Ratio measures in leading medical journals: structured review of accessibility of underlying absolute risks

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Abstract

Objective To examine the accessibility of absolute risk in articles reporting ratio measures in leading medical journals.

Design Structured review of abstracts presenting ratio measures.

Setting Articles published between 1 June 2003 and 1 May 2004 in *Annals of Internal Medicine*, *BMJ*, *Journal of the American Medical Association*, *Journal of the National Cancer Institute*, *Lancet*, and *New England Journal of Medicine*.

Participants 222 articles based on study designs in which absolute risks were directly calculable (61 randomised trials, 161 cohort studies).

Main outcome measure Accessibility of the absolute risks underlying the first ratio measure in the abstract.

Results 68% of articles (150/222) failed to report the underlying absolute risks for the first ratio measure in the abstract (range 55 – 81% across the journals). Among these articles, about half did report the underlying absolute risks elsewhere in the article (text, table, or figure) but half did not report them anywhere. Absolute risks were more likely to be reported in the abstract for randomised trials compared with cohort studies (62% *v* 21%; relative risk 3.0, 95% confidence interval 2.1 to 4.2) and for studies reporting crude compared with adjusted ratio measures (62% *v* 21%; relative risk 3.0, 2.1 to 4.3).

Conclusion Absolute risks are often not easily accessible in articles reporting ratio measures and sometimes are missing altogether—this lack of accessibility can easily exaggerate readers' perceptions of benefit or harm.

Introduction

Unless ratio measures are reported with the underlying absolute risks, readers cannot judge the clinical significance of the effect. A relative risk of 0.5, for example, is compatible with a wide range of changes in the risk of death: from 20% to 10%, from 1% to 0.5%, and from 0.0004% to 0.0002%. We systematically determined how frequently the absolute risks comprising ratio measures are reported in the medical literature.

Methods

We searched Medline (see bmj.com for search terms) and identified 320 articles with ratio measures in the abstract published between 1 June 2003 and 1 May 2004 in six leading medical journals: *Annals of Internal Medicine*, *BMJ*, *Journal of the American Medical Association*, *Journal of the National Cancer Institute*, *Lancet*, and *New England Journal of Medicine*. The final sample consisted of 222 articles in which absolute risks were directly calculable: 61 randomised trials, 161 cohort studies.

We reviewed each article using a standardised data extraction form (see fig A on bmj.com). The coder recorded the study design, the number of ratio measures in the results of the abstract, and the value and name of the first ratio measure in the abstract.

To facilitate understanding of the ratio measure, the coder specified the exposure groups being compared, categorised the groups as discrete or continuous, and specified the outcome variable. The coder then searched for the absolute risks underlying the first ratio measure. We use the phrase "absolute risks" to refer to the basic numbers comprising the numerator and denominator of the ratio.

We first determined if the absolute risks were in the abstract. For discrete exposures we looked for the two absolute risks underlying the ratio. For continuous exposures we looked for an absolute risk grounding the outcome at any single exposure level.

If the absolute risks were not in the abstract, we looked for them in the article (text, tables, and figures; n = 150). If the absolute risks were not reported anywhere, the coder attempted to calculate them based on the data reported (see fig B on bmj.com).

We used the χ^2 test to compare differences in proportions and *t* tests to compare means. All analyses were done using Stata version 9.0 and α was set at 0.05.

Results

Of the original research articles with abstracts during the study period, 30% (320/1051) included at least one ratio measure in the abstract. After excluding articles with study designs in which absolute risks may not be directly calculable (46 meta-analyses, 52 case-control studies), 222 articles were eligible for the study. About 30 terms, many synonymous, were used to name the ratio measures (see bmj.com).

On average, article abstracts included 3.3 distinct ratio measures (range 1-14; see bmj.com). Most of the articles identified were cohort studies (73% *v* 27% randomised trials), and the abstracts of cohort studies included more ratio measures than those of randomised trials (mean number of ratio measures 3.6 *v* 2.5; P = 0.002). In total, 72% (159/222) of the ratio measures were reported as being adjusted; and 28% (63/222) were crude.

The data extraction form and calculations carried out by coders are on bmj.com

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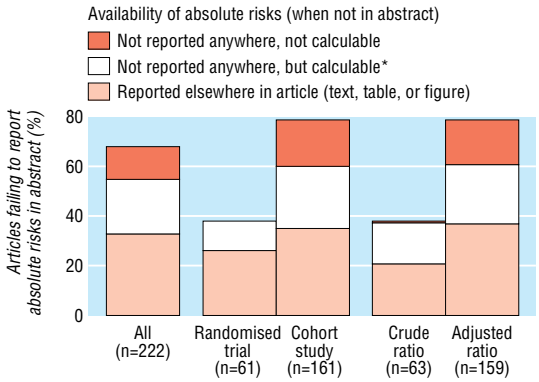

