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Study of Impact of Dietary Factors on Prevalence of Colon Cancer

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Abstract

The third most frequent cancer worldwide is colorectal cancer. Globally, 1.5 million new cases of colorectal cancer were reported in 2023, making up 10% of all new cancer cases. According to estimates, colorectal cancer is the fourth most prevalent cancer-related cause of death.be accountable for about 700,000 cancer-related deaths. Survival from colorectal cancer depends on the stage of the disease, with later-stage diagnoses having a worse prognosis. 90% of colorectal cancer patients who receive an early diagnosis survive five years. Western Africa has the lowest estimated rates, while Australia and New Zealand have the highest. Men and women worldwide experience colorectal cancer in similar ways. More than 2.2 million colorectal cancer cases are anticipated to be diagnosed during the next 15 years, a 60% rise. It is one of the malignancies whose incidence is rising globally. The diet has a direct connection with the colon cancer because inflammation in the bowels and gut is influenced by what we consume, and inflammation is a risk factor for the development of colorectal cancer. Researchers have identified sugar, animal fats, red and processed meats as the key food ingredients that produce inflammation in the body and may raise the risk of colon cancer.

Keywords: *Third, Colorectal Cancer, Diet*

1. Introduction

Colorectal cancer (CRC) is the third most common diagnosed cancer in men (746,000 new cases per year) and the second in women (614,000 new cases per year) worldwide. It is rare in people younger than 50 years, and its incidence increases with age. Interestingly, CRC incidence is 18% higher in developed regions in comparison with lower-income areas. There is high geography-dependent variability in CRC rates. The highest incidence is in European countries, North America and Oceania, where the incidence rate reaches 44.8 cases per 100,000 population in men and 32.2 cases per 100,000 population in women. On the contrary, Western Africa has the lowest rate with 4.5 cases and 3.8 per 100,000 population in men and women, respectively (F.J.A et al., 2012). This variability highlights the principal role of environmental factors in cancer development in general and CRC in particular, and diet is the most important risk factor apart from age, male sex and hereditary factors, which are responsible for 35% of CRC (Weng et al., 2012). The fact that industrialized countries have higher rates of colon cancer than developing ones leads one to speculate that the westernized lifestyle may be to blame for the elevated risk of the illness. Some dietary components, like fibre, antioxidants, calcium, and vitamin D, as well as fresh fruit and vegetables, reduce risk, while others, like red meat and saturated animal fat, increase it.

Based on different research paper we found that Americans may have a greater risk due to their high diet of red meat, whereas Africans may have a low incidence due to their high intake of maize (corn) meal and low consumption of meat and animal fat. Finding significant variations in the intestinal bacterial metabolism was a novel component of our research. Undigested carbohydrates were primarily fermented by methane-producing bacteria in Africans as opposed to African Americans, where they were primarily fermented by hydrogen-producing bacteria. It is established that a diet high in animal fat stimulates the growth of secondary bile salt-producing bacteria and further studies have shown that secondary bile salts are cytotoxic and carcinogenic.

Prior to the 20th century, colorectal cancer was not common, but incidence has rapidly increased, particularly during the past 50 years. The adoption of a westernized diet, obesity, and inactivity have all been identified as risk factors (Wiseman *et al.*,2008, Center *et al.*,2009). The majority of cases of colorectal cancer still happen in developed nations. According to estimates, dietary variables are to blame for 70% to 90% of all incidences of cancer and that nutrition may be the cause of more than one third of cancer-related deaths (Doll *et al.*,1981). As a result, diet modification may be able to lower the prevalence of this form of cancer (Ahmed *et al.*,1981, Shannon *et al.*,1996). Here, we go over the major data supporting the contribution of several dietary elements to the prevention and development of colorectal cancer.

Worldwide Effect of Colon Cancer

In 2020, colorectal cancer (CRC), the second most lethal cancer and the third most frequent malignancy, is expected to cause 0.9 million deaths worldwide. Due to westernization, the prevalence of CRC is rising in middle- and low-income countries whereas it is higher in more developed nations. Global public health is facing an increasing issue as a result of the high incidence of CRC. In order to encourage healthy lifestyle choices, cutting-edge CRC management options, and the adoption of worldwide screening programs, which are essential to reduce CRC morbidity and death in the future, it is crucial to increase awareness about CRC

