



postnote

April 2009 Number 330

DIET AND CANCER

Research shows that the risk of developing some cancers is linked to lifestyle, and scientists estimate that 26% of UK cancers could be prevented by altering diet.¹ This note examines the latest scientific research, advice and recommendations for a diet to lower cancer risk and the consequences for health policy. It also discusses the involvement of the government, charities, media and the food industry in giving dietary advice.

Background

UK Cancer Burden

One in three people in the UK develop cancer during their lifetime, and one in four die from it.² Figure 1 shows statistics for six of the most common cancers in the UK. Cancer incidence is increasing by 1.5% a year due to several factors, including improved diagnosis and the ageing population. It costs the NHS ~£4.5 billion a year (mostly on treatment) - 5% of its total budget.³

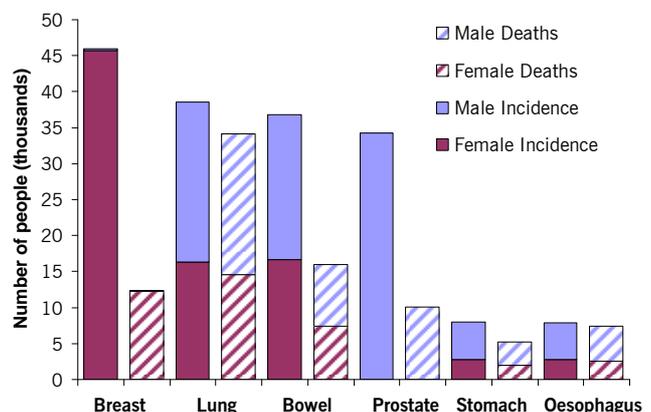
Diet and Cancer Prevention

A recent estimate indicates that 26% (equivalent to ~75,000 cases in 2005²) of the commonest cancers in the UK could be prevented by changing diet and increasing physical activity.¹ The link between diet and cancer is complex and not yet fully understood. Cancer can occur when DNA, the genetic material in cells, is damaged. Cells may then divide rapidly, forming a tumour. Research has shown that the breakdown of some foods produces chemicals that damage DNA, for example from red meat digestion or alcohol metabolism. Diet has thus been implicated in digestive tract cancers (such as oesophagus, bowel and stomach). Obesity influences hormone balance which can increase DNA damage; some diets may also affect hormone levels.

Early Associations between Diet and Cancer

Before 1970, levels of bowel cancer in Japan were low compared with the US. The traditional diet of Japan consists of a low intake of meat and fat, and a high intake of fish, fruit and vegetables. The observation that first-generation Japanese raised in the US had an increased risk of bowel cancer led to suggestions that

Figure 1. UK Cancer Incidence and Mortality 2005-2006²



diet may be a factor. Since then rapid “westernisation” of the Japanese diet towards one higher in meat and fat has seen the bowel cancer rate in Japan jump above that of the US. Similar patterns have been seen for breast and prostate cancer in other countries. However, these observations alone are very crude, and may be misleading, so further investigation is required.

Diet and Cancer Research

The main UK funders are the Medical Research Council (MRC) and Cancer Research UK. The MRC’s Centre for Nutrition in Cancer Epidemiology Prevention and Survival at the University of Cambridge was set up in 2006.

Studying the Effect of Diet on Cancer

Researchers study large groups to establish links between certain types of diet and increased rates of cancers. Study design varies (Box 1) but a common difficulty is accurately assessing what people eat. Studies often rely on self-reported questionnaires, or asking people to remember what they have eaten, which may be biased. Several large diet and cancer studies are ongoing. The European Prospective Investigation of Cancer and Nutrition (EPIC) recruited ~500,000 ‘healthy’ participants aged 35-70 years since 1991, across 10 European countries including the UK.⁴ Of these, 26,000 have developed cancer. EPIC uses two techniques to

measure diet: Food Frequency Questionnaires (FFQ) to estimate intake of some 120 food items and a 7 day diary (developed by EPIC) where participants record their diet, which is analysed for nutrient levels. On comparing the methods, researchers found that the diaries provide more accurate estimates of intake for some nutrients.

Identifying **biomarkers** (see POSTnote 329, Personalised Medicines), naturally occurring chemicals that can be measured in body fluids, will be useful for research:

- Biomarkers could objectively measure individual food (such as meat or sugar) intake without questionnaires and be useful for improving the accuracy of data.
- Biomarkers that indicate whether cells could become cancerous, or when cancer is at an early stage would be a quick and cheap method for cancer screening or monitoring cancer risk in scientific studies.

