Odds ratios are tricky. It isnt actually all that hard to come up with some decent ways to visualize them. The tricky part is interpreting the results in a way that makes sense to average readers. How do you put the phrase odds ratio into a clear and easily interpreted sentence?The Kansas Department of Health and Environment partnered with me to solve just such a problem. They had important data on the odds that people with histories of sexual violence will also have other health conditions. We went back and forth in our discussions about how to frame the results of their analysis. They wanted to say things like 5.8 greater odds, which doesnt have practical meaning to most of us. We had to work hard to balance out what is digestible to the public and most precise to the scientists responsible for data collection and analysis. We discussed (and I still ultimately favored) the option of framing it in terms of likelihood, as in Men who have experienced sexual violence are 5.8 times more likely to feel depressed, which I think is a more familiar concept the average readers. Ultimately, my clients felt the best balance was struck by using wording around greater odds.So ultimately, we decided to visualize the odds ratios as a simple bar graph, which textboxes that interpret the top bar of data.I get a handful of questions about how to visualize odds ratios every year and I usually tell those people what I just told you. Researchers Leon Gilman and Gerald Davis from University of Wisconsin Milwaukee were behind one of those emails. They were trying to graph odds ratios related to race and disciplinary suspensions within a school district but said that staff in the school district found odds ratio to be too abstract and that they particularly had trouble interpreting odds ratios that were below 1. They ran with the idea of likelihood and produced this visual:and they took it even further by completely rephrasing the discussion in terms of equality:and, wow, is that a pretty powerful statement.We help folks sort out these issues on their own projects, propelling them to data rockstar status, in our Academy and The Evergreen Data Certification Program. Written by Clay SmithThats right I will be your guide. The good thing about having an idiot for a guide is that I have to make it simple to understand it myself, which means, hopefully, you will understand it as well.ProbabilityProbability means the risk of an event happening divided by the total number of people at risk of having that event. I will use the example in a recent JAMA article. In a deck of 52 cards, there are 13 spades. So, the risk (or probability) of drawing a card randomly from the deck and getting spades is 13/52 = 0.25 = 25%. The numerator is the number of spades, and the denominator is the total number of cards.OddsOdds seems less intuitive. It is the ratio of the probability a thing will happen over the probability it wont. In the spades example, the probability of drawing a spade is 0.25. The probability of not drawing a spade is 1 0.25. So the odds is 0.25/0.75 or 1:3 (or 0.33 or 1/3 pronounced 1 to 3 odds).Moving back and forthTo go from odds to probability, simply take the numerator/(denominator + numerator). In the spades example, the odds of 1/3 is converted by taking 1/1+3 = 0.25 and now we are back to probability. To go from probability to odds, simply take the numerator/(denominator-numerator). In the spades example, given that the probability of drawing a spade is 1/4, take 1/(4-1) = 1:3 odds or odds = 0.33.Statistical SignificanceIf an odds ratio (OR) is 1, it means there is no association between the exposure and outcome. So, if the 95% confidence interval for an OR includes 1, it means the results are not statistically significant. Example, exposure to colored vs white Christmas lights was associated with an increase in jocularity score, OR = 1.2 (95%CI 0.98-1.45). Sorry, this is not statistically significant. Lets just go with white lightsUseEither the OR or risk ratio (RR) could be used in many study types. However, only the OR can be used in case-control studies. Because in order to calculate the RR, one must know the risk. Risk is a probability, a proportion of those exposed with an outcome compared to the total population exposed. This is impossible in a case-control study, in which those who already have the outcome are included without knowing the total population exposed.RR is a very intuitive concept. It is the probability (or risk) of one outcome over the probability (risk) of another. Lets use a study we covered on JF to discuss this concept. Survival was lower in pediatric patients intubated during arrest compared with those not intubated: 411/1135 (36%) vs 460/1135 (41%). So, the RR is 36.2%/40.5% = 0.89. This means survival was reduced by a factor of 0.89 for pediatric arrest patients who were intubated during arrest vs. those who were not. As an example, if survival was expected to be 40%, then intubating during arrest would reduce it to: 40% x 0.89 = 35.6%.Lets do one more example. Supination-flexion (SF) vs