



Consumption of Meat Products and Risk of Various Cancers

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Animal-based Protein Foods in a Healthful Diet

Animal-based protein foods are not only a great source of enjoyment for many consumers, but they could be an important part of a healthful diet, containing important micronutrients and macronutrients such as balanced protein, vitamin B12, riboflavin, zinc, and heme iron. Consumption of animal-based protein foods is also an indicator of economic prosperity since more affluent societies typically have much higher meat consumption per capita. However, recent studies



raise a concern about the potential associations between dietary intake of animal-based protein foods and the development of various cancers.

Drawing conclusions about this association is inherently a complicated task. On one hand, there is an array of meat and meat products that are an appreciable part of dietary intakes and on the other hand, there are many lifestyles, genetic, and dietary confounders that could make the scientific evaluation of the literature a complicated task. As an example, physical inactivity, excess dietary sodium, and an array of preservatives used in the processed meat industry could be important confounders in epidemiological studies investigating the effects of meat consumption on the increased likelihood of developing various cancers. Most importantly, and understandably, there is not sufficient evidence from long-term control

randomized trials investigating the association of this common dietary component with the risk of developing cancers. Nevertheless, the literature has an abundance of epidemiological and preclinical studies, exploring the association of meat and meat products with the development of various cancers. This study provides a brief overview of some of the literature in this area.

Animal-Based Dietary Fatty Acids

It is widely known that high-fat diets are associated with an elevated risk of disorders such as diabetes and cardiovascular diseases. Now, studies are showing a link between intake of meat and meat products and the risk of developing pancreatic cancer. Pancreatic cancer is one of the most rapidly proliferating cancers, being one of the top five in cancer mortality in the United States (1). A large-scale diet and health study by the National Institutes of Health was conducted on US men and women to analyze the relationship between intake of fat and risk of pancreatic cancer. Due to previous research showing an increase in pancreatic cancer risk as a result of red meat consumption, this study considered “*food sources of fat and individual fatty acids to better understand*” which component of fat is linked to pancreatic cancer etiology. Because previous research exhibited an increased pancreatic cancer risk associated with increased intake of red meat (2), food sources of fat and individual fatty acids were considered to better understand what aspects of fat may be important in pancreatic cancer etiology. One study gathered information from >525,000 American men and women between the

ages of 50-71. A questionnaire was administered to assess diet by asking the consumption frequency and portion size of 124 food items over the past year including 21 questions about foods that were described as sugar-free, reduced-fat, free of caffeine, or whole grain, and details about quantity and quality of fats, creamers, and sweetening agents added to foods or used in food preparation. After an average of more than six years of follow-up with the post-questionnaire, women and men in the highest quintile of fat consumption exhibited 23% and 53% higher incidence of pancreatic cancer, respectively, compared with the lowest quintiles. In this study, there was a statistically significant relationship between pancreatic cancer and intakes of total, saturated, and monounsaturated fat, but no relationship between pancreatic cancer and polyunsaturated fat. There was also a positive relationship between pancreatic cancer and saturated animal fats from red meats and dairy products as well as the individual fatty acids found in these sources. Another study from Finland showed that there was evidence of a positive correlation between the risk of developing pancreatic cancer and total saturated fat intake but not with other fat components (3). Further studies show total fat, as well as the saturated fat associated with red and processed meats, were positively associated with pancreatic cancer (4, 5). It is noteworthy that diabetes and insulin resistance are related to increased pancreatic cancer risk as well, thus could be confounders in these epidemiological studies that requiring careful considerations (6-8). These results, thus, suggest a role for animal fat intake in pancreatic carcinogenesis. Although it is important to add that some recent epidemiological studies do not necessarily show an association between animal fat and increased risk of other types of cancer (9).

Red Meat and Processed Meat

In addition to fatty acids, pancreatic cancer has been linked to red meat and processed meats as well (4). In general, elevated red and processed meat intake was associated with an elevated risk for pancreatic cancer, while consumption of poultry, fish, dairy products, and eggs showed no such association.

Consumption of pork, as well as total red meat, was associated with increases of nearly 50%, comparing the highest consumption quintile to the lowest. Additionally, seven prospective studies have similarly investigated the associations among consumption of various meat and meat products and the risk of developing pancreatic cancer (3,10-15).



Two of these studies found a statistically significant and positive correlation with the disease risk (11,12), while four illustrated no statistically significant association (3,10-12). One study reported a decreased risk with pork and sausage consumption (13). Among the associations discussed in this study, the strongest risk factor was the consumption of processed meat.

The individuals in the fifth quintile of intake had nearly 70% higher risk compared to those in the first quintile. This could be associated with N-nitroso compounds, which are found in nitrite-preserved meat products (additionally they could be produced endogenously in the stomach after such meats are ingested), which might be the underlying reason for the positive association (15,16). Other studies have similarly reported increased risk of pancreatic with the consumption of fried, grilled, cured, or smoked meats and/or foods (16-18). In conclusion, the studies suggest that red and processed meat intake could be positively associated with the risk of pancreatic cancer.