Box 1. Investigating Diet and Cancer

Results from randomised clinical trials are the gold standard in biomedical evidence. To prevent biased results, trials are “double-blind” with neither participant nor observer knowing which regime (test or control) an individual has been given. It is impossible to organise double-blind trials for dietary research. The main approaches are:

- **case-control studies**, where cancer patients are asked what food they used to eat. This is compared against a random selection of healthy individuals. If cancer patients ate more or less of a food, then this might suggest a link. Studies are relatively quick and cheap, but rely on participants remembering what they ate.
- **prospective studies**, where healthy individuals’ diets are measured and are then monitored for years. Those that go on to develop cancer are compared against the remaining healthy individuals to identify any dietary differences. Such studies are expensive as they need to recruit large numbers of participants and study them over a long time to obtain statistically valid results.
- **intervention trials**, where for example a group of people on a high-fat diet are moved to a low-fat diet. They are followed to identify whether those who changed diet have a lower rate of cancer. However, it is difficult to ensure participants adhere to different diets. Studies are expensive as they need many participants, and must be long enough for benefits to be manifest.

Statistical methods can be used to combine the results of several studies on a related subject where quality, methods and results may vary. It is then possible to make an estimate of the overall effect on cancer risk. As more studies are considered, the conclusions become more reliable.

The World Cancer Research Fund Report

The most recent comprehensive academic review of research on diet and cancer is the 2007 World Cancer Research Fund (WCRF) Report. Experts analysed over 7,000 research articles (including data from the EPIC study).⁵ It categorised dietary components according to the evidence (convincing, probable or limited) of a link to changes in the risk of developing specific cancers (Table 1). The report concluded that there is sufficient evidence that certain dietary choices protect against, or increase the risk of, one or more types of cancer. This expanded on previous reviews by the Department of Health’s (DH) Committee on Medical Aspects of Food (1998) and the World Health Organisation (2004). The WCRF report also demonstrated that obesity and insufficient exercise are important lifestyle factors that increase cancer risk.

Table 1. WCRF conclusions on Diet and Cancer.⁵

Food Group/Other	Risk Effect	Cancer Types	Evidence Strength	Recommendation
Obesity (linked to energy-dense foods high in fat/sugar)	Increase	Breast Bowel Oesophagus	Convincing	Maintain a healthy bodyweight, avoid foods >250 cal per 100g
Physical Activity	Decrease	Bowel	Convincing	30mins moderate exercise daily
Alcohol	Increase	Bowel Breast Liver	Convincing	Limit to 2 drinks/day (men) or 1/day (women)
Red Meat	Increase	Bowel	Convincing	Limit to <500g/week
Processed Meat	Increase	Bowel	Convincing	Avoid
Fibre	Decrease	Bowel	Probable	Eat more wholegrains
Fruit and Vegetables	Decrease	Digestive tract Prostate	Probable	Eat 5 portions/day

Alcohol Consumption and Vitamin Supplements

Convincing evidence shows that there is no safe lower limit for alcohol although substantial cancer risk arises only from heavy drinking. This includes red wine which does not decrease cancer risk. The WCRF concludes that the health benefits of one or two drinks a day for those at high risk of developing cardiovascular disease outweigh the small increase in risk for cancer.

One important conclusion from the WCRF report is that there is no evidence that high-dose vitamin supplements reduce cancer risk. In some cases such as beta-carotene supplements, evidence shows that lung cancer risk increases. A research study in 2009, the SELECT trial, was halted when it appeared that vitamin E supplements were increasing the risk of prostate cancer. The WCRF recommends avoiding supplements for cancer prevention, except in cases of deficiency, or with medical advice.

Interpreting the Results

Caution is needed in interpreting the results of observational studies, as observed links between cancer risk and food intake may not be causal. Risk could be due to other dietary components (people who eat lots of fruit and vegetables may drink less alcohol), or lifestyle factors such as exercise (people who eat more fatty foods may exercise less). The best studies correct for confounding variables, but this is difficult. Critics of the WCRF report suggest that some recommendations are not supported by the data. In addition to the alcohol contradiction, the link between fruit and vegetables and a decreased cancer risk is not yet convincing but the WCRF recommends at least five portions a day (Table 1). There is little evidence from research studies to show what the long-term benefits of improved diet are with respect to cancer risk. Some intervention studies that tested a diet similar to the WCRF diet showed no benefit to the participants (Box 2) although it is unclear whether they stuck to the diet. The WCRF agrees that some data are incomplete, but their recommendations are widely accepted and compatible with existing dietary advice for lowering the risk of developing other conditions such as cardiovascular disease and diabetes.

Box 2. The Women's Health Initiative (WHI)

The 1991 WHI study was a US National Institutes of Health funded dietary intervention trial involving ~50,000 women aged 50-79, monitored for 8-12 years. The intervention group diet was similar to that recommended by the WCRF.

