

Workshop

The relationships of young scientists with newspapers

Barcelona. March 28, 2019

Gonzalo Casino

Case 1	2
Paper	
Myopia and ambient lighting at night	4
Press release	
Near-sightedness in children linked to light exposure during sleep before age 2	5
News	
1. Babies left in the dark see way to a brighter future (The Guardian)	7
2. Night lights linked to vision problem (New York Times)	8
Case 2	9
Carcinogenicity of consumption of red and processed meat (The Lancet)	11
Cancer Research UK graphics	13
Paper	
Red and processed meat and colorectal cancer incidence: meta-analysis (PLoS One)	15
Press release	
IARC Monographs evaluate consumption of red meat and processed meat (WHO)	16
News	
1. Drop the bacon roll - processed meats including sausages 'as bad for you as smoking' (Daily Express)	18
2. Processed meats do cause cancer - WHO (BBC News)	19

Case 1

Paper	Myopia and ambient lighting at night (Nature)
Press release	Near-sightedness in children linked to light exposure during sleep before age 2
News	1. Babies left in the dark see way to a brighter future (The Guardian) 2. Night lights linked to vision problem (New York Times)

Paper
Study design
Outcome
Main results
Certainty (high / moderate / low / very low)

Message to communicate
Message in plain language
Main numbers to communicate
Cautions

Case 1**Press release**

Is the PR adequate? Is there any exaggeration?

News 1

Is the news adequate? Is there any exaggeration?

News 2

Is the news adequate? Is there any exaggeration?

Myopia and ambient lighting at night

Myopia, or short-sightedness, occurs when the image of distant objects, focused by the cornea and lens, falls in front of the retina. It commonly arises from excessive postnatal eye growth, particularly in the vitreous cavity. Its prevalence is increasing and now reaches 70–90% in some Asian populations^{1,2}. As well as requiring optical correction, myopia is a leading risk factor for acquired blindness in adults because it predisposes individuals to retinal detachment, retinal degeneration and glaucoma. It typically develops in the early school years but can manifest into early adulthood². Its aetiology is poorly understood but may involve genetic and environmental factors^{1,2}, such as viewing close objects, although how this stimulates eye growth is not known³. We have looked at the effects of light exposure on vision, and find a strong association between myopia and night-time ambient light exposure during sleep in children before they reach two years of age.

Research in species as diverse as chicks and monkeys indicates that postnatal eye growth and refractive development are governed by a vision-dependent retinal mechanism acting mainly within the eye, with only limited participation of the brain and extra-ocular neural pathways^{3,4}. The duration of the daily light period has been shown to affect eye growth in chicks⁵, so we investigated whether refractive development in children might associate with any

recognizable pattern of light exposure. Because early neonatal visual experience markedly affects refractive development in animals^{4–6}, we evaluated light exposure both at the child's present age and before the age of two years, a period during which the eye grows rapidly⁷ but before the usual onset of myopia².

Between January and June 1998, parents of children aged 2–16 years (median age 8.0 years; $n = 479$ children, 55% males; 70% Caucasian, 30% African-American, less than 1% Asian-American) that were seen as outpatients in a university paediatric ophthalmology clinic completed a questionnaire on the child's light exposure both at present and before the age of two years. Children with amblyopia, cataract, glaucoma or a history of prematurity were excluded.

The prevalence of myopia and high myopia during childhood was strongly associated with ambient light exposure during sleep at night in the first two years after birth (Fig. 1). The relation between refraction and night-time light was dose dependent, as a greater proportion of children became myopic if they slept at night during their first two years with room lighting rather than with a night light. The increased prevalence of myopia resulted from a smaller proportion of emmetropic children, as light exposure did not relate to the proportion of hyperopic children. We found no other association of refraction with report-

ed light exposure, including no relation with night-time lighting at the child's present age.

An influence of ambient lighting during sleep on refractive development is plausible, because eyelids of human adults and infants transmit some visible light, mostly at longer wavelengths⁸. The scotopic retinal sensitivity of infants is relatively good compared with that of adults, particularly by the age of 18 weeks⁹. Further, sutured eyelids of infant monkeys transmit a degraded image and perturb refractive development⁶.

This study does not indicate whether early visual experience influences ocular anatomy by age two or only later, and does not permit conclusions to be made about the timing of the onset or progression of myopia. It raises the possibility of a 'critical period' for refractive development analogous to that for visual function¹⁰.

Although it does not establish a causal link, the statistical strength of the association of night-time light exposure and childhood myopia does suggest that the absence of a daily period of darkness during early childhood is a potential precipitating factor in the development of myopia. The results are further qualified by the limitations of collecting behavioural data by questionnaire and the lack of information on whether parental lighting preferences independently associate with other factors known to be correlated with myopia, such as parental socio-economic or refraction status^{1,2}. The generalizability of this relationship, observed in a tertiary referral centre, also requires extension to other populations and especially to Asian groups, which are severely affected by myopia¹. Despite these qualifications, it seems prudent that infants and young children sleep at night without artificial lighting in the bedroom, while the present findings are evaluated more comprehensively.

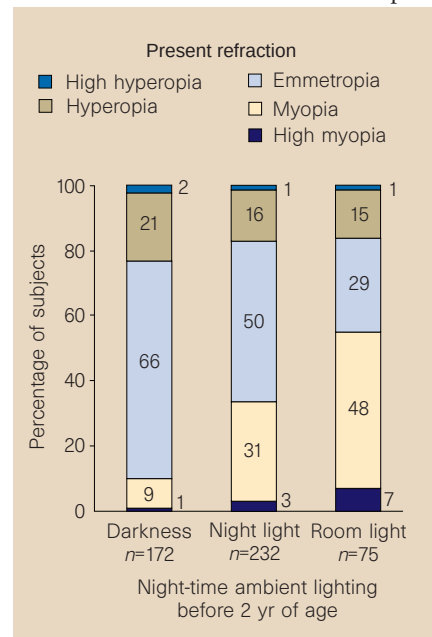
**Graham E. Quinn*†, Chai H. Shin*,
Maureen G. Maguire†, Richard A. Stone†**

*Department of Ophthalmology,
Children's Hospital of Philadelphia,
University of Pennsylvania School of Medicine,
Philadelphia, Pennsylvania 19104, USA

