



# Measures of Frequency

- Characterize part of the distribution
  - Count: Number of cases of health event
    - Number of college dorm residents who drink alcohol
    - Number of car crashes in Oklahoma during a 24 hour period
- Compare one part of the distribution to another part of the distribution, or to the entire distribution
  - What if there were 10 dorm residents who drank alcohol? What is the magnitude of the problem?
  - If dorm housed 20 students, then 50% alcohol use
  - If dorm housed 500 students, only 2% alcohol use
  - If occurred in state of OK (pop 3,923,561), 2.5 cases/1,000,000
- Central concern in epidemiology is appropriate denominators

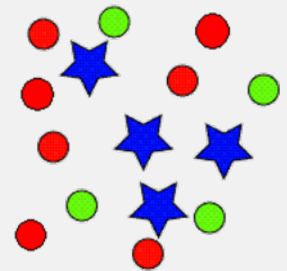
# Ratios, Proportions, and Rates



# Measures of Frequency: Ratios

**Ratio:** A relative magnitude of two quantities or a comparison of any two values

- Most general term, includes any expression with a numerator and a denominator
- Units: variable
- Range: variable
- E.g., 2.1 males cases to 1 female case



# Measures of Frequency: Ratios

$$\text{Ratio} = \frac{\text{Number or rate of events, items, persons, etc. in one group}}{\text{Number or rate of events, items, persons, etc. in another group}}$$

- Used as both descriptive measures and as analytic tools
- Numerators and denominators can be related or unrelated
- Result is often expressed as the result “to one” or written as the result “:1.”

# Ratios—An Example

Results of 2016 OPNA Northeast Region

Grade	Number of students participated in survey	Total number of students enrolled
6	884	3,288
8	823	3,291
10	710	3,433
12	527	3,126
Total	2,944	13,138

Of the students participated in the survey, 884 were in grade 6 and 527 were in grade 12. Calculate the ratio of 6<sup>th</sup> graders to 12<sup>th</sup> graders

$$\text{Ratio} = (884/527)$$

$$= 1.7 \text{ students in grade 6 to 1 student in grade 12 (or 1.7:1)}$$

# Measures of Frequency: Proportions

**Proportion:** A ratio in which the numerator is contained in the denominator

- Tells us what fraction of the population is affected
- Units: None
- Range: 0 to 1 (expressed as a decimal, percentage, or fraction)
- E.g., 10.3% of Oklahomans are Hispanic or Latino



# Proportions

*Number of persons or events with a particular characteristic*

$\times 10^n$

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*Total number of persons or events, of which the numerator is a subset*

- Used most often as descriptive measures
- Can be expressed as a fraction, a decimal, or a percentage
  - The statements "one fifth of the residents used prescription drugs" and "twenty percent of the residents used prescription drugs" are equivalent



# Proportions-An Example

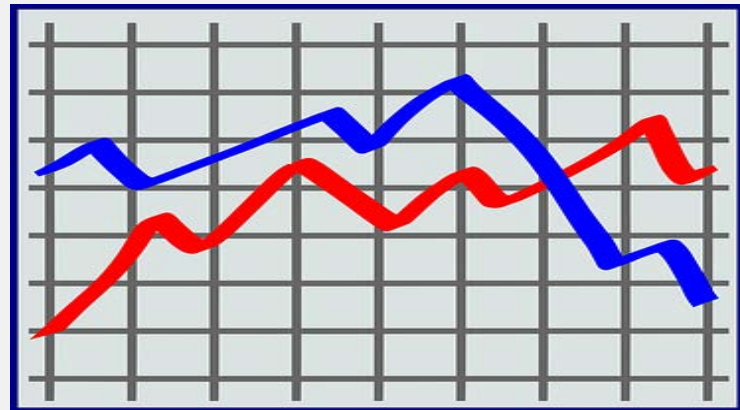
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Grade	Number of students participated in survey	Total number of students enrolled
6	884	3,288
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Total	2,944	13,138

Calculate the proportion of students participated  
 $= (2,944 / 13,138) \times 100$   
 $= 22.4\%$

# Measures of Frequency: Rates

- **Rate:** A ratio representing change over time
  - **Always** dependent on the size of the population during that time period
  - Units: change in unit 1 per unit 2 (usually time)
  - Range: 0 to infinity
  - E.g., Velocity of a car (km/h); incidence rate of cancer