The WHI trial showed no significant decrease in breast or bowel cancer risk for those on the intervention diet. However the study had a short follow-up time and it did not evaluate the influence on cancer risk of diet in earlier life, which is thought to be an important factor in assessing the risk. It is unclear whether participants adhered to the strict diet.

Public Health and Advice**Changing Diet in the UK**

Statistics on the UK diet for the average person show:

- Average weekly alcohol consumption is 18.9 units for men and 9.2 units for women (2006).⁶ This has decreased by ~10% since 2000.
- Meat consumption estimates exceed WCRF recommendations; 181g of fresh red meat and 417g of processed meat (including red meat) were consumed per week in 2007, up 7% and 5% respectively from 1994.⁷
- One third of average daily energy intake is from energy-dense foods (>250 calories per 100g). Indications are that fat intake was stable 2004-2007, but 'added' sugar has decreased 5% since 2004.⁷
- Approximately 30% of the population eat five or more portions of fruit and vegetables a day (2006). This has increased from ~25% in 2001.⁸
- Average intake of fibre is around 15g/day, which was stable from 2004-2007.⁷ DH recommends 18g/day.

Average consumption is some distance from WCRF recommended intakes. The consensus is that there is significant scope and an urgent need for improvement.

Foresight's obesity report found that ~25% of the UK population is obese. This figure has risen from 15% in 1993.⁹ Current trends indicate that one third of the population will be obese by 2015, due to dietary choice, low levels of physical activity and the influence of an "obesogenic environment".⁹ This suggests that current government advice on healthy diet and lifestyle is not being heeded. Policies to promote healthy behaviours were covered in POSTnote 283. UK diet is determined by the foods available and social norms and it is difficult to change to and maintain a new diet. The WCRF wants a consistent message from all involved to support people to change to a healthier diet.¹

Government Dietary Advice

The DH and the Food Standards Agency (FSA) provide advice on healthy balanced diets to prevent obesity and lower the risk of cardiovascular disease and cancer. Recommendations are broadly in line with the academic opinion of the WCRF, but are less prescriptive on the quantities for each food group. The maximum safe alcohol limits are slightly higher. Several health behaviour initiatives are under way including "5-A-DAY", "Change 4 life" and the "eat well, be well" campaign. The DH and FSA continually review the evidence for disease risk from individual food groups. The FSA's

Scientific Advisory Committee on Nutrition has investigated salt, folate and vitamin D in recent reports, in which the evidence for cancer risk was also considered alongside the cost benefits of changing existing advice. Forthcoming reports will consider iron and meat. The government is prioritising childhood diet through initiatives on school meals, a school fruit programme (free fruit for 4-6 year olds) and compulsory cooking classes for 11-14 year olds from 2011. Ofcom has recently banned 'junk' food advertising to children (2008). The WCRF has called for initiatives on healthy meals in schools to be expanded into adult workplaces, and all 'junk' food advertising to be restricted.¹

Food Labelling, Health Claims and Consumers

The FSA advocates a 'traffic light' labelling system (red for less healthy and green for more healthy) for foods, based on recommended daily values for nutrients (fat, sugar and salt) and has commissioned an independent review on food labelling. Calorie content labelling will be rolled out to restaurants and takeaways. Some producers make specific claims about the nutritional and health benefits of their products. However, some foods labelled "low fat" may contain high levels of added sugars. New European regulation on nutrition and health claims will specify the claims permitted. This will ensure that claims are balanced (so that high-sugar, low-fat foods must be labelled as such) and supported by scientific research.

Providing Information

There are many views on how to reduce the diet-related cancer risk in the population. Providing information on a healthy balanced diet may enable consumers to adopt a healthier one. However, health behaviour studies have shown that people do not necessarily act in their long-term interests (POSTnote 328, Delaying Gratification). The role of primary care health professionals in advising the public on healthy eating is seen as crucial by the British Dietetic Association and is the subject of a current Cancer Research UK policy study.

Behavioural Interventions

Cancer Research UK believes that decreasing cancer incidence through prevention requires significant investment. The DH acknowledges this and is increasing budgets for cancer prevention research and initiatives. The UK National Prevention Initiative, a partnership between the government and charities, develops behavioural interventions for preventing chronic diseases including diet-related disease. It has a £12m budget for the next five years. The DH is also investing in research on social marketing through the "Food and Health Action Plan" to focus information that may be over-looked by existing campaigns on lower income groups, including demonstrating that healthy food can be affordable.

