

## Diet and Colon Cancer Risk\*\*

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### Summary

Diseases prevalent in Western societies present the most serious threat to public health today. There is convincing experimental and human study evidence that the Western diet, rich in red meat and animal fat, and deficient in fiber, drives most of these diseases. These diseases include various allergies, autoimmune disease, osteoarthritis, inflammatory bowel disease, obesity, diabetes, osteoporosis, hypertension, coronary heart disease, and cancers of the colon, breast, and prostate. While much of the morbidity and mortality due to cardiovascular disease, diabetes, and the metabolic syndrome can be ascribed to excessive food consumption and obesity, it is becoming increasingly recognized that fiber deficiency in the microbiota, with suppressed butyrogenesis, plays the most prominent role in the genesis of chronic inflammatory conditions and colon cancer. The rarity of these diseases in elderly members of less affluent societies, coupled with the fact that genetic modification to environmental changes takes tens of thousands of years, suggests that the diet ideally suited to our genetically determined needs would contain higher intakes of fiber-rich foods and less meat and fat. Recent studies in high-risk westernized human volunteers provide evidence that a change to such a diet modifies the microbiota to produce metabolites that improve colonic mucosal health and suppress biomarkers of colon cancer risk within two weeks. This, taken together with the observation that it takes only one generation of westernization to increase cancer in migrants, as well as the estimation that more than 90% of colon cancer cases can be attributed to diet, provides compelling evidence that increasing the intake of fiber-rich foods in westernized populations will have an immediate effect on colon cancer risk.

### Current realities

Colon cancer has a remarkable geographic variation in incidence, being common in more affluent, and rare in less-affluent countries. It is one of the so-called "westernized diseases." Migrant studies have provided strong evidence that the disease results from factors in the environment as it only takes one generation for a migrant population from a low incidence area to assume the high incidence rate of the host country. Based on the analysis of epidemiological surveys around the world, Doll and Peto concluded that diet was the responsible environmental factor in more than 90% of gastroenterological cancer cases. In the United States, colon cancer is the third most common cancer among men and women and, perhaps more importantly, it is the second leading cause of cancer deaths for both sexes.

African Americans bear the brunt of the disease in the U.S. The age-adjusted incidence rate for cancer of the colon and rectum from 2002–2004 was 61.4 per 100,000 for white men versus 72.9 per 100,000 for black men, and 44.7 versus 56.1 per 100,000 for white and black women respectively. The age-adjusted death rate for colorectal cancer was 23.4 versus 33.4 per 100,000 for white and black men respectively and 16.2 versus 23.4 per 100,000 for white and black women respectively (see <http://seer.cancer.gov/csr>). Alaskan Native people have the highest recorded rate of colon cancer in the world at more than 100 per 100,000. In contrast, rural native Africans rarely get the condition, with an incidence of less than 5 per 100,000.

Westernization has been associated with a dramatic increase in expected lifespan from less than 25 years before the Industrial Revolution to 78.9 years in the U.S. today. This change cannot be attributed to genetic evolution, but it can be attributed to the remarkable ability of humans to adapt to their environment. The dramatic increases in food production, generated by the combined forces of the Agricultural and Industrial Revolutions, resulted in increased individual purchasing power that ultimately led to increases in the human gene pool. This further resulted in

improved standards of living, societal development, additional time and facilities for experimentation and entrepreneurship, and ultimately led to the modern scientific era. It is this sequence of events that is responsible for the advances in sanitation, housing, vaccination, antibiotics, medical care, and political diplomacy, all of which have increased life expectancy through our current ability to avoid life-threatening events such as perinatal complications, acute infections, trauma, and war.

The quality of our current expanded lifespan has been marred by the appearance of a group of diseases termed “westernized diseases,” which includes colon cancer. Westernized diseases contribute most to death and disability in the world. In 2005, at least 35 million people of all ages, nationalities, and socioeconomic levels died from heart disease, stroke, cancer, diabetes, respiratory disease, and other chronic diseases. The figures are even higher today, and increasing. For example, it has been estimated that by 2030 there could be up to 26.8 million new cases of cancer and 17.1 million cancer deaths every year, as well as 80 million people living with cancer within five years of diagnosis. While some argue that these diseases are a consequence of lengthening lifespans, pathological studies of hunter-gatherer communities have shown that those members who escaped life-threatening events were spared these diseases in old age. While cancer is rare in Africa as a whole, there is huge concern that rates will soar with progressive westernization, which is already occurring in certain cities (e.g., Harare, Zimbabwe).

