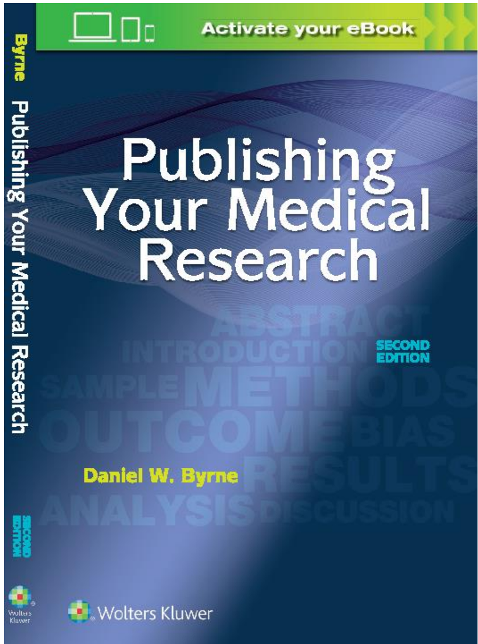
# Publishing Your Medical Research

Daniel Byrne



# Part I - Peer Review Survey

- The following slides summarize - in a question/answer format - the results of a survey conducted in January 2016.
- The methodology and complete results can be found in:
  - Byrne DW. Publishing Your Medical Research. Wolters Kluwer 2017.
- The methodology for the previous version of this survey can be found in:
  - Byrne DW. Common reasons for rejecting manuscripts at medical journals: A survey of editors and peer reviewers. Science Editor (formerly CBE Views) March-April 2000; 23:39-44.

Article

# Common Reasons for Rejecting Manuscripts at Medical Journals: A Survey of Editors and Peer Reviewers

**Daniel W Byrne**

**Abstract**

**Background.** Most manuscripts submitted to medical journals are rejected for publication, but scientific data on the reasons are sparse. Some suggest that flaws occur with random frequency; others claim that deficiencies are too diverse to measure.

**Methods.** In 1995, an eight-page questionnaire that contained 83 questions was mailed to a random sample of 50 peer reviewers for the *Journal of the American Medical Association*, 67 editors-in-chief of a sample of prominent medical journals, and 25 Nobel laureates in physiology or medicine of the preceding decade.

**Results.** The overall response rate was 22% (29 of 130); 12 undeliverable questionnaires were excluded. Respondents reported that study-design problems were the most common cause of rejection (71%). The survey results showed that the methods section contained the most flaws, was most often responsible for rejection, and was often too brief. Other common deficiencies were "conclusions unsupported by data" and "results unoriginal, predictable, or trivial". The most common writing problem was "wordiness".

**Conclusions.** Peer reviewers and editors reported that the manuscript deficiencies that most frequently led to rejection were related to study design and to the methods section. Scientific communication and likelihood of acceptance could be improved by more careful planning of study design and by including more reproducible detail in methods sections.

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## Introduction

Surprisingly little peer-reviewed research has been published on the aspects of the peer-review process that are of concern to potential authors.[1] In particular, the relative frequencies of deficiencies in manuscripts that lead to their rejection by medical journals have received little investigation. Qualitative editorials and subjective accounts of the most common flaws have appeared, but leave largely untouched the relative significance of the various cited flaws in rejected manuscripts. The few quantitative studies available are generally limited to the analysis of manuscripts submitted to a single journal.[2-5] The lack of scientific information on the reasons for manuscript rejection causes frustration and inefficiency for authors, editors, reviewers, and educators. In some cases those effects can prevent or delay the publication of important medical research findings.

The aim of this study was to obtain data on the opinions and recollections of leading medical-research experts regarding the relative frequencies of deficiencies in medical-research manuscripts that proved fatal to their acceptance for publication. The null hypothesis was that the frequencies of such fatal deficiencies would be randomly distributed among the respondents.