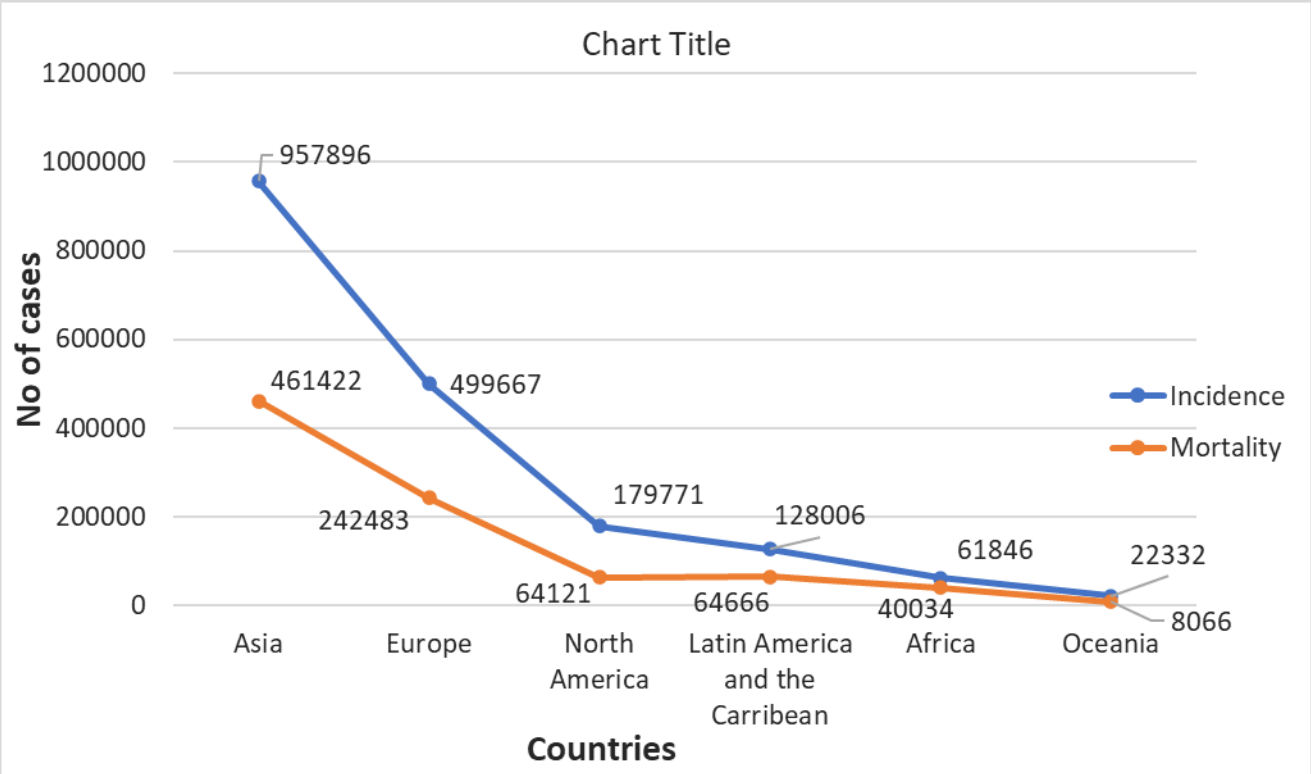

Fig:1 Graphical representation of incidence and mortality of colon cancer of different continents in 2018 (source: GLOBOCAN 2018)

