

Q&A on the carcinogenicity of the consumption of red meat and processed meat

Q. What do you consider as red meat?

A. Red meat refers to all mammalian muscle meat, including, beef, veal, pork, lamb, mutton, horse, and goat.

Q. What do you consider as processed meat?

A. Processed meat refers to meat that has been transformed through salting, curing, fermentation, smoking, or other processes to enhance flavour or improve preservation. Most processed meats contain pork or beef, but processed meats may also contain other red meats, poultry, offal, or meat by-products such as blood.

Examples of processed meat include hot dogs (frankfurters), ham, sausages, corned beef, and biltong or beef jerky as well as canned meat and meat-based preparations and sauces.

Q. Why did IARC choose to evaluate red meat and processed meat?

A. An international advisory committee that met in 2014 recommended red meat and processed meat as high priorities for evaluation by the IARC Monographs Programme. This recommendation was based on epidemiological studies suggesting that small increases in the risk of several cancers may be associated with high consumption of red meat or processed meat. Although these risks are small, they could be important for public health because many people worldwide eat meat and meat consumption is increasing in low- and middle-income countries. Although some health agencies already recommend limiting intake of meat, these recommendations are aimed mostly at reducing the risk of other diseases. With this in mind, it was important for IARC to provide authoritative scientific evidence on the cancer risks associated with eating red meat and processed meat.

Q. Do methods of cooking meat change the risk?

A. High-temperature cooking methods generate compounds that may contribute to carcinogenic risk, but their role is not yet fully understood.

Q. What are the safest methods of cooking meat (e.g. sautéing, boiling, broiling, or barbecuing)?

A. Cooking at high temperatures or with the food in direct contact with a flame or a hot surface, as in barbecuing or pan-frying, produces more of certain types of carcinogenic chemicals (such as polycyclic aromatic hydrocarbons and heterocyclic aromatic amines). However, there were not enough data for the IARC Working Group to reach a conclusion about whether the way meat is cooked affects the risk of cancer.

Q. Is eating raw meat safer?

A. There were no data to address this question in relation to cancer risk. However, the separate question of risk of infection from consumption of raw meat needs to be kept in mind.

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Q. Red meat was classified as Group 2A, *probably carcinogenic to humans*. What does this mean exactly?

A. In the case of red meat, the classification is based on *limited evidence* from epidemiological studies showing positive associations between eating red meat and developing colorectal cancer as well as *strong* mechanistic evidence.

Limited evidence means that a positive association has been observed between exposure to the agent and cancer but that other explanations for the observations (technically termed chance, bias, or confounding) could not be ruled out.

Q. Processed meat was classified as Group 1, *carcinogenic to humans*. What does this mean?

A. This category is used when there is *sufficient evidence* of carcinogenicity in humans. In other words, there is convincing evidence that the agent causes cancer. The evaluation is usually based on epidemiological studies showing the development of cancer in exposed humans.

In the case of processed meat, this classification is based on *sufficient evidence* from epidemiological studies that eating processed meat causes colorectal cancer.

Q. Processed meat was classified as carcinogenic to humans (Group 1). Tobacco smoking and asbestos are also both classified as carcinogenic to humans (Group 1). Does it mean that consumption of processed meat is as carcinogenic as tobacco smoking and asbestos?

A. No, processed meat has been classified in the same category as causes of cancer such as tobacco smoking and asbestos (IARC Group 1, *carcinogenic to humans*), but this does **NOT** mean that they are all equally dangerous. The IARC classifications describe the strength of the scientific evidence about an agent being a cause of cancer, rather than assessing the level of risk.

Q. What types of cancers are linked or associated with eating red meat?

A. The strongest, but still *limited*, evidence for an association with eating red meat is for colorectal cancer. There is also evidence of links with pancreatic cancer and prostate cancer.

Q. What types of cancers are linked or associated with eating processed meat?

A. The IARC Working Group concluded that eating processed meat causes colorectal cancer. An association with stomach cancer was also seen, but the evidence is not conclusive.

Q. How many cancer cases every year can be attributed to consumption of processed meat and red meat?

A. According to the most recent estimates by the Global Burden of Disease Project, an independent academic research organization, about 34 000 cancer deaths per year worldwide are attributable to diets high in processed meat.

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Eating red meat has not yet been established as a cause of cancer. However, if the reported associations were proven to be causal, the Global Burden of Disease Project has estimated that diets high in red meat could be responsible for 50 000 cancer deaths per year worldwide.

These numbers contrast with about 1 million cancer deaths per year globally due to tobacco smoking, 600 000 per year due to alcohol consumption, and more than 200 000 per year due to air pollution.

