

I-9.

Mervyn Susser: Judgment and Causal Inference:  
Criteria in Epidemiologic Studies.  
*American Journal of Epidemiology* 1977; 105:1-15.

Susser's "Judgment and Causal Inference: Criteria in Epidemiologic Studies" contains a message that I suspect will continue to require reinforcement for decades to come: that causal inference should not be equated with statistical inference, and in particular that statistical expertise alone is insufficient for causal analysis of data. Susser brought this message home not by abstract arguments, but by fascinating historical illustrations of how failure to appreciate the nonstatistical aspects of causal inference led to major inferential errors by renowned statisticians. The last paragraph of Susser's quote from Wright (p.5) illustrates an early awareness of the predominant importance of nonstatistical sources of error, such as confounding ("want of conformity between the test cases and control cases") and misclassification.

Susser argued that overreliance on statistical criteria tends to lead to excessive false-negative judgments regarding causality. Some of the conservative bias observed by Susser may be attributed not to overemphasis of statistics *per se*, but rather an overreliance on certain statistical methods, especially significance testing [Rothman, 1978 and 1986; Salsburg, 1985; Wonnacott, 1985; Gardner and Altman, 1986]. Empirical evidence for such "test-based" bias has been given by Freiman et al., [1978]. But all statistical methods are limited to dealing with precisely quantified sources of error. When unquantified sources of error are recognizably the largest ones, Susser argued that judgment must take precedence over statistical inference.

One can also see in Susser's examples the tension between the scientific and public-health objectives of epidemiologic research. As scientists, epidemiologists (and statisticians) may be well-advised to adopt a Popperian attitude and never treat a causal explanation of an association as anything more than a tentative hypothesis about nature. While a pure scientist can always afford to wait for more evidence to test such explanations, a fair number of epidemiologists are health officials or close advisors of executive authorities, and will be confronted with situations demanding action. Susser recognized that the latter situations require principles beyond those of statistical and causal inference, and that these principles need to be elucidated by and for such epidemiologists, much as principles of statistical and causal inference have been elucidated by earlier authors.

References:

- Freiman JA, Chalmers TC, Smith H, et al. The importance of beta, the Type II error and sample size in the design and interpretation of the randomized control data. *N Engl J Med* 1978; 299:690-694.
- Gardner MJ, Altman DG. Confidence intervals rather than P values: estimation rather than testing. *Br Med J* 1986; 292:746-750.
- Rothman KJ. A show of confidence. *N Engl J Med* 1978; 299:1362-1363.
- Rothman KJ. *Modern Epidemiology*. Boston: Little, Brown, 1986.
- Salsburg DS. The religion of statistics as practiced by medical journals. *Am Statist* 1985; 39:220-223.
- Wonnacott T. "Statistically significant." *Can Med Assoc J* 1985; 133:843.