## Methods

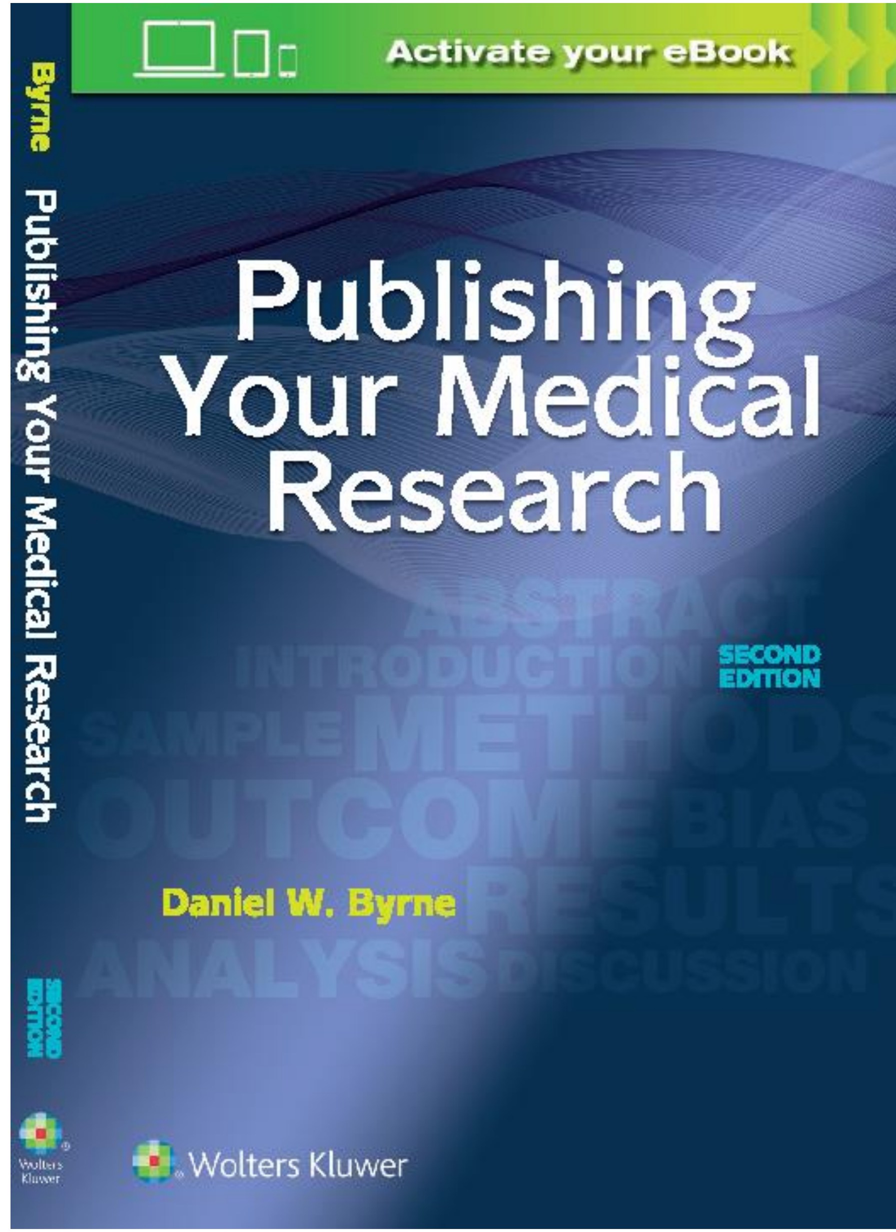
The study was based on a questionnaire developed as part of the research for my recent book.[6] The project was privately funded and thus independent of any journal or organization. The primary purpose of this survey was to estimate the frequencies of the most common reasons for rejection of manuscripts by medical journals. The eight-page questionnaire contained 83 questions. To enhance comparison with previous research, some questions were worded to match reasons for rejections described in previous publications.[2,7]

The questionnaire was sent to three groups: a selection of editors-in-chief of English-language medical journals, a random sample of peer reviewers for the *Journal of the American Medical Association* (*JAMA*), and 25 Nobel laureates in physiology or medicine in 1985-1995.

The sample of 67 medical journals was based on three criteria: the 25 journals with the largest circulation (according to *Ulrich's International Periodical Directory*, 34th ed), the 25 with the highest impact factors (according to the *1994 Science Citation Index Journal Citation Report*), and 17 selected from the stacks of various medical-school and hospital libraries in the New York area. I drew a random sample of 50 *JAMA* peer reviewers from a table of 3023 *JAMA* reviewers.[8] I selected column and row numbers in the table of names by using a random-number table generated with the software True Epistat (Richardson, TX). (The random number 1311, for example, was used to denote the 13th column from the left and the 11th row from the top.) I surveyed reviewers for *JAMA* rather than reviewers for other journals for two reasons: *JAMA* reviews are generally regarded by the medical community as high-quality and thorough, and *JAMA* reviewers' names were readily available. The addresses of the *JAMA* reviewers were found in the American Medical Association's *Directory of Physicians in the United States* (34th edition) or various Marquis *Who's Who* directories. I obtained the names of Nobel laureates from an almanac and their addresses from *Who's Who*. If the addresses were not available from those sources, a MEDLINE search was conducted to find recent publications and contact information.

I took several steps to improve response rates: I used first-class postage, included a self-addressed stamped return envelope