hyperpronation (HP) to reduce nursemaids elbow was more likely to fail. The risk of failure with SF was 96/351 (27%) vs. 32/350 (9%) with HP. The RR was 3. This has a very intuitive meaning: risk of failure with SF was three times more likely than HP.The OR is a way to present the strength of association between risk factors/exposures and outcomes. If the OR is 1 means the odds are increased for a given outcome. Lets look at the examples again and consider odds.For pediatric arrest, the risk of survival if intubated during arrest was 411/1135 (36%) vs 460/1135 (41%) if not intubated. Lets convert to odds and calculate an OR. Intubated: 411/1135-411 = 411/724 = 0.57 odds.Non-intubated: 460/1135-460 = 460/675 = 0.68 odds. So, the OR is 0.57/0.68 = 0.83.Note, this is very close to the RR (0.89) but is a slight overestimate of the effect on the outcome. This is always the case with the OR compared to the RR it overestimates the effect.Take the example of supination-flexion vs hyperpronation for nursemaids. The risk of failure for SF was 96/351 vs. 32/350 with HP. Lets convert this to odds. SF: 96/351-96 = 0.376 odds HP: 32/350-32 = 0.10 odds The OR is 0.376/0.10 = 3.7Note, the OR overestimates the RR, which was 3. Although one could say the risk of failure using SF is 3 times greater than HP, one could not say, based on the OR, the risk was 3.74 times greater. The OR and RR are not the same. What could be said is that the odds of failure is 3.74 times greater.Whereas RR can be interpreted in a straightforward way, OR can not. A RR of 3 means the risk of an outcome is increased threefold. A RR of 0.5 means the risk is cut in half. But an OR of 3 doesnt mean the risk is threefold; rather the odds is threefold greater. Interpretation of an OR must be in terms of odds, not probability. Again, the OR will always be an overestimate compared to the RR. However, the RR and OR will be similar for rare outcomes, 1 means greater odds of association with the exposure and outcome. OR = 1 means there is no association between exposure and outcome. OR < 1 means there is a lower odds of association between the exposure and outcome. If the 95% confidence interval for the OR includes 1, the results are not statistically significant. OR and RR are not the same. OR always overestimate RR, but OR approximates RR when the outcome is rare but markedly overestimates it as outcome exceeds 10%. Share copy and redistribute the material in any medium or format for any purpose, even commercially. Adapt remix, transform, and build upon the material for any purpose, even commercially. The licensor cannot revoke these freedoms as long as you follow the license terms. Attribution You must give appropriate credit , provide a link to the license, and indicate if changes were made . You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use. ShareAlike If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original. No additional restrictions You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits. You do not have to comply with the license for elements of the material in the public domain or where your use is permitted by an applicable exception or limitation . No warranties are given. The license may not give you all of the permissions necessary for your intended use. For example, other rights such as publicity, privacy, or moral rights may limit how you use the material. Odds ratios have a unique part to play in describing the effects of logistic regression models. But that doesnt mean theyre easy to communicate to an audience who is likely to misinterpret them. So writing up your odds ratios has to be done with care.Precise word choice is vital. So I give you the precise language I use when writing up the results of a logistic regression, as well as an explanation.The logistic regression exampleIve borrowed an example from my free Craft of Statistical analysis webinar: Understanding Probability, Odds, and Odds Ratios. If you need a refresher on what any of these terms means, Id suggest watching it. Imagine youve just run a logistic regression and get the following results:In this example, were exploring the effect of a few predictors on the odds of successfully navigating an asteroid field. Although the odds may, in general, be small, wed like to see which variables affect those odds.Weve entered three predictors:Size of Ship is numerical.Presence of an R2 Unit* is binary. It is dummy coded so that Yes=1 and No = 0.Presence of a Jedi has three categories: None; Yes, Padawan only; and Yes, Jedi Knight with or without a Padawan. We need two dummy variables to measure the effect of the three categories.Guidelines of the write-upIll give you examples of how youd write each one, but first I want to point out a few guidelines I suggest following in order to be both accurate and clear.1. Always use the word odds, not likely. (And never probability when you mean odds. Theyre not the same measure). While in everyday English, it makes sense to substitute likely for odds, most readers will interpret likely as a probability, not an