**Instructions**

Please complete the following lab assignment. You may work on the assignment in groups or on your own. However, to get credit, you must submit your own answers in Canvas. This lab is open note and open book. You may also ask the instructor and the TA questions. Please note that in most cases we will try to guide you towards answering your own question rather than directly providing you with an answer.

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# Q1. RR

[Numerical Answer]

Assume we followed an entire population of 300,000,000 people for one year and were able to categorize every person at the end of the year based on their diet and whether or not they developed heart disease. The data from this population is in the table below.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Heart Disease +** | **Heart Disease -** |  |
| **Bad Diet +** | 36,000,000 | 144,000,000 | 180,000,000 |
| **Bad Diet -** | 6,000,000 | 114,000,000 | 120,000,000 |
|  | 42,000,000 | 258,000,000 | 300,000,000 |

Where 20% with a bad diet get heart disease in 1 year vs. 5% without a bad diet.

What is the relative risk of heart disease associated with a bad diet in this population?

**Exact Answer: 4**

# Q1. Feedback

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Heart Disease +** | **Heart Disease -** |  |
| **Bad Diet +** | 36,000,000 | 144,000,000 | 180,000,000 |
| **Bad Diet -** | 6,000,000 | 114,000,000 | 120,000,000 |
|  | 42,000,000 | 258,000,000 | 300,000,000 |

Risk in bad diet = (36,000,000 / 180,000,000) = 0.2

Risk in good diet = (6,000,000 / (120,000,000) = 0.05

Relative risk = 0.2 / 0.05 = 4.0

Please make sure you understand why this is the correct answer. You may use the "Previous" button below to update your answer if your original answer was incorrect.

Click the "Next" button below to move on to the next question.

# Q2. RR Interpretation

You previously found that the relative risk of heart disease associated with a bad diet in this population was 4. Which of the following is the best interpretation of this relative risk?

|  |  |
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|  | The probability of heart disease during the 1-year follow-up was 4.0. |
|  | 1 person developed heart disease in this population for every 4 people who did not develop heart disease in the 1 year period. |
| ✅ | The proportion of people in this population that end up with heart disease in a year was 4 times higher when they had a bad diet than when they had a good diet. |
|  | In this population, the odds of heart disease in a year was 4 times higher among those with a bad diet than among people with a good diet. |

# Q2. Feedback

The correct answer was: The proportion of people in this population that end up with heart disease in a year was 4 times higher when they had a bad diet than when they had a good diet.

It would also be appropriate to refer to risk or probability in this circumstance.

Please make sure you understand why this is the correct answer. You may use the "Previous" button below to update your answer if your original answer was incorrect.

Click the "Next" button below to move on to the next question.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 3. What is the attributable risk (AR) of heart disease associated with a bad diet among people in this population with a bad diet (the 2x2 table is once again given below)?   |  |  |  |  | | --- | --- | --- | --- | |  | **Heart Disease +** | **Heart Disease -** |  | | **Bad Diet +** | 36,000,000 | 144,000,000 | 180,000,000 | | **Bad Diet -** | 6,000,000 | 114,000,000 | 120,000,000 | |  | 42,000,000 | 258,000,000 | 300,000,000 | | | |
| X | 0.15 | Risk in bad diet = (36,000,000 / 180,000,000) = 0.2  Risk in good diet = (6,000,000 / (120,000,000) = 0.05  Attributable risk = 0.2 - 0.05 = 0.15 |

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| 4. You previously found that the attributable risk (AR) of heart disease associated with a bad diet among people in this population with a bad diet was 0.15. Which of the following is the best interpretation of this attributable risk? | | |
|  | The probability of heart disease during the 1-year follow-up was 0.15 times higher in people with a bad diet compared to people with a good diet. |  |
|  | 1 person developed heart disease in this population for every 7 people who did not develop heart disease in the 1 year period. |  |
|  | If causality had been established, 15% of the total risk of heart disease among people in this population with a bad diet that is attributable to a bad diet. | This is a percent attributable risk interpretation. |
| X | The excess risk associated with a bad diet is 0.15. That is, assuming a causal association (and thus, no confounding or bias), and if the excess incidence were completely reversible, the cessation of the exposure (bad diet) would lower the risk among people with a bad diet by 0.15, from 0.2 to 0.05. |  |

5. But, we can rarely, if ever, collect data on our entire population. Now suppose that we took a simple random sample of 1% of this population instead. What would you expect the results of our study to look like now (the population crosstab is included for reference)?

