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ACSH Explains: Odds and Odds Ratios

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Much of medical care is uncertain, especially when it comes to evaluating an individual's risks or whether they will or will not develop a disease. The medical literature quantifies that uncertainty in several ways, most commonly as probabilities, odds and hazard ratios. And like the blind men describing the elephant, each tells us something about our future.

Probability

This is the traditional home of the gambler, especially the one with a system – a system based on the likelihood of an occurrence, say pulling a diamond from a deck of cards. With a regular pack, 13 of 52 are diamonds, so the probability of drawing that one suit from the deck is 13/52 or 25%. One caveat before pushing on, there are only two outcomes to consider, yes or no, we either do or do not pull a diamond from the deck.

The medical literature is full of probabilities; there is a 5% chance you will die or a 30% chance that you will get heart disease if you have diabetes. For the most part, these numbers are manageable, intuitively grasped. Odds are mathematical manipulations of probabilities.

Odds

Maybe the best way to consider odds is as a more personalized form of probability, asking the question not of whether the outcome is probable, but will it happen to me. Odds are the ratio of the positive and negative probabilities of an event. Using our card analogy, the probability of drawing a diamond is 25%, the probability of not drawing a diamond is 75% - the odds of pulling a diamond from the deck is .25/.75 or 0.33.

The value of odds is that they can be used to compare to someone else's odds. The can be joined

with other odds to indicate the direction and strength of a treatment effect or a disease association. Let's reconsider that 30% association of diabetes with heart disease, the odds are 0.43. Let introduce a treatment, say tight control of blood sugar, which results in a 20% association of diabetes with heart disease – for whatever reason, our treatment lowers the probability. But again what does that mean to me? The odds with treatment are 0.25, without treatment 0.43 – our probability is less than without treatment, and the strength is expressed as the odds ratio,

0.25 (with treatment)/ 0.43 (without treatment) = .58

In other words, you are almost half as likely (0.58) to have an association with heart disease if you follow the treatment. I will spare you the math, but when the probability of a risk or a disease association if 50%, a coin flip, the odds ratio is 1.

Interpretation

When you look at reported odds ratios first, look to see whether the ratio and the confidence interval included 1 – if so, there is no statistical or clinical significance. How much the odds ratio and confidence interval differs from 1 will tell you the strength of the relationship. Twice as likely is smaller than four times as likely, and .25 is far more unlikely than 0.8.

Odds and their ratios are most commonly used to describe the effect of multiple variables on risk or a disease association - in performing regression analysis. In turn, because of how regressions are performed adding more variables to the regression can increase or decrease the odds ratios. From a practical standpoint, merely comparing the odds in two studies is not always accurate, the number and type of variable used to calculate the odds makes a difference.
