Incidence, Prevalence, and Measures of Risk

STAT 244NF: Infectious Disease Modeling

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Agenda

- Questions from R Lab 0
- Announcements/Reminders
- Discussion + Notes: Incidence vs. Prevalence
- Class Activity: Incidence vs. Prevalence

Frequency Measures

- Ratio
- Proportion
- Rate

Frequency Measures: Ratio

What is a ratio?

Frequency Measures: Ratio

What is a ratio?

Oxford Dictionary defines it as: "the quantitative relation between two amounts showing the number of times one value contains or is contained within the other."

A *ratio* can be a useful way to compare relative magnitudes of two quantities. The numerator and denominator need not be related (e.g., number of patients per hospital)

Frequency Measures: Ratio

Which of the following is a ratio?

(a)

(b)

(c)

Frequency Measures: Ratio

Ratios in epidemiology are used both as descriptive statistics and as analytic tools (for which we will fit models, state and test hypotheses, and drawn conclusions).

Examples:

- Relative risk (also known as a risk ratio)
- Odds ratio
- Death-to-case ratio

$$\frac{\text{number or rate of events, items, people, etc. in one group}}{\text{number or rate of events, items, people, etc. in second group}}$$

Note: we will spend more time on these quantities and their associated regression models in later classes – stay tuned!

Frequency Measures: Proportion

What is a proportion?

Frequency Measures: Proportion

What is a proportion?

Generally speaking, a proportion allows us to compare a part to the whole. It is a special case of a ratio, where the numerator is also included in the denominator.

$$\frac{\text{number of people or events with a particular characteristic}}{\text{total number of people or events, or which numerator is a subset}} \times 10^n$$

Frequency Measures: Rate

What is a rate?

Frequency Measures: Rate

What is a rate?

- Generally, a rate might be thought of as how fast something happens or goes.
- In epidemiology, a *rate* is more specific and refers to a measure of *how frequently an event of interest occurs in a defined population over a specific period of time*.

Rate, Ratio, or Proportion?

Question 1:

$$\frac{\text{number of people that died from cholera in 1854 London}}{\text{number of people who died in 1854 London}}$$

Which of the choices (a)-(d) best describes the above value?

(a) Rate
(b) Ratio
(c) Proportion
(d) None of the above

Rate, Ratio, or Proportion?

Question 2:

$$\frac{\text{number of people hospitalized for COVID-19 in the US in 2020}}{\text{number of people infected with COVID-19 in the US in 2020}}$$

Which of the choices (a)-(d) best describes the above value?

(a) Rate
(b) Ratio
(c) Proportion
(d) None of the above

Rate, Ratio, or Proportion?

Question 3:

$$\frac{\text{number of women that died from heart disease in 2010}}{\text{number of women that died from cancer in 2010}}$$

Which of the choices (a)-(d) best describes the above value?

(a) Rate
(b) Ratio
(c) Proportion
(d) None of the above

Rate, Ratio, or Proportion?

Question 4:

$$\frac{\text{number of new cases of COVID-19 in State A last week}}{\text{total number of people in State A last week}}$$

Which of the choices (a)-(d) best describes the above value?

(a) Rate
(b) Ratio
(c) Proportion
(d) None of the above

Incidence

- Incidence describes the occurrence of new cases of disease (or some other health event) in a population *over a specified period of time*.
- Incidence sometimes means the number of new cases in a community.
- Incidence sometimes means the number of new cases *per unit of population*

Incidence Proportion

- Proportion of an initially disease-free population that develops disease during a specified, usually limited, period of time.
- Also known as attack rate, risk, probability of getting disease, or cumulative incidence.

$$\frac{\text{Number of new cases of disease or injury during specified time period}}{\text{Size of population at start of time period}}$$

Incidence Rate

- A rate may be used to describe how quickly a particular disease occurs in a population (per unit time, like day, month, year).
- Incorporates time directly into the denominator.
- This kind of rate is focused on *new cases*, and is called an *incidence rate*.

$$\frac{\text{Number of new cases of disease during specified period}}{\text{Time each person was observed, totaled for all persons}}$$

Prevalence Rate

- A rate may also be used to describe the proportion of people that have a particular health condition in a particular population at a point in time.
- This kind of rate is focused on all cases, new and continuing, and is called a *prevalence rate*.
- A prevalence rate may be measured at a particular point in time, like a date. This is called *point prevalence*.
- A prevalence rate may also be measured over an interval of time - this is called *period prevalence*.

$$\frac{\text{All new and pre-existing cases during a given time period}}{\text{Population during the same time period}} \times 10^n$$

Prevalence Rate

- If prevalence is high, what might this tell us about how fatal a particular illness is? What about how quickly people recover?
- If prevalence is low, what might this tell us about how fatal a particular illness is? What about how quickly people recover?

Class Activity

References

- Principles of Epidemiology in Public Health Practice, 3rd Edition. https://www.cdc.gov/csels/dsepd/ss1978/SS1978.pdf
- Pagano and Gauvreau, 2000. Principles of Biostatistics, 2nd Edition. Brooks/Cole CENGAGE Learning.