

A DICTIONARY OF EPIDEMIOLOGY

by

John M. Last

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*Edited for the International Epidemiological Association
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Foreword

The International Epidemiological Association is pleased to have the opportunity of sponsoring this Dictionary of Epidemiology. Although many of its members have contributed to the Dictionary, it is not exclusively the work of the Association.

This is the first time that an extensive compilation of epidemiological terms has been produced in the form of a dictionary. Such a work should help to unite epidemiologists around the world in furthering the more precise use of terms among ourselves and in fostering a better understanding of our concepts by others.

Carol Buck
President,
International Epidemiological Association

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Preface

Epidemiology has been as confounded as any other rapidly expanding science by the proliferation of words and phrases to describe its concepts, principles, methods, and procedures. The creation of new terms and disagreement about the meaning of old ones can confuse beginners and established epidemiologists alike.

This book is an attempt to bring some order to the occasionally chaotic nomenclature. The initiative came from the late Anita Bahn, and the work was continued, after her untimely death, by many of us. My role has been that of coordinating editor, but the task would not have been possible without vigorous debate with many colleagues. It is a tribute to their tolerance that the sometimes passionate arguments about the meanings of words have helped to cement rather than rupture friendships.

A word about what the dictionary is not: It is not an index of permitted and prohibited usage. As Sander Greenland put it, we have tried to create a Rosetta Stone, not the Ten Commandments. In a few instances, we have remarked that the use of a term is to be deprecated. Where synonyms exist, we have tried to enter the definition under the most commonly used of these, but no preference for one term over another is thereby implied. We have not made much distinction between what could be called proper technical terminology and jargon. Jargon is defined by Murphy as "obscure and/or pretentious language, circumlocutions, invented meanings, and pomposity delighted in for its own sake." I hope not too much of it can be detected in this dictionary.

The compilers of dictionaries must exercise the greatest care in the choice of words and their arrangement. Most entries in this dictionary have been repeatedly discussed with members of the editorial team and others, and in nearly all instances the wording has been agreed upon by us all. On the rare occasions that agreement eluded us, the final decision was mine alone; therefore I accept full responsibility for any deficiencies in the work. My colleagues can be absolved also from responsibility for the occasional "editorial" comments that are intended to enliven the text.

All of us were perplexed about boundaries. Inclusion of some terms associated with biostatistics, microbiology, and genetics, and omission of others, may seem haphazard. Some terms used in epidemiology, moreover, probably have been inadvertently left out. Such defects can be corrected in future revisions, which we hope to make with the aid of suggestions from users of this edition.

We used many sources and several methods. As a first step, we compiled a list of words and phrases from the indexes in standard textbooks and monographs on epidemiology; this list was circulated to about 40 colleagues and, guided by their comments, Jonathan Amsel and Eileen Lynch, in Philadelphia, and Donna Jowett and I, in Ottawa, assembled a first rough draft. This was circulated to about 70 correspondents around the world. After their amendments had been incorporated, a further revision went out to about 100 persons in July 1981 (the numbers grew as a result of rumor). There were discussions at the annual meeting of the Society for Epidemiologic Research at Snowbird, Utah, in June 1981, and at the Ninth Scientific Conference of the International Epidemiological Association in Edinburgh, in August 1981. A third draft was circulated to about 130 correspondents in December 1981. This final version incorporates comments from some of these, but is mostly the result of hard work at a meeting sponsored by the Rockefeller Foundation, in New York in February 1982. Participants at this meeting were J. H. Abramson, Jonathan Amsel, Carol Buck, J. L. Fleiss, Gary D. Friedman, Sander Greenland, Donna Jowett, John M. Last, Eileen Lynch, Mervyn Susser, Michel C. Thuriaux, and Kerr L. White. In addition to these oral discussions, there was much correspondence with the contributors.

Many books were consulted and definitions in them borrowed. Existing dictionaries, especially the *Oxford English Dictionary* (OED) and *Webster's*, and technical dictionaries and glossaries were invaluable. A list of the sources we consulted appears at the end of the book.

University of Ottawa
Ottawa, Canada
September 1982

J.M.L.

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A

ACCEPTABLE RISK The risk that has minimal detrimental effects, or for which the benefits outweigh the potential hazards. Epidemiologic study has provided data for calculation of risks associated with many medical procedures and also with occupational and environmental exposures; these data are used, for instance, in **CLINICAL DECISION ANALYSIS**.