†Department of Ophthalmology,
Scheie Eye Institute,
University of Pennsylvania School of Medicine,
Philadelphia, Pennsylvania 19104, USA

e-mail: stone2@mail.med.upenn.edu

Figure 1 Present refractions of children of ages 2–16 yr and night-time light exposure before the age of 2 yr. The prevalence of myopia increases markedly with increased levels of night-time ambient lighting during sleep before the age of 2 yr. On a questionnaire approved by an institutional review board, parents were asked, "Under which lighting condition did/does your child sleep at night?" before the age of 2 yr and at present; they chose between 'room lighting', 'a night light' (typically, in the USA, a dim socket-mounted fixture of ~4 W) and 'darkness'. Other questions addressed the lighting in various rooms at home, lighting at day care or school, geographical locations where the child had lived and current use of sunglasses. On the basis of the mean cycloplegic spherical equivalent of both eyes at the child's most recent ophthalmic examination, we separated the refractions into five groups: high hyperopia (long-sightedness), $\geq +5.0$ dioptres (D); hyperopia, $+2$ to $< +5$ D; emmetropia ('normal' childhood refraction), $< +2$ to < -0.5 D; myopia, -0.5 to < -5.0 D; high myopia, ≤ -5.0 D. The percentage of children in the combined myopia and high myopia groups at their present age increased with increasing night-time light exposure before the age of 2 yr (χ^2 with 1 degree of freedom = 55.1, $P < 0.00001$). The strength of the relation was maintained after adjustment for age by logistic regression analysis. The same relation held for separate analyses of the Caucasian and African-American subjects ($P < 0.00001$ for each group; results not shown).



1. Saw, S.-M., Katz, J., Schein, O. D., Chew, S.-J. & Chan, T.-K. *Epidemiol. Rev.* **18**, 175–187 (1996).
2. Zadnik, K. & Mutti, D.O. in *Borish's Clinical Refraction* (ed. Benjamin, W. J.) 30–46 (Saunders, Philadelphia, 1998).
3. Stone, R.A. in *Myopia Updates: Proceedings of the 6th International Conference on Myopia* (ed. Tokoro, T.) 241–254 (Springer, Tokyo, 1997).
4. Wallman, J. *Prog. Retinal Res.* **12**, 133–153 (1993).

PRESS RELEASE

Near-Sightedness in Children Linked to Light Exposure During Sleep Before Age 2

Say Philadelphia Ophthalmologists

Source

The Children's
Hospital of
Philadelphia &
Univ. of Pa.
Medical Center

PHILADELPHIA, May 12, 1999 -- Children who sleep with a light on in their bedrooms at night before the age of 2 may be at significantly higher risk of developing myopia -- near-sightedness -- when they become older than children who sleep as infants in the dark at night, according to a collaborative study by researchers at the University of Pennsylvania Medical Center and The Children's Hospital of Philadelphia. A report on the findings will appear in the May 13 issue of *Nature*.

The team's results showed that, of children aged 2 to 16 who had slept in darkness before age 2, 10 percent were myopic at the time of the study. Of children who had slept with a night light on before 2 years of age, 34 percent were myopic. And of children who had slept at night with a room light on before 2 years of age, 55 percent were myopic -- more than a five-fold increase over the children who slept in darkness during early childhood.

"Our findings suggest that the absence of a nightly period of full darkness in early childhood may be an important risk factor in the future development of near-sightedness," says Richard A. Stone, M.D., a professor of ophthalmology at Penn's Scheie Eye Institute and senior author on the study. "The study does not establish that nighttime lighting during early childhood is a direct cause of myopia, and there are undoubtedly other risk factors. Still, it would seem advisable for infants and young children to sleep at night without artificial lighting in the bedroom until further research can evaluate all the implications of our results."

Near-sightedness is more than a minor inconvenience to be corrected with glasses or contact lenses, the scientists emphasize. "Especially in the more severe degrees, myopia itself is a leading risk factor for acquired blindness, putting individuals at increased risk for retinal detachment, retinal degeneration and glaucoma," says Graham E. Quinn, M.D., a pediatric ophthalmologist at The Children's Hospital of Philadelphia and lead author on the study. "The earliest years of life appear to represent a critical time in the proper growth and development of the eye, so this strong association, not noted before, between a daily dark period -- nighttime -- during infancy and later near-sightedness in children may well have significant clinical ramifications."

Large numbers of people are affected by the problem of near-sightedness. In the United States, at least 25 percent of the population is myopic, and in Asia the proportion of people with myopia is even higher. "This is an extension of myopia research in animals done by Dr. Stone and others," said Carl Kupfer, M.D., director of the National Eye Institute, one of the National Institutes of Health, and the agency that primarily funded the study. "The investigators have reported an association between ambient light exposure during sleep before age 2 and myopia. Additional studies are needed to determine whether eliminating such light exposure during sleep in early childhood can affect the development of this common form of refractive error."

Beyond its immediate clinical implications, the study also offers a novel explanation for the increasing prevalence of myopia over the last two centuries, as populations shifted from

agricultural to urban, industrialized environments. Many clinicians and investigators have theorized that so-called nearwork -- reading and other close-at-hand occupations -- is responsible for the increase. While not bearing directly on the nearwork hypothesis, the current findings suggest that the greater ambient nighttime light levels associated with industrialization may be a leading factor in the high incidence of myopia in developed nations.

This study was designed as an extension of results of basic laboratory research in chicks demonstrating that the relative proportions of light and dark during the 24-hour day greatly affected eye growth and refractive development.

The study was conducted using a survey instrument. The parents of 479 children aged 2 to 16 -- the median age was 8 -- were asked whether their children slept with room lighting, with a night light or in darkness before the age of 2. They were also asked to report on the current nighttime lighting conditions for the same children. Other questions addressed the lighting in various rooms of the home, in day care or school settings, and in the geographical region in which the child lived. The use of sunglasses was also assessed.

An association was found only between current refraction and nighttime lighting before age 2. No association was found between current refraction and room lighting during sleep at the children's current ages. The investigators chose the cut-off age of 2 years because the eye grows particularly rapidly before this. Whether or not the specific age of 2 years actually defines the precise end of the susceptibility period to nighttime illumination can only be known from future research.

