk. High intake of fiber, fruits, and vegetables promotes the growth of beneficial bacteria and may reduce CRC risk, whereas diets high in fat and red meat favor the proliferation of potentially pathogenic bacteria associated with CRC development. Fermented foods rich in probiotics have been shown to exert protective effects against CRC by modulating the gut microbiota. These findings underscore the importance of dietary interventions in CRC prevention and management.

Conclusion

In conclusion, dietary factors play a significant role in shaping gut microbiota composition, which in turn influences CRC risk. Consumption of a diet rich in fiber, fruits, and vegetables, and low in red and processed meats, is associated with a favorable gut microbiota profile and reduced CRC risk. Future research should focus on elucidating the mechanisms underlying the interaction between diet, gut microbiota, and CRC development, and exploring novel dietary interventions for CRC prevention and treatment.

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