

## Dietary strategies to reduce the burden of cancer and cardiovascular disease in the UK

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The importance attributed to dietary change as a means of helping to achieve the major goals of the UK's public health policy as articulated in the Health of the Nation White paper (Department of Health, 1992) is less apparent in the most recent strategy document (Department of Health, 1999). Greater emphasis is given to amelioration of the socio-economic circumstances that are believed to contribute to inequalities in health. Better understanding of the elements of foods and diets which help protect health together with better evidence of effective dietary interventions are essential if the opportunities to use diet to reduce the burden of non-communicable diseases are to be realised. This is likely to need new research strategies that take advantage of emerging information from genomics and proteomics to produce evidence of safety, efficacy and applicability. Ethical exploitation of the rapid growth in interest in 'functional foods' by the food industry will require a level of investment in biomedical research unusual in the past.

### Health of the Nation: Cardiovascular disease: Cancers: Functional foods

#### Public health strategies in the UK in the 1990s

The publication in July 1992 of 'The Health of the Nation' White Paper by the UK Government (Department of Health, 1992) represented a major shift in policy from treatment of disease to its prevention. Against a background of continuing health improvement over the previous century, the Health of the Nation slogan was '*Not just adding years to life but also adding life to years*'. Life-style was identified as a major determinant of health so to achieve the goal of people living longer with these additional years free from ill health would require promotion of healthier life-styles. The strategy adopted was a co-ordinated effort not just by the Department of Health but also all government departments, industry and the public. Everyone had a part to play in Healthy Alliances if the strategy was to be successful. Central to the strategy was the identification of measurable targets for improvement in five key areas for immediate action, i.e.

- Coronary heart disease and stroke
- Cancers
- Mental health

- HIV/AIDS and sexual health
- Accidents.

Most of the targets were set for 2000 or 2005.

Improvement in diet was given a high priority especially in helping to achieve the coronary heart disease and stroke targets. A Nutrition Task Force was established which brought together expertise from the food industry and health professionals working with representatives of consumers and the voluntary sector. Following widespread consultation, the focus for change was placed on dietary fat with targets to reduce the proportion of dietary energy consumed as total fat and as saturated fatty acids. The reduction in energy intake would be compensated for by increases in the consumption of starchy, fibre-rich foods, vegetables and fruits (Department of Health, 1994*a*). The food industry responded by increasing the range of lower fat (and lower saturated fatty acids) foods on the market. Whilst there is good awareness among the public about these elements of a 'healthy diet', this has not translated into marked changes in the fat content of the UK diet. Much of the UK public appears resistant to Government

**Abbreviations:** CAPP, concerted action polyp prevention; CRC, colo-rectal cancer; CVD, cardiovascular death; FSA, food standards agency; MRC, medical research council.

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**Table 1.** Public health targets for 2010 by UK Government (Department of Health, 1999)

Cause of premature death	Target for 2010
Cancers	↓ death rates by >20 %
Coronary heart disease and stroke	↓ death rates by >40 %
Accidents	↓ death by >20 %, ↓ serious injuries by >10 %
Mental health	↓ deaths from suicide by >20 %

advice on aspects of life-style that they consider to be matters of personal choice, e.g. smoking and diet. Accusations of interference by the 'nanny state' has discouraged the Government from offering specific advice on 'healthy eating' and there is little robust evidence of what types of intervention (at a local or national level) are effective in achieving positive changes in dietary choices.

The new Labour government which replaced the Conservative administration on 1 May 1997 had food as a high priority because of the series of crises over bovine spongiform encephalitis and bacterial food poisoning in the previous couple of decades. The early promise to establish an 'independent' Food Standards Agency (FSA) was slow to be fulfilled and the Agency did not come to be established until April 2000. There was a major debate over whether the FSA should have responsibility for developing policy, issuing guidance and proposing legislation on the nutritional quality of diets and their effect on public health. In the event, responsibility for this area has been shared between the FSA and the Department of Health with the links between diet and health remaining with the Department of Health. There is clear direction from Government that the FSA may inform consumers about, for example, the nutritional content of foods but 'it will not tell people what they should eat' (Ministry of Agriculture, Fisheries and Food, 1998).

In July 1999, the UK Government published a successor to the 'Health of the Nation' in its White Paper 'Saving Lives: Our Healthier Nation' (Department of Health, 1999). Although portrayed as a radical advance, the targets within 'Saving Lives' are a logical extension of those of its predecessor (Table 1). The major change is the higher priority given to cancer, the removal of HIV, AIDS and sexual health from the list of targets and the explicit recognition that inequalities in health experience are determined largely by socio-economic circumstances. Improvements in health are expected to come from individuals and communities working together with 'Government addressing the big issues that affect our health, like housing, jobs and education' (Department of Health, 1999). Although acknowledging that diet is central to our health throughout life, the 'Saving Lives' White Paper gives rather less emphasis to the role of diet in the prevention or treatment of disease than was apparent in the 'Health of the Nation' White paper.