ACCURACY The degree to which a measurement, or an estimate based on measurements, represents the true value of the attribute that is being measured. See also **MEASUREMENT**, **PROBLEMS WITH TERMINOLOGY**.

ACQUAINTANCE NETWORK Group of persons in contact or communication among whom transmission of an infectious agent and of knowledge, attitudes, and values is possible, and whose social interaction may have health implications. See also **TRANSMISSION OF INFECTION**.

ACTIVITIES OF DAILY LIVING (ADL) SCALE A scale devised by Katz and others¹ to score physical ability/disability; used to measure outcomes of interventions for various chronic disabling conditions such as arthritis. The scale is based on scores for responses to questions about mobility, self-care, grooming, etc. This was the first widely used scale of this type; others, mostly refinements or variations of the ADL scale, have since been developed.

¹Katz, S., Ford, A. B., Moskowitz, R. W., Jackson, B. A., Jaffe, M. W. Studies of illness in the aged. The index of ADL, a standardized measure of biological function, *JAMA* 185:914-919, 1963.

ACTUARIAL RATE See **FORCE OF MORTALITY**.

ACTUARIAL TABLE See **LIFE TABLE**.

ADJUSTMENT A summarizing procedure for rates or measures of association in which the effects of differences in composition for variable(s) among populations being compared have been removed by mathematical procedures. Most often, adjustment is performed on **RATES**. Age is the variable for which adjustment is most often carried out. See also **STANDARDIZATION**.

AETIOLOGY, AETIOLOGIC See **ETIOLOGY, ETIOLOGIC**.

AGENT (OF DISEASE) A factor, such as a microorganism, chemical substance, or form of radiation, whose presence, excessive presence, or (in deficiency diseases) relative absence is essential for the occurrence of a disease. A disease may have a single agent, a number of independent alternative agents (at least one of which must be present), or a complex of two or more factors whose combined presence is essential for the development of the disease. See also **CAUSALITY**.

AGE-PERIOD COHORT ANALYSIS See **COHORT ANALYSIS**.

AGE-SEX PYRAMID See **POPULATION PYRAMID**.

AGE-SEX REGISTER List of all clients or patients of a medical practice or service, classified by age (birthdate) and sex; provides denominator for calculating age- and sex-specific rates.

AGE-SPECIFIC FERTILITY RATE (ASFR) The number of live births to women in an age group in one year per 1000 women in that age group.

AGE-SPECIFIC RATE A rate for a specified age group. The numerator and denominator refer to the same age group.

Example:

$$\text{Age-specific death rate (age 25-34)} = \frac{\text{Number of deaths among residents age 25-34 in an area in a year}}{\text{Average (or midyear) population age 25-34 in the area in that year}} \times 100,000$$

The multiplier (usually 100,000 or 1,000,000) is chosen to produce a rate that can be expressed as a convenient number.

AGE-STANDARDIZED RATE See STANDARDIZATION.

AIRBORNE INFECTION A mechanism of transmission of an infectious agent by particles, dust, or droplet nuclei suspended in the air. See also TRANSMISSION OF INFECTION.

ALGORITHM Any systematic process that consists of an ordered sequence of steps with each step depending on the outcome of the previous one. The term is commonly used to describe a structured process, for instance, relating to computer programming or to health planning. See also DECISION TREE.

ALGORITHM, CLINICAL (Syn: clinical protocol) An explicit description of steps to be taken in patient care in specified circumstances. This approach makes use of branching logic and of all pertinent data, both about the patient and from epidemiologic and other sources, to arrive at decisions that yield maximum benefit and minimum risk.

ALLELE Alternative forms of a gene, occupying the same locus on a chromosome.

ALPHA ERROR See ERROR.

ANALYSIS OF VARIANCE A statistical technique that isolates and assesses the contribution of categorical factors to variation in the mean of a continuous outcome variable. The data are divided into categories based on their values for each of the independent variables, and the differences between the mean outcome values of these categories are tested for STATISTICAL SIGNIFICANCE.

ANALYTIC STUDY A hypothesis-testing method of investigating the association between a given disease or health state or other dependent variable and possible causative factors. In an analytic study, individuals in the study population may be classified according to absence or presence (or future development) of specific disease and according to "attributes" that may influence disease occurrence. Attributes may include age, race, sex, other disease(s), genetic, biochemical, and physiological characteristics, economic status, occupation, residence, and various aspects of the environment or personal behavior. Three types of analytic study are cross-sectional (prevalence), cohort (prospective), and case control (retrospective). See also CASE CONTROL STUDY; COHORT STUDY; CROSS-SECTIONAL STUDY; STUDY DESIGN.

