Relative Risk

Identifying Factors That Alter Risk

Understanding those factors that alter the risk of developing a disease/disorder is of critical importance to public health. Without such an understanding, we would not be able to create effective interventions to promote greater health. But how do we even assess the risk of developing a disease/disorder?

Topics: Incidence — Prevalence — Relative Risk

Assessing the incidence and the prevalence of the disease/disorder can provide important information to understand how common a disease/disorder may be in a given population and the effectiveness of public health measures in addressing the disease/disorder. Depending upon the question of interest assessing the prevalence can give insight into the risk of a disease/disorder at a given **Point** (do you currently have asthma?), a **Period** (Have you had asthma at any point in the last 2 years?), or across a **Lifetime** (Have you ever had asthma?).

Incidence — $\frac{New\ Cases\ of\ Disease\ During\ a\ Period}{Population\ at\ Risk\ During\ a\ Period}$

Prevalence — $\frac{Number\ of\ Cases\ of\ Disease}{Population}$

> As a part of a large heart health study, 10,600 men between the ages of 50-59 years of age were assessed in 2002 and then followed up with again in 2007.
> • During the period 2002 to 2007 (inclusive), 317 men developed coronary heart disease.
> • 842 men were found to have coronary heart disease at some point in their life.
>
> $$Incidence = \frac{317}{10,600} = 0.0299 = 3.0\%$$
>
> $$Prevalence = \frac{842}{10,600} = 0.0794 = 7.9\%$$

So this study observed that the lifetime prevalence of coronary heart disease was 7.9%, meaning that 7.9% of the population assessed had/have coronary heart disease at some point in their life. The presumption then is that a similar proportion of the broader population — beyond just the sample studied — would have a lifetime prevalence of coronary heart disease. But prevalence does not give insight into how things might be changing. For that we need to focus on **incidence** which tells us information about new cases of a disease/disorder. This study observed that the incidence of developing coronary heart disease during the 6 years of the study was 3.0%, meaning that 3.0% of the population assessed developed coronary heart disease. We can use this information about the development of new cases of a disease/disorder to understand how disease/disorder risk might be changing.

Relative Risk — How much a treatment or intervention altered the risk of an outcome relative to the risk of that outcome occurring in a control group.

$$\frac{Incidence\ in\ Active\ Group}{Incidence\ in\ Control\ Group}$$

In order to properly assess disease/disorder risk, it is necessary to have some comparison. This comparison could use historical data to contrast how the incidence may be changing over time (e.g., what was the incidence of a disease over the past year relative to the incidence of a disease in the prior year) or could use some control population/group (e.g., what was the incidence of a disease in Texas relative to the incidence of a disease in New Mexico) that enables us to focus on a particular factor that could contribute to altering an individual's risk of developing a disease/disorder. Using relative risk we can identify those factors or determinants (causes) that relate to a disease/disorder manifesting. As relative risk is a ratio, the interpretation becomes easier as we can look at the degree to which the relative risk deviates from 1.0. If the relative risk of the disease/disorder is the same, the ratio should be closer to 1.0. The further away from 1.0 the relative risk is, the larger the effect and the more likely it is to be clearly observable. If the factor we are interested in results in a relative risk greater than 1.0 that tells us that the factor increases the risk of the disease/disorder. If the factor we are interested in results in a relative risk less than 1.0 that tells us that the factor decreases the risk of the disease/disorder.

> As a part of a large heart health study, 10,600 men between the ages of 50-59 years of age were assessed in 2002 and then followed up with again in 2007. In 2007, the men were asked to indicate if they had regularly engaged in exercise at least 3 days a week during the study period or not.
> • 3,153 men indicated they regularly exercised, with 62 of them developing coronary heart disease.
> • 7,447 men indicated they did not regularly exercise, with 255 of them developing coronary heart disease.
>
> $$Active\ Group\ Incidence = \frac{62}{3153} = 0.0197 = 1.97\%$$
>
> $$Control\ Group\ Incidence = \frac{255}{7447} = 0.0342 = 3.42\%$$
>
> $$Relative\ Risk = \frac{0.0197}{0.0342} = 0.57$$

By contrasting the development of new cases of coronary heart disease between two groups, we can look at how a factor of interest — in this case habitual exercise — might alter disease risk. The relative risk of developing coronary heart disease in those who exercised at least 3 days per week was 0.57. As the relative risk was less than 1.0, it tells us that exercising at least 3 days per week reduced the risk of developing coronary heart disease by nearly half (0.57). Clearly then this is a critical risk factor that we should pay attention to if we are trying to address coronary heart disease.

Within health sciences there is debate as to what we should choose to use as the appropriate control group. Clearly whatever control group is used should minimize the number of factors that could contribute to altering the risk to allow for assessing the distinct risk profile associated with the factor of interest. But when it comes to health behaviors and environments, should we consider the healthy factor as the active group of interest? Or if the assumption is that the healthy factor is the evolutionary default then should we consider the unhealthy factor as the active group of interest? For example, should we consider the group that regularly exercises the control group and the group that does not the active group? There is no one commonly accepted answer, as it comes down to interpretation (does exercising reduce the risk, or does not exercising increase the risk). As it is simply a matter of switching the numerator (number on top) and denominator (number on bottom), either approach is appropriate as they are mathematically related.

