New Study Links Chlorination and Cancer

New studies have strengthened the evidence for an association between rectal, colon, and bladder cancer and chlorinated water, according to a recent report from the President's Council on Environmental Quality (CEQ). The studies show that individuals who drink chlorinated surface water generally bear a greater risk of developing one of these forms of cancer than do individuals who drink well water, chlorinated or not. In most cases, this risk ratio was found to vary between 1.13 and 1.93, indicating a 13 to 93 percent increase in tumor incidence. The increased risk does not arise from the chlorine itself, but from carcinogens produced by the action of chlorine on naturally occurring organic compounds in the water, particularly humic acids from the soil.

Chlorinated drinking water first gave cause for concern about 6 years ago when it was observed that some chemicals commonly found in such water—especially the trihalogenated methanes such as chloroform, bromoform, and others—produce tumors in laboratory animals. Subsequently, a fairly large number of so-called ecological studies have suggested a link between chlorinated surface water and an increased incidence of tumors at various sites. In ecological studies, aggregate mortality rates for cancers at specific sites are compared to aggregate water quality measurements; county totals for rectal cancer, for example, might be compared to the fraction of the county's population drinking chlorinated water. These studies have been reviewed in a recent report from the National Academy of Sciences (NAS).* Most investigators agree that ecological studies are useful primarily for generating hypotheses that can subsequently be tested by more detailed epidemiological studies in which data for individuals are compared.

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The new report,† prepared for CEQ by Kenny S. Crump and Harry A. Guess of Science Research Systems, Inc., of Ruston, Louisiana, reviews five recent epidemiological studies. The studies were conducted by Michael Alavanja and his colleagues at the Columbia University School of Public Health, Gary R. Brenniman and his colleagues at the University of Illinois School of Medicine, Martin S. Kanarek and T. B. Young of the University of Wisconsin, Marise S. Gottlieb and her colleagues at Tulane University, and Robert J. Struba and his colleagues at the University of North Carolina.

Cumulatively, the studies included 11,398 people who died of gastrointestinal or urinary tract cancer in five New York counties, 20 Louisiana parishes, 70 Illinois counties, 28 Wisconsin counties, and North Carolina. In general, the investigators obtained death certificates for each individual and identified the type of water used at the deceased's last address. Similar data were obtained for controls. Little other information about the cancer victims was available, however.

"While the epidemiological studies compiled to date are not sufficient to establish a causal relation between chlorinated organic contaminants in drinking water and cancer," Guess and Crump conclude, "they do contain evidence which supports such a relationship for rectal cancer and, to a lesser extent, for bladder and colon cancer." But by traditional epidemiological standards, they add, "risk ratios below about 2.0 (which include nearly all the risk ratios discussed in the CEQ report) are generally subject to doubt no matter how large the study," since unidentified factors could be responsible for the effects observed.

To remove some of this doubt, two more comprehensive studies are now in progress. Kenneth P. Cantor and his associates at the National Cancer Institute are compiling interview data from more than 3000 individuals with bladder cancer newly diagnosed in 1978 and some 6000 controls. Struba, who is now at the Research Triangle Institute, is collecting similar data from about 450 individuals with newly diagnosed colorectal cancer and about 900 controls. By interviewing the cancer victims, it should be possible to eliminate potential confounding caused by saccharin use, industrial exposure to carcinogens, and other variables. These results may be available this year.

Most epidemiologists and cancer specialists interviewed by *Science* agree that the evidence linking chlorinated organic contaminants in drinking water and an increase in cancer incidence is becoming persuasive. Most, however, also urge caution before any action is taken as a result of the studies. We must remember, says David P. Rall of the National Institute of Environmental Health Sciences, that "the two major health advances of this century" were filtration of drinking water and chlorination. Any cessation of water treatment could produce health consequences of near catastrophic proportions.

"What are the alternatives?" adds Joseph F. Borzelleca of the Medical College of Virginia, who was chairman of an NAS subcommittee on organic contaminants in drinking water. "Ozonation at the treatment plant is costly and leaves no residual ozone" in the water to control contaminants that enter the water between plant and home; the same is true for treatment with ultraviolet light. Granular activated carbon will remove organic contaminants very effectively, but installation of a filter on every drinking water tap in the country would be prohibitively expensive.

Perhaps the most cost-effective method of control would be to make greater efforts to remove organics from water before chlorination, better control of the chlorination process, and selective charcoal treatment of water supplies that have exceptionally high concentrations of organics. One step in this direction is new federal regulations—effective in November of this year for cities with populations greater than 75,000, and 3 years later for those with populations between 10,000 and 75,000—requiring that concentrations of trihalogenated methanes remain below 100 parts per billion. A 1976 study showed that 31 of 112 municipal water systems surveyed exceeded this limit. Beyond that, there seems little more that should be done unless a causal relation between organic contaminants and cancer is more firmly established.—THOMAS H. MAUGH II

**Drinking Water and Health* (National Academy of Sciences, Washington, D.C., 1980), vol. 3 and references therein.
†*Drinking Water and Cancer: Review of Recent Findings and Assessment of Risks* (Council on Environmental Quality, Washington, D.C., 1980).

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