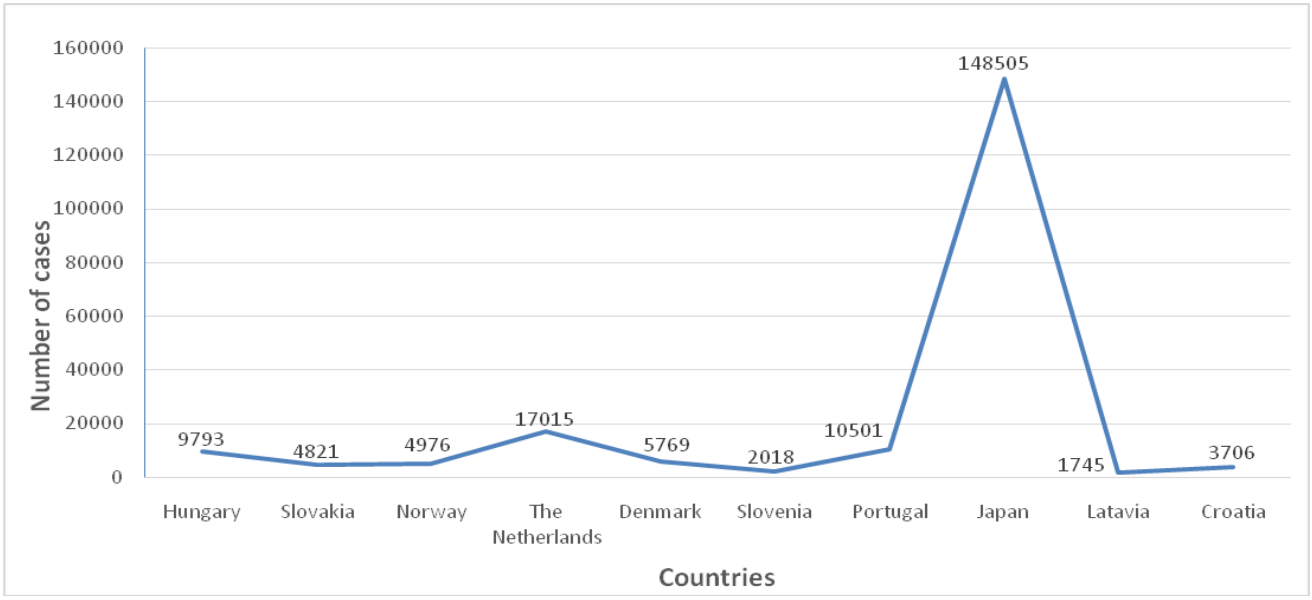

Fig 2: Graphical representation of the most colon cancer cases in different countries

Different factors that effects the colon cancer

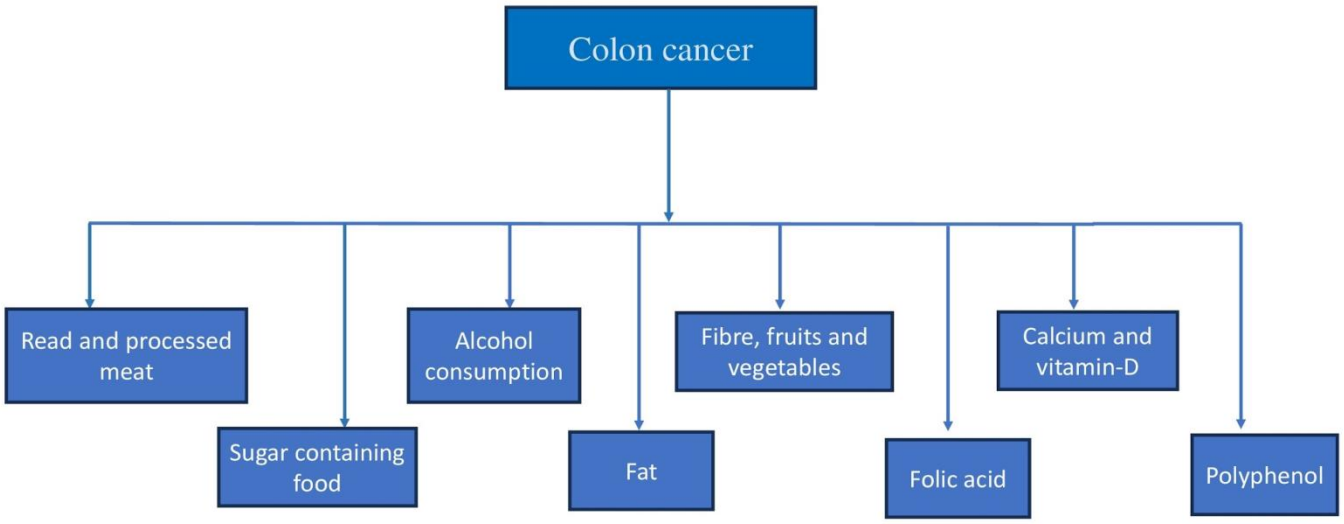

Fig 3: The different factors effecting the risk of colon cancer depicted in a flow chart

Red meat and processed meat: Consumption of red meat might be related directly to the incidence of CRC or indirectly because a diet high in meat tends to be low in vegetables, fruit, and fibre. Whether red meat itself or the method by which it is prepared influences risk of CRC has also been investigated. Bidoli et al (Biodoli*etal.*,1992) found that high intake of refined starches, eggs, cheese, and red meat increased risk of CRC. Risk of colon or rectal cancer was about twice as great among those who consumed these foods more frequently. On the other hand, more frequent consumption of tomatoes was associated with a 50% and 60% reduction in risk of colon cancer and rectal cancer, respectively. A study of CRC among people residing in northern Italy (La Vecchia*et al.*,1997) revealed that 17% of CRC cases were attributable to consumption of red meat.