Fig 1 Proportion of articles where absolute risks for first ratio measure were not reported in the abstract

Overall, 68% of articles (n=150) failed to report the underlying absolute risks for the first ratio measure in the abstract (range 55-81% across the journals; see bmj.com). Among articles failing to report the absolute risks in the abstract, about half reported them elsewhere in the article (text, tables, or figures); but half did not report them anywhere. When absolute risks were not reported, the coders tried to calculate them from the data presented but were often unable to do so. As shown in the figure, the final breakdown of the 222 articles was: 32% (n=72) had underlying absolute risks that were easily accessible (in the abstract), 32% (n=72) had somewhat accessible absolute risks (reported elsewhere in the article), 22% (n=49) had absolute risks that were not easily accessible (not reported but calculable), and 13% (n=29) had inaccessible absolute risks (not reported and not calculable).

Randomised trials were more likely than cohort studies to report the absolute risks in the abstract (62% *v* 21%; relative risk 3.0, 95% confidence interval 2.1 to 4.2; see bmj.com). Absolute risks were also more likely to be reported for crude as opposed to adjusted ratio measures (62% *v* 21%; relative risk 3.0, 2.1 to 4.3).

Finally, we compared the accessibility of absolute risks for discrete (for example, taking or not taking a drug) and continuous exposures (for example, years of age). Nine per cent (21/222) of the ratio measures involved continuous exposures; all occurred in the subset of 136 articles that were cohort studies and presented adjusted ratio measures. When the analysis was restricted to this subset, absolute risks were more likely to be reported in the abstract for discrete rather than for continuous exposures (21% *v* 5%, relative risk 4.1, 0.6 to 28.9).

Discussion

Underlying absolute risks in six major medical journals were often difficult to access or missing altogether. The lack of accessibility of these fundamental data may well lead readers to have exaggerated perceptions of the reported effect sizes.

Some may worry that our suggestion of reporting absolute risks solves one problem by creating its opposite—that absolute risks may lead people to minimise important effects. For example, whereas most doctors would consider the benefit of a drug that reduced all-cause mortality among relatively healthy outpatients over five years from 4% to 3% to be important, many patients might dismiss the 1% point change as trivial. The challenge here is calibration—to provide the context that this effect is big compared with most drugs in this setting. The solution is not to revert to the language of a "25% reduction," because that fails to distinguish between a change from 4% to 3% and a change from 0.004% to 0.003%, but to calibrate people by exposing them to absolute risks (with and without the intervention) for a variety of medical therapies.

We also found that accessibility of absolute risks is more of a problem for cohort studies than for randomised trials. The more complete reporting for randomised trials may reflect the widespread acceptance of the consolidated standards of reporting trials

Problem	Suggestion	Example of format in abstract
Incomplete numbers		
Crude ratio measure without absolute risks	Report crude absolute risks adjacent to crude ratio measure	Drug A lowered risk of myocardial infarction at 1 year compared with placebo (10% *v* 15%; relative risk = 0.67, 95% confidence interval 0.53 to 0.85)
Adjusted ratio measure without absolute risks	Report crude absolute risks adjacent to crude ratio measure + adjusted relative risk **or** adjusted relative risk and absolute risk*	Drug A lowered the risk of myocardial infarction at 1 year compared with placebo (10% *v* 15%; relative risk = 0.67, 95% confidence interval 0.53 to 0.85) + after controlling for age, sex, and smoking status, adjusted relative risk = 0.8 (0.64 to 1.00) **or** after controlling for age, sex, and smoking status, the corresponding values were: adjusted risks 12% *v* 15%; adjusted relative risk = 0.80 (0.64 to 1.00)
Continuous exposure groups (for example age, age+1) without absolute risks	Report absolute risk at one level of exposure	Risk of myocardial infarction was higher with increasing age (relative risk (per year of age) = 1.05, 95% confidence interval 1.03 to 1.07). For context, risk of myocardial infarction at 1 year for those age 65 was 2.5%
Poorly formatted numbers		
Multiple ratio measures in abstract	Use tables within results section of abstract; alternatively limit number of ratio measures reported	**Abstract** Objective..... Design..... Setting..... Results **Outcome** / **Absolute risk** Drug A / Placebo / **Relative risk** / **95% CI** Myocardial infarction 10% 15% 0.67 0.53 to 0.85 Death 4% 5% 0.80 0.53 to 1.20 Conclusion.....
Confusing language		
Multiple labels for same ratio measure	Default to one label and carry out analyses that generate relative risks,[4 5] or transform odds ratios into relative risks[6]	Relative risk
Ambiguity about whether ratio measure is crude or adjusted	Journals agree that adjusted ratio measures will always be explicitly listed as such (crude ratio measures will not have a modifier)	Relative risk Adjusted relative risk

*Journal instructions for authors could specify reporting of adjusted risks and how to calculate them (for example, what population to use for adjustment)

Fig 2 Suggested approaches to improve communication of ratio measures

(CONSORT) statement.[1] With the advent of newer organisations such as strengthening the reporting of observational studies in epidemiology (STROBE),[2] focusing on observational studies, the reporting of cohort studies may improve.

