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Does a plant based diet actually decrease the risk of colorectal cancer?

Introduction

Colorectal cancer (CRC) is the third most prevalent cancer (World Cancer Research Fund/American Institute for Cancer Research; Bray et al., 2018) and the second leading cause of cancer mortality worldwide (World Health Organisation).

There are various lifestyle and dietary risk factors for CRC. Diet is the most influential risk factor for CRC other than increasing age, particularly over the age of 50 (Baena & Salinas, 2015); male gender; and genetic predispositions (Brenner et al., 2014). CRC is therefore a threat to public health especially due to increased unhealthy diets rich in meat, processed foods, cholesterol and fat. In fact, CRC incidence is higher in developed countries in comparison with less developed countries (Bishehsari et al., 2014), as studies have shown that a more westernised lifestyle leads to a higher prevalence of CRC (Carroll et al., 2014).

A European study was carried out which involved 347,237 participants who were followed up for 12 years, which led to the conclusion that a decrease in CRC risk can be obtained through the implementation of lifestyle changes such as increased exercise, maintaining a healthy body mass index (BMI), little to no smoking or alcohol intake, and a healthy diet, rich in fibre and low in processed and red meats (Aleksandrova et al., 2014). Implementing various of these lifestyle changes led to the largest decrease in CRC risk.

Meat consumption

Studies show that there is a clear correlation between the prevention of CRC and the implementation of a vegetarian diet (Orlich et al., 2015), as a major variable risk factor for CRC is diet. Most notably a high consumption of red and processed meat are linked to an increased risk (Cross et al., 2007; Norat et al., 2005), whereas a decreased risk is linked to plant foods as they are rich in dietary fiber and nutrients (World Cancer Research Fund/American Institute for Cancer Research, 2011). The International Agency for Research on Cancer has classified processed meats as a Group 1 carcinogen and red meat as a Group 2A carcinogen (International Agency for Research on Cancer; Sobiecki, 2017).

The World Cancer Research Fund/American Institute for Cancer Research stated red and processed meats lead to an increased CRC risk, and therefore one should limit red meat in their diet, and avoid processed meats as much as possible (WCRF/AICR, 2007; WCRF/AICR, 2010). Studies have shown that red and processed meats encourage precancerous lesions to develop in the colons of rats (Pierre et al., 2010; Bastide et al., 2015).

There are various mechanisms which have been studied to explain the relationship between meat and CRC. The mechanisms which seem to be most significant for the development of CRC are: (1) Peptide-derived amines

found in processed meats may be N-nitrosated into carcinogenic N-nitroso compounds in the gastrointestinal tract (Bingham et al., 2002); (2) Heme iron from red and processed meats promote CRC due to the cytotoxic effects of heme on epithelial cells (Sesink et al., 1999; Bastide et al., 2012), as well as heme iron acting as a catalyst for both the formation of nitrate compounds and the oxidative degradation of lipids by free radicals which leads to cell injury (Glei et al., 2006); and (3) Mutagenic heterocyclic amines (HCA) are consumed when meat is cooked at high temperatures (Sinha et al., 1998).

The advantages of a vegetarian diet in relation to CRC

Vegetarian diets are also linked to a lower body mass index (BMI), as studies have proven that meat-eaters consume high protein and low fibre, which is associated with an increased BMI (Tonstad et al., 2009). The European Prospective Investigation found that BMI was lowest in vegans, followed by vegetarians, fish eaters, and finally highest in meat-eaters (Spencer et al., 2003). Obesity has been proven to increase the risk of CRC (Baena & Salinas, 2015).

Fruits and vegetables are rich in antioxidants and polyphenols, which have been proven to reduce chronic, cardiovascular and cancer diseases (Vauzour et al., 2010), mainly through their effect on metabolic pathways such as mitogen-activated protein kinase

(MAPK) pathways and cytochrome P450 pathways amongst others (Androutsopoulos et al., 2010). This interplay with metabolic pathways can inhibit the progression of metastatic tumours (Baena & Salinas, 2015).