Author, year published	Meta analysis center/ country	Number and type of studies for red meat	RR for red meat (95% CI) *-	RR for processed meat (95%) *-
Sandhu *et al.*, 2001	UK	13 cohort	1.17(1.05-1.31)	1.49(1.22-1.81)
Norat*et al., 2002*	IARC	14 case-control and 9 cohort	1.35(1.21-1.51)	1.31(1.13-1.15)
Larsson and Wolk, 2006	Karolinska Inst., Sweden	15(13 cohort and 2 case-control)	1.28(1.15-1.42)	1.20(1.11-1.31)
Huxley et al.,2009	Australia and Iran	26 cohort	1.21(1.13-1.29)	1.19(1.12-1.27)

Smolinska and Paluszkiewicz,2009	Poland	22(12 case-control and 10 cohort)	1.21(1.07-1.37)	NA
Bastide et al.,2011	France	5 cohort	1.18(1.06-1.32)	NA
Alexander et al., 2011 and 2005	USA, Mexico	27 cohort	1.11(1.03-1.19)	NA
Chan et al., 2011	UK and Netherlands	24(2 case-cohort, 3 nested case-control and 19 cohort)	1.22(1.11-1.34)	1.17(1.09-1.25)
Johnson et al., 2013	USA	14(8 case-control and 6 cohort)	1.13(1.09-1.16)	1.09(0.93_1.25)
Bernstein et al., 2015	USA, china, Vietnam	2 cohort	1.06(0.97-1.16)	1.15(1.01-1.32)

Fig 4: table representing the relative risk of colon cancer for red meat and processed meat consumption (Source- Aykan N.F. (2015))

Sugar containing food and drinks: The consumption of caloric sweeteners has increased globally, increasing daily energy intake by an average of 74 kcal between 1962 and 2000 (Popkin *et al.,2007*). Drinking beverages with added sugar has been associated with weight gain, obesity, insulin resistance, and type 2 diabetes (Popkin *et al.*,2007) , all of which are possible risk factors for colorectal cancer (Ma *et al.*,2013,Giovannucci *et al.*,2010,Larsson *et al.*,2005) . By promoting the creation of insulin and insulin-like growth factor-I, a diet high in carbohydrates may encourage colorectal carcinogenesis (Kaaks *et al.*,2001). By lengthening the mouth-to-anus transit time and elevating the concentration of secondary bile acids in feces, a high consumption of carbohydrates (specifically sucrose) may further raise the risk of colorectal cancer (Kruis *et al.*,1991, Bostick *et al.*,1994). Numerous epidemiological studies explicitly linked a high sugar or sucrose intake to a higher risk of colon cancer, but the results varied.

Alcohol consumption: There is an association between alcohol intake (ethanol) and CRC development. Ethanol by itself has no direct carcinogenic effect on gut mucosa. In its stead, acetaldehyde (the first compound formed in ethanol metabolism) has mutagenic and carcinogenic activity, and it is through that it plays a critical role in CRC onset. An intake of 30 g/day of alcohol is associated with a 16% increase in CRC risk, whereas an intake of 45 g/day elevates this risk by 41%.

