The use of odds ratio in the large population-based studies: Warning to readers

Luigi Di Lorenzo
Valeria Coco
Francesco Forte
Giovanni Felice Trinchese
Alfonso Maria Forte
Marco Pappagallo

Rehabilitation Unit, Gait Analysis Lab, Neuroscience Department. "RUMMO" Hospital, Benevento, Italy
Biomedical Research Centre, Gruppo Forte Salerno
The New Medical Home for Pain Management and Medical Mentoring, New York, USA

Corresponding author:
Luigi Di Lorenzo
Rehabilitation & Gait Analysis Lab Unit, AO RUMMO
Benevento, Italy
E-mail: luigidilorenzo2005@libero.it

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Summary

When researchers conduct large prospective studies, they provide results generating statistical analysis; therefore readers need considerable familiarity with descriptive and inferential statistics. If quantitative judgments are based on interpreting odds ratios as though they were relative risks, they are unlikely to be seriously in error. Because of the calculating method, the OR is often less precise than the RR in estimating the strength of an association, and this should definitely be kept in mind by anyone who reads and interprets the results of a large population-based study.

KEY WORDS: statistic analysis, relative risk, odds ratio, risk ratio, multivariate analysis.

Introduction

When researchers conduct large prospective studies, they provide results generating statistical analysis and therefore readers need considerable familiarity with descriptive and inferential statistics. When preparing a research project, it is also important to make realistic, well-researched and supported assumptions. For these reasons, distinguished journals request "authors reporting clinical trials to indicate who carried out the analysis" and how to generate analysis to determine if an exposure to a treatment is associated with a specific outcome. In recent years, odds ratio (OR) has become widely used in medical reports and Bland clearly explained why: firstly, OR provides an estimate (with confidential interval) for the relationship between two binary (“yes or no”) variables. Secondly, it enables us to examine the effects of other variables on that relationship, using logistic regression. Thirdly, it has a special and very convenient interpretation in case-control studies. Despite its usefulness – he concluded – OR can cause difficulties in interpretation. Unfortunately, after more than a decade, after reading recent large cohort studies we think that it is still useful to review this debate and also discuss the choice of odds ratios in logistic regression and case-control studies.

Relative risks as measures of outcome changes

The most direct way to determine if an exposure to a treatment is associated with an outcome is to prospectively follow two groups and observe the frequency with which each group develops the outcome. When researchers carry out a study, after describing the main measures of the frequency of a symptom, they usually study the correlations between variables through the analysis of measures of association. The most common measures of association are the relative risks and odds ratio. However, we should keep on mind that there are other similar measures, with the same meaning but different calculation methods (Hazard ratio, rate ratio, etc.) and others with equal calculation method but with different meanings (attributable risk or risk differential). The relative risk (RR) compares the frequency of an outcome between groups and represents the ratio of the probability of the out-
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The odds ratio: misconceptions and doubts

Odds ratio (OR) represents the approximate estimate of the relative risk of the strength of association between risk factor and disease. It is calculated by the formula: \(\text{OR} = \frac{A \times C}{B \times D} = \frac{AD}{BC}\). Behind misconceptions 5-8, OR is not considered a perfect and true measure of risk as it relates to the probability of having a disease already, while the term "risk" is implicit in the idea of an event that will occur in the future. With an extreme simplification, we could say that, from a conceptual point of view, OR and RR are relatively similar, and the OR approximates RR in cohort studies and it is well known that such an approximation is poor and can generate misleading conclusions 5-8. Odds ratios are a way of representing probability and OR is used in the majority of systematic reviews and large cohort studies, but if we interpret it as a relative risk, we could overstate the effects. The extent of overstatement increases as both the initial risks increases and the OR departs from units. Standard tables of interpretation of OR and RR report as "modest" the association when OR is > zero up to 3, 0 (up to 1, 3 "faint", up to 1, 7 "modest" and up to 3, 0 "moderate"). OR calculations in the context of a large number of cases is not easy and OR can be often less precise when estimating the strength of the RR in an association 12. In particular, OR tends to increase the result, to make it look greater than it is: OR is always higher than RR if this is greater than 1, it is always lower than RR if this is lower. This approximation is negligible in studies where the incidence or prevalence of the disease is relatively low. The difference between OR and RR becomes greater, instead, the more the incidence or prevalence are elevated 4,5. Early last year, Wang 13 presented a method extending a previous popular method 14 reporting it to be able to convert the odds ratio to the relative risk, if an odds ratio and/or a confidence interval as well as the sample sizes for the treatment and control group are available. Namely, the method developed is reported to be useful to approximate the RR based on the adjusted OR from logistic regression or other multiple regression model 13,14.

Conclusion

As stated by Wang 13, epidemiologists are often interested in comparing a risk of a binary outcome between a treatment and control group, or between exposed and unexposed. Such an outcome can be an onset of a symptom or condition and the OR and RR is the important measures. In a case-control study, OR is often used as a surrogate for RR. OR evaluates whether the probability of a study outcome is the same for two groups and can approximate RR or risk ratio, which is a more direct measure that the odds ratio. The approximation between the two values is negligible in studies where the incidence or prevalence of the disease is relatively low, but the difference is more significant as most are high incidence or prevalence. In other words, as pointed out by several eminent? "The overestimation of the strength of the association on the part of the RR is much more pronounced as there is a high prevalence or incidence. So far, if quantitative judgments are based on interpreting odds ratios as though they were relative risks, they are unlikely to be seriously in error. Because of the calculation method, OR is often less precise than RR in estimating the strength of an association, and this should definitely be kept in mind by anyone who reads and interprets the results of a large population based-study.

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References

13. Wang Z. Converting Odds ratio to relative risk in cohort studies with partial data information.