Our study has several limitations. Firstly, our analysis was limited to six leading medical journals. We think it is unlikely, however, that less prestigious journals with less statistical support and fewer full time editors would be doing a better job. Secondly, our search strategy did not include some study designs (such as meta-analyses) and some ratio measures (hazard ratios) as we wanted to focus on designs where the absolute rates could be directly calculated, and on the most familiar ratio measures. Finally, we evaluated only the first ratio measure in the abstract to ensure consistency in coding. But there is no reason to believe that subsequent ratio measures are better reported than the first. We argue that because the initial ratio measure may receive extra prominence it should be communicated as clearly as possible.

Ultimately we think it is the responsibility of journal editors to ensure that the absolute risks are easily accessible and in fact they have come to a consensus on this point. More than 190 medical journals[3] endorse the CONSORT statement for randomised trials, which calls for reporting absolute risks. Many have also endorsed the STROBE statement for cohort studies. Just as editors have insisted that authors write a structured abstract, they can insist that authors provide absolute risks with the corresponding ratio measure. If authors cannot, the paper should not be published.

Figure 2 highlights our suggestions for ensuring that absolute risks underlying ratio measures are made easily accessible in abstracts. When the ratio measure is crude the process is straightforward; when the ratio measure is adjusted the process is more challenging. Two possible methods are considered. Authors could provide the crude absolute risk in each group and the crude and adjusted relative risk to highlight the effect of adjustment. An alternative would be to explicitly provide both the crude and adjusted absolute risks, in addition to the crude and adjusted relative risks. Editors would have to specify how authors should calculate adjusted absolute risks for each group. Three possible standards to use for adjustment are the study population as a whole, the unexposed group, or the exposed group.

Editors will also need to provide guidance for how authors should report the underlying absolute risks for ratio measures on the basis of continuous exposures. We suggest that authors report the absolute risk for at least one level of exposure.

To improve the reporting of ratio measures in the medical literature editors need to ensure that absolute risks are routinely included in the abstract with the corresponding ratio measure. Without the absolute risks, ratio measures alone may leave readers with an exaggerated sense of what studies find. Exaggerated perceptions matter because they may lead to unwarranted enthusiasm for new medical interventions or unwarranted concern about potentially harmful exposures.

What is already known on this topic

Ratio measures without the underlying absolute risks often exaggerate readers' perceptions of benefit or harm

What this study adds

In major medical journals, more often than not ratio measures are reported in the abstract without the underlying absolute risks

The inaccessibility of absolute risks is a bigger problem for cohort studies than for randomised trials, and for studies reporting adjusted compared with crude ratio measures

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Competing interests: None declared.

Ethical approval: Not required.

1 The CONSORT Group. Consort statement. www.consort-statement.org/Statement/revisedstatement.htm (accessed 18 Nov 2005).
2 STROBE statement: checklist of essential items. www.strobe-statement.org/PDF/STROBE-Checklist-Version3.pdf (accessed 18 Nov 2005).
3 Consort Journals. www.consort-statement.org/Endorsements/Journals/journals.html (accessed 18 Nov 2005).
4 glm-Generalized linear models. *Stata 9 reference manual*. College Station, Tx: Stata Press, 2005:392-420.
5 Zou G. A modified Poisson regression approach to prospective studies with binary data. *Am J Epidemiol* 2004;159:702-6.
6 Zhang J, Yu K. What's the relative risk? A method of correcting the odds ratio in cohort studies of common outcomes. *JAMA* 1998;280:1690-1.

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Corrections and clarifications

Obituary: Peter Maguire

In the obituary by Francis Creed and Carolyn Pitceathly, the authors inadvertently gave the wrong date of birth for Peter Maguire (*BMJ* 2006;333:973, 4 Nov, doi: 10.1136/bmj.333.7575.973). The correct date is 24 December 1939.

Effectiveness of telephone counselling by a pharmacist in reducing mortality in patients receiving polypharmacy: randomised controlled trial

In this research article by Jennifer Y F Wu and colleagues (*BMJ* 2006;333:522-5, 9 Sep, doi: 10.1136/bmj.38905.447118.2F) we failed to spot an error in the abstract. In the final sentence of the results section, the second set of confidence intervals should be 1.80 to 4.57 (not 1.80 to 2.57).

Chronic constipation in children

A mis-spelling in this clinical review by Greg Rubin and Anne Dale might have confused readers (*BMJ* 2006;333:1051-5, 18 Nov, doi: 10.1136/bmj.39007.760174.47). In box 3 the phrase (twice) "x ray of kidney, urether, and bladder" should of course have referred to ureter, not urether.