In addition to pancreatic cancer, red meats have also been associated with increasing the risk of breast cancer (19). There was a 10% increase in the risk of breast cancer with red meat and an 8% increase for processed meat consumption. Many studies have been done in order to see the true effects that red and processed meats have on breast cancer rates. One study with 20 years of follow-up among more than 88,000 premenopausal women from the Nurses' Health Study II concluded that a greater intake of total red meat is correlated with an elevated risk of breast cancer (20). Another study showed high

consumption of total red meat in adolescence was significantly correlated with an increased risk of premenopausal breast cancer (21). A mechanism that may explain why there is a positive association relates to the presence of some carcinogenic compounds such as heterocyclic amines (HCA) and



polycyclic aromatic hydrocarbons (PAH), by-products that are synthesized in the process of high-temperature cooking (e.g. grilling and deep-

frying) of red meat (22-25). Overall, the study results show that a high intake of red and/or processed meat is statistically and positively correlated with an increased risk of breast cancer. Similar to breast cancer, red and processed meats are also linked to colorectal cancer incidences in epidemiological studies (26). As previously discussed, this could be associated with the potential mutagenic effects of HCA contained in meat and meat products cooked at high temperatures (27). Processed and red meat consumption was as well significantly associated with an elevated risk of rectal, colorectal, and colon cancer. The risk increase in colorectal cancer, as an example, was 14% for every 100 g per day increase in total red and/or processed meats. The risk increase was 25% in the colon and 31% in rectal cancers (26).

Poultry, Eggs, Fish, and Dairy

A study by Dong et al. was carried out for exploring the associations between poultry and egg consumption and the risk of developing Non-Hodgkin Lymphoma (NHL). Three cohort studies and nine case-control studies (n=11,271) with NHL were analyzed and the analyses showed no significant overall association between consumption of poultry and eggs and increased risk for NHL (28). It is noteworthy that some studies show that meat, dairy products, and eggs have been associated with elevated disease risk while others reported no significant association (10-12). However, considering all these studies collectively, there have been no associations of pancreatic cancer risk with

an intake of poultry, fish, dairy products, eggs, total fat, saturated fat, or cholesterol (4). Thus, currently, the consensus is that consumption of poultry, fish, dairy products, as well as eggs results in no such associations. Similarly, fat from dairy products was not associated with increased risks for pancreatic cancer. Dairy products, as well as egg consumption, also were studied prospectively in two additional studies and no associations with pancreatic cancer were found (11,12).

Summary

At the current time, there is consensus that increases in red meat and processed meat product consumption could be a health concern as several epidemiological studies are showing they can increase the risk of various cancers. In regard to breast cancer, it is estimated that the risk of breast cancer increases as red meat intake surpasses 120 g per day and of processed meat consumption of >50 g per day (19). Others estimate that there is a 14% increased risk for colorectal cancer, and 31% for colon cancer for every 100 g per day consumption of total red and processed meats (26). These estimates were in concordance with another study where the risk increase of colon cancer was 37% for every 100 g per day increase in red and processed meats, and the risk increase of colorectal cancer was 29% for every 100 g per day increase in red meat, and 21% for every 50 g per day increase of processed meat intake (29). The overall evidence, thus, supports limiting red and processed meat consumption as one of the dietary recommendations for the prevention of colorectal cancer. The American Cancer Society also advises the intake of fish and poultry as a substitution for red and processed meat products. This recommendation is due to the previously discussed study of the World Cancer Research Fund and the American Institute for Cancer Research that exhibited that evidence for poultry intake and cancer risk is “*too limited in amount, consistency, and quality to draw any conclusions.*” Conclusions from others also are emphasizing that individuals should reduce their intake of red meat and processed meats to mitigate the risk of pancreatic cancer (4).

It should be noted that the fatty acids commonly found in red meat also have components that could be attributed to the carcinogenic potential of red meat. These components and compounds should be further studied in order to determine if they are responsible for being a carcinogen and to what extent. Future studies could also focus on meat preparation and other related carcinogens.

Conclusions

Although there is a lack of sufficient evidence from long-term randomized trials, epidemiological evidence suggests that consumption of red meat and red meat products could be important contributors to the development of various cancers. These associations are robust and clinically significant for consumption of higher amounts of red meat,



processed meat products, and high-fat meat products. Meat and meat products on the other hand could be an important part of a healthful diet

containing high levels of balanced proteins, vitamin B12, riboflavin, zinc, and heme iron. It appears that relying on moderation and balance and utilizing primarily animal foods such as fish, poultry, and lean meats, and minimizing the use of high-fat processed red meat products could have a positive impact on one's health. This conclusion is in harmony with 2020-2025 Dietary Guidelines for Americans (30) where there is a recommendation for incorporating protein foods such as lean meats and poultry and certain species of fish in an everyday diet for maintaining a healthy lifestyle (30). Of course, science is self-correcting, and more epidemiological studies in the future such as information from the NHANES cohort, and clinical and preclinical studies could provide additional evidence-based recommendations about the consumption of red meat in a healthful diet. Until then, perhaps we could all enjoy lean meat and meat products only in moderation and balance.

Finally, it is noteworthy that reducing the amount of meat consumption in addition to potential health benefits might have additional co-benefits. Meat products typically have a much larger carbon footprint relative to plant-based foods, thus reducing the overall reliance on animal-based protein foods could be an important improvement in the sustainability of our food chain and protecting our environment (31).

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