

Rate Calculation Work Sheet

Rate: is a measure of the frequency of a health event in “a defined population, usually in a specified period of time.” (Porta, 2009, p 207) It is a ratio of one number to another but it is not a proportion (percentage), because the denominator is a function of both the population size and the dimension of time, whereas the numerator is the number of events (Stanhope & Lancaster, 2016, p262)

Three categories:

Crude: Rates computed for a population as a whole

Specific: Rates calculated for subgroups of a population

Adjusted: Rates calculated to compare populations with different distributions of a factor known to affect the health condition of interest.

Two types of rates are especially important in epidemiology. These are morbidity (illness) and mortality (death) rates. There are several specialized rates in each of these two broad categories.

Some examples of these specialized **mortality (death) rates** are:

1. **Crude death rate:** the proportion of the population that has died from **any** cause irrespective of age.

Example: $\frac{\text{\# of deaths in Illinois}}{\text{Total estimated mid-year Population of Illinois}} \times 100,000 = \text{crude death rate}$

2. **Age-specific rate:** the number of deaths among persons of a **given age group**.

Example: $\frac{\text{\# of deaths of persons 18-30 years old in Illinois}}{\text{\# total estimated mid-year Population of Illinois}} \times 100,000 = \text{Age specific death rate}$

3. **Cause-specific rate:** the number of deaths from a **specific cause**

Example: Cancer $\frac{\text{\# of deaths for cancer from Illinois}}{\text{\#Total Population}} \times 100,000 = \text{rate}$

4. **Case-fatality rate:** number of deaths from a **specific cause** within a **given period**.

$\frac{\text{\# of deaths from breast cancer in Illinois}}{\text{Among all individuals diagnosed with the disease over a certain period of time}} \times 100,000 = \text{rate}$

Note: Case fatality rate typically is used as a measure of disease severity and is often used for prognosis (predicting disease course or outcome), where comparatively high rates are indicative of relatively poor outcomes.

Vital Statistics

5. **Birth rate** $\frac{\text{\# of live births}}{\text{\#Total population}} \times 1,000 = \text{birth rate}$

6. **Infant mortality rate-** -number of infant deaths **under 1 year of age** in a year. The rate formula uses live births as the denominator.

$\frac{\text{\# of infant deaths < 1 year in state}}{\text{\# live births}} \times 1,000 = \text{infant mortality rate state}$

7. **Neonatal mortality rate**- -number of infant deaths **under 28 days** in a year.

The rate formula uses live births as the denominator

$$\frac{\# \text{ of neonatal deaths under 28 days in the state}}{\# \text{ live births}} \times 1,000$$

Two of the specialized **morbidity (disease) rates**:

1. **Prevalence rate**- -measure of **existing** disease in a population at a **particular time**

Example: Rubella $\frac{\# \text{ of cases of a disease from a specific cause for one year for the state}}{\text{Total population of state that year}} \times 100,000 = \text{rate}$

2. **Incidence rate**--the number of **new** cases developing in a population **at risk** during a specified time.

Example: HIV $\frac{\# \text{ of new cases of disease over a specific period of time}}{\# \text{ of persons at risk of disease over that specific period of time}} \times 100,000 = \text{rate}$

All rates are calculated using a **scaling factor** (multiplier) which is usually between 1,000 to 100,000 to avoid small fractions. This multiplier represents the population base and can vary for different purposes. The results are expressed as the number of deaths per 100,000 persons, or the number of cases or number of new cases of disease per 100,000, With vital statistics they are usually figured per 1,000 population. This is different than a percentage which doesn't give an idea of the actual population base i.e. a rate of illness is 13% in one city and 25% in another but doesn't give an idea of what that might mean in terms of numbers.

The **numerators** in the rate problems represent the persons of interest. For example, in a crude death the numerator is the total number of persons who died within the defined period (usually during the past year). It is necessary to know the persons of interest that the rate requires.

The **denominators** in the rate problems can represent the total population of interest. **It is necessary to know which population figure the rate requires.**

Calculate the following rates using the information provided. Use the scaling factor of 100,000 for all of the problems.

1. The total death in County Z last year was 6,092. The population of County Z last year was 524,263. What was the crude death rate?

$$\frac{6,092}{524,263} = .01162 \times 100,000 = 1,162 \text{ per } 100,000 \quad \text{or } 12 \text{ per } 1000 \quad \text{Anderson \& McFarlane Rate work sheet}$$

2. There were 4,953 deaths from neoplasms in City B during the past year. The year end population was 3,495,678. What was the specific cancer death rate for last year?

$$4,953/3,495,678 = 0.014168 \times 100,000 = 141.6 \text{ rounded to } 142 \text{ per } 100,000 \quad \text{Anderson \& McFarlane Rate work sheet}$$

3. The population of the US in 2000 was 281,421,906. The number of deaths from heart disease in the US in 2000 was 710,760. The total number of deaths in the US in 2000 was 2,403,351.

