Measures of disease frequency

Epidemiology training
Animal health cooperation platform
Embassy of France to the OECS States

Sophie Molia

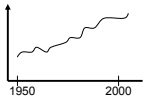
Contributors: Sophie Molia, David Chavernac, Stéphanie Desvaux, Flavie Goutard, François Roger and Jérôme Thonnat

Importance of denominators

- Example 1:
  - 200 cases of dengue fever in Guadeloupe
    70 in Dominica
    → Which one is more infected??
  - Guadeloupe: 200/400,000 → 0.5/1000
    Dominica: 70/70,000 → 1/1000

Dominica twice more infected!!

- Example 2:
  - Food-borne outbreaks in Trinidad
  - Y axis = # x axis = time
    → Situation has worsened??



Depends on population size, difference in reporting method (more sensible), definition of case!!

Some definitions

- Case
- Ratio
- Proportion
- Rate
- Prevalence
- Incidence

Case

- Episode of disorder, illness, or injury affecting an individual
- Various sources provide case information
  - Surveillance systems
  - Structured surveys
- Case-definition is essential in epidemiology
  - harmonization
  - standardization
  - for comparisons

Example: Chytrid fungus in mountain chicken.
Case identified by clinical signs? Microscopic observation of zoospores in skin? PCR?

Ratio, proportion, rate

- Definitions can vary depending on data available
- Need to compare with previous studies, biological factors

Ratio

$\frac{a}{b}$

- Where a and b are 2 mutually exclusive frequencies
- Examples: female/male ratio in a herd
  odds ratio

Proportion

$\frac{a}{a+b}$

- Where a included in the denominator
- Dimensionless; 0≤ ≤ 1; often expressed as %
- Examples: proportion of rams in a flock sheep

Ratio, proportion, rate (cont)

Rate

$\frac{a}{x}$

- a is included in x
- x represents "population time"
- Rate expresses the relationship between an event and a defined population at risk over a specified time period
- a is # of affected individuals in a given time T
- x is population at risk over the same time T

⇨ Expresses numbers at risk and velocity of becoming infected
Most commonly used in epidemiology because it most clearly expresses probability or risk of disease or other events in a defined population over a specified period of time

Prevalence

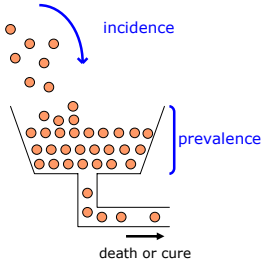
- Number of **existing cases** of disease
  - Proportion of individuals in a population with disease or condition at a specific point of time
    - FMD prevalence in June 2005 in Bolivia
  - Provides estimate of the probability or risk that one will be affected at a point in time
  - Provides an idea of how severe a problem may be (Useful for planning animal health services)

$$\text{Prevalence} = \frac{\text{\# of cases observed at time t}}{\text{total \# of individuals at time t}}$$

Incidence

- Measure of **new cases** of disease that develop in a population during a specified period of time
  - Annual incidence of HPAI in Vietnam
  - Measure of the probability that unaffected animals will develop the disease
  - Used when examining an outbreak of a animal health problem (more useful to get risk factors)

Prevalence vs. Incidence



- Prevalence ~ Incidence x Duration
- Example: prevalence of AIDS ↑
  - Could be good: duration of disease ↑
  - Could be bad: incidence ↑
- Incidence generally a more relevant measure of disease occurrence
- However in chronic diseases, where flow of new disease is slow, prevalence is more employed

Types of Prevalence

- **Point prevalence**: number of cases that exist at a given point in time
- **Period prevalence**: number of cases that exist in a population during a specified period of time
- **Lifetime prevalence**: proportion of the population that has an history of a given disease at some point in time

Types of Incidence

- **Cumulative Incidence**
  - The proportion of animals that become diseased during a specified time period

$$CI = \frac{\text{\# of newly diseased individuals for a specified time T}}{\text{population at risk for the same time t}}$$

  - Range from 0 to 1
  - Measure of average risk
  - Other important CIs:
    - Case-fatality
    - Attack risk
- **Incidence Rate**
  - Also known as incidence density rate

$$IDR = \frac{\text{\# of newly diseased individuals}}{\text{Sum of disease-free time for all individuals of population}}$$

  - Measure of incidence that is able to handle varying observation periods
  - Denominator is population-time
  - Dynamic measure
  - Range from 0 to ∞
  - Other important ID rate
    - Mortality rate

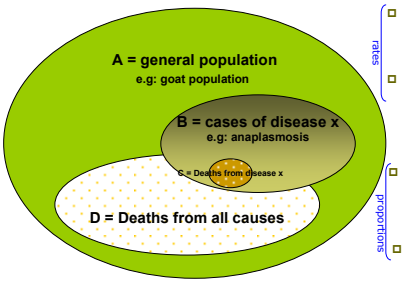
Types of Incidences

- **Cumulative incidence vs. Incidence density**
  - Whereas CI represents the proportion of individuals affected,
  - ID takes into account for each individuals at risk, the time elapsed before disease occurs
- **Methods to estimate population-time**
  - Sum-up each individual's time contribution
  - Count the population midway through time T
  - Take the average of the population at the beginning and end of time T

Types of Incidences

- **Crude vs. specific ID rates**
  - Crude rates reflect the total number of observed cases and the total population at risk time experience
  - Specific rates characterise the frequency of the cases for a specific subpopulation
    - Example: age or sex specific

Indices of mortality



- **Crude mortality rate** $\frac{D}{A}$
- **Cause-specific mortality rate for disease x** $\frac{C}{A}$
- **Case-fatality for disease x** $\frac{C}{B}$
- **Proportionate mortality for disease x** $\frac{C}{D}$

Adjustment of rates

- An important use of rates (morbidity, mortality) is to compare 2 or more populations. But such populations may differ with regards to factors that affect morbidity or mortality
  - *Example:* comparison of the prevalence of mastitis in two cattle populations, one of which has a larger proportion of dairy cows
- Most common factors affecting morbidity and mortality are sex and age
- Methods have been developed for comparing such populations: adjustment of rates