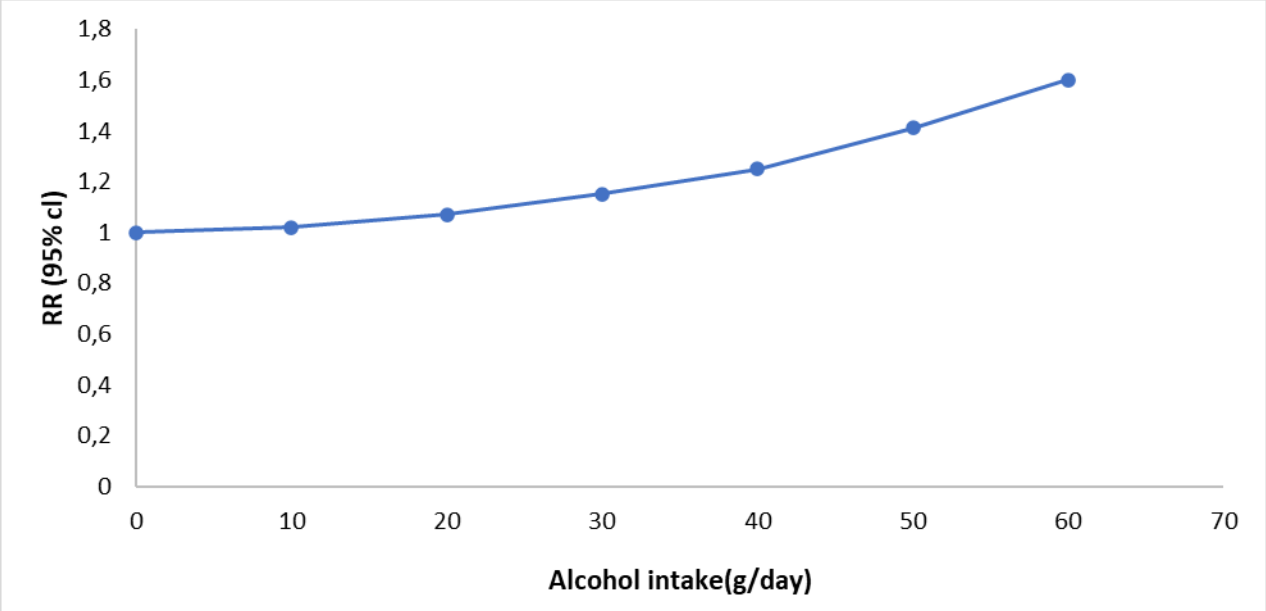

Fig 5: Graphical representation of relative risk of colon cancer for increasing the alcohol intake(g/day) (Source -)

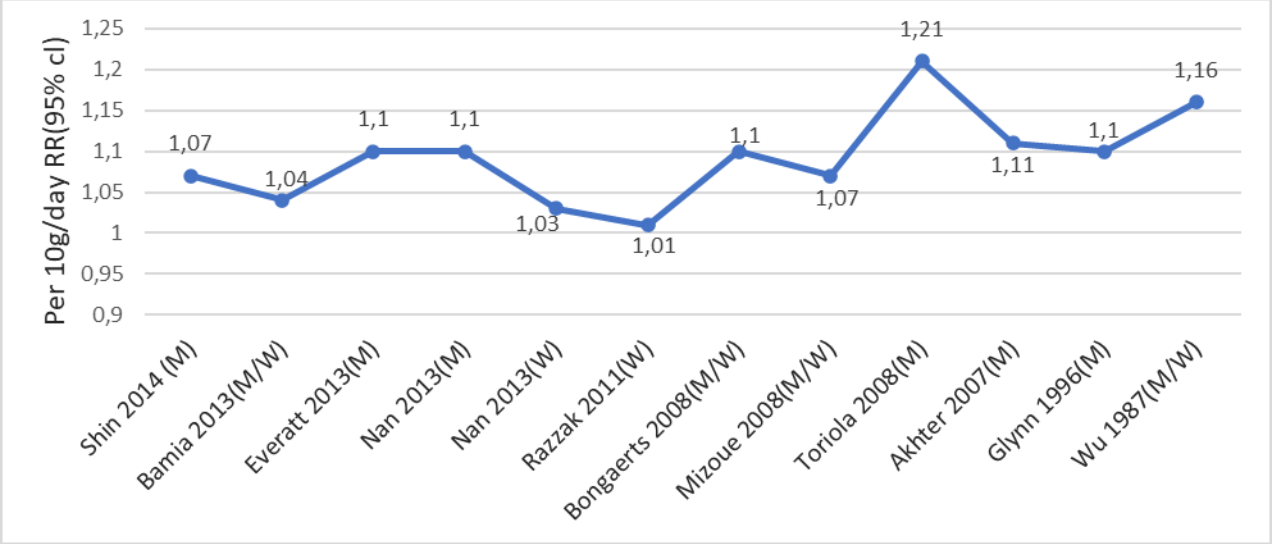

Fig 6: Graphical representation showing the relative risk of colon cancer for alcohol consumption (Source -

Fats: A number of case-control studies have shown that consuming more total calories increases the risk of colon cancer (Magalhaes *et al.*,2011). In addition to being a rich source of energy, dietary lipids, particularly animal fat, have been linked to an increased risk of colon cancer (Hamer *et al.*,2008). Large cohort studies, however, do not establish a link between dietary fat and colon cancer (Giovannucci *et al.*,1994).

Saturated fat - Animal food like red meat and dairy items like cheese and butter are the main sources of saturated fats. Saturated fats from plants can be found in cocoa butter, coconut oil, coconut milk, and palm oil. Studies using case-control data (Franceschi *et al.*, 1998) and prospective cohort data (Willet *et al.*,1990) showed an increased risk of colorectal cancer in those who consumed more saturated fat, but red meat and low intake of dietary fiber continue to be challenges for researchers. The risk of colon cancer is increased by a high consumption of animal fat, according to a prospective research of 88,751 women, and fish or chicken should be substituted for red meat as a source of protein (Willet et al.,1990). According to the Dietary Approaches to Stop Hypertension (DASH) research, which included 130,000 participants, individuals who consumed less animal fat had a 20% relative risk reduction (Fung *et al.*,2010).

