The making of an epidemiological theory of bias and confounding

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We have chosen to discuss the history of epidemiology, as the history of the emergence and formalisation of its methods. In this issue and the following, Vineis (2002) and Vandenbroucke (2002) will be looking into the history of bias and confounding in epidemiology. These authors demonstrate convincingly how much epidemiology has borrowed from the social sciences and adapted methods and concepts to its own needs.

We would like to point to the fact that these developments have often occurred while trying to solve particular problems. In particular the controversy for the recognition of the harmful effects of tobacco on health has been an important crucible for the concept of confounding and the theory of bias.

Statisticians opposed to the smoking-lung cancer association have played a major role in formulating concepts of confounding and mechanisms of bias which have become fundamental components of the epidemiological methods. The role of Ronald Fisher was discussed and illustrated by Stolley about 10 years ago (1991). Fisher did not agree that there could be some causal link between tobacco smoke and lung cancer. He considered that both being a smoker and developing lung cancer was genetically determined. As explained by Vandenbroucke (2002), Fisher was very familiar with the concept of confounding, at least since he wrote his book on the "Design of experiments". To argue against the smoking-lung cancer connection, he presented data showing that dizygotic twins were more likely to differ in their smoking habits than monozygotic twins. Of 31 heterozygotic twin pairs, half (16 pairs) comprised a smoker and a non-smoker versus only one fourth of the monozygotic twins (12/51 pairs). Thus, for Fisher, a genetic factor was confounding the otherwise artifactual association between smoking and lung cancer. People that have known Fisher in person say that in his older days he admitted having been wrong on this, recognising that much of his acrimony was due to the fact that Austin Bradford Hill, the author with Richard Doll of one of the early case-control study on smoking and lung cancer, was a student of Pearson. Thus, criticising Hill was only another expression of the old and enduring antipathy between Karl Pearson and him.

The Mayo Clinic statistician, Joseph Berkson (1946) also criticised the first hospital-based case-control studies on smoking and lung cancer by arguing that the joint distribution of exposure and disease was different in the hospital and in the community of origin of the patients: smokers with lung cancer being more likely to be hospitalised than smokers without cancer (Berkson 1946). This Berkson Bias, nicely described by Vineis (2002), has become part of the foundation of a theory of selection bias in epidemiology. It has been taught for years even though its empirical demonstration will come very late.

These two examples illustrate how a rising discipline such as epidemiology in the fifties, sixties and seventies was able to transform the ideas formerly used by Fisher and Berkson to criticise its findings into core concepts of its own, such as confounding and selection bias.

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References

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