Co-authors on the paper with Stone and Quinn are biostatistician Maureen G. Maguire, Ph.D., at Penn's Scheie Eye Institute and Chai H. Shin, M.D., a clinical fellow at Children's Hospital. Primary funding for the investigators' myopia research has been provided by the National Eye Institute. Additional support has been provided by Research to Prevent Blindness, the Pennsylvania Lions Sight Conservation and Eye Research Foundation, Inc., and the Ethel Brown Foerderer Fund for Excellence at The Children's Hospital of Philadelphia.

The Children's Hospital of Philadelphia, the nation's first children's hospital, is a leader in patient care, education and research. This 406-bed multispecialty hospital provides comprehensive pediatric services to children from before birth through age 19. The University of Pennsylvania Medical Center's sponsored research and training ranks second in the United States based on grant support from the National Institutes of Health, the primary funder of biomedical research and training in the nation -- \$201 million in federal fiscal year 1998.

Web site: <http://www.chop.edu>

CONTACT: Sarah Jarvis of The Children's Hospital of Philadelphia, 215-590-4092, or Franklin Hoke of the University of Pennsylvania Medical Center, 215-349-5659

Babies left in the dark see way to a brighter future

The Guardian, Thursday 13 May 1999 01.31 BST

Night lights, those nursery standbys for tearful infants, could soon be snuffed out everywhere. US eye specialists claim that babies who sleep with a light on in their bedrooms are five times more likely to develop myopia - nearsightedness - in later life. Richard Stone of Pennsylvania University's School of Medicine and Graham Quinn of Philadelphia Children's Hospital report in *Nature* today that they made a survey of 479 children aged from two to 16 who had slept in darkness before they were two. Of the whole group, one in 10 was myopic. But of children who slept with a dim lamp or candle in their bedroom under the age of two, 34% were myopic. And of children who slept with the bedroom light on before age two, 55% were nearsighted.

'Our findings suggest that the absence of a nightly period of full darkness in early childhood may be an important risk factor in the future development of nearsightedness,' Prof Stone said. 'The study does not establish that night time lighting during early childhood is a direct cause of myopia, and there are undoubtedly other risk factors. Still, it would seem advisable for infants and young children to sleep at night without artificial lighting in the bedroom.'

The association of night light with myopia was 'extraordinarily strong'. But even so, it was a finding based only on a selection of children who went to an eye clinic within a children's hospital: it had yet to be confirmed in a wider population.

'The first thing is: no parents should have guilt,' Prof Stone said. 'We had night lights with our kids - one's in high school and two are in college - and two of them are nearsighted. I don't feel guilty. And if I don't feel guilty, nobody should feel guilty. I'm the one who put all this stuff together and said gee, we ought to really look at this. I didn't think twice about it when my kids were little.'

Worried parents should not over-react. Babies should sleep in the dark - but parents should not be anxious about it, he said. 'We don't know how much dark, we don't know how long the dark should be - for all we know a couple of hours of dark is OK.'

'Babies are babies: turn the light off when they are asleep. They wake up two or three times during the night, and they have to be cared for. So turn on the light so you don't have any accidents with the baby. We don't know enough to say anything else.'

Nearsightedness is common worldwide: a quarter of Americans are myopic, and the proportion in Asia is even higher. In most cases, the problem is corrected with spectacles or contact lenses.

Myopia results from excessive postnatal eye growth. It alters the geometry of the eye so that images of distant objects, focused by the cornea and the lens, fall in front of the retina. It has been increasing in the last two centuries as populations shifted to cities.

The New York Times

May 13, 1999

Night Lights Linked To Vision Problem

Children who sleep under the soft glow of a night light may be more likely to suffer from nearsightedness, a new study suggests.

Researchers at the University of Pennsylvania and Children's Hospital of Philadelphia say that youngsters who sleep in a dimly lighted room until age 2 may be as much as five times more likely to develop myopia, or nearsightedness, as they grow up.

The study of 479 children was published in today's issue of the journal *Nature* and raises the possibility that too much light affects the natural focus of the eyes by prompting excessive growth during the first two years of life.

"Just as the body needs to rest, this suggests that the eyes need a period of darkness," said Dr. Graham E. Quinn, the ophthalmologist who was study's lead author.

But eye specialists from many institutions dismissed the study as premature and incomplete, saying the researchers had failed to take into account obvious factors like heredity.

"There are other factors involved in childhood myopia," said Donald Mutti of the University of California at Berkeley, "the most important of which is whether the parents are nearsighted or not."

Copyright 2012 The New York Times Company

Case 2

Paper	Red and processed meat and colorectal cancer incidence: meta-analysis (PLOS One)
Press release	IARC Monographs evaluate consumption of red meat and processed meat (WHO)
News	1. Drop the bacon roll - processed meats including sausages 'as bad for you as smoking' (Daily Express) 2. Processed meats do cause cancer - WHO (BBC News)

Paper
Study design
Outcome
Main results
Certainty (high / moderate / low / very low)

Message to communicate
Message in plain language
Main numbers to communicate
Cautions

Case 2**Press release**

Is the PR adequate? Is there any exaggeration?

News 1

Is the news adequate? Is there any exaggeration?

News 2

Is the news adequate? Is there any exaggeration?

Carcinogenicity of consumption of red and processed meat

In October, 2015, 22 scientists from ten countries met at the International Agency for Research on Cancer (IARC) in Lyon, France, to evaluate the carcinogenicity of the consumption of red meat and processed meat. These assessments will be published in volume 114 of the IARC Monographs.¹

Red meat refers to unprocessed mammalian muscle meat—for example, beef, veal, pork, lamb, mutton, horse, or goat meat—including minced or frozen meat; it is usually consumed cooked. 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 might also contain other red meats, poultry, offal (eg, liver), or meat byproducts such as blood.

Red meat contains high biological-value proteins and important micronutrients such as B vitamins, iron (both free iron and haem iron), and zinc. The fat content of red meat varies depending on animal species, age, sex, breed, and feed, and the cut of the meat. Meat processing, such as curing and smoking, can result in formation of carcinogenic chemicals, including N-nitroso-compounds (NOC) and polycyclic aromatic hydrocarbons (PAH). Cooking improves the digestibility and palatability of meat, but can also produce known or suspected carcinogens, including heterocyclic aromatic amines (HAA) and PAH. High-temperature cooking by pan-frying, grilling, or barbecuing generally produces the highest amounts of these chemicals.^{2,3}

Depending on the country, the proportion of the population that consumes red meat varies worldwide from less than 5% to up to 100%, and from less than 2% to 65% for processed meat. The mean intake of red meat by those who consume it is about 50–100 g per person per day, with high consumption equalling

more than 200 g per person per day.⁴ Less information is available on the consumption of processed meat.