Omega-3 (n-3) PUFA - The prevalence of colon cancer has been observed to be reduced in communities and epidemiological studies that consume substantial amounts of polyunsaturated fish oils (Blot *et al.*,1975). As a result, the idea that diets rich in n-3 fatty acids may lower the incidence of colorectal cancer has emerged. In case-control **(**Kimura *et al.*,2007, Theodoratou *et al.*,200, Kim *et al.*,2010) and prospective studies (Weijenberg *et al.*,2007, Sasazuki *et al.*,2011), an antagonistic relationship has been found between n-3 PUFA (omega-3) and colorectal cancer.

Fish that are fatty are a great source of vitamin D and omega-3 fatty acids. Butler et al. demonstrated a favorable association between dietary marine n-3 PUFAs and advanced colorectal cancer (Butler *et al.*,2009). N-3 fatty acids have no preventive effects on colorectal cancer risk, according to a Chinese meta-analysis of prospective studies involving approximately 500,000 people (Shen *et al.*,2012). Fish eating may reduce the incidence of colon cancer by 12%, according to a recent meta-analysis of case-control and prospective cohort studies.

Fiber, fruits and vegetables: Dietary fiber varies considerably in its physical properties and chemical composition, but can be classified according to its water solubility. This affects its action in the body and might be relevant to the issue of risk of CRC.

Following the observation of the low incidence of colorectal cancer in African people that consume a high-fiber diet, the theory that high fiber consumption may be lowering the risk of colorectal cancer has been proposed (Burkitt *et al.*,1969). Plant substance made up of cellulose, hemicellulose, and pectin is referred to as fiber. It has been proposed to work by reducing fecal transit times, diluting and binding carcinogens, altering the proliferation of gastrointestinal epithelium, maintaining colorectal epithelial cell integrity (Rieger *et al.*,1999), adsorbing heterocyclic amines (Harris *et al.*,1996) affecting bile acid metabolism, and stimulating bacterial anaerobic fermentation to increase the production of short-chain fatty acids (SCFAs) such as acetate, propionate, and butyrate. It has been demonstrated that SCFAs lower intestinal pH and prevent carcinogenesis (Scharlau *et al.*,2009).

The majority of colorectal malignancies have their origins in colorectal adenomas. Numerous research looked into the impact of nutrition on colorectal adenomas and adenoma recurrence. Consuming a diet rich in wheat bran (Alberts *et al.*,2000), fruit and vegetables (Hamer *et al.*,2008, Schatzkin *et al.*,2000), citrus fruits (Michels *et al.*,2006), dark-green vegetables, onions, garlic, and tomatoes (Bidoli *et al.*,1992) may offer protection from colorectal adenomas, which may then develop into colorectal cancer. This connection was not demonstrated by several prospective investigations (Alberts *et al.*,2000, Schatzkin *et al.*,2000).

However, Park et al. suggested in a meta-analysis of prospective studies that a high consumption of dietary fiber was actually not linked to a lower risk of colorectal cancer (Park *et al.*,2005). For every 10 g/day of total dietary fiber and cereal fiber consumed, the authors of a recent meta-analysis of prospective cohort and nested case-control studies on dietary fiber predict a 10% decrease in the risk of colorectal cancer (Aune *et al.*,2011). Also negatively related was whole grain (87). Other studies (27,88,89) found no evidence of a protective relationship between particular kinds of fiber, such as fruit, vegetables, or cereal.

One can draw the conclusion that there is conflicting evidence about the benefits of fiber in lowering the colonic adenoma pathway and the development of colorectal cancer.

