Measures of Frequency
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• 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.”
Results of 2016 OPNA Northeast Region

<table>
<thead>
<tr>
<th>Grade</th>
<th>Number of students participated in survey</th>
<th>Total number of students enrolled</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>884</td>
<td>3,288</td>
</tr>
<tr>
<td>8</td>
<td>823</td>
<td>3,291</td>
</tr>
<tr>
<td>10</td>
<td>710</td>
<td>3,433</td>
</tr>
<tr>
<td>12</td>
<td>527</td>
<td>3,126</td>
</tr>
<tr>
<td>Total</td>
<td>2,944</td>
<td>13,138</td>
</tr>
</tbody>
</table>

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

\[
\text{Ratio} = \frac{884}{527}
\]

= 1.7 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

\[
\frac{\text{Number of persons or events with a particular characteristic}}{\text{Total number of persons or events, of which the numerator is a subset}} \times 10^n
\]

• 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

### Results of 2016 OPNA Northeast Region

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</tr>
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Calculate the proportion of students participated

\[
= \left( \frac{2,944}{13,138} \right) \times 100
\]

\[
= 22.4\%
\]
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:
Rates

- Can be use where per units of time is not expressed. Examples include:
  - Participation rate
    - Proportion of 8th 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:
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:
Morbidity and Mortality Measures

**Morbidity Frequency Measures**

- **Incidence**
  
  \[
  \text{Number of new cases} \over \text{Total population at risk over specific period}
  \]

- **Prevalence**
  
  \[
  \text{Number of existing cases} \over \text{Total population at risk over specific period}
  \]

**Mortality Frequency Measures**

- **Crude rates**
  
  \[
  \text{Total number of deaths} \over \text{Total population over specific period}
  \]

- **Age-specific rates**
  
  \[
  \text{Total number of deaths in specific age group} \over \text{Total population in same age group over specific period}
  \]

- **Age-adjusted rates**

Source:

Rates-an Examples

Hypothetical alcohol related car crashes death data, 2015

<table>
<thead>
<tr>
<th>Age</th>
<th>Community A</th>
<th>Community B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of Deaths</td>
<td>Mid-year Population</td>
</tr>
<tr>
<td>Young</td>
<td>50</td>
<td>5,000</td>
</tr>
<tr>
<td>Middle</td>
<td>15</td>
<td>3,000</td>
</tr>
<tr>
<td>Old</td>
<td>1</td>
<td>1,000</td>
</tr>
<tr>
<td>Total</td>
<td>66</td>
<td>9,000</td>
</tr>
</tbody>
</table>

*Rate per 100,000 population
Rates—An Example

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?

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

\[ = \frac{20}{10,000} \times 100,000 \]

\[ = 200 \text{ deaths per 100,000 residents} \]

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

\[ = \frac{20}{50} \times 100 \]

\[ = 40\% \text{ died among those with Oxycodone addiction} \]
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

   - E. All of the above

2. All proportions are ratios, but not all ratios are proportions.
   A. True
   B. False

   - A. True

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

   - C. Crude mortality rate

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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. Number of men in Oklahoma who died from drug overdose in 2004
   Number of men in Oklahoma who died in 2004

C  2. Number of men in Oklahoma who died from drug overdose in 2004
   Estimated number of men living in Oklahoma on July 1, 2004

A  3. Number of men in Oklahoma who died from drug overdose in 2004
   Number of men in Oklahoma who died from car crashes in 2004

B  4. Number of men in Oklahoma who died from lung cancer in 2004
   Number of men in Oklahoma who died from cancer (all types) in 2004

A  5. Number of men in Oklahoma who died from lung cancer in 2004
   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

<table>
<thead>
<tr>
<th>Population Size</th>
<th>Survey Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>100,000 +</td>
<td>400</td>
</tr>
<tr>
<td>7,000</td>
<td>364</td>
</tr>
<tr>
<td>5,000</td>
<td>357</td>
</tr>
<tr>
<td>2,500</td>
<td>333</td>
</tr>
<tr>
<td>1,000</td>
<td>278</td>
</tr>
</tbody>
</table>
Questions or Comments??

Contact Information
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REOW Coordinator
Oklahoma Department of Mental Health and Substance Abuse Services
405-248-9153
vi.pham@odmhsas.org

Please complete the evaluation form

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