The Working Group assessed more than 800 epidemiological studies that investigated the association of cancer with consumption of red meat or processed meat in many countries, from several continents, with diverse ethnicities and diets. For the evaluation, the greatest weight was given to prospective cohort studies done in the general population. High quality population-based case-control studies provided additional evidence. For both designs, the studies judged to be most informative were those that considered red meat and processed meat separately, had quantitative dietary data obtained from validated questionnaires, a large sample size, and controlled for the major potential confounders for the cancer sites concerned.

The largest body of epidemiological data concerned colorectal cancer. Data on the association of red meat consumption with colorectal cancer were available from 14 cohort studies. Positive associations were seen with high versus low consumption of red meat in half of those studies, including a cohort from ten European countries spanning a wide range of meat consumption and other large cohorts in Sweden and Australia.^{5–7} Of the 15 informative case-control studies considered, seven reported positive associations of colorectal cancer with high versus low consumption of red meat. Positive associations of colorectal cancer with consumption of processed meat were reported in 12 of the 18 cohort studies that provided relevant data, including studies in Europe, Japan, and the USA.^{5,8–11} Supporting evidence came from six of nine informative case-control studies. A meta-analysis of colorectal cancer in ten cohort studies reported a statistically significant dose-response relationship, with a 17% increased risk (95% CI 1.05–1.31) per 100 g per

day of red meat and an 18% increase (95% CI 1.10–1.28) per 50 g per day of processed meat.¹²

Data were also available for more than 15 other types of cancer. Positive associations were seen in cohort studies and population-based case-control studies between consumption of red meat and cancers of the pancreas and the prostate (mainly advanced prostate cancer), and between consumption of processed meat and cancer of the stomach.

On the basis of the large amount of data and the consistent associations of colorectal cancer with consumption of processed meat across studies in different populations, which make chance, bias, and confounding unlikely as explanations, a majority of the Working Group concluded that there is sufficient evidence in human beings for the carcinogenicity of the consumption of processed meat. Chance, bias, and confounding could not be ruled out with the same degree of confidence for the data on red meat consumption, since no clear association was seen in several of the high quality studies and residual confounding from other diet and lifestyle risk is difficult to exclude. The Working Group concluded that there is limited evidence in human beings for the carcinogenicity of the consumption of red meat.

There is inadequate evidence in experimental animals for the carcinogenicity of consumption of red meat and of processed meat. In rats treated with colon cancer initiators and promoted with low calcium diets containing either red meat or processed meat, an increase in the occurrence of colonic preneoplastic lesions was reported in three and four studies, respectively.^{13–15}

The mechanistic evidence for carcinogenicity was assessed as strong for red meat and moderate for processed meat. Mechanistic evidence is mainly available for the



Lancet Oncol 2015

Published Online
October 26, 2015
[http://dx.doi.org/10.1016/S1470-2045\(15\)00444-1](http://dx.doi.org/10.1016/S1470-2045(15)00444-1)

For more on the **IARC Monographs** see <http://monographs.iarc.fr/>

Upcoming meetings

Feb 2–9, 2016, Volume 115:
Some industrial chemicals;
May 24–31, 2016, Volume 116:
Coffee and some other hot beverages

IARC Monograph Working Group Members

B W Stewart (Australia)—meeting chair; S De Smet (Belgium); D Corpet, M Meurillon (France); G Caderni (Italy); S Rohmann; P Verger (Switzerland); S Sasazuki, K Wakabayashi (Japan); M P Weijenberg (Netherlands); A Wolk (Sweden); M Cantwell; T Norat; P Vineis (UK); F A Beland, E Cho, D M Klurfeld, L Le Marchand, R Sinha, M Stern, R Turesky, K Wu (USA)

Declaration of interests

TN was involved in a research project funded by the World Cancer Research Fund, a registered charity. All other working group members declare no competing interests.

Invited Specialists

None

Representatives

A Christodoulidou, for the European Food Safety Authority (EFSA), Italy; I Margaritis, for the French Agency for Food, Environment and Occupational Health and Safety (ANSES), France; Y Totsuka, for the National Cancer Center Research Institute, Japan

Declaration of interests

All representatives declare no competing interests.

Observers

D D Alexander, for the EpidStat Institute, USA; B L Booren, for the North American Meat

Institute, USA; J Carretier, for the Léon Bérard Centre, France; J J Hlywka, for the Kraft Heinz Company, USA; D A Kovich, for the National Pork Producers Council, USA; H J Lazaneo, for the National Meat Institute (INAC), Uruguay; M McCullough, for the American Cancer Society, USA; S McNeill, for Beef Checkoff, USA

Declaration of interests
DDA has received consulting fees from Beef Checkoff for research on red meat and cancer. BLB receives a salary from the North American Meat Institute (NAMI) and the North American Meat Institute Foundation (NAMIF). BLB publicly represents in media, government, and scientific meetings, among others, the NAMI and NAMIF position and analysis of scientific evidence. DAK is employed by the National Pork Producers Council, USA. SMCn is an employee of the National Cattlemen's Beef Association and is a contractor to the Beef Checkoff. All other observers declare no competing interests.

IARC/WHO Secretariat
L Benbrahim-Tallaa; V Bouvard; F El Ghissassi; C Espina; E Fioletto; J Gomes; Y Grosse; N Guha; K Z Guyton; I Huybrechts; D Loomis; H Mattock; A Mullee; I Romieu; C Santamaria-Ulloa; M Stepien; K Straif

Declaration of interests
All secretariat declare no competing interests.