#### *Inequalities in health*

There are strong socio-economic gradients in risks for most of the common causes of morbidity and mortality in the UK

with the less advantaged usually having a greater incidence of disease and poorer long-term survival. For example, death rates from cardiovascular disease are two-fold greater for the least well-paid civil servants than for those in the highest grades even after controlling for risk factors including age, smoking, systolic blood pressure, plasma cholesterol concentration, height and fasting glucose concentration (Marmot *et al.* 1984). Prevalence of obesity is nearly twice as great among unskilled (relatively poorly paid) workers as for those in the professions (Department of Health, 1999). A goal of the 'Saving Lives: Our Healthier Nation' White Paper is to 'improve the health of the worst off in society and to narrow the health gap' (Department of Health, 1999). The Government aims to avoid charges of 'the nanny state'. Citizens will not be told what to do to be healthier but socio-economic circumstances, especially for the least privileged, will be improved which will enable people to make healthier choices about life-style.

#### *Prevention of cardiovascular disease*

In common with the experience of other Western countries, cardiovascular death (CVD) rates in the UK have been declining steadily for several years although rates are still among the highest in Europe (Department of Health, 1999). Life-style factors, including diet, are considered to be major aetiological determinants for CVD (Department of Health, 1994b) and it is probable that the decline in smoking has made a notable contribution to the improvement in CVD. Despite the wealth of evidence that high saturated fatty acid intake is a risk factor for CVD (Department of Health, 1994b), the decline in CVD experience in the UK has occurred without a corresponding fall in proportion of dietary energy obtained from fat.

#### *The problem of obesity*

Over the past 15 years, there has been a 2–3-fold increase in the proportion of the UK population who are clinically obese (body mass index >30 kg/m<sup>2</sup>) (British Nutrition Foundation Task Force, 1999). Myocardial infarction, hypertension and congestive heart failure are all more common in the obese (British Nutrition Foundation Task Force, 1999) so one would anticipate that this growth in obesity would attract a health penalty in due course. However, the sustained fall in CVD death rates coincident with a sustained rise in rates of obesity in the UK deserves further investigation.

#### **Effective dietary intervention models**

The UK public has been fairly resistant to health promotion messages encouraging reduced fat intake. Consumer knowledge of the desirability of lower fat intakes is good but translation into altered food choice is poor as the proportion of food energy eaten as fat remains close to 40 % (Ministry of Agriculture Fisheries and Food, 1996). A majority of consumers may consider that they have already reduced their fat intake despite continuing to consume high fat diets (Lloyd *et al.* 1993) and there may be resistance to

negative messages. An alternative approach is to encourage the consumption of low fat, starchy staple foods such as bread, potatoes, rice and pasta. The 'Family Food and Health' project in progress in Newcastle, UK is designed to test the hypothesis that a more positive message to eat more of such starchy foods would be better received and achieve the desired dietary goals of lower energy intake from total fat (Adamson *et al.* 2000). The family has been chosen as the setting for this study because 70–75 % of food is eaten at home (Adamson *et al.* 1996) and family attitudes and finances are major influences on food choice. Families who do not meet current dietary targets for fat and starch (<35 and >29 % of dietary energy, respectively) are being recruited to one of three interventions designed to encourage and enable them to choose diets richer in starchy foods. Dietary outcomes are being measured at 3, 6 and 18 months after the interventions and we are investigating the process of change via questionnaires and by in-depth interviews with both 'achievers' and 'non-achievers'. This study is due for completion in 2002. There may be specific health advantages of consuming larger quantities of starchy foods in addition to their role as an energy substitute for fats. These include reductions in the risk of dental caries, colorectal cancer and diabetes (Cummings & Englyst, 1992; Burn *et al.* 1998; Mathers & Daly, 1998) and greater intakes of micronutrients such as iron and folic acid which are now used extensively in the fortification of breakfast cereals.

### Prevention of cancer

There is good evidence that approximately three quarters of human cancer is potentially avoidable and, of that, one third could be prevented by appropriate changes in eating patterns (Doll & Peto, 1981; Willett, 1995; Department of Health, 1998). However, the particular changes to diets that would result in protection are much less well established. Observational epidemiological studies are a relatively blunt instrument for identifying causal relationships between specific nutrients or other dietary factors and risk of cancer at specific sites. The recent report of no detectable relationship between fibre intake and risk for colorectal adenoma or cancer during a 16-year follow-up in the large Nurses' Health Study (Fuchs *et al.* 1999) and the lack of effect of a cereal bran fibre supplement in preventing adenoma recurrence (Alberts *et al.* 2000) were a considerable disappointment to many. However, there is very consistent and convincing epidemiological evidence that diets rich in fruits and, particularly, in vegetables are associated with lower risks of cancer at several sites [albeit not supported by the very recent intervention study of colorectal adenoma recurrence (Schatzkin *et al.* 2000)] on which a recommendation that consumption of vegetables and fruit in the UK should increase by 50 % (Department of Health, 1998) is based.