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| --- | --- | --- | --- |
|  | **Heart Disease +** | **Heart Disease -** |  |
| **Bad Diet +** | 36,000,000 | 144,000,000 | 180,000,000 |
| **Bad Diet -** | 6,000,000 | 114,000,000 | 120,000,000 |
|  | 42,000,000 | 258,000,000 | 300,000,000 |

|  |  |  |  |
| --- | --- | --- | --- |
|  | Heart Disease + | Heart Disease - |  |
| Bad Diet + | 360,000 | 1,440,000 | 1,800,000 |
| Bad Diet - | 60,000 | 1,140,000 | 1,200,000 |
|  | 420,000 | 2,580,000 | 3,000,000 |

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| 6. What is the relative risk of heart disease associated with a bad diet in this sample (the 2x2 table is once again given below)?   |  |  |  |  | | --- | --- | --- | --- | |  | Heart Disease + | Heart Disease - |  | | Bad Diet + | 360,000 | 1,440,000 | 1,800,000 | | Bad Diet - | 60,000 | 1,140,000 | 1,200,000 | |  | 420,000 | 2,580,000 | 3,000,000 | | | |
| X | 4.0 | Risk in bad diet = (360,000 / 1,800,000) = 0.2  Risk in good diet = (60,000 / (1,200,000) = 0.05  Relative risk = 0.2 / 0.05 = 4.0 |

7. But, we can rarely, if ever, collect data from a simple random sample of our entire population. Now suppose that we took a simple random sample of 1,000 exposed people from our population and 2,000 unexposed people from our population. What would you expect the results of our study to look like now (the population crosstab is included for reference)?

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| --- | --- | --- | --- |
|  | **Heart Disease +** | **Heart Disease -** |  |
| **Bad Diet +** | 36,000,000 | 144,000,000 | 180,000,000 |
| **Bad Diet -** | 6,000,000 | 114,000,000 | 120,000,000 |
|  | 42,000,000 | 258,000,000 | 300,000,000 |

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| --- | --- | --- | --- |
|  | Heart Disease + | Heart Disease - |  |
| Bad Diet + | 200 | 800 | 1,000 |
| Bad Diet - | 100 | 1,900 | 2,000 |
|  | 300 | 2,700 | 3,000 |

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| 8. What is the relative risk of heart disease associated with a bad diet in this sample (the 2x2 table is once again given below)?   |  |  |  |  | | --- | --- | --- | --- | |  | Heart Disease + | Heart Disease - |  | | Bad Diet + | 200 | 800 | 1,000 | | Bad Diet - | 100 | 1,900 | 2,000 | |  | 300 | 2,700 | 3,000 | | | |
| X | 4.0 | Risk in bad diet = (200 / 1,000) = 0.2  Risk in good diet = (100 / (2,000) = 0.05  Relative risk = 0.2 / 0.05 = 4.0 |

9. Now suppose we sample from the population based on disease status (as in a traditional case-control study) rather than exposure. Specifically, we took a simple random sample of 1% of the people in the population with heart disease and matched them each to one randomly selected person from the population who does not have heart disease and then asked them about their diet in the past year. Assuming everyone is honest and able to recall their diet with perfect accuracy, what would you expect the results of our study to look like now (the population crosstab is included for reference)?

