How bad is it, really? Measures of risk.

Steve Simon, P.Mean Consulting

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2. Abstract

- The odds ratio and the relative risk are both measures of risk used for binary outcomes, but sometimes they can differ markedly from one another. The relative risk offers a more natural interpretation, but certain research designs preclude its computation.

3. Objectives

In this class you will learn how to:

- compute an odds ratio and a relative risk from a two by two table;
- list the types of research designs where the relative risk should not be computed, and

4. Sources

Part of the material for this webinar comes from:

- Simon SD. Understanding the odds ratio and the relative risk. J Androl. 2001 Jul-Aug;22(4):533-6.
- Stats: Odds ratio versus relative risk (January 9, 2001).
  - http://www.childrens-mercy.org/stats/journal/oddsratio.asp

5. Very bad joke

A doctor is advising her patient about the risks of an upcoming surgery. She warned that the probability that the patient would die during surgery was 60%. Then she looked up an said, no wait, the risk is twice as big in your demographic group. The chances that you will die during surgery is actually 120%. The patient seemed a bit confused. I know what a 100% risk of mortality would be—I'm a goner. But what would a 120% risk of mortality be? The doctor replied, that is a fate worse than death.

6. Pop quiz #1

A relative risk should not be computed for the following design because the prevalence of the disease is artificially constrained.

1. Case-control design
2. Cohort design
3. Cross-sectional design
4. Historical control design
5. Don’t know/Not sure

7. Pop quiz #2

The odds ratio and the relative risk are close to one another when

1. The prevalence of the disease is low
2. The prevalence of the disease is high
3. The sample size is small
4. The sample size is large
5. Don’t know/Not sure

8. What are odds ?

If you head south from Kansas City on Highway 71, you will encounter a town called “Peculiar”. This town is very proud of its name and has a sign which says “Welcome to Peculiar, where the odds are with you.”

Mathematicians and gamblers use odds frequently but the concept may be alien to most of the rest of the public. Odds is the ratio of successes to failures.

9. What are odds ?

“If there is a 50-50 chance that something will go wrong, then nine times out of ten it will.” (Paul Harvey).

In this silly example a 50-50 chance means one success for every failure or 1 to 1 odds. This is sometimes called even odds.

Nine times out of ten means one success for every nine failures or one to nine odds.

10. What are odds?

To be perfectly accurate, you should specify whether you are talking about the odds of success or the odds of failure, but in most setting, it should be obvious from the context.

If your odds of winning the lottery are a million to one, that means either that:

- One million people win for every person that loses, or
- One person winds for every million that lose.

11. What are odds?

If you know the probability of a success, you can calculate the odds using the formula

- Odds = prob / (1- prob).
- For example, a probability of 0.25 corresponds to an odds of 0.25 / (1-0.25) = 0.25 / 0.75 = 1 / 3. This means that for every single success, there are three failures.

If you know the odds, then you can calculate the probability of success using the formula

- Prob = Odds / (1 + Odds).
- For example, if the odds are 3 to 1, then prob = 3 / (1 + 3) = 3 / 4.

12. Odds ratio/relative risk

Consider the following data on survival of passengers on the Titanic. Clearly, a male passenger on the Titanic was more likely to die than a female passenger. But how much more likely? You can compute the odds ratio or the relative risk to answer this question.

	Alive	Dead	Total
Female	308	154	462
Male	142	709	851
Total	450	863	1313

13. Odds ratio/relative risk

The odds ratio compares the relative odds of death in each group.

- For females, 2 to 1 odds against dying
- For males, almost 5 to 1 in favor of death

The odds ratio is approximately 10.

	Alive	Dead	Odds	
Female	308	154	154/308 = 0.5	(2 to 1 against)
Male	142	709	706/142 = 4.993	(5 to 1 in favor)

Odds ratio=4.993/0.5
=9.986

14. Odds ratio/relative risk

The relative risk (sometimes called the risk ratio) compares the probability of death in each group rather than the odds.

- The females probability of death is 1/3 (2/6).
- The male probability of death is 5/6.

The relative risk of death is 2.5

	Dead	Total	Probability	
Female	154	462	154/462 = 0.3333	(1/3 chance)
Male	709	851	709/851 = 0.8331	(5/6 chance)

Relative risk

0.8331/0.3333 = 2.5

15. Odds ratio/relative risk

There is quite a difference. Both measurements show that men were more likely to die. But the odds ratio implies that men are much worse off than the relative risk. Which number is a fairer comparison?

16. Odds ratio/relative risk

There are three issues here:

1. The relative risk measures events in a way that is interpretable and consistent with the way people really think.
2. The relative risk, though, cannot always be computed in a research design.
3. Also, the relative risk can sometimes lead to ambiguous and confusing situations.

17. Repeat of Pop quiz #1

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18. Repeat of Pop quiz #2

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