#### *Lessons from the $\beta$ -carotene trials*

Although there are many candidate substances, which factor (or factors) in vegetables and fruits is responsible for the apparent protection against cancer at various sites is not

known. One way to resolve such issues is to carry out intervention studies in which the putative chemopreventative agent is tested for efficacy against a placebo in a randomised, double blind trial. Such trials have been undertaken with  $\beta$ -carotene based on the extensive epidemiological and environmental evidence that this plant-derived vitamin precursor may reduce cancer burden (Peto *et al.* 1981). These trials produced unequivocal evidence that large supplements (20–30 mg/day) of  $\beta$ -carotene have no beneficial effects on cancer risk in middle-aged men and, indeed, may increase the risk of lung cancer in smokers and in those exposed to asbestos (Alpha-Tocopherol, Beta Carotene Cancer Prevention Study Group, 1994; Omenn *et al.* 1996; Hennekens *et al.* 1996). A possible mechanism to explain the adverse effects of high dose supplementation with  $\beta$ -carotene in smokers comes from studies in ferrets that are a good model for  $\beta$ -carotene absorption and metabolism by humans (Wang *et al.* 1999). Both the intermediate markers cell proliferation and squamous metaplasia in the lung were increased by  $\beta$ -carotene supplementation; responses that were exacerbated by exposure to tobacco smoke (Wang *et al.* 1999).

The finding of adverse effects of large dose supplements of  $\beta$ -carotene in middle-aged men underlines the importance of well-designed intervention trials that not only test for efficacy but also seek evidence of potential harm even when the intervention agent is thought to be quite innocuous (as was the case for  $\beta$ -carotene). However, disappointment with this agent should not damage public health campaigns aimed at increasing intakes of fruits and vegetables.

#### *The Concerted Action Polyp Prevention (CAPP) studies*

In contrast to the aetiology of cardiovascular disease, there is good evidence of the key genes that are mutated in the development of cancer and particularly of colo-rectal cancer (CRC). Some individuals are at high risk of CRC because they carry a germline mutation in one allele of such genes. We have initiated a series of intervention studies in such gene carriers to test hypotheses about the efficacy of dietary and pharmacological agents in CRC prevention. Since it is probable that all CRC results from interactions between environmental agents, especially diet, and susceptibility/resistance encoded in the genome, studies in such persons provide a paradigm for genetically targeted interventions (Burn *et al.* 1998).

In the CAPP1 Study, young persons carrying mutations in the APC gene (a tumour suppressor gene likely to be the gatekeeper gene for CRC) are being entered into a randomised, double blind, placebo-controlled intervention study. Aspirin (600 mg/d) and resistant starch (30 g/d of a 1:1 mix of raw potato starch and Hylon<sup>®</sup> VII) are the intervention agents and the major outcome measure is the appearance of the rectum before and 1-year after initiation of treatment. For the CAPP2 Study, we are using a similar design but in this case the subjects being recruited are hereditary non-polyposis colon cancer patients who carry a germline mutation in one of the genes encoding the DNA mismatch repair consortium of proteins.

### The role of the food industry

The growing evidence that food intake patterns are a major determinant of health provides the food industry with a challenge and with novel product development and marketing opportunities. Governments, including that in the UK, are reacting to the greater longevity of their populations, with its associated greater costs for pensions and health care, by a retreat from mainly state-funded provision. This devolution of greater financial responsibility to the individual for his/her health care has coincided with several other socio-economic factors that have resulted in much less cooking from raw ingredients in the home. The result is that consumers rely to a greater extent than ever on products and advice from the food industry. This could place a considerable responsibility on the food industry to provide attractive, moderately priced ready meals which are well balanced in terms of nutritional content and which enable consumers to choose healthy diets.

#### *The example of folate*

The Medical Research Council (MRC) vitamin trial provided strong evidence that women who took 4 mg folic acid/day as a supplement before and during pregnancy had substantial protection against the risk of conceiving a baby with a neural tube defect (MRC Vitamin Study Research Group, 1991). The women in the study were at high risk because of a previous affected pregnancy but the investigators concluded, 'public health measures should be taken to ensure that the diet of all women who may bear children contains an adequate amount of folate'. Later advice from the UK Department of Health recommended that women consumed an additional 400 µg folate/folic acid provided by natural foods, foods fortified with folic acid or supplements. However, Cuskelly *et al.* (1996) showed that, compared with supplements and fortified foods, consumption of extra folate present naturally as folates in foods is relatively ineffective in raising folate status in young women possibly because of the poorer bioavailability of natural folates.