# Which section of a manuscript is usually:
# a ) too long?
# b ) too short?

1) Introduction

2) Methods

3) Results

4) Discussion

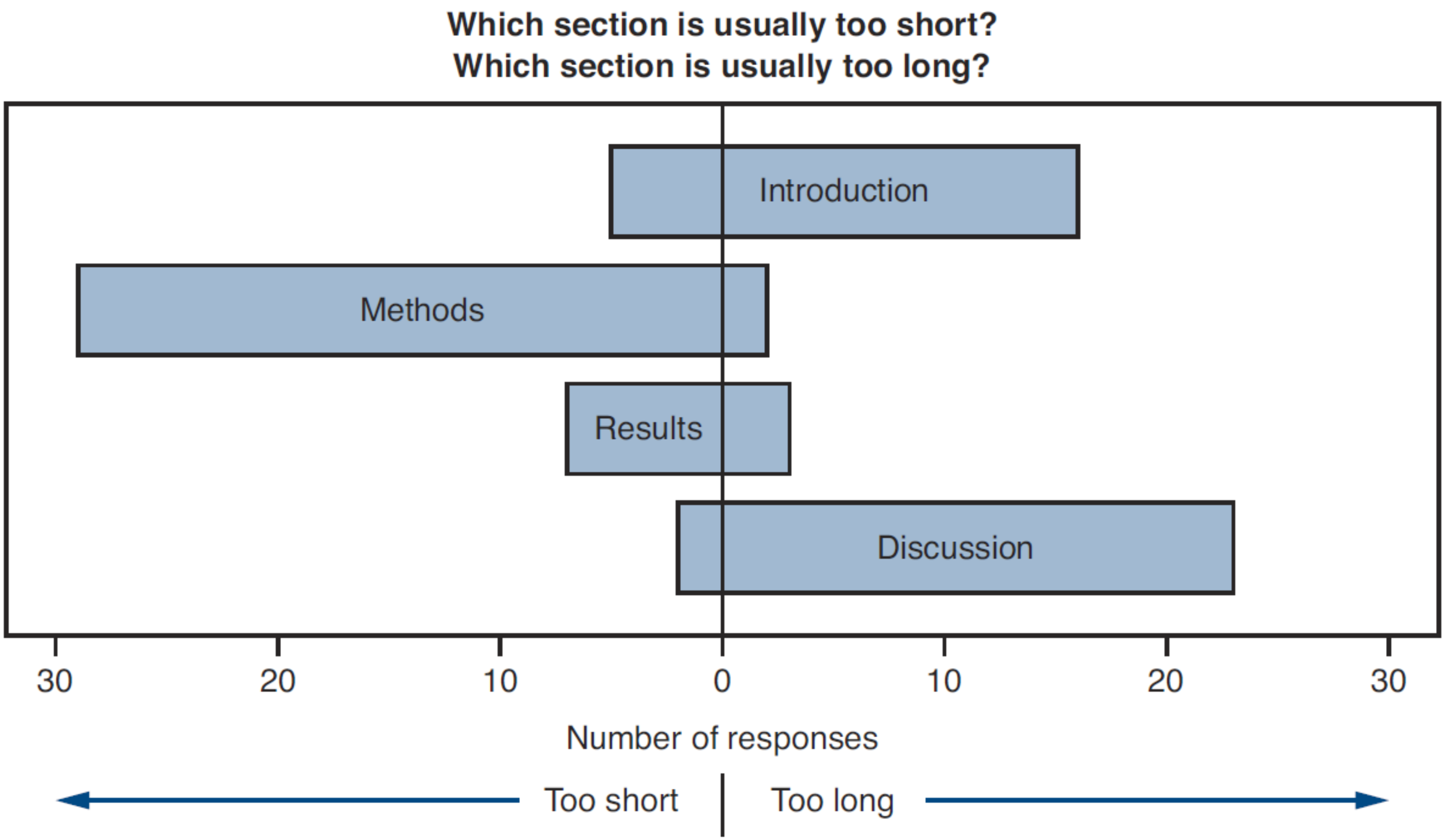



***FIGURE 12.1.*** Sections of a manuscript that are too long and too short. From questions 5 and 6 of the Peer Review Questionnaire (Appendix B). $P < .001$ based on a chi-square test.

# What is the single most common type of flaw that results in outright rejection of a manuscript?

- 1. Importance of the topic.
- 2. Presentation of the results.
- 3. Design of the study.
- 4. Interpretation of the findings.

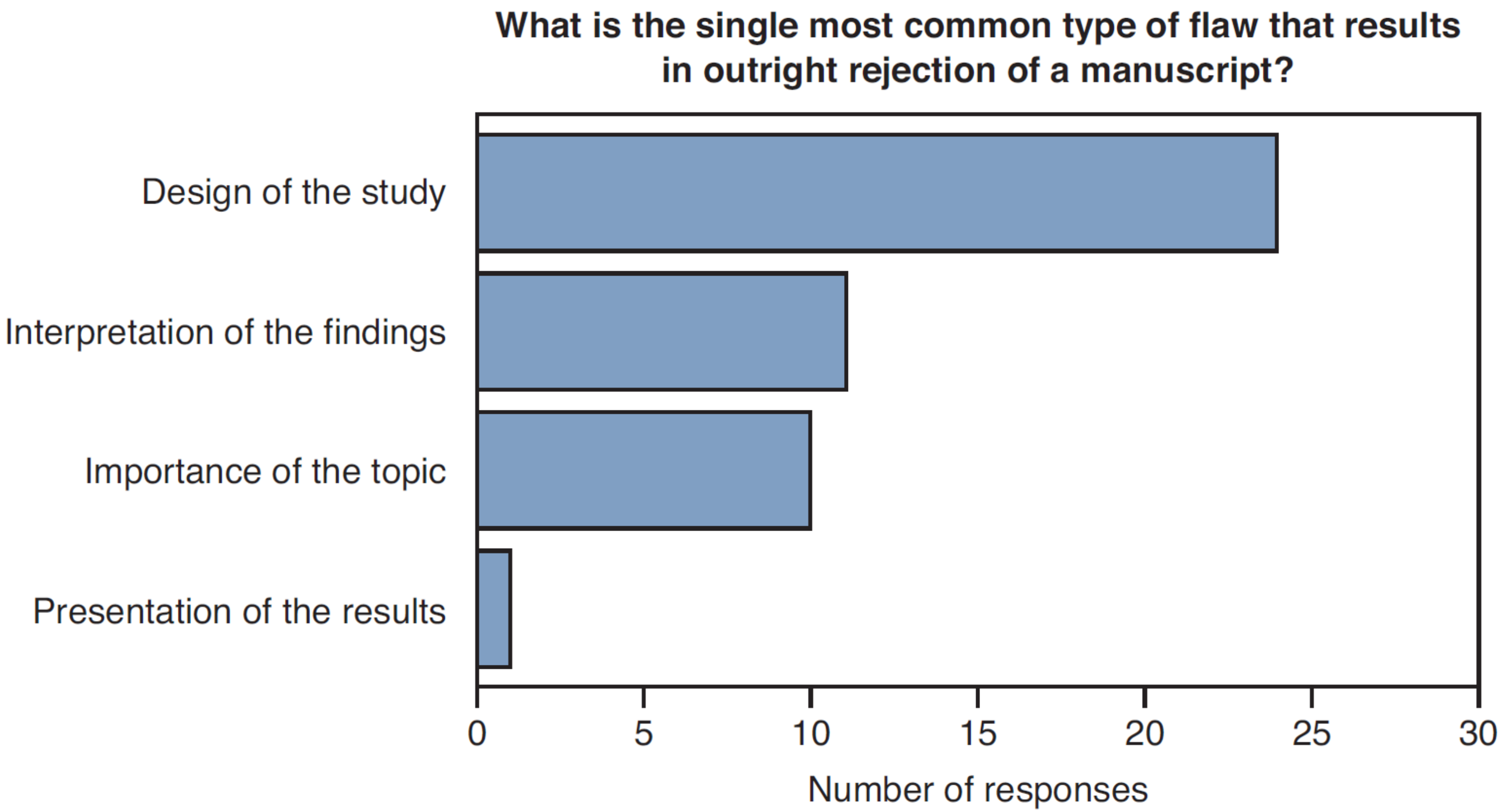



***FIGURE 3.1.*** The four major types of study flaws. From question 7 of the Peer Review Questionnaire (Appendix B). $P < .001$ based on a chi-square test.

