

## Surgeons General's Reports on Smoking and Cancer: Uses and Misuses of Statistics and of Science

Regarding the statistical relationship between cigarette smoking and cancer, Koop and Luoto (1) present "Criteria for Judgment of Causality." Earlier, the Surgeon General's report of 1964 asserted: "Statistical methods cannot establish proof of a causal relationship in an association. The causal significance of an association is a matter of judgment which goes beyond any statement of statistical probability" (2). These statements are at the root of the problem of use, or misuse, of statistics and of science.

As was noted (3), the first statement is correct; causality *cannot* be inferred from statistical association (4). Moreover, as Fisher (4) has warned, properly used, statistical methods can *reject* an hypothesis, but statistics alone can *never* establish that an hypothesis is certainly true. This general principle is contained in textbooks of statistics, such as that of Snedecor and Cochran (5). In contrast, the second statement is false. Opinion and subjective judgment are not fact, and do not constitute substantive evidence. They are not science.

A confirmed statistical association in an epidemiological situation requires the evaluation of existing explanatory hypotheses and, if possible, added new hypotheses. Koop and Luoto (1) neither consider nor evaluate competing hypotheses, such as the genetic hypothesis offered by Fisher (6) and examined in depth by Burch and by a number of discussants in his recent paper (7). Burch concluded that the genetic, or "genotype," hypothesis is still "alive and well." This hypothesis asserts that an underlying genetic variable, among individuals, influences both the tendency to smoke and the tendency to develop lung cancer (6,7) and other afflictions. This hypothesis, and any other, cannot be rejected nor validated merely on the basis of non-scientific factors such as opinion, judgment, and popularity.

The warnings of Fisher (4,6) are consistent with an earlier warning by Yule (8), both of whom were former Presidents of the Royal Statistical Society, London. Yule's warning is applicable to interpretation of smoking-health statistical data. He stated: "You can prove anything by statistics' is a common gibe. Its contrary is more nearly true—you can never prove anything by statistics. The statistician is dealing with the most complex cases of multiple causation. He may show that the facts are in accordance with this hypothesis or that. But it is quite another thing to show that all other possible hypotheses are excluded, and that the facts do not admit of any other interpretation than the particular one he may have in mind." The Surgeons

General's reports, and that of Koop and Luoto (1), have ignored the warnings of both Fisher and Yule. They have also ignored comparable warnings by Berkson (9-15), and reports showing statistically significant associations between concentrations of several air pollutant chemicals, such as nitrogen dioxide and sulfate, and lung cancer mortality rate (16-19).

For example, Berkson (10a) warned that it is not ". . . conclusive that the considerable number of statistical studies . . . all agree in showing an association between smoking and cancer of the lungs. On the contrary, undeviating consistency of statistical results all in support of the same conclusion is [sometimes] the hallmark of spurious correlation. If correlation is produced by some elements of the statistical procedure itself, it is almost inevitable that the correlation will appear whenever the statistical procedure is used." Since non-random samples (e.g., heavy smokers, light smokers, non-smokers, ex-smokers), which may be biased, have been widely used in smoking-health studies (1,2), and if smokers differ constitutionally from non-smokers (6,7), the observed correlations would not be surprising.

Another problem overlooked by Koop and Luoto (1) is the principle that a statistical association cannot distinguish between cause and symptom (20-22). Smoking may be symptomatic of a physiological deficiency, as of biogenic monoamines, that nicotine tends to alleviate. Regular insulin usage is "associated with" diabetes mellitus. But insulin is hardly a "cause" of diabetes, though usage is symptomatic of it. Nicotine induces the release of cellularly stored biogenic monoamines (22).

In a discussion before the Royal Statistical Society, London, Altman (23) asserted: "The general standard of statistics in medical journals is poor." We do not disagree.

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**Editor's Note:** The Public Health Service's 1982 report on smoking and cancer, which concludes that cigarette smoking is a major cause of cancers of multiple organs, was extensively reviewed by dozens of experts in many fields both inside and outside the Federal sector. Its findings are consistent with those of other respected scientific bodies including the American Medical Association, the Royal College of Physicians, and the World Health Organization. The Public Health Service maintains its position that cigarette smoking is the single most important preventable environmental factor contributing to illness, disability, and death in the United States.

### AIDS Hotline Expanded

To meet the demand for information about Acquired Immune Deficiency Syndrome (AIDS), the Department of Health and Human Services has expanded its nationwide AIDS hotline from three to eight lines. Each day the hotline has averaged 8,000-10,000 calls. The toll-free line (800: 342-AIDS) was installed July 1

to provide timely, accurate information on AIDS.

In addition to increasing the number of lines, the hotline is now active 24 hours a day. Callers hear a 3-minute tape explaining AIDS symptoms, methods of transmission, and the AIDS high-risk groups. From 8:30 a.m. to 5:30 p.m., callers may stay on the line for more detailed information. Free copies of "Facts

About AIDS" are also available to callers.

Secretary of Health and Human Services Margaret M. Heckler said, "the Public Health Service professional employees who are taking these calls tell me that 90 percent of the callers have fears about AIDS. I intend to provide these people with all the help and information we can."