For the **Preamble to the IARC Monographs** see <http://monographs.iarc.fr/ENG/Preamble/index.php>

For **IARC declarations of interests** see <http://monographs.iarc.fr/ENG/Meetings/vol.114-participants/>

digestive tract. A meta-analysis published in 2013 reported a modest but statistically significant association between consumption of red or processed meat and adenomas (preneoplastic lesions) of the colorectum that was consistent across studies.¹⁶ For genotoxicity and oxidative stress, evidence was moderate for the consumption of red or processed meat. In human beings, observational data showed slight but statistically significant associations with APC gene mutation or promoter methylation that were identified in 75 (43%) and 41 (23%) of 185 archival colorectal cancer samples, respectively.¹⁷ Consuming well done cooked red meat increases the bacterial mutagenicity of human urine. In three intervention studies in human beings, changes in oxidative stress markers (either in urine, faeces, or blood) were associated with consumption of red meat or processed meat.¹⁸ Red and processed meat intake increased lipid oxidation products in rodent faeces.¹³

Substantial supporting mechanistic evidence was available for multiple meat components (NOC, haem iron, and HAA). Consumption of red meat and processed meat by man induces NOC formation in the colon. High red meat consumption (300 or 420 g/day) increased levels of DNA adducts putatively derived from NOC in exfoliated colonocytes or rectal biopsies in two intervention studies.^{19,20} Few human data, especially from intervention studies, were available for processed meat. Haem iron mediates formation of NOC, and of lipid oxidation products in the digestive tract of human beings and rodents. Haem iron effects can be experimentally suppressed by calcium, supporting its contribution to carcinogenic mechanisms. Meat heated at a high temperature contains HAA. HAA are genotoxic, and the extent of conversion of HAA to genotoxic metabolites is greater in man than in rodents. Meat smoked or

cooked over a heated surface or open flame contains PAH. These chemicals cause DNA damage, but little direct evidence exists that this occurs following meat consumption.

Overall, the Working Group classified consumption of processed meat as “carcinogenic to humans” (Group 1) on the basis of sufficient evidence for colorectal cancer. Additionally, a positive association with the consumption of processed meat was found for stomach cancer.

The Working Group classified consumption of red meat as “probably carcinogenic to humans” (Group 2A). In making this evaluation, the Working Group took into consideration all the relevant data, including the substantial epidemiological data showing a positive association between consumption of red meat and colorectal cancer and the strong mechanistic evidence. Consumption of red meat was also positively associated with pancreatic and with prostate cancer.

We declare no competing interests.

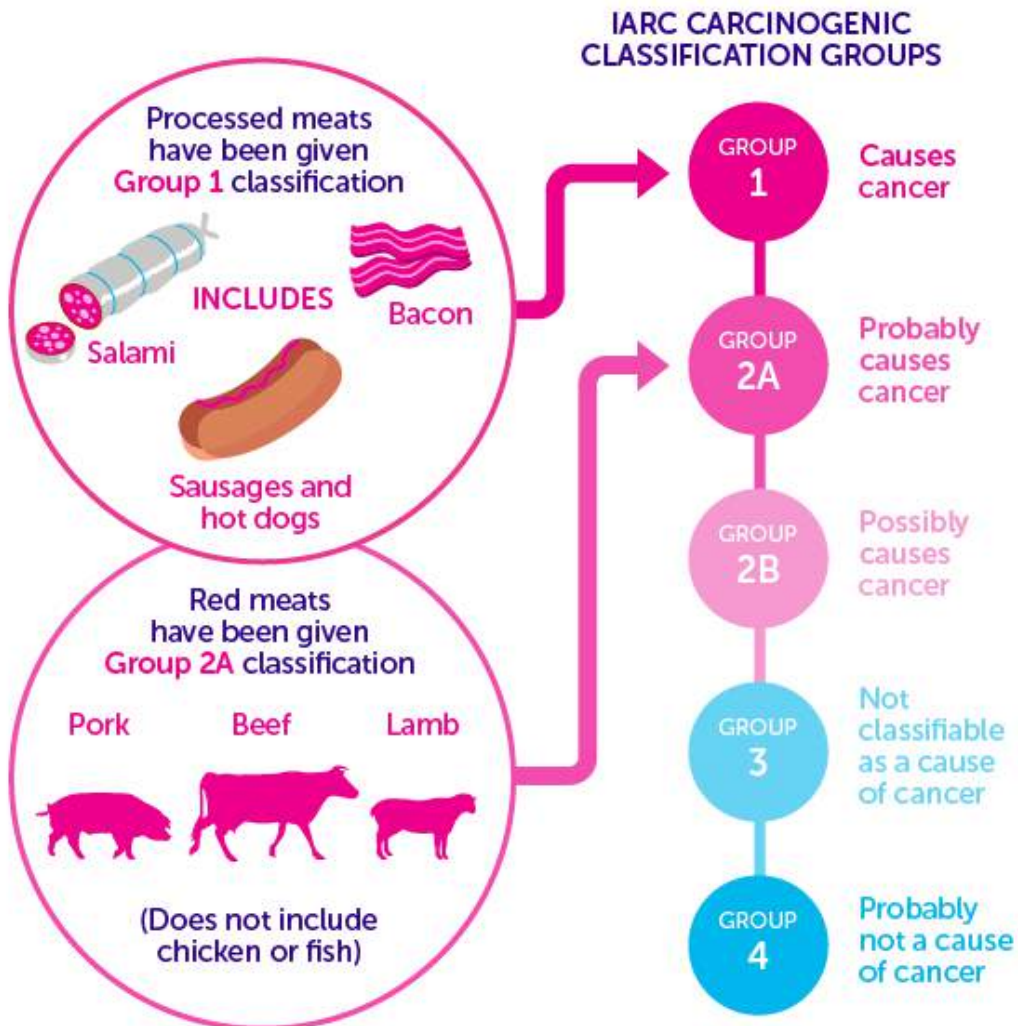
Véronique Bouvard, Dana Loomis, Kathryn Z Guyton, Yann Grosse, Fatiha El Ghissassi, Lamia Benbrahim-Tallaa, Neela Guha, Heidi Mattock, Kurt Straif, on behalf of the International Agency for Research on Cancer Monograph Working Group