ANIMAL MODEL Study in a population of laboratory animals that uses conditions of animals analogous to conditions of man to model processes comparable to those that occur in human populations. See also EXPERIMENTAL EPIDEMIOLOGY.

ANTAGONISM Opposite of SYNERGISM. The situation in which the combined effect of two or more factors is smaller than the solitary effect of any one of the factors. In bioassay, the term may be used to refer to the situation when a specified response is produced by exposure to either of two factors but not by exposure to both together.

ANTHROPOMETRY The technique that deals with the measurement of the size, weight, and proportions of the human body.

ANTIBODY Protein molecule formed by exposure to a "foreign" or extraneous substance, e.g., invading microorganisms responsible for infection, or active immunization. May also be present as a result of passive transfer from mother to infant, via immune globulin, etc. Antibody has the capacity to bind specifically to the foreign substance (antigen) that elicited its production, thus supplying a mechanism for protection against infectious diseases. Antibody is epidemiologically important because its concentration (titer) can be measured in individuals, and, therefore, in populations.

ANTIGEN A substance (protein, polysaccharide, glycolipid, tissue transplant, etc.) that is capable of inducing specific immune response. Introduction of antigen may be by the invasion of infectious organisms, immunization, inhalation, ingestion, etc.

ARBOVIRUS A group of taxonomically diverse animal viruses that are unified by an epidemiologic concept, i.e., transmission between vertebrate host organisms by blood-feeding (hematophagous) arthropod vectors such as mosquitoes, ticks, sand flies, and midges. The term is a contraction of *arthropod-borne virus*.

The interaction of arbovirus, vertebrate host(s), and arthropod vector gives this class of infections several unique epidemiologic features. See VECTOR-BORNE infection for definition of terms used to describe these features.

ARITHMETIC MEAN See MEAN, ARITHMETIC.

ASSOCIATION The degree of statistical dependence between two or more events or variables. Events are said to be associated when they occur more frequently together than one would expect by chance. Association does not necessarily imply a causal relationship. Statistical significance testing enables us to determine how unlikely it would be to observe the sample relationship by chance if in fact no association exists in the population that was sampled. If the use of the term "association" is confined to situations in which the relationship between two variables is statistically significant, the terms "statistical association" and "statistically significant association" become tautological. However, ordinary usage is seldom so precise as this. The terms "association" and "relationship" are often used interchangeably.

Associations can be broadly grouped under two headings, symmetrical or non-causal (see below) and asymmetrical or causal.

ASSOCIATION, ASYMMETRICAL (Syn: Asymmetrical Relationship) The definitive conditions of asymmetrical associations are direction and time. Independent variable *X* must cause changes in dependent variable *Y*, and the "causal" variable must precede its "effects." Bradford Hill¹ and others² have pointed out that the (subjective) likelihood of a causal relationship is increased by the presence of the following attributes. However, temporality is the only indispensable condition among these.

1. Consistency—The association is consistent if the results are replicated when studied in different settings and by different methods.
2. Strength—This is an expression of the disparity between the frequency with which a factor is found in the disease and the frequency with which it occurs in the absence of the disease. Not to be confused with statistical significance.
3. Specificity—This is established with the limitation of the association to a single putative cause and single effect.
4. Dose-response relationship—This is established when an increased risk or severity in disease occurs with an increased quantity ("dose") or duration of exposure to a factor.
5. Temporality—The exposure to a putative cause always precedes, never follows, the outcome.
6. Biological plausibility—It is desirable that the association agree with current understanding of the response of cells, tissues, organs, and systems to stimuli.

This criterion should not be applied rigidly. The association may be new to science or medicine. As Sherlock Holmes advised Dr. Watson, "When you have eliminated the impossible, whatever remains, however improbable, must be the truth."

7. Coherence—The associations should not *conflict* with the generally known facts of the natural history and biology of disease.
8. Experiment—It is sometimes possible to appeal to experimental, or quasi-experimental evidence, e.g., an observed association leads to some preventive action. Does this action in fact prevent?

¹A. Bradford Hill, "The Environment and Disease: Association or Causation," *Proc. Roy. Soc. Med.* 58: 295-300, 1965.

²Susser, M. W., Judgement and Causal Inference, *Am. J. Epidemiol.* 105:1-15, 1977.

See also CAUSALITY: EVANS'S POSTULATES; KOCH'S POSTULATES.