odds. While both probability and odds measure how likely the outcome is, this is a situation where lack of precision in your language will lead to misinterpretation.Its like talking about the temperature in degrees in the US, without specifying that you mean degrees Celsius. Its not wrong to say degrees, its just imprecise and therefore likely to be misinterpreted.2. Always make it crystal clear which outcome category youre predicting the odds of.3. If your data are observational, not experimental, your predictors will not be independent. So youll have to always include the caveat that each odds ratio is the effect of that predictor, after adjusting for the effects of the other predictors.Since it would unethical to randomly assign Jedi to ships unlikely to make it through an asteroid field, well assume these results came from observational data.4. There are two ways to describe an odds ratio. One is simply OR times the odds. The other is as a (OR-1)*100% increase.The former is easier to understand if the Odds Ratio is 2 or more. I use this for the R2 unit odds ratio.The latter is easier to understand if the odds ratio is between 1 and 2. I use this for the Jedi odds ratios. The latter is also easier to understand if the odds ratio is below 1, but the negative percentage can be described as a decrease. I use this for the Size of the Ship odds ratio.Examples of writing up each odds ratioBinary predictor, odds ratio > 2:After adjusting for size of ship and presence of a Jedi (Padawan or Knight), ships with an R2 unit have odds of successfully navigating an asteroid field that are 2.61 times those of ships without an R2 unit.Numerical predictor, odds ratio < 1:After adjusting for the presence of an R2 unit and a Jedi (Padawan or Knight), larger ships show a decreased odds of successfully navigating an asteroid field. For each additional ton of the size of the shop, the odds of success decrease by 12%.Multicategory predictor, odds between 1 and 2:After adjusting for size of ship and presence of an R2 unit, having a Jedi aboard is associated with increased odds of successfully navigating an asteroid field, though the effect appears larger for a Jedi Knight than it is for a Jedi Padawan. Compared to ships with no Jedi at all, having only a Padawan aboard is associated with odds that are 19% higher and having a Knight aboard is associated with odds that are 76% higher.*Yes, this is one of those effects that is so obvious it may seem silly to test. We all know who is really flying the ship. Understanding Probability, Odds, and Odds Ratios in Logistic Regression Despite the way the terms are used in common English, odds and probability are not interchangeable. Join us to see how they differ, what each one means, and how to tame that tricky beast: Odds Ratios. As a library, NLM provides access to scientific literature. Inclusion in an NLM database does not imply endorsement of, or agreement with, the contents by NLM or the National Institutes of Health. Learn more: PMC Disclaimer | PMC Copyright Notice J Can Acad Child Adolesc Psychiatry. 2010 Aug;19(3):227229.An odds ratio (OR) is a measure of association between an exposure and an outcome. The OR represents the odds that an outcome will occur given a particular exposure, compared to the odds of the outcome occurring in the absence of that exposure. Odds ratios are most commonly used in case-control studies, however they can also be used in cross-sectional and cohort study designs as well (with some modifications and/or assumptions).When a logistic regression is calculated, the regression coefficient (b1) is the estimated increase in the log odds of the outcome per unit increase in the value of the exposure. In other words, the exponential function of the regression coefficient (eb1) is the odds ratio associated with a one-unit increase in the exposure.Odds ratios are used to compare the relative odds of the occurrence of the outcome of interest (e.g. disease or disorder), given exposure to the variable of interest (e.g. health characteristic, aspect of medical history). The odds ratio can also be used to determine whether a particular exposure is a risk factor for a particular outcome, and to compare the magnitude of various risk factors for that outcome.OR=1 Exposure does not affect odds of outcomeOR>1 Exposure associated with higher odds of outcomeOR 1 the control is better than the intervention.If the OR is < 1 the intervention is better than the control.Concept check 1If the trial comparing SuperStatin to placebo with the outcome of all cause mortality found the following:Odds of all cause mortality for SuperStatin were 0.4Odds of all cause mortality for placebo were 0.8Odds ratio would equal 0.5So if the trial comparing SuperStatin to placebo stated OR 0.5What would it mean?A) The odds of death in the SuperStatin arm are 50% less than in the placebo arm.B) There is no difference between groupsC) The odds of death in the placebo arm are 50% less than in the SuperStatin arm. Confidence interval (CI)The confidence interval indicates the level of