Role of the Food Industry

The food industry has disputed the benefits of traffic light labelling, preferring to mark products with percentages of "guideline daily amount" based on DH recommendations. Voluntary agreements between manufacturers and the FSA have significantly reduced the amount of salt in food, especially processed foods. Similar agreements are

under way for saturated fats. Industry supports this model for making food healthier, instead of regulation. However, UK agreements do not apply to imported foods, highlighting the need for wider participation. The WCRF has called on industry to price healthy foods more competitively and if necessary, for the government to tax foods on the basis of fat or sugar content. Tax revenue from 'unhealthy' food could subsidise healthier options.¹

Role of the Media

The public view of diet and cancer is influenced by the media, which often publishes, out of context, sensational headlines from single studies, which can be misleading or harmful. The focus on linking individual foodstuffs to increased or decreased cancer risk is confusing for the public and emphasises reliance on so-called "superfoods" when a healthy balanced diet is supported by scientists and advisory organisations. There are several ways that inaccuracies can creep into news stories. For instance, scientists might wish to highlight conclusions from their data, or university/scientific journal press offices can tailor the research to achieve media attention. Some journalists handling science stories do not have a scientific background and may misinterpret research or may not have time to check the science behind a story. Editors may have an established angle on a topic according to the demographics of their readership. Specialist organisations work to improve accurate science communication, including diet and cancer research.

- The **Science Media Centre** works with scientists who will discuss scientific issues with journalists and provide quotes.
- **Sense About Science** is a charity that encourages scientists to speak out about inaccuracies in the media and promote scientific reasoning.
- **"Behind the Headlines"** is an NHS-run website that provides independent daily analysis of health stories.

Future Research Priorities

New Pharmaceutical Products

Many people take vitamin supplements to maintain general health. There is little evidence that they offer cancer prevention benefits. If some supplements could reduce cancer risk, they could easily be incorporated into daily dietary habits. Cancer Research UK scientists are looking at foods in the diets of populations with low cancer risk, to identify if they contain chemicals that could protect against cancer. For example, rural Thailand has a very low breast cancer rate and the chemical triclin, found in Thai brown rice is being investigated. Other substances include curcumin in turmeric and resveratrol in grapes. These have shown benefits in some animal trials but have not yet been tested in humans.

Epidemiology

The conclusions on several dietary links to cancer, (such as fibre) are not yet complete. Scientists agree that more studies involving large groups of people are necessary, to build on previous research (Box 3). The WCRF intend to update its analysis of risk as new studies are published. Due to the follow-up time for cancer to develop, participants are normally aged 40 and over in prospective studies. Some data imply that diet at specific stages in

life could be important, and studying these stages should be informative. For example, the risk of breast cancer may be more strongly affected by diet during puberty or post-menopausally.

Box 3. Analysing Data from New Studies

The difference in quality of data obtained from dietary questionnaires shows that study design must be carefully considered. The UK Biobank prospective study aims to look at lifestyle, environment, genetics and their relationship to disease. It is recruiting 500,000 UK participants (aged 40-69). Dietary data will be obtained with Food Frequency Questionnaires. Diet data collection will also be improved by using technologies such as internet-based questioning.

Diet, Genetics and Cancer Risk

Researchers are investigating the link between cancer, genes and environmental factors, including diet. The EPIC study has begun analysing participants' DNA. UK Biobank is also intending to investigate this genetic link. Identifying genes that may affect cancer risk will enable clinicians to tailor specific diets to individuals with a view to decreasing their chance of developing cancer.

Overview

- Poor diet, obesity and insufficient levels of physical activity increase the risk of developing some cancers.
- A healthy balanced diet with moderate exercise could decrease obesity, the incidence of cancer, diabetes and cardiovascular disease as well as the economic burden placed on public services.
- Persuading the public to eat a healthy balanced diet requires focused information, behavioural interventions and involvement of health services, without singling out specific foods as causing or preventing cancer.
- New research is investigating the possible links between genes, diet and cancer risk.

Endnotes

- 1 World Cancer Research Fund, *Policy and Action for Cancer Prevention*, 2009
- 2 Cancer Research UK, *Latest UK Cancer Incidence and Mortality Summary*, September 2008
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- 4 *European Prospective Investigation into Cancer and Nutrition*, March 2009, <http://epic.iarc.fr/>
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- 6 National Health Service, *Statistics on Alcohol: England 2008*
- 7 Department for Environment, Food and Rural Affairs, *Family Food 2007*, 2008
- 8 National Health Service, *Statistics on Obesity, Physical Activity and Diet: England*, February 2009
- 9 Foresight, *Tackling Obesities: Future Choices*, 2007

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POST is grateful to Jerome Boyd-Kirkup for researching this briefing, to the Medical Research Council for funding his fellowship and to all contributors and reviewers. For further information on this subject please contact Dr Sarah Bunn, at POST.

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The Parliamentary Office of Science and Technology, 7 Millbank, London, SW1P 3JA; Tel: 020 7219 2840; email: post@parliament.uk

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