The authors of the original MRC study report recommended that 'consideration be given to extending the fortification of staple foods with folic acid'. Some UK food manufacturers have added folic acid to products such as breakfast cereals and bread voluntarily and this has contributed approximately 80 mg folic acid to the diet of those who eat such products (Cuskelly *et al.* 1999). In the USA, fortification of cereals and grains with folic acid began in 1996 and the addition of 140 µg folic acid per 100 g cereal grain has been mandatory since 1 January 1998. There is evidence that this measure is raising serum folate concentrations among American citizens (Lawrence *et al.* 1999) but it is too early to say whether this intervention will have public health benefits. For several decades, the incidence of neural tube defects in the UK has been decreasing (Kadir *et al.* 1999) long before there was any understanding of links with folate status. Indeed the availability in the 1990s of folic acid by prescription and over the counter sales has had little detectable effect on the

incidence of neural tube defects (Kadir *et al.* 1999; Abramsky *et al.* 1999).

Additional folic acid/folate consumption could have major health benefits in reducing the risk not only of neural tube defects but also of cardiovascular disease (Homocysteine Lowering Trialists' Collaboration, 1998), some cancers notably CRC (Giovannucci *et al.* 1998) and Alzheimer's disease. Given the apparently large benefit to cost ratio for food fortification with folic acid, why are some governments, such as that in the UK slow to introduce legislation to make such fortification mandatory? There is a long history of mandatory fortification of bread flour with vitamins and minerals in the UK, which has been widely accepted by the public, and voluntary fortification/supplementation of foods with micronutrients is common. Much of the debate concerns the *potential* risks of folic acid fortification, e.g. in masking the early (reversible) stages of vitamin B<sub>12</sub> deficiency (Campbell, 1996) or in exacerbating marginal zinc deficiency (Simmer *et al.* 1986). It is also possible that, although folic acid is considered to be very safe even at relatively high intakes, there may be some individuals who will experience adverse responses to fortification/supplementation as did smokers in the β-carotene supplementation studies (Alpha-Tocopherol, Beta Carotene Cancer Prevention Study Group, 1994; Omenn *et al.* 1996). Mandatory food fortification removes the element of choice from consumers but this disadvantage could be avoided if certain products, e.g. wholemeal bread or flour for home baking remained non-fortified.

#### *Functional foods*

The case for fortification of staple foods with folate is strong and may provide a paradigm for future public health measures designed to reduce the risk of common non-communicable diseases. There is a major opportunity for the food industry to improve the health of the public by providing fortified, or otherwise modified, products at affordable prices. However, there seems to be more interest in so-called 'functional foods' that offer possibly greater marketing opportunities. The development of 'functional foods' is in its early stages and criteria for judging the efficacy of products (on which health claims might be based) are beginning to emerge (Diplock *et al.* 1999). Ethical exploitation of this opportunity is likely to require much greater investments in both basic and applied research than has been usual for the food industry. Strategies are likely to become more similar to those of the pharmaceutical industry with a greater emphasis on demonstration of safety (as well as efficacy). Despite current public disenchantment with the application of recombinant DNA technology by some sectors of the food industry, thoughtful use of genetic modification offers considerable potential benefits in terms of 'functional foods'. Such developments should not undermine public health advice focused on encouragement to consume diets rich in plant foods, especially vegetables, fruits and low-fat starchy foods.



## Conclusions

Health gains in recent years have failed to bridge the gap between the more advantaged and the socio-economically underprivileged in the UK. These inequalities in health are readily apparent in the major contributors to morbidity and mortality including obesity, CVD and cancers. Current Government policies are designed to reduce these inequalities by addressing factors such as poor housing, employment and education which are considered to reduce individuals' ability to choose healthier life-styles. Whilst acknowledging the central role played by diet in health throughout life, the UK Government appears reluctant to become closely involved in offering advice on healthy eating. This provides industry with an opportunity to exploit consumers' appetite for foods that have health benefits but carries with it the need to market such products responsibly. The separation between foods and pharmaceutical agents is becoming less clear. The demonstration of efficacy and safety of 'functional foods' will require research strategies (and investment) which has been unusual for the food industry in the past. These developments will be a challenge to researchers concerned with diet and health especially if they are to take advantage of the emerging knowledge in human genetics and of discoveries in the area of diet:gene interactions.

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