uncertainty around the measure of effect (precision of the effect estimate) which in this case is expressed as an OR. Confidence intervals are used because a study recruits only a small sample of the overall population so by having an upper and lower confidence limit we can infer that the true population effect lies between these two points. Most studies report the 95% confidence interval (95%CI).If the confidence interval crosses 1 (e.g. 95%CI 0.9-1.1) this implies there is no difference between arms of the study.Concept check 2So if the trial comparing SuperStatin to placebo stated OR 0.5 95%CI 0.4-0.6What would it mean?A) The odds of death in the SuperStatin arm are 50% less than in the placebo arm with the true population effect between 20% and 80%.B) The odds of death in the SuperStatin arm are 50% less than in the placebo arm with the true population effect between 60% and 40%.C) The odds of death in the SuperStatin arm are 50% less than in the placebo arm with the true population effect between 60% and up to 10% worse. P valuesP < 0.05 indicates a statistically significant difference between groups. P>0.05 indicates there is not a statistically significant difference between groups.Concept check 3So if the trial comparing SuperStatin to placebo stated OR 0.5 95%CI 0.4-0.6 p 2:After adjusting for size of ship and presence of a Jedi (Padawan or Knight), ships with an R2 unit have odds of successfully navigating an asteroid field that are 2.61 times those of ships without an R2 unit.Numerical predictor, odds ratio < 1:After adjusting for the presence of an R2 unit and a Jedi (Padawan or Knight), larger ships show a decreased odds of successfully navigating an asteroid field. For each additional ton of the size of the shop, the odds of success decrease by 12%.Multicategory predictor, odds between 1 and 2:After adjusting for size of ship and presence of an R2 unit, having a Jedi aboard is associated with increased odds of successfully navigating an asteroid field, though the effect appears larger for a Jedi Knight than it is for a Jedi Padawan. Compared to ships with no Jedi at all, having only a Padawan aboard is associated with odds that are 19% higher and having a Knight aboard is associated with odds that are 76% higher.*Yes, this is one of those effects that is so obvious it may seem silly to test. We all know who is really flying the ship. Understanding Probability, Odds, and Odds Ratios in Logistic Regression Despite the way the terms are used in common English, odds and probability are not interchangeable. Join us to see how they differ, what each one means, and how to tame that tricky beast: Odds Ratios. In statistics,probabilityrefers to the chances of some event happening. It is calculated as:PROBABILITY: P(event) = (# desirable outcomes) / (# possible outcomes)For example, suppose we have four red balls and one green ball in a bag. If you close your eyes and randomly select a ball, the probability that you choose a green ball is calculated as:P(green) = 1 / 5 = 0.2.Theoddsof some event happening can be calculated as:ODDS: Odds(event) = P(event happens) / 1-P(event happens)For example, the odds of picking a green ball are (0.2) / 1-(0.2) = 0.2 / 0.8 =0.25.Theodds ratiois the ratio of two odds.ODDS RATIO: Odds Ratio = Odds of Event A / Odds of Event BFor example, we could calculate the odds ratio between picking a red ball and a green ball.The probability of picking a red ball is 4/5 = 0.8.The odds of picking a red ball are (0.8) / 1-(0.8) = 0.8 / 0.2 = 4.Theodds ratiofor picking a red ball compared to a green ball is calculated as:Odds(red) / Odds(green) = 4 / 0.25 = 16.Thus, the odds of picking a red ball are 16 times larger than the odds of picking a green ball.When Are Odds Ratios Used in the Real World?In the real world, odds ratios are used in a variety of settings in which researchers want to compare the odds of two events occurring.Here are a couple examples.Example #1: Interpreting Odds RatiosResearchers want to know if a new treatment improves the odds of a patient experiencing a positive health outcome compared to an existing treatment. The following table shows the number of patients who experienced a positive or negative health outcome, based on treatment.The odds of a patient experiencing a positive outcome under the new treatment can be calculated as:Odds = P(positive) / 1 P(positive) = (50/90) / 1-(50/90) = (50/90) / (40/90) =1.25The odds of a patient experiencing a positive outcome under the existing treatment can be calculated as:Odds = P(positive) / 1 P(positive) = (42/90) / 1-(42/90) = (42/90) / (48/90) =0.875Thus, the odds ratio for experiencing a positive outcome under the new treatment compared to the existing treatment can be calculated as:Odds Ratio = 1.25 / 0.875 =1.428.We would interpret this to mean that the odds that a patient experiences a positive outcome using the new treatment are 1.428 times the odds that a patient experiences a positive outcome using the existing treatment.In other words, the odds of experiencing a positive outcome are increased by 