International Agency for Research on Cancer, Lyon, France

- 1 International Agency for Research on Cancer. Volume 114: Consumption of red meat and processed meat. IARC Working Group. Lyon; 6–13 September, 2015. *IARC Monogr Eval Carcinog Risks Hum* (in press).
- 2 Alaejos MS, Afonso AM. Factors that affect the content of heterocyclic aromatic amines in foods. *Comp Rev Food Sci Food Safe* 2011; **10**: 52–108.
- 3 Alomirah H, Al-Zenki S, Al-Hooti S, et al. Concentrations and dietary exposure to polycyclic aromatic hydrocarbons (PAHs) from grilled and smoked foods. *Food Control* 2011; **22**: 2028–35.
- 4 Food and Agriculture Organization of the United Nations Statistics Division. Food balance. 2015. http://faostat3.fao.org/browse/FB/*E (accessed July 9, 2015).
- 5 Norat T, Bingham S, Ferrari P, et al. Meat, fish, and colorectal cancer risk: the European Prospective Investigation into cancer and nutrition. *J Natl Cancer Inst* 2005; **97**: 906–16.
- 6 Larsson SC, Rafter J, Holmberg L, Bergkvist L, Wolk A. Red meat consumption and risk of cancers of the proximal colon, distal colon and rectum: the Swedish Mammography Cohort. *Int J Cancer* 2005; **113**: 829–34.
- 7 English DR, MacInnis RJ, Hodge AM, Hopper JL, Haydon AM, Giles GG. Red meat, chicken, and fish consumption and risk of colorectal cancer. *Cancer Epidemiol Biomarkers Prev* 2004; **13**: 1509–14.
- 8 Oba S, Shimizu N, Nagata C, et al. The relationship between the consumption of meat, fat, and coffee and the risk of colon cancer: a prospective study in Japan. *Cancer Lett* 2006; **244**: 260–67.
- 9 Bernstein AM, Song M, Zhang X, et al. Processed and unprocessed red meat and risk of colorectal cancer: analysis by tumor location and modification by time. *PLoS One* 2015; **10**: e0135959.
- 10 Cross AJ, Ferrucci LM, Risch A, et al. A large prospective study of meat consumption and colorectal cancer risk: an investigation of potential mechanisms underlying this association. *Cancer Res* 2010; **70**: 2406–14.
- 11 Chao A, Thun MJ, Connell CJ, et al. Meat consumption and risk of colorectal cancer. *JAMA* 2005; **293**: 172–82.
- 12 Chan DS, Lau R, Aune D, et al. Red and processed meat and colorectal cancer incidence: meta-analysis of prospective studies. *PLoS One* 2011; **6**: e20456.
- 13 Pierre F, Freeman A, Tache S, van der Meer R, Corpet DE. Beef meat and blood sausage promote the formation of azoxymethane-induced mucin-depleted foci and aberrant crypt foci in rat colons. *J Nutr* 2004; **134**: 2711–16.
- 14 Pierre F, Santarelli R, Tache S, Gueraud F, Corpet DE. Beef meat promotion of dimethylhydrazine-induced colorectal carcinogenesis biomarkers is suppressed by dietary calcium. *Br J Nutr* 2008; **99**: 1000–06.
- 15 Santarelli RL, Vendeuvre JL, Naud N, et al. Meat processing and colon carcinogenesis: cooked, nitrite-treated, and oxidized high-heme cured meat promotes mucin-depleted foci in rats. *Cancer Prev Res (Phila)*; **3**: 852–64.
- 16 Aune D, Chan DS, Vieira AR, et al. Red and processed meat intake and risk of colorectal adenomas: a systematic review and meta-analysis of epidemiological studies. *Cancer Causes Control* 2013; **24**: 611–27.
- 17 Gay LJ, Mitrou PN, Keen J, et al. Dietary, lifestyle and clinicopathological factors associated with APC mutations and promoter methylation in colorectal cancers from the EPIC-Norfolk study. *J Pathol* 2012; **228**: 405–15.
- 18 Pierre FH, Martin OC, Santarelli RL, et al. Calcium and alpha-tocopherol suppress cured-meat promotion of chemically induced colon carcinogenesis in rats and reduce associated biomarkers in human volunteers. *Am J Clin Nutr* 2013; **98**: 1255–62.
- 19 Le Leu RK, Winter JM, Christophersen CT, et al. Butyrylated starch intake can prevent red meat-induced O6-methyl-2-deoxyguanosine adducts in human rectal tissue: a randomised clinical trial. *Br J Nutr* 2015; **114**: 220–30.
- 20 Lewin MH, Bailey N, Bandaletova T, et al. Red meat enhances the colonic formation of the DNA adduct O6-carboxymethyl guanine: implications for colorectal cancer risk. *Cancer Res* 2006; **66**: 1859–65.

MEAT AND CANCER

HOW STRONG IS THE EVIDENCE?



These categories represent how likely something is to cause cancer in humans, not how many cancers it causes.

WE WILL BEAT CANCER SOONER
cruk.org



TOBACCO vs MEAT WHAT'S THE RISK?

The **EVIDENCE** that processed meat causes cancer is as strong as the evidence for tobacco, but the **RISK** from tobacco is much higher...

CANCERS CAUSED
BY TOBACCO



19%

OF ALL CANCERS

CANCERS CAUSED
BY PROCESSED
AND RED MEAT

21%

OF BOWEL
CANCERS

3%

OF ALL CANCERS

THE NUMBER OF CANCERS PER YEAR IN THE UK THAT COULD
BE PREVENTED IF...

NO-ONE SMOKED



64,500 FEWER CASES

 = 1,000 PEOPLE

NO-ONE ATE
ANY PROCESSED
OR RED MEAT



8,800 FEWER CASES

Source: cruk.org/cancerstats

WE WILL BEAT CANCER SOONER
cruk.org



Red and Processed Meat and Colorectal Cancer Incidence: Meta-Analysis of Prospective Studies

Doris S. M. Chan¹, Rosa Lau¹, Dagfinn Aune¹, Rui Vieira¹, Darren C. Greenwood², Ellen Kampman³, Teresa Norat^{1*}

1 Department of Epidemiology and Biostatistics, School of Public Health, Imperial College London, London, United Kingdom, **2** Biostatistics Unit, Centre for Epidemiology and Biostatistics, University of Leeds, Leeds, United Kingdom, **3** Division of Human Nutrition, Wageningen University, Wageningen, The Netherlands

Abstract

Background: The evidence that red and processed meat influences colorectal carcinogenesis was judged convincing in the 2007 World Cancer Research Fund/American Institute of Cancer Research report. Since then, ten prospective studies have published new results. Here we update the evidence from prospective studies and explore whether there is a non-linear association of red and processed meats with colorectal cancer risk.