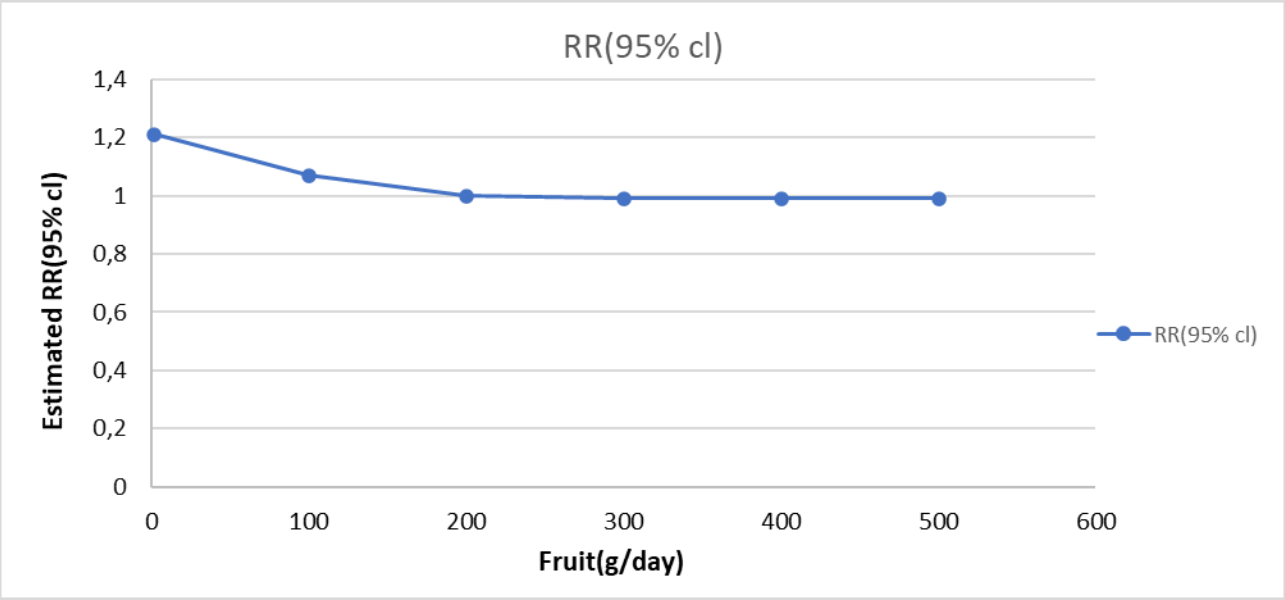

Fig 7 – Graphical representation of relative risk of colon cancer due to fruit(g/day) consumption (Source -)

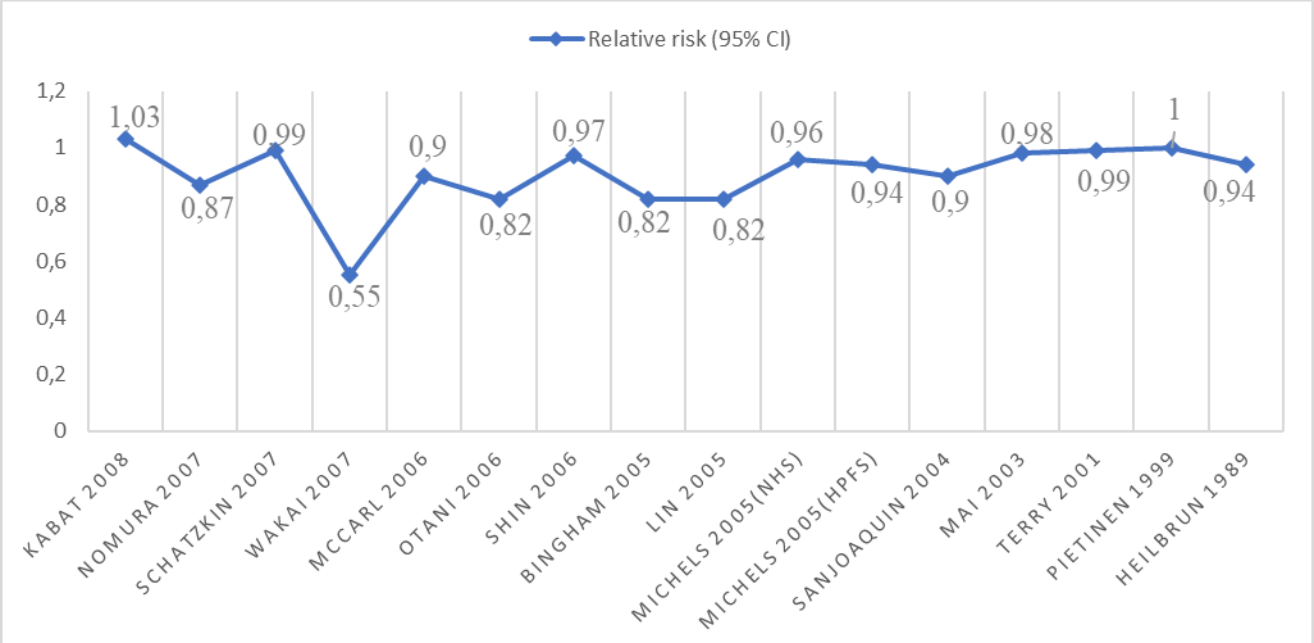

Fig 8: Graphical representation of relative risk of colon cancer due to fruit consumption (Source – Dagfinn *et al.*,2011)

Folic acid: The observation that folic acid supplementation was associated with a substantial decrease in colon cancer among ulcerative colitis patients led researchers to examine the role of folic acid in prevention of CRC. Two case-control studies in Majorca and Italy found a protective effect of folic acid on risk of CRC (Benito *et al.*,1991, Ferraroni*et al.,* 1994). Bird and colleagues (Bird *et al.*, 1995) investigated folate and risk of adenomatous polyps; the strongest relationship was found between red-cell folate concentration and colorectal polyp development in men.