Plant foods tend to be rich in dietary fiber and nutrients, which protect against CRC, as can be illustrated by Figure 1 below:

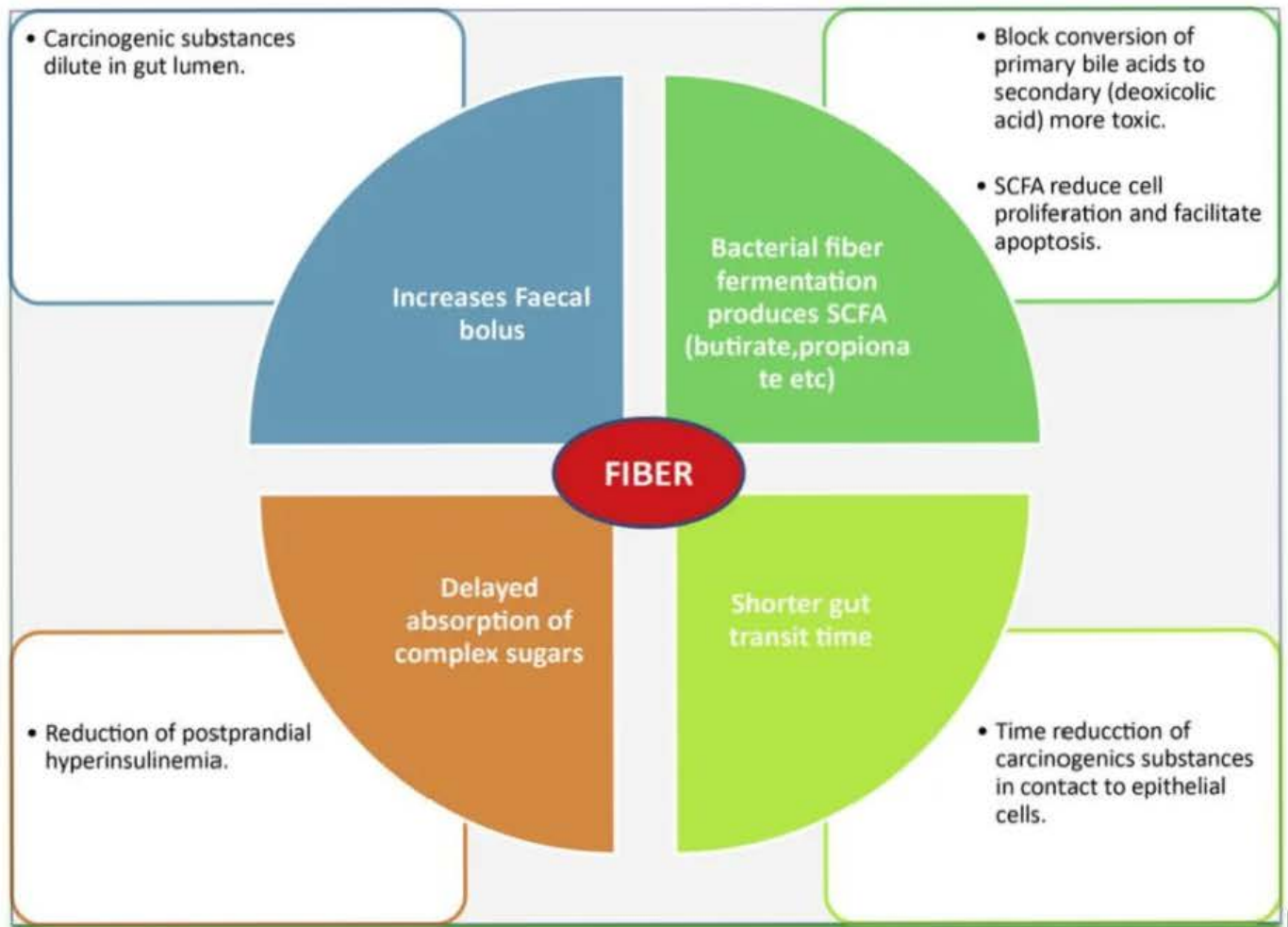


Figure 1. Scheme of potential mechanisms of protection of fiber in colorectal cancer (Baena & Salinas, 2015).

