19.2: Proportions

Learning Objectives

- Compute absolute risk reduction
- Compute relative risk reduction
- Compute number needed to treat

Often the interpretation of a proportion is self-evident. For example, the obesity rate for white non-Hispanic adults living in the United States was estimated by a study conducted between 2006 and 2008 to be 24%. This value of 24% is easily interpretable and indicates the magnitude of the obesity problem in this population.

Often the question of interest involves the comparison of two outcomes. For example, consider the analysis of proportions in the case study "Mediterranean Diet and Health." In this study, one group of people followed the diet recommended by the American Heart Association (AHA), whereas a second group followed the "Mediterranean Diet." One interesting comparison is between the proportions of people who were healthy throughout the study as a function of diet. It turned out that 0.79 of the people who followed the AHA diet and 0.90 of those who followed the Mediterranean diet were healthy. How is the effect size of diet best measured?

We will take the perspective that we are assessing the benefits of switching from the AHA diet to the Mediterranean diet. One way to assess the benefits is to compute the difference between the proportion who were not healthy on the AHA diet (0.21) with the proportion who were not healthy on the Mediterranean diet (0.10). Therefore, the difference in proportions is:

$$0.21-0.10=0.11 \tag{19.2.1}$$

This measure of the benefit is called the **Absolute Risk Reduction** (ARR).

To define ARR more formally, let C be the proportion of people in the control group with the ailment of interest and T be the proportion in the treatment group. ARR can then be defined as:

$$ARR=C-T \tag{19.2.2}$$

Alternatively, one could measure the difference in terms of percentages. For our example, the proportion of non-healthy people on the Mediterranean diet (0.10) is 52% lower than the proportion of non-healthy people on the AHA diet (0.21). This value is computed as follows:

$$\frac{(0.21-0.10)}{0.21}\times 100=52\% \tag{19.2.3}$$

This measure of the benefit is called the **Relative Risk Reduction** (RRR). The general formula for RRR is:

$$RRR=\frac{(C-T)}{C}\times 100 \tag{19.2.4}$$

where C and T are defined as before.

A third commonly used measure is the "*odds ratio*." For our example, the odds of being healthy on the Mediterranean diet are $90:10=9:1$; the odds on the AHA diet are $79:21=3.76:1$. The ratio of these two odds is $9/3.76=2.39$. Therefore, the odds of being healthy on the Mediterranean diet is 2.39 times the odds of being healthy on the AHA diet. Note that the odds ratio is the ratio of the odds and not the ratio of the probabilities.

A fourth measure is the number of people who need to be treated in order to prevent one person from having the ailment of interest. In our example, being treated means changing from the AHA diet to the Mediterranean diet. The number who need to be treated can be defined as:

$$N=\frac{1}{ARR} \tag{19.2.5}$$

For our example,

$$N=\frac{1}{0.11}=9 \tag{19.2.6}$$

Therefore, one person who would otherwise not be healthy would be expected to stay healthy for every nine people changing from the AHA diet to the Mediterranean diet.

The obvious question is which of these measures is the best one. Although each measure has its proper uses, the RRR measure can exaggerate the importance of an effect, especially when the absolute risks are low. For example, if a drug reduced the risk of a certain disease from 1 in $1,000,000$ to 1 in $2,000,000$, the RRR is 50%. However, since the ARR is only 0.0000005, the practical reduction in risk is minimal.