42.8% under the new treatment.Example #2: Interpreting Odds RatiosMarketers want to know if one advertisement causes customers to buy a certain item more often than another advertisement so they show each advertisement to 100 individuals. The following table shows the number of people who bought the item, based on which advertisement they saw:The odds of an individual buying the item after seeing the first advertisement can be calculated as:Odds = P(bought) / 1 P(bought) = (73/100) / 1-(73/100) = (73/100) / (27/100) =2.704The odds of an individual buying the item after seeing the second advertisement can be calculated as:Odds = P(bought) / 1 P(bought) = (65/100) / 1-(65/10) = (65/100) / (35/100) =1.857Thus, the odds ratio for a customer buying the item after seeing the first advertisement compared to buying after seeing the second advertisement can be calculated as:Odds Ratio = 2.704 / 1.857 =1.456.We would interpret this to mean that the odds that an individual buys the item after seeing the first advertisement are 1.456times the odds that an individual buys the item after seeing the second advertisement.In other words, the odds of buying the item are increased by 45.6% using the first advertisement.Additional ResourcesHow to Calculate Odds Ratio and Relative Risk in ExcelHow to Interpret an Odds Ratio Less Than 1How to Interpret Relative Risk In the realm of data analysis, where associations and relationships hold the key to unlocking valuable insights, odds ratios (OR) emerge as a powerful tool. But interpreting them correctly can be tricky. This article delves into the world of odds ratios, exploring their meaning, calculation, and interpretation, along with practical examples and formulas to equip you with the knowledge to confidently navigate their complexities. An odds ratio compares the odds of an event occurring in one group to the odds of it happening in another group. Imagine studying the effect of exercise on heart disease risk. You might compare the odds of developing heart disease among people who exercise regularly to the odds of it occurring in those who dont. The odds ratio itself is a numeric value, typically expressed as a decimal or ratio. OR > 1:Indicates anincreasedodds of the event occurring in one group compared to the other. OR = 1:Suggestsno differencein odds between the groups. OR < 1:Indicates adecreasedodds of the event occurring in one group compared to the other. Odds ratios are calculated using a simple formula: OR = Odds of event in Group A / Odds of event in Group B where: Odds = Number of individuals with event / Number of individuals without event Example: In a study of 1000 people, 100 exercisers developed heart disease, while only 50 non-exercisers did. Odds of heart disease in exercisers: 100/900 = 1/9 Odds of heart disease in non-exercisers: 50/950 = 1/19 OR = (1/9) / (1/19) = 2.11 This OR of 2.11 suggests that exercisers have 2.11 times greater odds of developing heart disease compared to non-exercisers. While the OR provides a quantitative measure of association, interpreting it requires careful consideration: Magnitude:Consider the size of the OR. A small OR like 1.2 might not be clinically significant, while a large OR like 5 could indicate a strong association. Confidence intervals:Look for confidence intervals around the OR to assess the precision of the estimate. A wider interval indicates less certainty in the result. Causality:Remember that correlation does not imply causation. The OR only shows an association, not necessarily a cause-and-effect relationship. Confounding variables:Consider other factors that might influence the outcome and potentially bias the results. Example 1: Smoking and Lung Cancer An OR of 10 for lung cancer in smokers compared to non-smokers suggests a strong association, but further investigation is needed to determine if smoking directly causes lung cancer. Example 2: Education and Income An OR of 2 for earning high income among college graduates compared to high school graduates suggests a link between education and income, but factors like individual skills and opportunities also play a role. As you delve deeper, youll encounter more complex scenarios and formulas: Matched analysis:Controlling for potential confounding variables. Meta-analysis:Combining results from multiple studies to increase precision. Logistic regression:Analyzing relationships with multiple explanatory variables. Odds ratios offer a valuable tool for uncovering associations between variables in research and data analysis. By understanding their calculation, interpretation, and limitations, you can gain valuable insights into the world around you and make informed decisions. So, embrace the power of odds ratios, but remember to interpret them with a critical lens and a thirst for deeper understanding.

How to put odds ratio into words. How to odds work in betting. How do you interpret an odds ratio of 0.75. How to interpret odds ratio example. How to interpret odds ratio. How to interpret odds ratio more than 1. How to explain odds ratio in words.