# Steps to Avoid Having Your Paper Rejected for Study Design Issues

- Carefully plan for rigorous reproducible research.
- Minimize, but measure, biases.
- Randomize whenever possible.
- Learn more about study design issues
  - (see following slide)

## TABLE 1.1 A Self-Education Reading List for Medical Researchers

*Designing Clinical Research* by Hulley et al. (2013)
*Fundamentals of Clinical Trials* by Friedman et al. (2015)
*Evaluating Clinical and Public Health Interventions: A Practical Guide to Study Design and Statistics* by Katz (2010)
*Basic Statistics for the Health Sciences* by Kuzma and Bohnenblust (2004)
*How to Write a Lot: A Practical Guide to Productive Academic Writing* by Silvia (2007)
*Medical Uses of Statistics* by Bailar and Hoaglin (2009)
*Statistics with Confidence: Confidence Intervals and Statistical Guidelines* by Altman et al. (2000)
*How to Report Statistics in Medicine: Annotated Guidelines for Authors, Editors, and Reviewers* by Lang and Secic (2006)
*The Man Who Discovered Quality: How W. Edwards Deming Brought the Quality Revolution to America—The Stories of FORD, XEROX, and GM* by Gabor (1992)
*Epidemiology* by Gordis (2013)
*Essentials of Medical Statistics* by Kirkwood and Sterne (2003)
*Clinical and Translational Science: Principles of Human Research* by Robertson and Williams (2016)
*Statistical Modeling for Biomedical Researchers: A Simple Introduction to the Analysis of Complex Data* by Dupont (2009)
*Modern Epidemiology* by Rothman et al. (2012)
*Clinical Prediction Models: A Practical Approach to Development, Validation, and Updating* by Steyerberg (2010)
*Encyclopedia of Biostatistics: 8-Volume Set* by Armitage and Colton (2005)
*Essentials of Writing Biomedical Research Papers* by Zeiger (1999)
*Statistical Issues in Drug Development* by Senn (2008)
*Experimental Design for Biologists* by Glass (2014)
*Experimental Design for the Life Sciences* by Ruxton and Colegrave (2010)
*Thinking, Fast and Slow* by Kahneman (2013)

# Of the following nine problems, which is most often responsible for outright rejection?

- 1. Inadequate control of variables
- 2. Deficiency in methodology
- 3. Research design problems
- 4. Poor conceptualization of problem or approach
- 5. Inappropriate statistical analysis
- 6. Duplication of previous work
- 7. Lack of medical supervision
- 8. Poor literature review
- 9. Inadequate protection of human subjects