ASSOCIATION, DIRECT Directly associated, i.e., not via a known third variable: $A \rightarrow B$. Refers only to causality.

ASSOCIATION, INDIRECT CAUSAL Two types are distinguished:

1. Association of a factor C with disease A only because both are related to a common underlying factor B .



Alteration of factor C will not produce an alteration in the frequency of disease A unless an alteration in C affects B . It has been suggested that to avoid confusion with the alternative meaning of *indirect association*, this type should be called "secondary association."

2. Association of a factor C with disease A by means of an intermediate or intervening factor B .



Alteration of factor C would produce an alteration in the frequency of disease A . To avoid confusion, this type should be called "indirect causal association."

ASSOCIATION, SPURIOUS A term, preferably avoided, used with different meanings by different authors. It may refer to artifactual, fortuitous, false secondary, or to all kinds of noncausal associations due to chance, bias, failure to control for extraneous variables, etc.

ASSOCIATION, SYMMETRICAL An association is noncausal if it is symmetrical, as in the statement $F = MA$ (force equals mass times acceleration). This is a noncausal, nondirectional expression of the mathematical relationship between the physical properties of force, mass, and velocity. If one side of the equation is changed, then the other must also change to maintain equilibrium.

Although epidemiologists are usually most interested in asymmetrical statements that have direction, the symmetrical equation can be useful. For instance, prevalence can be expressed in terms of incidence and duration in the simple equation, $P = I \times D$. If two of these three elements are known, the third can be derived. See also SYMMETRICAL RELATIONSHIP.

ASSORTATIVE MATING Selection of a mate with preference (or aversion) for a particular genotype, i.e., nonrandom mating.

ASYMMETRICAL ASSOCIATION See ASSOCIATION, ASYMMETRICAL.

ASYMPTOTIC METHOD See LARGE SAMPLE METHOD.

ATTACK RATE Attack rate, or case rate, is a CUMULATIVE INCIDENCE RATE often used for particular groups, observed for limited periods and under special circumstances, as in an epidemic.

The secondary attack rate expresses the number of cases among contacts occurring within the accepted incubation period following exposure to a primary case, in relation to the total of exposed contacts; the denominator may be restricted to susceptible contacts when determinable.

Infection rate expresses the incidence of manifest and inapparent infections.

ATTRIBUTABLE FRACTION (AF) (Syn: Attributable proportion) A term sometimes used to refer to the attributable fraction in the population, and sometimes to the attributable fraction among the exposed. See also ATTRIBUTABLE FRACTION (EXPOSED); ATTRIBUTABLE FRACTION (POPULATION).

ATTRIBUTABLE FRACTION (EXPOSED) (Syn: etiologic fraction [exposed], attributable risk [exposed]) In a situation in which exposure to a given factor is believed to be a cause of a given outcome, the attributable fraction among the exposed is the proportion of the outcome (among those exposed to the factor) that can be attributed to exposure to the factor. This value must be interpreted with caution, as part or all of the apparent causal effect may be due to other factors associated with the apparent causal factor. In a study of a total population or in a cohort study it is computed as

$$AF_e = \frac{I_e - I_u}{I_e} \\ = \frac{RR - 1}{RR}$$

where I_e is the incidence rate of the outcome among people exposed to the factor, I_u is the incidence rate among the unexposed, and RR is the rate ratio, I_e/I_u . See also RATE RATIO.

ATTRIBUTABLE FRACTION (POPULATION) (Syn: etiologic fraction [population], Levin's attributable risk, population attributable risk)

A measure of the amount of disease associated with an exposure within a population. In a situation in which exposure to a given factor is believed to be a cause of a given disease (or other outcome), the population attributable fraction is the proportion of the disease (in the total population) that can be attributed to exposure to the factor. The value must be interpreted with caution, as part or all of the apparent causal effect may be due to other factors associated with the apparent causal factor.

In a study of a total population, it is computed as

$$AF_p = \frac{I_p - I_u}{I_p} \\ = \frac{P_e (RR - 1)}{1 + P_e (RR - 1)}$$

where I_p is the incidence rate of the disease (or other outcome) in the population, I_u is the incidence rate of the disease in the unexposed, RR is the rate ratio, I_p/I_u , and P_e is the proportion of the population exposed to the factor. See also ATTRIBUTABLE FRACTION (EXPOSED).

ATTRIBUTABLE RISK This term has been used by different authors to denote a number of different concepts, including the attributable fraction in the population, the attributable fraction among the exposed, the population excess rate, and the rate differ-