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Practical epidemiology and biostatistics in research III Rates

M A. Lobo
Aga Khan University

A F. Qureshi
Aga Khan University

S N. Inam
Aga Khan University

Practical Epidemiology and Biostatistics in Research III. Rates

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Melvyn A. Lobo, Asma Fozia Qureshi, S.N. Bazmi Inam (Department of Community Health Sciences, Aga Khan University, Karachi.)

What Is a Rate

A rate is defined as the number of events in a specified period divided by the population at risk of the events in the same time period. Commonly a “rate” measures a wide variety of events such as frequency of disease or other phenomena in relation to the size of a population or some other quantity, such as episodes of illness.

Uses of Rates

Rates summarize frequency of events In defined populations and enable comparison of differences in illness and death in geographical areas, over time, between groups of people (sex, socio-economic status, age, etc). Rates can also be used to predict the “expected” number Of events in a population. If, for example, we wish to know the burden of malnutrition in children under 5 in an area, but local data is lacking, then the “expected” number of malnourished children under 5 can be estimated using a national rate. The national prevalence rate of malnutrition multiplied by the total number of children under 5 in the district, will provide the “expected” number of malnourished children under

Calculation of Rates

The number of events or individuals with a characteristic, is divided by a denominator viz, the population at risk and multiplied by a multiple of 100 (usually 1000 or 100,000). This permits comparison of frequencies between populations of different sizes.

Categories of Rates

Rates are used to describe the occurrence of events such as births, disease (morbidity rates), deaths (mortality rates), and even persons with a specific attribute or characteristic (for example contraceptive prevalence rates).

Prevalence rates

Prevalence rates estimate the disease burden or magnitude of a health problem or other attribute at a given time, and are especially useful for administrative and planning purposes. They tell us what proportion of individuals have a given disease. For chronic disorders, for example, prevalence rates provide numbers for estimating resources for curative and rehabilitative care. Prevalence rates for a condition may also provide a guide to the probabilityofadiagnosis. In Pakistan, for example, thalassaemia has to be considered in the diagnosis of anaemia as the prevalence rate is high. A “point prevalence” rate refers to a specific point in time. The number of people with the disease at that time is divided by the size of the group or population. The numerator contains people who developed the disease before the specified point in time, and were alive and in the population, at that time. The rate depends on the incidence rate and the mean duration of the disease, until recovery or death. The longer the duration of a disorder, the higher is the prevalence. A “period prevalence” rate is the proportion of the population with the disease at any time during a specified period (usually a year). The numerator comprises people who developed the disease before and during the period, including those who left, died, or recovered during the period. When used without qualification, “prevalence” usually refers to point prevalence.

Incidence Rates

Incidence rates measure the frequency of events, such as episodes of acute disease, that occur during a specified period. Death rates are incidence rates that measure the frequency of deaths. Incidence rates are useful for studying disease causation and the evaluation of preventive measures. They indicate recent activity of causal factors, and thus point to a need for primary prevention. They also help

identify high risk groups such as the high incidence of AIDS amongst drug users and homosexuals. In an acute epidemic "attack" rates denote the new cases (incidence) of disease in the population at risk when exposed for a short period of time. For example, in an outbreak of chickenpox, 200 children in a school of 1000 develop the disease, the incidence is described as an attack rate of 20%. Another measure of incidence is the person-time incidence rate. It is generally used whenever individuals are followed up for different durations or at different calendar times. Generally incidence rates estimate the person-time incidence rate, since the average size of the population at risk during a year is an estimate of the number of person-years of risk during that year.

Problems and Issues about Rates

The problems regarding rates and their interpretation lie mainly with:

i. definition of the cases to be included in the numerator, ii. the population to be included in the denominator, and iii. the time period. Consistency should be used in defining cases (e.g., age groups to be included as "adults"), or events that form the numerator. Similarly, uniform criteria for inclusion and exclusion of cases, as well as standardized methods for interviews and/or observations should be used. Inconsistency will artificially increase or decrease the rate. Logically, the denominator should include all those at risk of the event in the numerator, i.e., the rate should be calculated from a proportion. This does not always happen. For example, the crude birth rate comprises of the total number of births in a year per 1000 population; here the denominator includes males and many others' not "at risk" for giving birth to a child. This "weakens" the magnitude of the rate. Other rates, such as the infant mortality rate (IMR) uses the number of infant deaths in a year divided by the total number of births in the same year. In this case, some of the infants that died may have actually been born in the previous year, thus making this a rate calculated on the basis of a ratio. Often, for reasons of convenience, the mid-year population in the defined area is used as the denominator. Time is important in the calculation and interpretation of rates. A rate describing the frequency of an event in one thy; i.e., a "point" in time, uses the mid-year or average population as the denominator. "Period" rates, i.e., those which include events which may not be present on the day of the interview, but occurred within a specified time period, are calculated using the mid-period population as the denominator. Rates may be biased, if the sample that they are calculated from, is not representative of the population from which it is drawn. Furthermore, the size and structure of the population affects the calculation of a rate. Standardization procedures are used to control the effects of population structure and permit comparisons.

Standardization of Rates

Comparison of health indicators between two populations using crude rates may lead to erroneous conclusions. Population structures influence crude rates, and differences in rates could just be due to differences in age or sex groups or some other characteristic (e.g., smoking). To make comparisons possible, certain factors need to be standardized or adjusted. For example, Crude Death Rate (CDR) in Florida is higher as the population over 65 years is very high in that state. There are two methods for standardization, direct and indirect. When population structures and deaths in the different age groups are known then direct standardization procedures are used, and the age specific rates are weighted by the size of the population in the matching age group. If, however, crude rates are available but specific rates are not, then, specific rates from a large population (such as national rates) are applied.

Definitions of Commonly Used Rates

* Admission rate: hospital admissions in a specified period per 1000 population.
* Age specific mortality rate: number of deaths among persons of a given age group in one year per 1000 (average mid-year population) in the specified age group.
* Cause-specific death rate (or cause-of-death rate): deaths assigned to a specific cause in a specified period per 1000 population.
* Consultation rate: consultations (usually with a doctor) in a specified period per 1000 population.
* Crude birth rate: live births in a specified period (usually a year) per 1000 population.
* Crude death rate: Total number of deaths in a specified period (usually a year) per 1000 population.

* Gross fertility rate: live births in a specified period per 1000 women aged 15-44.
* Infant mortality rate: deaths under the age of one year in a specified period per 1000 live births in the same period.
* Maternal mortality rate: deaths from complications of pregnancy, childbirth, and the puerperium in a specified period per 100,000 live births in the same period.
* Neonatal mortality rate: deaths in first 28 days of life in a specified period per 1000 live births in the same period.
* Perinatal mortality rate: foetal deaths plus deaths in the first seven days of life in a specified period per 1000 total (live and still) births in the same period.
* Post-neonatal mortality rate: deaths occurring from 29 days to under 1 year of age, in a specified period per 1000 live births in the same period.
* Proportional mortality ratio: deaths assigned to a specific cause in a specified period per 100 total deaths in the period.
* Under five mortality rate: number of deaths of children under five years of age per 1000 live births.

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