Methods and Findings: Relevant prospective studies were identified in PubMed until March 2011. For each study, relative risks and 95% confidence intervals (CI) were extracted and pooled with a random-effects model, weighting for the inverse of the variance, in highest versus lowest intake comparison, and dose-response meta-analyses. Red and processed meats intake was associated with increased colorectal cancer risk. The summary relative risk (RR) of colorectal cancer for the highest versus the lowest intake was 1.22 (95% CI = 1.11–1.34) and the RR for every 100 g/day increase was 1.14 (95% CI = 1.04–1.24). Non-linear dose-response meta-analyses revealed that colorectal cancer risk increases approximately linearly with increasing intake of red and processed meats up to approximately 140 g/day, where the curve approaches its plateau. The associations were similar for colon and rectal cancer risk. When analyzed separately, colorectal cancer risk was related to intake of fresh red meat (RR for 100 g/day increase = 1.17, 95% CI = 1.05–1.31) and processed meat (RR for 50 g/day increase = 1.18, 95% CI = 1.10–1.28). Similar results were observed for colon cancer, but for rectal cancer, no significant associations were observed.

Conclusions: High intake of red and processed meat is associated with significant increased risk of colorectal, colon and rectal cancers. The overall evidence of prospective studies supports limiting red and processed meat consumption as one of the dietary recommendations for the prevention of colorectal cancer.

Citation: Chan DSM, Lau R, Aune D, Vieira R, Greenwood DC, et al. (2011) Red and Processed Meat and Colorectal Cancer Incidence: Meta-Analysis of Prospective Studies. PLoS ONE 6(6): e20456. doi:10.1371/journal.pone.0020456

Editor: Daniel Tomé, Paris Institute of Technology for Life, Food and Environmental Sciences, France

Received: February 16, 2011; **Accepted:** April 21, 2011; **Published:** June 6, 2011

Copyright: © 2011 Chan et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Funding: This work was funded by the World Cancer Research Fund International (Grant number: 2007/SP01) (<http://www.wcrf-uk.org/>). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript. The views expressed in this review are the opinions of the authors. They may not represent the views of WCRF International/AICR and may differ from those in their future updates of the evidence related to food, nutrition, physical activity and cancer risk.

Competing Interests: The authors have declared that no competing interests exist.

* E-mail: t.norat@imperial.ac.uk

Introduction

Colorectal cancer is the third most frequently diagnosed cancer worldwide, accounting for more than one million cases and 600 000 deaths every year. Incidence rates are highest in North America, Western Europe, Australia/New Zealand, and in Asian countries that have experienced nutrition transition, such as Japan, Singapore, and North-Korea [1]. Incidence rates are stable or decreasing in long-standing economically developed countries, while they continue to increase in economically transitioning countries. Recent declines in mortality from colorectal cancer have been observed in North America and Japan, possibly due to primary prevention (surveillance and screening) and improved treatment [2]. Decreasing trends in colorectal cancer mortality have also been observed in most Western European countries [3].

The role of environmental and lifestyle factors on colorectal carcinogenesis is indicated by the increase in colorectal cancer

incidence in parallel with economic development and adoption of a western lifestyle [4], as well as by the results of migration studies that demonstrate a greater lifetime incidence of colorectal cancer among immigrants to high-incidence, industrialized countries compared to residents remaining in low-incidence countries [5]. Screening and surveillance of adenomatous polyps, a precursor of colorectal cancer, is currently the cornerstone for primary prevention of colorectal cancer [6]. However, understanding the role of environmental factors in colorectal carcinogenesis may inform additional primary prevention strategies that can further reduce risk.

Several plausible biological mechanisms have been suggested to explain the association of red and processed meats with colorectal cancer [7–9]. These include the potential mutagenic effect of heterocyclic amines (HCA) contained in meat cooked at high temperature [10], but this is not specific of red and processed meats since HCA's are also formed in poultry. A second

International Agency for Research on Cancer



PRESS RELEASE
N° 240

26 October 2015

IARC Monographs evaluate consumption of red meat and processed meat

Lyon, France, 26 October 2015 – The International Agency for Research on Cancer (IARC), the cancer agency of the World Health Organization, has evaluated the carcinogenicity of the consumption of red meat and processed meat.

Red meat

After thoroughly reviewing the accumulated scientific literature, a Working Group of 22 experts from 10 countries convened by the IARC Monographs Programme classified the consumption of red meat as *probably carcinogenic to humans* (Group 2A), based on *limited evidence* that the consumption of red meat causes cancer in humans and *strong mechanistic evidence* supporting a carcinogenic effect.

This association was observed mainly for colorectal cancer, but associations were also seen for pancreatic cancer and prostate cancer.

Processed meat

Processed meat was classified as *carcinogenic to humans* (Group 1), based on *sufficient evidence* in humans that the consumption of processed meat causes colorectal cancer.

Meat consumption and its effects

The consumption of meat varies greatly between countries, with from a few percent up to 100% of people eating red meat, depending on the country, and somewhat lower proportions eating processed meat.

The experts concluded that each 50 gram portion of processed meat eaten daily increases the risk of colorectal cancer by 18%.

“For an individual, the risk of developing colorectal cancer because of their consumption of processed meat remains small, but this risk increases with the amount of meat consumed,” says Dr Kurt Straif, Head of the IARC Monographs Programme. “In view of the large number of people who consume processed meat, the global impact on cancer incidence is of public health importance.”

The IARC Working Group considered more than 800 studies that investigated associations of more than a dozen types of cancer with the consumption of red meat or processed meat in many countries and populations with diverse diets. The most influential evidence came from large prospective cohort studies conducted over the past 20 years.

Public health

“These findings further support current public health recommendations to limit intake of meat,” says Dr Christopher Wild, Director of IARC. “At the same time, red meat has nutritional value. Therefore, these results are important in enabling governments and international regulatory agencies to conduct risk assessments, in order to balance the risks and benefits of eating red meat and processed meat and to provide the best possible dietary recommendations.”

IARC Monographs evaluate consumption of red meat and processed meat

Note to the Editor:

Red meat refers to all types of mammalian muscle meat, such as beef, veal, pork, lamb, mutton, horse, and goat.

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.

A summary of the final evaluations is available online in [The Lancet Oncology](#), and the detailed assessments will be published as Volume 114 of the IARC Monographs.