# Rates

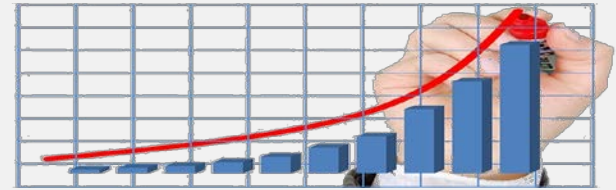
- Compare problems among different populations that include 2 or more groups differing by a selected characteristic
  - E.g., Compare risky behaviors between men and women
- Monitoring trends and determining unusual activities in the community
  - E.g., Death due to opioid overdose



Source:

Centers for Disease Control and Prevention (CDC). Introduction to Public Health. In: Public Health 101 Series. Atlanta, GA: U.S. Department of Health and Human Services, CDC; 2014. Available at: <http://www.cdc.gov/publichealth101/epidemiology.html>

# Rates



- Can be use where per units of time is not expressed. Examples include:
  - Participation rate
    - Proportion of 8<sup>th</sup> graders participated in the OPNA survey among all students enrolled in grade 8
  - Attack rate
    - E.g., 20 of 130 persons developed diarrhea after attending a picnic
  - Case-fatality rate: Proportion of persons with the condition who die from it
    - E.g., 8 of the 10 cases of pancreatic cancer are fatal.
- Not considered "true" rates by some, although use of the terminology is widespread.
- Note: medical literature may use terms “proportion”, “ratio” and “rate” interchangeably

# Rate Formula

To calculate a rate, determine frequency of disease, which includes:

1. Number of condition or death
2. Size of population at risk
3. Time period during which rate is being calculated
4. Constant, K
  - Arbitrary multiplier of some power of 10 used to express and compare measures in similar population units



$$\text{Rate} = \frac{\text{Number of events in a specified period}}{\text{Population at risk of the event during the specified time period}} \times K$$

Source:

Centers for Disease Control and Prevention (CDC). Introduction to Public Health. In: Public Health 101 Series. Atlanta, GA: U.S. Department of Health and Human Services, CDC; 2014. Available at: <http://www.cdc.gov/publichealth101/epidemiology.html>

# Additional Concepts and Terms

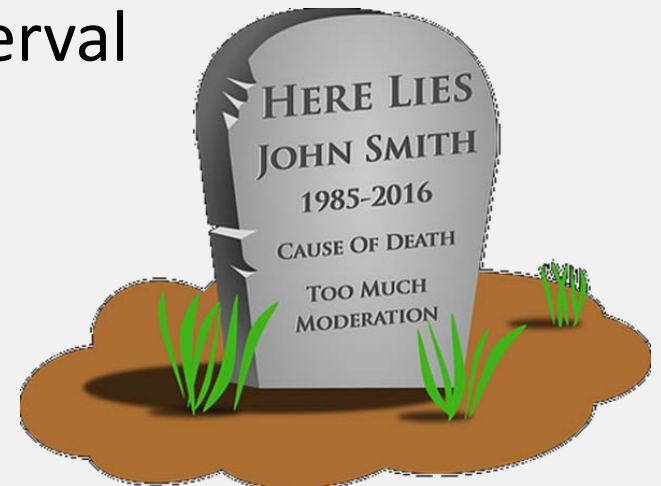
## Morbidity

- Measure of the frequency of **disease** in a specific population



## Mortality

- Measure of the frequency of occurrence of **death** in a defined population during a specified interval



# Morbidity Terminology Defined

## Incidence

- Refers to the occurrence of **new** cases of disease or injury in a population over a specified period of time
- Synonyms:
  - Risk
  - Cumulative incidence
  - Attack Rate
  - Probability of developing disease

## Prevalence

- Proportion of persons in a population who have a particular disease or attribute at a specified point in time or over a specified period of time
- Includes **all** cases, new and pre-existing, in the population at a specified time

Source:

Centers for Disease Control and Prevention, 2006. Principles of epidemiology in public health practice: an introduction to applied epidemiology and biostatistics. <https://www.cdc.gov/ophss/csels/dsepd/ss1978/lesson3/section2.html>