(SCFA = short-chain fatty acids)

Folic acid and CRC

Folic acid, also known as vitamin B9, can be obtained naturally in one's diet from foods such as broccoli, leafy green vegetables, kidney beans and fortified breakfast cereals, and has been shown to reduce the risk of CRC (Tárraga López et al., 2013). However, when folic acid is obtained from folic acid supplements and exceeds the daily recommended dose of 1000 µg/day, it may increase the risk of neoplasms (Durko & Malecka-Panas, 2014).

What about pescovegetarians?

Research has however shown that a moderate amount of fish may provide some protection against developing CRC (Baena & Salinas, 2015), as fish contain high amounts of vitamin D and omega-3 fatty acids (Vargas & Thompson, 2012). High vitamin D intake has been linked to a decreased risk for various types of cancer. Various epidemiological studies have proven that Vitamin D offers a direct protective role on CRC (Garland & Garland, 1980; Byers et al., 2012) and on the contrary, low levels of Vitamin D have been linked to increased risk of CRC (Jenab et al., 2010). Fish are primary sources of n-3 long chain polyunsaturated fatty acids (n-3 LC-PUFAs) (Delarue et al., 2004). Research shows that n-3 LC-PUFAs produce anti-inflammatory eicosanoids which may inhibit tumour development (DiNicolantonio & O'Keefe, 2018).

Individuals who incorporated fish into their diet exhibited approximately a 10% reduced risk for CRC (Aglago et al., 2019).

A major study published in the Journal of the American Medical Association, called the Adventist Health Study 2 (AHS-2) involved 96,354 Adventist North Americans who were followed up for 7.3 years. This study concluded that overall meat-eaters showed an increased frequency of CRC, and most notably pescovegetarians (vegetarians who include fish in their diet) had the largest decrease in CRC risk (Orlich et al., 2015).

In spite of these studies, the World Cancer Research Fund analysed various studies and concluded that evidence that fish reduces the risk for CRC is "limited but suggestive," so there is still certain uncertainty whether implementing fish into one's diet prevents CRC (World Cancer Research Fund/American Institute for Cancer Research, 2018; Aglago et al., 2019).

The effects of alcohol and smoking on CRC

Alcohol can also directly affect one's risk for CRC, as when ethanol is metabolised, acetaldehyde is produced, which is carcinogenic and may lead to CRC development (Reidy et al., 2011). There is a 16% increase in CRC risk associated with 30g/day of alcohol intake, and a 41% increase in risk associated with a 45g/day intake (Durko & Malecka-Panas,

2014), indicating that the risk for CRC increases with increasing alcohol intake (Tárraga López et al., 2013). This correlation is observed less frequently in females than in males (Baena & Salinas, 2015).

Smoking is another well known carcinogen which is associated with CRC. Studies show that non-smokers have an increased survival rate when compared to smokers (Zhu et al., 2014). Therefore there is a clear dose-response relationship between smoking and CRC outcome (Phipps et al., 2013; Walter et al., 2015).

Conclusion

CRC incidence is steadily increasing, especially due to the fact that more countries are adopting a more westernised lifestyle. Studies have shown there is a direct link between high consumption of red and processed meat and CRC, as these foods are carcinogenic. Therefore, the implementation of a vegetarian diet may lead to a decrease in CRC risk, especially since plant foods are rich in antioxidants, polyphenols, dietary fiber and nutrients such as folic acid, which are all protective factors against CRC. Pescovegetarians also seem to have a further decreased risk of CRC, notably due to the fact that fish contain high amounts of vitamin D, which plays an active role in immunity and has a protective role against various types of cancers. Other than these major dietary

risk factors, alcohol and smoking are among other major links attributed with CRC, so eliminating these from one's lifestyle further helps to decrease their risk of CRC.

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