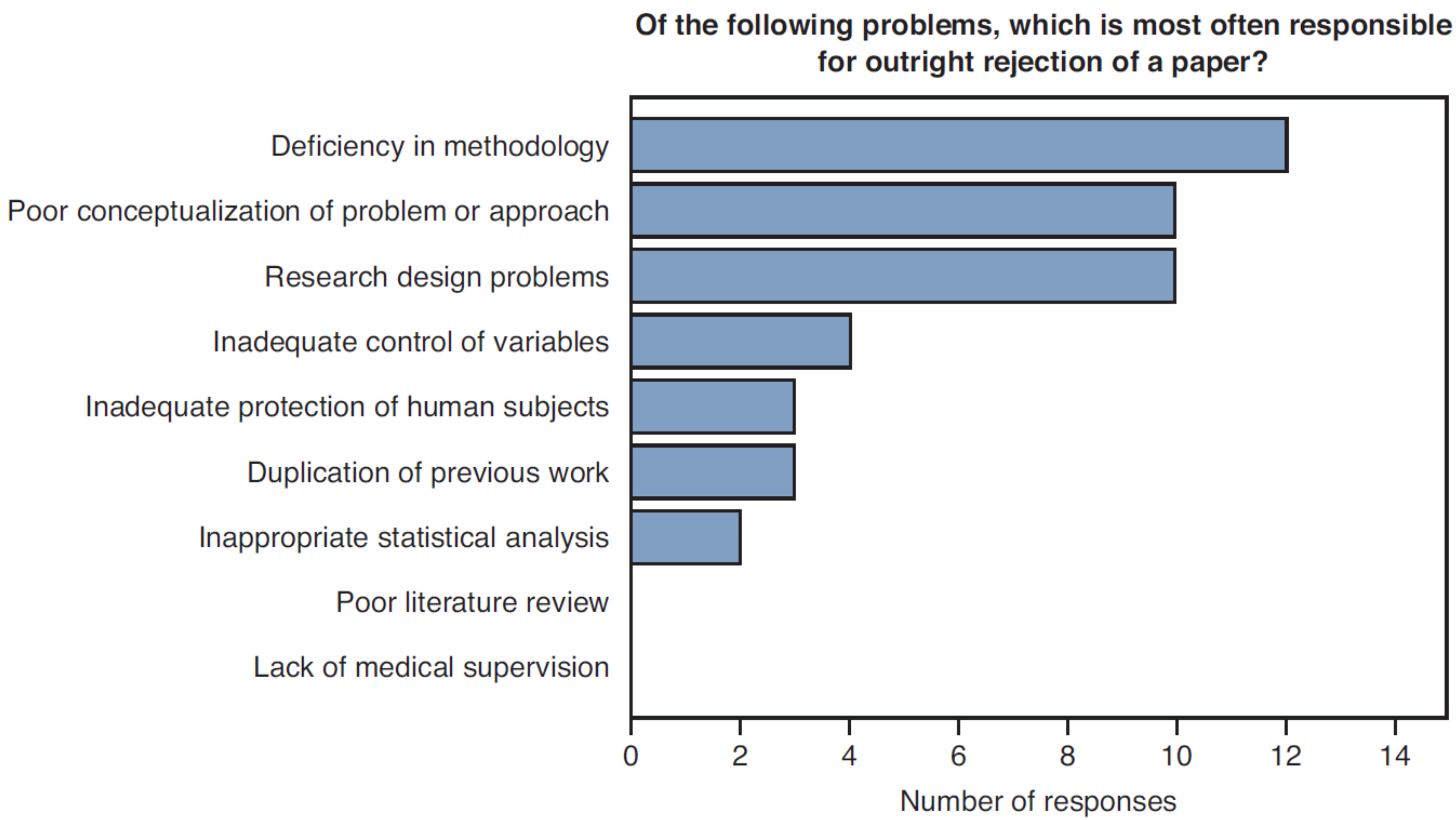



***FIGURE 3.3.*** Study deficiencies responsible for rejection. From question 20 of the Peer Review Questionnaire (Appendix B). $P = .010$ based on a chi-square test.

# Of the following four problems, which is most often responsible for outright rejection?

- 1. Failure to collect data on variables that could influence the interpretation of results
- 2. Poor response rates in surveys
- 3. Subjects lost to follow-up or inadequate duration of follow-up in long-term studies
- 4. Extensive missing data and quality control problems

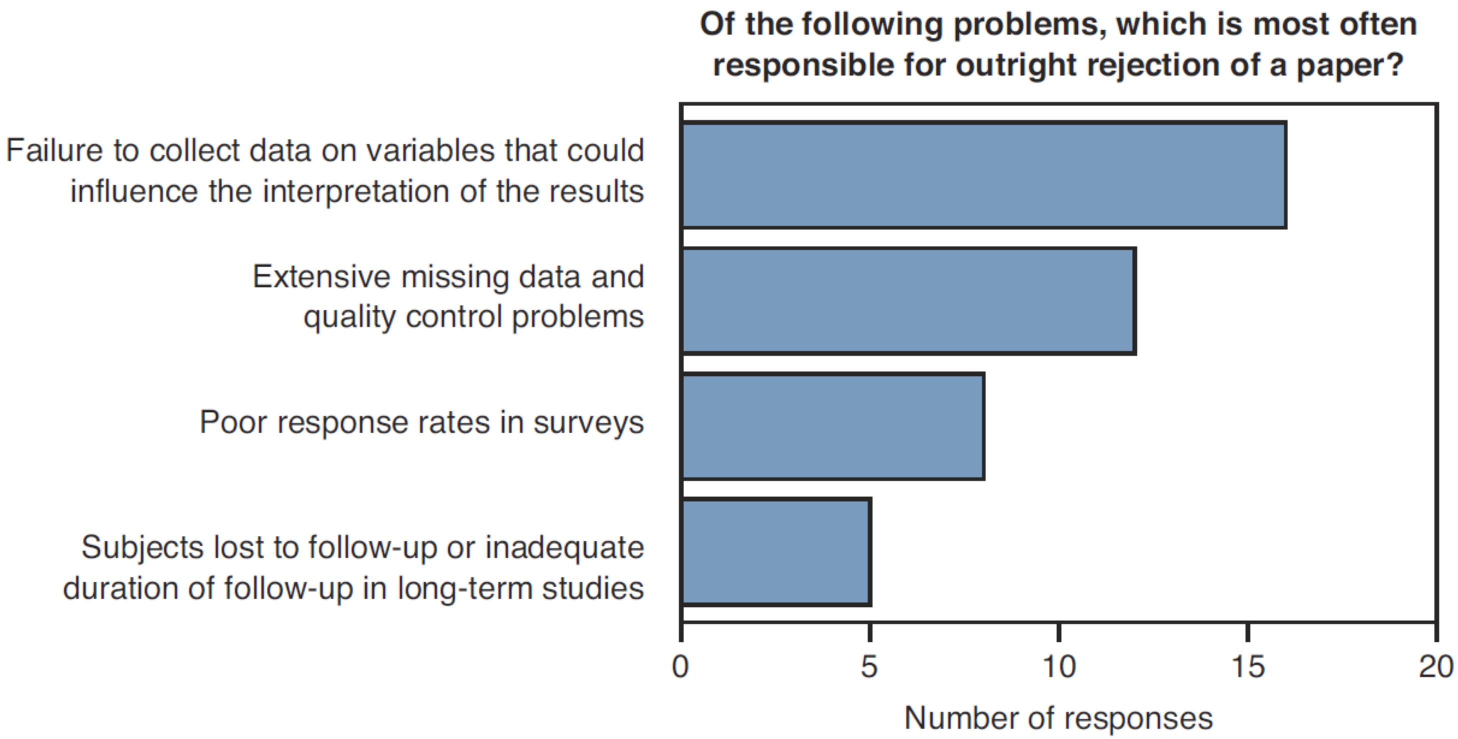



***FIGURE 5.2.*** Data quality problems that result in rejection. From question 26 of the Peer Review Questionnaire (Appendix B). *P* = .082 based on a chi-square test.