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Heart Disease +** | **Heart Disease -** |  |
| **Bad Diet +** | 36,000,000 | 144,000,000 | 180,000,000 |
| **Bad Diet -** | 6,000,000 | 114,000,000 | 120,000,000 |
|  | 42,000,000 | 258,000,000 | 300,000,000 |

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| --- | --- | --- | --- |
|  | Heart Disease + | Heart Disease - |  |
| Bad Diet + | 360,000 | 234,419 | 594,419 |
| Bad Diet - | 60,000 | 185,581 | 245,581 |
|  | 420,000 | 420,000 | 840,000 |

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| 10. What number do you get if you try to calculate the relative risk of heart disease associated with a bad diet in this sample in the same way you have in previous samples (please round your answer to two decimal places)?   |  |  |  |  | | --- | --- | --- | --- | |  | Heart Disease + | Heart Disease - |  | | Bad Diet + | 360,000 | 234,419 | 594,419 | | Bad Diet - | 60,000 | 185,581 | 245,581 | |  | 420,000 | 420,000 | 840,000 | | | |
| X | 2.48 | Risk in bad diet = (360,000 / 594,419) = 0.606  Risk in good diet = (60,000 / (245,581) = 0.244  Relative risk = 0.606 / 0.244 = 2.48 |

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| 11. Why does the typical method of calculating a relative risk produce a nonsense estimate when we sample based on disease status? | | |
| X | Because the total numbers of exposed and unexposed people are no longer proportionate to the numbers in the population. using these numbers as the denominator for risk no longer gives us an unbiased estimate of actual risk. |  |
|  | Because it is never possible to calculate an unbiased estimate of the relative risk in a study that samples based on disease status. | Not true. The rare-disease assumption is irrelevant in situations in which the control group is a sample of the total reference population, which is the usual strategy in case-control studies within a defined cohort. In this situation, the odds ratio is a direct estimate of the relative risk regardless of the frequency of the outcome of interest.  Szklo, Moyses, Nieto, F. Javier. Epidemiology (Kindle Locations 2860-2863). Jones & Bartlett Learning. Kindle Edition. |
|  | Because unbiased estimates of the relative risk can only be derived from population or cohort data. |  |
|  | Because the odds ratio only approximates the risk ratio when the disease is rare. | This not true and not relevant to the current question. In the current question you were not asked to calculate the odds ratio. |

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| 12. What would be the best relative measure to use if we wanted a valid measure of association using the case-based sample described in the previous question? | | |
| X | Odds ratio | “The odds ratio is especially valuable because it can be measured in case-control (case–noncase) studies”  Szklo, Moyses, Nieto, F. Javier. Epidemiology (Kindle Locations 2493-2494). Jones & Bartlett Learning. Kindle Edition. |
|  | Attributable risk |  |
|  | Prevalence ratio |  |
|  | Rate ratio |  |

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| 13. Please calculate the odds ratio association between a bad diet and heart disease in the case-based sample from the previous question (the 2x2 table is once again given below).   |  |  |  |  | | --- | --- | --- | --- | |  | Heart Disease + | Heart Disease - |  | | Bad Diet + | 360,000 | 234,419 | 594,419 | | Bad Diet - | 60,000 | 185,581 | 245,581 | |  | 420,000 | 420,000 | 840,000 | | | |
| X | 4.75 | Risk in bad diet = (360,000 / 234,419) = 1.536  Risk in good diet = (60,000 / (185,581) = 0.323  Relative risk = 1.536 / 0.323 = 4.75 |

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| 14. You previously found that the odds ratio association between a bad diet and heart disease in the case-based sample was 4.75. Which of the following is the best interpretation of this odds ratio? | | |
|  | Among people in this sample with a bad diet, 1 person developed heart disease for every 4.75 people who did not develop heart disease in a 1 year period. |  |
|  | In this sample, the risk of heart disease in the past year was 4.75 times higher among those with a bad diet than among people with a good diet. |  |
| X | In this sample, the odds of heart disease in the past year was 4.75 times higher among those with a bad diet than among people with a good diet. |  |
|  | The probability of having a bad diet in the past year was 4.75 higher among people with heart disease than among people without heart disease. |  |

Feedback

**Optional**: Please feel free to leave any comments below about the usefulness of this lab. Which parts were helpful? What could I do to improve it? What is still unclear?

I'm also interested in knowing how much of the material in Chapter 3 was new and how much was review. For the topics you've seen before, was the review helpful or should it be dropped next semester?