Q. Could you quantify the risk of eating red meat and processed meat?

A. The consumption of processed meat was associated with small increases in the risk of cancer in the studies reviewed. In those studies, the risk generally increased with the amount of meat consumed. An analysis of data from 10 studies estimated that every 50 gram portion of processed meat eaten daily increases the risk of colorectal cancer by about 18%.

The cancer risk related to the consumption of red meat is more difficult to estimate because the evidence that red meat causes cancer is not as strong. However, if the association of red meat and colorectal cancer were proven to be causal, data from the same studies suggest that the risk of colorectal cancer could increase by 17% for every 100 gram portion of red meat eaten daily.

Q. Is the risk higher in children, in elderly people, in women, or in men? Are some people more at risk?

A. The available data did not allow conclusions about whether the risks differ in different groups of people.

Q. What about people who have had colon cancer? Should they stop eating red meat?

A. The available data did not allow conclusions about risks to people who have already had cancer.

Q. Should I stop eating meat?

A. Eating meat has known health benefits. Many national health recommendations advise people to limit intake of processed meat and red meat, which are linked to increased risks of death from heart disease, diabetes, and other illnesses.

Q. How much meat is it safe to eat?

A. The risk increases with the amount of meat consumed, but the data available for evaluation did not permit a conclusion about whether a safe level exists.

Q. What makes red meat and processed meat increase the risk of cancer?

A. Meat consists of multiple components, such as haem iron. Meat can also contain chemicals that form during meat processing or cooking. For instance, carcinogenic chemicals that form during meat processing include *N*-nitroso compounds and polycyclic aromatic hydrocarbons. Cooking of red meat or processed meat also produces heterocyclic aromatic amines as well as other chemicals including polycyclic aromatic hydrocarbons, which are also found in other foods and in air pollution. Some of these chemicals are known or suspected carcinogens, but despite

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this knowledge it is not yet fully understood how cancer risk is increased by red meat or processed meat.

Q. Can you compare the risk of eating red meat with the risk of eating processed meat?

A. Similar risks have been estimated for a typical portion, which is smaller on average for processed meat than for red meat. However, consumption of red meat has not been established as a cause of cancer.

Q. What is WHO's health recommendation to prevent cancer risk associated with eating red meat and processed meat?

A. IARC is a research organization that evaluates the evidence available on the causes of cancer but does not make health recommendations as such. National governments and WHO are responsible for developing nutritional guidelines. This evaluation by IARC reinforces a 2002 recommendation from WHO that people who eat meat should moderate the consumption of processed meat to reduce the risk of colorectal cancer. Some other dietary guidelines also recommend limiting consumption of red meat or processed meat, but these are focused mainly on reducing the intake of fat and sodium, which are risk factors for cardiovascular disease and obesity. Individuals who are concerned about cancer could consider reducing their consumption of red meat or processed meat until updated guidelines related specifically to cancer have been developed.

Q. Should we eat only poultry and fish?

A. The cancer risks associated with consumption of poultry and fish were not evaluated.

Q. Should we be vegetarians?

A. Vegetarian diets and diets that include meat have different advantages and disadvantages for health. However, this evaluation did not directly compare health risks in vegetarians and people who eat meat. That type of comparison is difficult because these groups can be different in other ways besides their consumption of meat.

Q. Is there a type of red meat that is safer?

A. A few studies have investigated the cancer risks associated with different types of red meat, such as beef and pork, and with different kinds of processed meats, like ham and hot dogs. However, there is not enough information to say whether higher or lower cancer risks are related to eating any particular type of red meat or processed meat.

Q. Could the preservation method influence the risk (e.g. salting, deep-freezing, or irradiation)?

A. Different preservation methods could result in the formation of carcinogens (e.g. *N*-nitroso compounds), but whether and how much this contributes to the cancer risk is unknown.

Q. How many studies were evaluated?

A. The IARC Working Group considered more than 800 different studies on cancer in humans (some studies provided data on both types of meat; in total more than 700 epidemiological

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studies provided data on red meat and more than 400 epidemiological studies provided data on processed meat).

Q. How many experts were involved in the evaluation?

A. The IARC Working Group consisted of 22 experts from 10 countries ([List of Participants](#)).

Q. What actions do you think governments should take based on your results?

A. IARC is a research organization that evaluates the evidence on the causes of cancer but does not make health recommendations as such. The IARC Monographs are, however, often used as a basis for making national and international policies, guidelines and recommendations to minimize cancer risks. Governments may decide to include this new information on the cancer hazards of processed meat in the context of other health risks and benefits in updating dietary recommendations.