# Of the following eight problems, which is most often responsible for outright rejection?

- 1. Weak discussion
- 2. Weak conclusions
- 3. Poor presentation
- 4. Poor methods
- 5. Inadequate results
- 6. Lack of originality
- 7. Failure to adhere to journal format and policy
- 8. Inappropriate statistical analysis

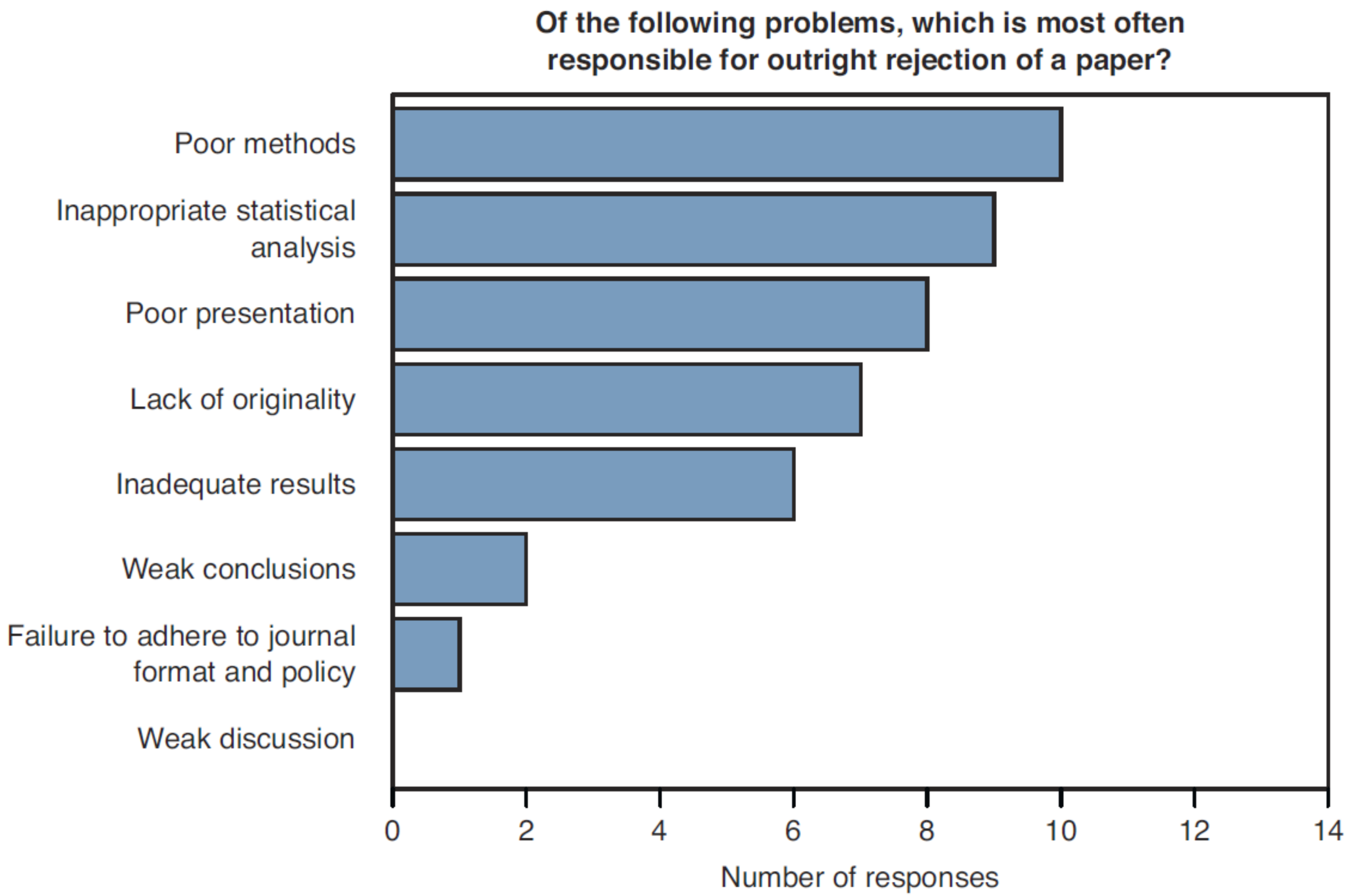



***FIGURE 12.2.*** General problems responsible for rejection of manuscripts submitted for publication. From question 16 of the Peer Review Questionnaire (Appendix B). $P = .073$ based on a chi-square test.

# Of the following problems, which is most often responsible for outright rejection of a paper?

- Data too preliminary
- Data inconclusive
- Conclusions unsupported by data
- Unconvincing evidence of cause and effect
- Results not generalizable
- Excessive bias in interpretation
- Insufficient recognition of previous research
- Economic consequences ignored or overinterpreted