# Morbidity and Mortality Measures

## Morbidity Frequency Measures

- Incidence

$$\frac{\text{Number of *new cases*}}{\text{Total population at risk over specific period}}$$

- Prevalence

$$\frac{\text{Number of *existing cases*}}{\text{Total population at risk over specific period}}$$

## Mortality Frequency Measures

- Crude rates

$$\frac{\text{Total number of deaths}}{\text{Total population over specific period}}$$

- Age-specific rates

$$\frac{\text{Total number of deaths in specific age group}}{\text{Total population in same age group over specific period}}$$

- Age-adjusted rates

Source:

1. Centers for Disease Control and Prevention, 2006. Principles of epidemiology in public health practice: an introduction to applied epidemiology and biostatistics.
2. Gordis, L., 2009. Epidemiology. Saunders.



# Rates-an Examples

Hypothetical alcohol related car crashes death data, 2015

Community A					Community B			
Age	No. of Deaths	Mid-year Population	Crude Rate*	Age-adjusted Rate*	No. of Deaths	Mid-year Population	Crude Rate*	Age-adjusted Rate*
Young	50	5,000	1,000	353	20	1,500	1,333	471
Middle	15	3,000	500	260	20	3,000	667	347
Old	1	1,000	100	13	10	5,000	200	25
Total	66	9,000	733	626	50	9,500	526	843

\*Rate per 100,000 population

# Rates—An Example

$$\text{Rate} = \frac{\text{Number of events in a specified period}}{\text{Population at risk of the event during the specified time period}} \times K$$

In County Y with a population of 10,000 people of whom 50 are addicted to Oxycodone, an opioid pain medication, and in 1 year 20 of the 50 die from Oxycodone overdose.

What is County Y mortality rate in that year?

$$\begin{aligned} &= (20/10,000) \times 100,000 \\ &= 200 \text{ deaths per } 100,000 \text{ residents} \end{aligned}$$

What is County Y case-fatality rate as a result of Oxycodone in that year?

$$\begin{aligned} &= (20/50) \times 100 \\ &= 40\% \text{ died among those with Oxycodone addiction} \end{aligned}$$

# Assessment Quiz

1. Which of the following are frequency measures?

- A. Birth rate
- B. Incidence
- C. Mortality rate
- D. Prevalence
- E. All of the above ✓
- F. None of the above

2. All proportions are ratios, but not all ratios are proportions.

- A. True ✓
- B. False

3. Which of the following mortality rates use the estimated total mid-year population as its denominator? (hint: More than one answer)

- A. Age-specific mortality rate
- B. Sex-specific mortality rate
- C. Crude mortality rate
- D. Cause-specific mortality rate

# Assessment Quiz

For each of the fractions shown below, indicate whether it is:

A. Ratio      B. Proportion      C. Rate      D. None of the above

  B   1.  $\frac{\text{Number of men in Oklahoma who died from drug overdose in 2004}}{\text{Number of men in Oklahoma who died in 2004}}$

  C   2.  $\frac{\text{Number of men in Oklahoma who died from drug overdose in 2004}}{\text{Estimated number of men living in Oklahoma on July 1, 2004}}$

  A   3.  $\frac{\text{Number of men in Oklahoma who died from drug overdose in 2004}}{\text{Number of men in Oklahoma who died from car crashes in 2004}}$

  B   4.  $\frac{\text{Number of men in Oklahoma who died from lung cancer in 2004}}{\text{Number of men in Oklahoma who died from cancer (all types) in 2004}}$

  A   5.  $\frac{\text{Number of men in Oklahoma who died from lung cancer in 2004}}{\text{Estimated revenue in Oklahoma from cigarette sales in 2004}}$

# Survey Response Rate



Depends on the number in the total population and respective **target** populations

- Know the demographics

# Survey Sample Size

Approximation of survey sample using population size based on a random survey

Population Size	Survey Sample Size
100,000 +	400
7,000	364
5,000	357
2,500	333
1,000	278

# Questions or Comments??

## Contact Information

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Please complete the  
evaluation form



Oklahoma Department of Mental Health  
and Substance Abuse Services

**Our Mission: To promote healthy communities  
and provide the highest quality care to enhance  
the well-being of all Oklahomans.**