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Preface

Environmental hazards, lifestyle and disease prevention

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The public has expressed concerns that some major diseases, including cancer, stem from environmental hazards. There is also the view that heart attacks, hypertension and stroke are the result of continuing stresses in peoples' busy lives. This commentary will briefly discuss the recent advances and knowledge which would help to address the issue of environmental hazards, provide estimated causes of cancer mortality in the United States, and present approaches to chronic disease prevention based on what is known about dietary habits, lifestyle, and other human activities.

In order to address environmental hazards, environmental protection agencies were established at the Federal and State levels with the desire of the public to have a clean, wholesome environment. A major justification for legislative action and implementation through executive activities is the view that cancers of various types and some chronic disease stem from environmental contamination. Another area that is high on the list of environmental concerns is the occurrence of fetal malformation and defects, again attributed to some environmental problems. New environmental laws either directly or indirectly requires risk assessment of environmental chemicals to provide a basis for risk management and decision making. Such regulatory activities can help to prevent unwarranted exposure to environmental chemicals and the associated health effects. However, there are other major factors associated with disease causation and providing the basis for disease prevention.

What are the major causes of coronary heart disease? Sound studies in humans and associated laboratory research, especially by comparing people in areas with a high incidence like the United States, and the Western world generally, with populations in the low incidence area such as Japan, demonstrated that there were two key etiological factors. One was a dietary tradition high in saturated fats and meats, and a relatively low intake of protective vegetables and fruits. This custom leads to elevated levels of plasma cholesterol, LDL cholesterol and triglycerides, and relatively low levels of HDL cholesterol. Such a blood picture, in turn, leads to atherosclerosis and vascular obstruction and sets the stage for myocardial infarction. A major contributing factor is the smoking of cigarettes. An additional component is our

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sedentary habits, although the first two elements are the key determinants of coronary heart disease. In the last 20 years, the incidence in males has displayed a declining trend, because the public is becoming aware of the risk of certain dietary habits and especially of smoking. Regrettably, in women the trend is stable or indeed increasing, mainly because there are more women smokers than men.

High blood pressure leading to stroke is also due to a dietary imbalance, with too much dietary sodium chloride/salt and too little potassium from vegetables and fruits, and especially calcium from low fat dairy products and some vegetables. Thus, there are national recommendations in the United States, and especially in Japan where this condition used to be major health problem, to limit salt intake to 5 g or less per day.

The term cancer represents many distinct diseases, each with its own set of etiological factors. That chemicals were associated with cancer risk stems from historic observations of specific types of cancer occurring in connection with certain jobs, where decades ago workmen were exposed to certain chemicals under unhygienic conditions. For example, urinary bladder cancer was found after extensive exposure to 2-naphthylamine or 4-aminobiphenyl. Angiosarcoma of the liver was noted in vinyl chloride polymerization reactor cleaners, who had to scrub the inside of tanks with high levels of prevailing vinyl chloride. Such unwholesome practices have been corrected voluntarily or by regulation. Of a total of approximately 540,000 cancer deaths, less than 1% is associated with occupation at this time.

Also, rapid and economic methods are now available to establish whether or not a given chemical is a human cancer risk. This includes tests for mutagenicity as developed by Ames, for DNA repair in liver cells as defined by Williams, and the 32P-postlabeling technique invented by Randerath. Reliable, positive results in these three tests can be used to classify a carcinogen as genotoxic. Virtually all human cancers are associated to exposure to genotoxic carcinogens, and thus their avoidance is important in effective cancer prevention.

In the context of the overall carcinogenic process, account needs to be taken of the existence of promoting agents, that foster the more rapid growth of early cancer cells initiated by genotoxic carcinogens. Many halogenated hydrocarbons like chloroform, chlordane or DDT can be promoters, in this instance specifically of liver cancer, especially in mice. The genome of mice often used in bioassay is already abnormal, with translocated and amplified codons, explaining their sensitivity to promoters.

About 35% of the existing cancer burden, a large number, specifically in the lung, pancreas, kidney, urinary bladder and cervix occurs in smokers of cigarettes (Table 1). Cigarette smoke and other tobacco uses (chewing, sniffing) also increase the risk of cancer of head and neck, oral cavity, pharynx, larynx and esophagus. For these diseases, the regular consumption of alcoholic beverages has a potentiating action. Extensive alcohol use by itself increases the risk of cancer of the esophagus and of the rectum.

In the United States, gastric cancer has declined in the last 60 years, but this disease still has a high incidence in the Orient, parts of South America and Eastern Europe. A major reason for the decline in the USA is the replacement of salting and pickling as a means of food preservation by refrigeration and freezing, and also the year around availability of low cost fresh fruits and vegetables that have a protective action. We have observed in the laboratory that salting and pickling of certain foods generates