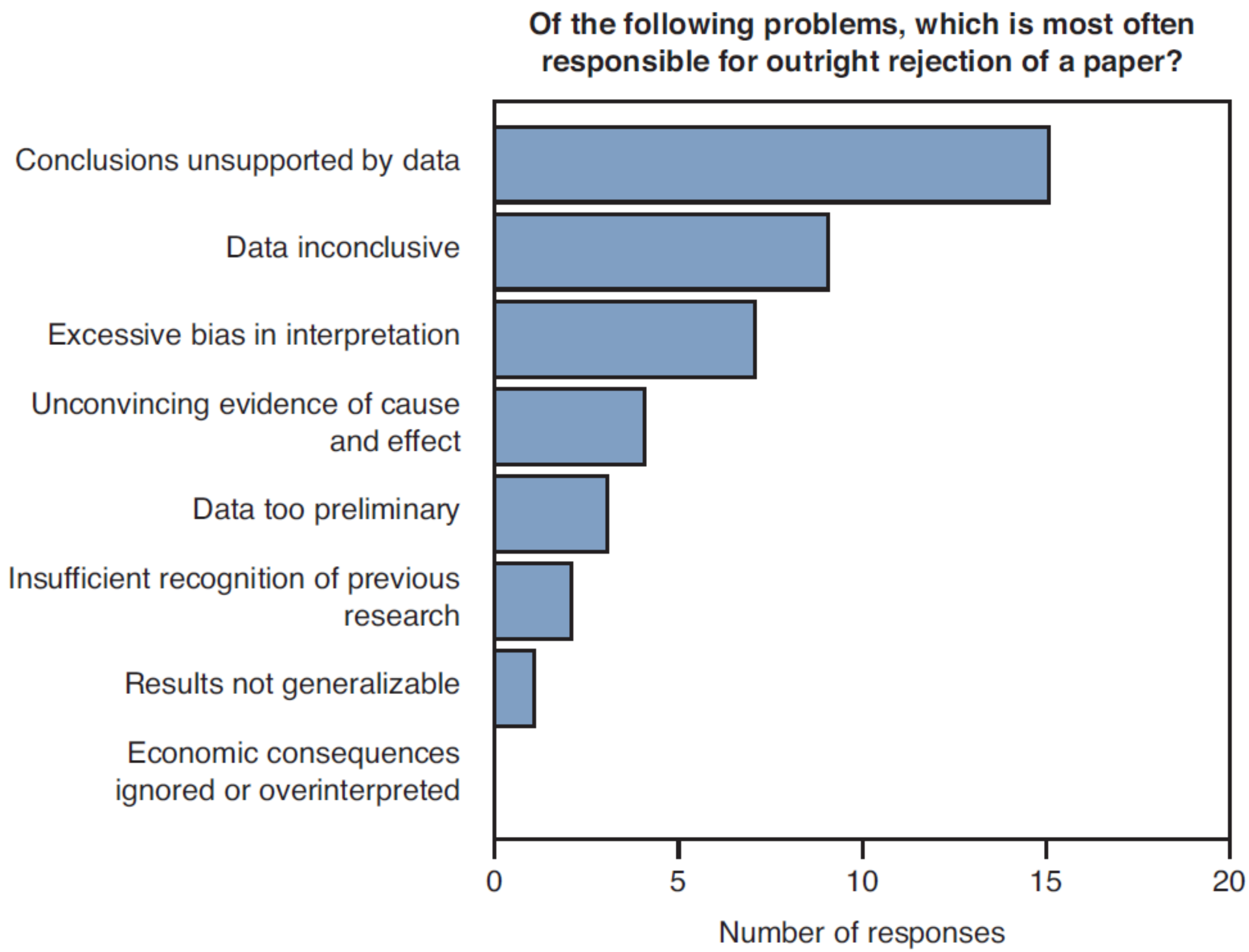



***FIGURE 25.2.*** Interpretation problems and rejection. From question 9 of the Peer Review Questionnaire (Appendix B). *P* < .001 based on a chi-square test.