In the Nurses' Health Study, Giovannucci et al (Giovannucci*et al.*,1998) found a considerably lower risk of colon cancer among women reporting use of multivitamins containing 400 µg of folate for 15 or more years. In practical terms, long-term folate supplementation reduced the number of new cases of colon cancer from 68 to 15 per 10 000 women aged 55 to 69. At least 1 other study (Jacobs *et al.*,2003) has confirmed that having taken multivitamins containing folic acid in the past is associated with a reduced risk of CRC.

Calcium and Vitamin-D: Calcium and vitamin D are thought to reduce risk of CRC through mechanisms that decrease cell proliferation or promote cell differentiation (Peters *et al.*,2001). In general, cohort studies have found that milk and dairy products have a protective effect on CRC, but case-control studies do not support this relationship (Norat *et al*., 2003). Nevertheless, scientists are intrigued that the risk of dying from CRC is highest in geographic areas that get less sunlight (Tangpricha *et al*.,2001). In contrast, the diet of people living in the Faroe Islands in the north Atlantic is high in fat and low in vegetables, but also high in fish, calcium, and vitamin D. Incidence rates of both colon and rectal cancer there were among the lowest in northwestern Europe and North America (Dalberg *et al*.,1999). Case -control studies have had inconsistent results.

Recent research indicates that calcium and vitamin D might act together, rather than separately, to reduce risk of colorectal adenomas (Grau *et al*., 2003). In a previous study, (Baron *et al*., 1999) 1200 mg of elemental calcium was associated with a moderate but significant reduction in risk of recurrent colorectal adenomas (P = .03). Grau et al (Grau *et al*., 2003) found later that calcium supplementation was not associated with adenoma recurrence when vitamin D levels were at or below the median (29.1 ng/mL), and that vitamin D levels were associated with reduced risk only among those receiving calcium supplements.

Polyphenols: One of the many advantages of polyphenols is their role as antioxidants (Scalbert *et al*.,2005, Ramos *et al*.,2008), as well as their ability to suppress cellular growth, induce cell cycle arrest, interact with apoptotic pathways, and have antiangiogenic and antimetastatic actions. Fruits, vegetables, seeds, and drinks like fruit juice, green tea, coffee, cocoa drinks, red wine, and beer are the main dietary sources of polyphenols. Numerous studies have been done on polyphenols' ability to chemoprotective against cancer. Animal studies, cell culture research, and case-control studies all support the idea that there is a preventive effect against colorectal cancer (Johnson *et al*.,2007, Manson *et al*.2003).

Curcumin - This polyphenol, a curcuminoid, is an antioxidant, anti-inflammatory, and anti-tumor compound found in turmeric spice. It has been demonstrated that curcumin functions by preventing cell invasion and possessing anti-inflammatory qualities (Chen *et al.*,2006, Su *et al*.,2006).

Flavonoids- It has been demonstrated that the flavonoid apigenin, which is present in celery and parsley, prevents colonic carcinogenesis by triggering apoptosis in animal models (Su *et al.*,2006). In vitro and animal studies have demonstrated the anti-carcinogenic properties of cyanidin, a flavonoid found in strawberries and cherries (Chung *et al*.,2007).

Green tea - The Flavanols, a subclass of Flavonoids, are abundant in green tea. Catechin and Epicatechin are two examples. The most prevalent catechin in green tea is called epigallocatechin-3-gallate (EGCG). Large population studies as well as in vitro and animal models (Scalbert *et al.*,2005) have demonstrated the advantages. In a cohort of 69,710 Chinese women, green tea consumption has been linked to a 40% lower incidence of colorectal cancer (Yang *et al.*,2007).

2. Conclusion

In this review, we sought to pinpoint nutritional elements that might contribute to the emergence of colorectal cancer. White meat and fish can be substituted for red or processed meats, especially when they are cooked at high temperatures. High dietary fiber, folate, vitamin D, calcium, fruit and vegetables reach diets may guard against colorectal cancer and the development of colorectal adenomas. As well as quit smoking and alcohol consumption, increasing the physical activity

decrease the risk of colon cancer. As the cases of colon cancer in increasing day by day so this paper will help people' s to understand which diet they should follow to avoid the risk of colon cancer.

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Conflict of Interest

There is no conflict of interest related to the study

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