- a Calculate the % of heart disease deaths for the US in 2000.

$$\frac{710,760}{2,403,351} = 0.296 \times 100 = 29.6 \text{ rounded to } 30\%$$

Cause-specific death rate . $\frac{\# \text{ of deaths from a specific cause} \times 100,000}{\# \text{ total Population}} = \text{rate}$
 $\frac{710760}{2,403,351} \times 100,000 = 29,574 \text{ per } 100,000$
 281,421,906

- b Calculate the rate of heart disease deaths in the US in 2000 for the US.

$$\frac{710,760}{2,403,351} \times 100 = 29.57 \text{ rounded to } 30\%$$

Cause-specific death rate . $\frac{\# \text{ of deaths from a specific cause} \times 100,000}{\# \text{ total Population}} = \text{rate}$
 $\frac{710,760 \times 100,000}{281,421,906} = 0.2957 \times 100,000 = 29,574 \text{ per } 100,000$
 Anderson & McFarlane
 Rate work sheet

4. In Illinois in 2000 the population was 12,419,293. The number of Salmonella cases in 2000 was 1,502 in Illinois. Calculate the disease rate for Salmonella for Illinois in 2000.

$$1,502 / 12,419,293 = 1.209 \times 1000 = .12 \text{ per } 1000 \quad \text{Anderson \& McFarlane}$$

$$1,502 / 12,419,293 = 1.209 \times 100,000 = 12 \text{ per } 100,000 \quad \text{Rate worksheet}$$

5. There were 45,238 neonatal deaths out of 5,672,000 live births in City F. Calculate the neonatal mortality (death) rate.

$$45,238 / 5,672,000 = 7.975 \times 1000 = 7.98 \text{ per } 1000 \text{ rounded to } 8/1000 \quad \text{Anderson \& McFarlane}$$

6. The population in Sangamon county in 2000 was 188,951

- a The number of live births in Sangamon county in 2000 was 2,646. Figure the Live Birth rate for Sangamon country for 2000.

$$2,646 / 188,951 = 0.014 \times 1000 = 14 \text{ per } 1000 \quad \text{Rate worksheet}$$

- b The number of infant deaths in Sangamon county in 2000 was 18. Figure the infant mortality rate for Sangamon country for 2000.

$$18 / 2,646 = 0.00680 \times 1000 = 6.8 \text{ per } 1000 \text{ rounded to } 7 \text{ per } 1000 \quad \text{Anderson \& McFarlane}$$

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INFANT MORTALITY, CHICAGO COMMUNITY AREAS

TABLE 1

| <u>DEATHS UNDER ONE YEAR</u> | | | |
|------------------------------|-------------------------|----------|-----------------------------|
| <u>COMMUNITY AREA</u> | <u># of LIVE BIRTHS</u> | <u>#</u> | <u>RATE PER 1000 BIRTHS</u> |
| 01. Rogers Park | 1,054 | 13 | 12.3 |
| 02. West Ridge | 966 | 5 | 5.2 |
| 03. Uptown | 1,340 | 26 | 19.4 |
| 04. Lincoln Square | 760 | 13 | 17.1 |
| 05. North Center | 610 | 7 | 11.5 |
| 27. East Garfield Park | 763 | 19 | 24.9 |
| 28. Near West Park | 1,338 | 34 | 25.4 |
| 36. Oakland | 295 | 8 | 27.1 |
| 39. Grand Boulevard | 1,209 | 24 | 19.9 |
| 40. Washington Park | 735 | 17 | 23.1 |
| 68. Englewood | 1,303 | 27 | 20.7 |
| 73. Washington Heights | 507 | 17 | 33.5 |
| CHICAGO | 55,216 | 914 | 16.6 |
| UNITED STATES | -- | -- | 12.5 |

(cont.), Table 1, page 3

1. A. Fill in the blank columns in Table 1 using the formula to calculate infant mortality rate. A hand or desk calculator speeds calculations but is not essential.
- B. Compare the infant mortality rate you calculated for Lincoln Square with that of East Garfield Park. Are they the same or different?

They are different but without other data it isn't possible to know what contributes to these.

- C. What general trends, if any, are apparent from these data?

There are some areas of Chicago which have a significantly higher infant mortality rate. i.e. Oakland & Washington Heights, and one that has a significantly lower infant mortality rate i.e. Westridge compared to the overall infant mortality rate of Chicago.

- D. Compare the infant mortality rate of the City of Chicago with that of the United States. Are the rates the same or different? What factors may account, between Chicago and the United States, affect these rates?

The infant mortality rate of Chicago is higher than that of the United States. This may be due to lack of access to affordable healthcare or lack of prenatal health care and education.