Table 1
Estimated causes of cancer mortality in the United States, 1992

Type	Percentage of total
Lifestyle cancers	
Tobacco-related: lung, bladder, kidneys, renal pelvis, pancreas	30–35
Tobacco and alcohol-related: oral cavity, esophagus	3–4
Diet related:	
High fat, low fiber, broiled or fried foods? – large bowel, breast, pancreas, prostate, ovary	30–35
Obesity – endometrium, kidney	0–1
Nitrate–nitrite, salt, low vitamin C and E – stomach	2–3
Alcohol, mycotoxins – liver, esophagus	3–4
Viral-linked:	1–5
human papilloma viruses – cervix, penis, anus;	
hepatitis B – liver;	
HTLV-1 – adult T cell leukemia;	
Epstein Barr virus – B cell lymphoma	
Sunlight – skin (melanoma)	1–2
Occupational cancers: various carcinogens – bladder, other organs	0–1
Lifestyle and occupation: tobacco and asbestos; tobacco and mining; tobacco and uranium and radium – lung, respiratory tract	3–4
Iatrogenic: radiation, drugs – diverse organs, leukemia	1–2
Genetic: retinoblastoma, soft tissue sarcomas	0–1

gastric carcinogens. In addition, some individuals carry in the stomach a newly discovered bacterium, *Helicobacter pylori*. Though as yet unknown mechanisms, this agent, probably involving chronic injury to the gastric mucosa, leads to an increased rate of repair and cell duplication, favoring carcinogenesis by gastric carcinogens. Individuals with *H. Pylori* are also prone to ulcer, especially with people who favor highly salted foods.

Major types of cancer, accounting for about 35% of cancer deaths, are associated with our Western dietary tradition, with too much total fat, too few foods containing protective bran fiber, vegetables and fruits and essential micronutrients (Table 1). The associated diseases are cancer in the postmenopausal breast, distal colon and rectum, pancreas, prostate, ovary and endometrium. The underlying mechanisms are reasonably well established and involve promotion, through specific mechanisms associated with the level of dietary fat. The initiating factors are still under study. Frying or broiling of meats leads to powerful carcinogens, heterocyclic amines, that in animals cause cancer of the colon, breast and pancreas. For the other nutritionally linked cancers, the formation of modified hormones with genotoxic attributes, or of hydroxy radicals or active oxygen have been postulated. In the latter case, intake of foods containing antioxidants such as vitamins C, A, E, and beta-carotene as well as the beverage tea, rich in antioxidant polyphenols, would serve to lower the risk. Methods

Table 2
Approaches to chronic disease prevention based on mechanisms

Action	Lower risk
Control smoking	Coronary heart disease, cancers of the lung, kidney, bladder, pancreas, and head and neck (chewing tobacco)
Lower total fat intake (aim for 20% of calories)	Coronary heart disease; cancers of the colon, pancreas, breast, prostate, ovary, endometrium
Increase fiber, vegetables, fruits, and Ca^{2+}	Cancer of the colon, breast, constipation, diverticulosis, appendicitis
Have regular moderate exercise	Coronary heart disease, cancer of the colon, breast
Avoid obesity	Coronary heart disease, cancer of the endometrium, kidneys
Moderate or no use of alcoholic beverages	Liver cirrhosis, cardiomyopathy; male impotence; head and neck cancers (in smokers)
Lower intake of fried foods	Cancers of colon, breast, pancreas (?); heart disease
Lower salt Na^+ intake; Balance $K^+ + Ca^{2+}/Na^+$ ratio	Hypertension, stroke, cardiovascular disease
Avoid pickled, smoked, salted foods	Cancer of the stomach, esophagus, nasopharynx, liver (?); hypertension, stroke
Practice sexual hygiene	Cancer of the cervix, penis, AIDS
Avoid illicit, addictive street drugs	Poor physical and mental health, AIDS

have also been developed, but remain to be applied, to limit formation of heterocyclic amines during cooking.

There are neoplastic diseases where the etiological factors are as yet unknown. This includes the cancers generally classified as leukemias, lymphomas and myelomas. They account for only about 10% of cancer deaths. Basicallly, most types of cancer due to tobacco use or to improper nutritional traditions, as defined above, account for about 90% of premature mortalitly due to cancer. Similar causative factors, tobacco use and high fat and salt foods, apply to coronary heart disease, and stroke and even adult onset diabetes.

Thus, a feasible, realistic and effective means of prevention of most chronic diseases, including cancer, is to change dietary habits to a small, but definite extent as shown in Table 2, which also includes changes in approaches in other human activities. This means avoidance of tobacco products and limited alcoholic beverage intake. It suggests a new dietary tradition low in salt and salted and pickled foods, low in total fat (less than 20% of calories), and high in wheat bran, vegetables and fruits (5–9 servings per day) and an adequate fluid intake of 1–1.5 l for adults, including tea with chemopreventive attributes. Food intake should be equivalent to energy needs, to avoid obesity. Regular moderate exercise is part of a healthy lifestyle. Clearly, of course, the public is entitled to a health promoting environment, sufficiently low in air, water or food contaminants. A good environment includes an accident free railroad, road, and air traffic system to avoid accidental release of toxic chemicals (spills) and effective regulation and management of chemicals in the environment we live in.

Medical and toxicological research over the last 40 years, funded in great part by the federal government, especially the National Institutes of Health, and various State agencies and voluntary groups such as the American Cancer Society or the American Heart Association, have led to the acquisition of knowledge as described. Expenditure of these funds has been a valuable investment, but translation of knowledge to public health action needs further efforts and public education. Also, lifetime health maintenance will lower sharply the annual cost of medical (disease) care.

Further reading

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