How common is a disease/disorder?

Incidence

How many new cases of a disease/ disorder occurred.

$$\frac{\text{New Cases of Disease During a Period}}{\text{Population at Risk During a Period}}$$

- Tells us information about how things might be changing.

Prevalence

How many cases of a disease/ disorder are there.

$$\frac{\text{Number of Cases of Disease}}{\text{Population}}$$

- **Point**: *Do you currently have Asthma?*
- **Period**: *Have you had Asthma at any point in the last 2 years?*
- **Lifetime**: *Have you ever had Asthma?*

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Relative Risk

- How much a treatment or intervention altered the risk of an outcome relative to the risk of that outcome occurring in a control group.
  - **Active Group:** Group that has the characteristic of interest.
  - **Control Group:** Group that does not have the characteristic of interest.
    - This can also be historical data.

$$\frac{\text{Incidence in Active Group}}{\text{Incidence in Control Group}}$$

Magnitude:

- The closer to 1.0 the less of a risk.
- The further from 1.0 the larger the effect and the more likely it is to be clearly observable.

Direction:

- Greater than 1.0 means the risk is increased.
- Less than 1.0 means the risk is decreased.

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- 7,447 men indicated they did not regularly exercise, with 255 of them developing coronary heart disease.

$$\text{Incidence} = \frac{\text{New Cases of Disease During a Period}}{\text{Population at Risk During a Period}}$$

$$\text{Incidence}_{\text{exercise}} = \frac{62}{3{,}153} = 0.0197 = 1.97\%$$

$$\text{Incidence}_{\text{control}} = \frac{255}{7{,}447} = 0.0342 = 3.42\%$$

$$\text{Relative Risk} = \frac{\text{Incidence in Active Group}}{\text{Incidence in Control Group}}$$

$$\text{Relative Risk} = \frac{1.97\%}{3.42\%} = 0.57$$

Exercising at least 3 days per week reduced the risk of developing coronary heart disease by nearly half.

Who should be the control group?

- When it comes to health behaviors and environments, should we consider the healthy factor as the active group of interest?
  - Should we be looking at relative risk as $\frac{\text{Incidence in those who Exercise}}{\text{Incidence in those who Do Not Exercise}}$
  - Or would it be better to look at it as $\frac{\text{Incidence in those who Do Not Exercise}}{\text{Incidence in those who Exercise}}$

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$$\text{Relative Risk} = \frac{\text{Incidence in Active Group}}{\text{Incidence in Control Group}}$$

$$\text{Relative Risk} = \frac{1.97\%}{3.42\%} = 0.57$$

Exercising at least 3 days per week reduced the risk of developing coronary heart disease by nearly half.

$$\text{Relative Risk} = \frac{3.42\%}{1.97\%} = 1.736$$

Not exercising at least 3 days per week increased the risk of developing coronary heart disease by nearly double.

Relative Risk Worksheet

1. What does the term prevalence refer to? What is the formula?

2. What does the term incidence refer to? What is the formula?

3. How is a point estimate of a disease different from a lifetime estimate?

Data: As a part of a large investigation of 200,000 women over a 3 year period, 262 women developed breast cancer. 622 women were found to have breast cancer at some point in their life.

4. Using the information above, what is the incidence of breast cancer?

5. Using the information above, what is the prevalence of breast cancer?

Data: Public health records indicate that the rate of new cases of asthma is 2,100 per 100,000 people per year with 8,900 per 100,000 people being diagnosed with asthma at some point in their life.

6. Using the information above, what is the incidence of asthma?

7. Using the information above, what is the prevalence of asthma?

8. What does the term relative risk refer to?

9. What is the formula for relative risk?

Data: As a part of a larger investigation of 100,000 individuals over the past 3 summers: 3,829 out of 98,200 individuals reported developing stomach issues following swimming in public pools and swimming areas. 232 out of 1,800 individuals reported developing stomach issues following swimming in the infant and kiddie pool area.

10. Using the information above, what is the incidence of stomach issues following swimming in the infant and kiddie pool area?

11. Using the information above, what is the incidence of stomach issues following swimming in public pools and swimming areas?

12. Using the information above, what is the relative risk of swimming in the infant and kiddie pool area?

13. What is your interpretation of the relative risk of swimming in the infant and kiddie pool area for developing stomach issues?

Data: Public health records indicate that the rate of new cases of measles is 3 per 100,000 people among unvaccinated individuals and 1 per 1,000,000 people among those who were vaccinated.

14. Using the information above, what is the incidence of measles among unvaccinated individuals?

15. Using the information above, what is the incidence of measles among vaccinated individuals?

16. Using the information above, what is the relative risk of not getting vaccinated for the measles virus?

17. What is your interpretation of the relative risk of contracting the measles virus for those who are unvaccinated?