Read the IARC Monographs Q&A

<http://www.iarc.fr/en/media-centre/iarcnews/pdf/Monographs-Q&A.pdf>

Read the IARC Monographs Q&A on the carcinogenicity of the consumption of red meat and processed meat.

http://www.iarc.fr/en/media-centre/iarcnews/pdf/Monographs-Q&A_Vol114.pdf

For more information, please contact

Véronique Terrasse, Communications Group, at +33 (0)4 72 73 83 66 or terrassev@iarc.fr
or Dr Nicolas Gaudin, IARC Communications, at com@iarc.fr

The International Agency for Research on Cancer (IARC) is part of the World Health Organization. Its mission is to coordinate and conduct research on the causes of human cancer, the mechanisms of carcinogenesis, and to develop scientific strategies for cancer control. The Agency is involved in both epidemiological and laboratory research and disseminates scientific information through publications, meetings, courses, and fellowships. If you wish your name to be removed from our press release e-mailing list, please write to com@iarc.fr.

Drop the bacon roll - processed meats including sausages 'as bad for you as SMOKING'

BAD news for fans of a cooked breakfast - it could be as bad for you as smoking

By FELICITY THISTLETHWAITE

09:12, Fri, Oct 23, 2015 | UPDATED: 09:19, Fri, Oct 23, 2015

Bacon, burgers and sausages are about to be black-listed by the World Health Organisation, a report claims.

It is claimed the WHO is preparing to list processed meat - including Britain's much-loved sausages - as amongst the most "cancer-causing substances, alongside arsenic and asbestos".

The Mail Online reports a 'well-known source' has revealed to them the United Nations' public health arm's plans for the categorisation.

No doubt the news will cause havoc in supermarkets, with people struggling to understand the findings of the investigation.

Fresh red meat is also up for the chop, with the same source claiming beef, pork, lamb and mutton will join the 'encyclopaedia of carcinogens'.

While it's likely to be categorised as ever so slightly LESS dangerous than processed meats, it could be the end of steak and chips night as we know it.

The news comes after the Department of Health's advisers recently revealed red and processed meat "probably" increase the odds of bowel cancer.

Could it be the WHO will go a whole step further and announce red meat DOES give you cancer, as has been reported? The decision is due on Monday.

Express.co.uk has contacted the World Health Organisation for comment on these claims.

Cancer Research UK report around 16,200 people died of bowel cancer in 2012 in the UK, that's more than 44 people every day. Meanwhile, stomach cancer is the fifth most common cancer for men and the ninth most common cancer for women in the UK.

It's not just a cancer risk on the table after enjoying a bacon sandwich - heart attacks are on the rise too.

Enjoying a couple of slices of ham can raise the risk of dying from heart failure by more than a third.

Stark findings from a study were reported earlier this year - with more than 37,000 men taking part in the research.

Dr Joanna Kaluza, who led the study, said the message for good health was clear.

She said: "To reduce your risk of heart failure and other cardiovascular -diseases, we suggest avoiding - processed red meat in your diet, and limiting the amount of unprocessed red meat to one to two servings per week or less.

"Instead, eat a diet rich in fruit, -vegetables, whole grain products, nuts and increase your servings of fish."

Processed meats do cause cancer - WHO

By James Gallagher | Health editor, BBC News website

Its report said 50g of processed meat a day - less than two slices of bacon - increased the chance of developing colorectal cancer by 18%.

Meanwhile, it said red meats were "probably carcinogenic" but there was limited evidence. The WHO did stress that meat also had health benefits.

Cancer Research UK said this was a reason to cut down rather than give up red and processed meats.

And added that an occasional bacon sandwich would do little harm.

It is the chemicals involved in the processing which could be increasing the risk of cancer. High temperature cooking, such as on a barbeque, can also create carcinogenic chemicals. In the UK, around six out of every 100 people get bowel cancer at some point in their lives. If they were all given an extra 50g of bacon a day for the rest of their lives then the risk would increase by 18% to around seven in 100 people getting bowel cancer.

"So that's one extra case of bowel cancer in all those 100 lifetime bacon-eaters," argued Sir David Spiegelhalter, a risk professor from the University of Cambridge.

How bad?

The WHO has come to the conclusion on the advice of its International Agency for Research on Cancer, which assesses the best available scientific evidence.

It has now placed processed meat in the same category as plutonium, but also alcohol as they definitely do cause cancer.

However, this does not mean they are equally dangerous. A bacon sandwich is not as bad as smoking.

"For an individual, the risk of developing colorectal (bowel) cancer because of their consumption of processed meat remains small, but this risk increases with the amount of meat consumed," Dr Kurt Straif from the WHO said.

That is in contrast to one million deaths from cancer caused by smoking and 600,000 attributed to alcohol each year.

Red meat does have nutritional value too and is a major source of iron, zinc and vitamin B12.

However, the WHO said there was limited evidence that 100g of red meat a day increased the risk of cancer by 17%.

An eight ounce steak is 225g.

The WHO said its findings were important for helping countries give balanced dietary advice.

Little harm

Prof Tim Key, from the Cancer Research UK and the University of Oxford, said: "This decision doesn't mean you need to stop eating any red and processed meat, but if you eat lots of it you may want to think about cutting down.

"Eating a bacon bap every once in a while isn't going to do much harm - having a healthy diet is all about moderation."

Dr Teresa Norat, one of the advisors to the WHO report and from Imperial College London, said there were many factors causing bowel cancer.

She told BBC News website: "People should limit consumption of red meat and avoid consuming processed meat, but they should also have a diet rich in fibre, from fruit and vegetables and maintain an adequate body weight throughout life and limit the consumption of alcohol and be physically active."

The industry body the Meat Advisory Panel said "avoiding red meat in the diet is not a protective strategy against cancer" and said the focus should be alcohol, smoking and body weight.

Red meat risk

In context

21%

of bowel cancers are caused by processed or red meat

86%

of lung cancers are caused by tobacco

19% of all cancers caused by tobacco compared to

3% of all cancers ascribed to red or processed meat

Source: Cancer Research UK



What is processed meat?

Processed meat has been modified to either extend its shelf life or change the taste and the main methods are smoking, curing, or adding salt or preservatives.

Simply putting beef through a mincer does not mean the resulting mince is "processed" unless it is modified further.

Processed meat includes bacon, sausages, hot dogs, salami, corned beef, beef jerky and ham as well as canned meat and meat-based sauces.

WHO classification of red and processed meats

IARC* Carcinogenic Classification Groups

Likelihood
causes cancer
High to Low

- 1
- 2a
- 2b
- 3
- 4

Causes cancer: Processed meats including

Sausages and hotdogs 	Bacon 	Salami 
---	--	---

Probably causes cancer: Red meats including

Pork 	Beef 	Lamb 
---	--	---