### **Scientific opportunities and challenges**

Recent advances in genetics, microbiology, analytic chemistry, and systems biology have revealed an extraordinarily high level of mutualism between our species and the microbiota that could explain the strong association between diet and colon cancer, and could also potentially explain the genesis of other diseases prevalent in Western societies (e.g., obesity, atherosclerosis, diabetes). The challenge is to define the “ideal diet.” With regard to the colon, it is likely that there is an ideal microbiome that evolved *in tandem* with human diet and the human digestive tract. There is good evidence that this relationship has been lost with westernization and that there has been insufficient time for us to genetically adapt to sumptuous modern diets. It is likely that our health will be better maintained by the diet that first established *Homo sapiens* in the Paleolithic Era in Africa, a period that lasted from about 2.5 million to 11,000 years ago. Some insight into the composition of this “ideal” diet has been gained by coprolite analysis from prehistoric deposits dating back 14,000 years in caves in southwest Arizona, which suggests that complex carbohydrates and fiber dominated the diet. Ills that can be ascribed to a Western diet can be attributed to its low content of fresh fruits, vegetables and unrefined grains, and its excess of meat and terrestrial fat. This has been supported by epidemiological surveys from around the globe, experimental studies, and most recently by study in humans, which showed biomarkers of colon cancer risk diminished within two weeks of diet change to a high fiber, low fat diet.

### **Policy issues**

Efforts to increase the intake of fruits, vegetables, and unrefined grains, and to reduce terrestrial fat consumption, will reduce the incidence and mortality associated with colon cancer in westernized communities around the world. It is often claimed that changing someone’s diet, like stopping smoking or drinking, is impossible. However, the application of evidence-based health strategies through urban planning, education, agricultural policy, and health systems development, along with health targets to focus and prioritize needed interventions at national, regional, and local levels, has been shown to be effective. Such application of evidence-based health strategies have proven robust and successful in regards to cardiovascular disease and cancer mortality, and the reduction in cigarette smoking and physical inactivity. However, whilst these approaches have proven effective in western societies, they have not in less-affluent countries where the supporting infrastructure is absent. Strategies can be divided into local strategies and national/international public health programs. An example is “Health in All Policies,” public policy and governmental interventions designed to change both the environment, as well as individual behavior to promote health and prevent chronic disease throughout society.

### Local Strategies:

- Promote consumption of fresh fruits, salads, and vegetables in school cafeterias, workplaces, urban and rural cafes, and restaurants. Replace unhealthy foods in school cafeterias with increased choices of fruits, vegetables, and coarse grains, and apply restrictions to fried and fatty foods.
- Educate children and adults on the dangers of overeating and obesity, and the need to combine good eating with frequent exercise.
- Ban advertising of unbalanced calorie rich ‘fast foods’ on TV and other public media, and instead promote balanced diets and healthy eating.
- Advertise the benefits of a balanced diet and physical activity, and healthy lifestyle on good health and longevity.
- Promote nutrition education in supermarkets, provide appropriate information of the nutrient content of foods.
- Support community gardening to grow vegetables and fruits.
- Introduce healthier foods and beverages to local stores.
- Make farmer’s markets available to urban communities.

### National/international public health programs:

- Regulate food advertising and marketing to children and adults to emphasize the consumption of a balanced diet based on the above.
- Tax low fiber, fatty foods and snacks. This is feasible, just like what was done to reduce cigarette smoking.
- Impose zoning laws that regulate the location of fast food establishments.
- Transfer the ownership of dietary intervention projects to the national health authorities to strengthen national autonomy. Population-based cancer preventive strategies are remarkably cost-effective because increasing population health is also a way to ensure continuing capacity to produce wealth.
- National leadership is required to place the eradication of westernized diseases high on national agendas (e.g., National Institutes of Health funding of studies designed to reduce western diseases).
- International organizations (e.g., World Health Organization [WHO]) should help to promote national capacity building to meet this goal. It should be noted that the portion of the WHO 2006-07 budget devoted to noncommunicable diseases accounted for just 12% of the total; 86% of WHO funds in the Western Pacific region went towards combating infectious diseases, despite the fact that these pathologies are only responsible for 14% of the mortality burden.
- Forge a common united mission between foreign (western) and national healthcare organizations through workshops and close networking. Funding for these activities could be obtained through U.S. government international cooperation initiatives, world cancer research societies, the WHO, the Food and Agriculture Organization, and the Gates Foundation.

### References

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\*\*A policy position paper prepared for presentation at the conference on Food Safety, Security, and Defense (FSSD): Food Security and Diet-linked Public Health Challenges, convened by the Institute on Science for Global Policy (ISGP), Sept. 20–23, 2015, at North Dakota State University, Fargo, North Dakota, U.S.