# Which section is most often responsible for outright rejection?

- Introduction
- Methods
- Results
- Discussion

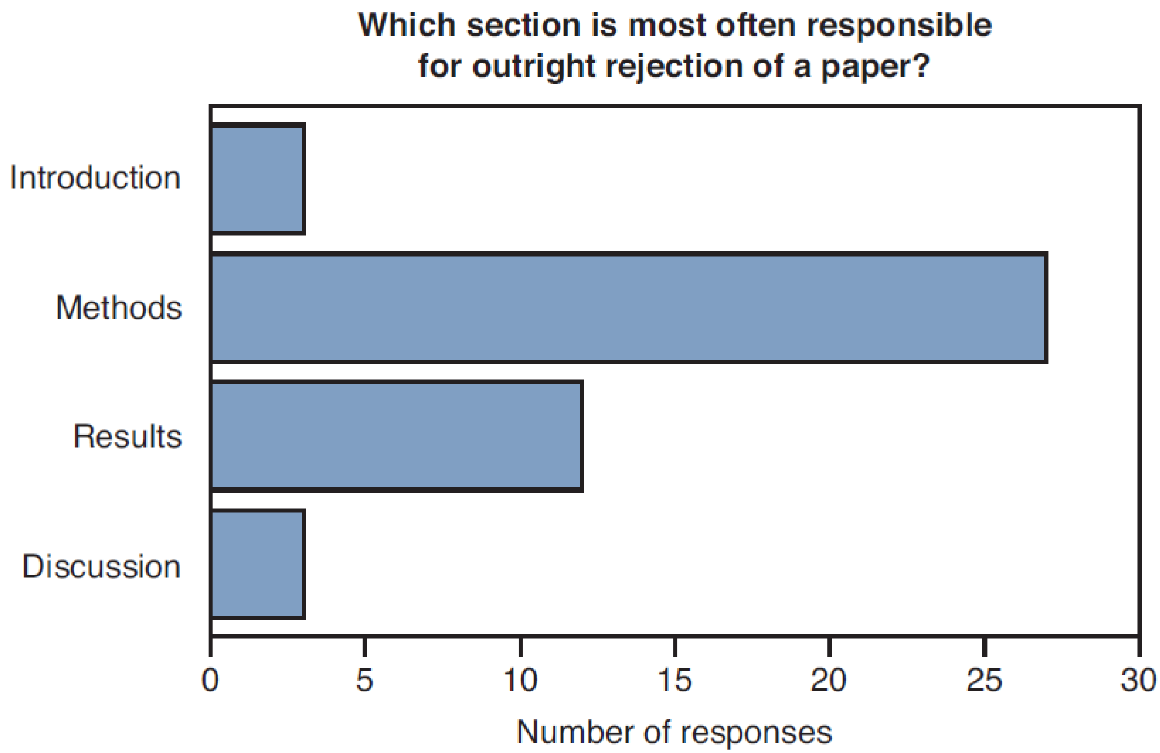



***FIGURE 23.2.*** The manuscript section that is most often responsible for rejection. From question 4 of the Peer Review Questionnaire (Appendix B). $P < .001$ based on a chi-square test.

# Of the eight problems listed above, which is most often responsible for outright rejection?

- Rationale confused or contradictory
- Important work by others ignored
- Failure to give a detailed explanation of the experimental design
- Inadequate or inappropriate presentation of data
- Essential data omitted or ignored
- Poorly written; excessive jargon
- Excessive zeal and self-promotion
- Boring

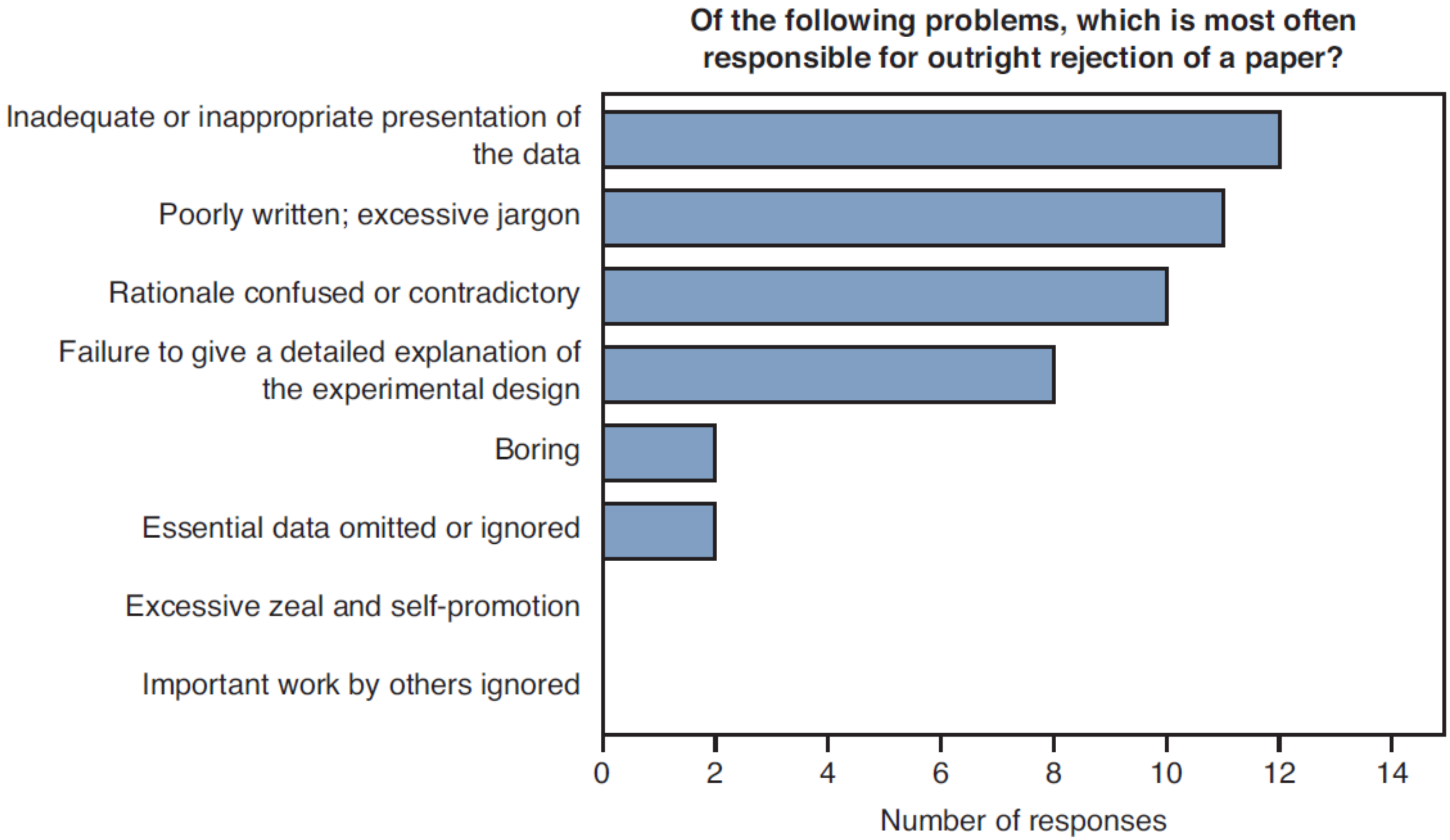



**FIGURE 23.3.** Presentation problems and rejection. From question 13 of the Peer Review Questionnaire (Appendix B). $P = .021$ based on a chi-square test.

# Of the seven problems listed above, which is the most often responsible for outright rejection?

- Insufficient information about the patient population
- Inadequate sample size
- Biased sample that reduced the representativeness of the population studied
- Confounding factors that were not taken into account
- Vague end points, such as, “much improved,” without explanation
- Straying from the hypothesis or changing the objective
- Poor control of numbers (errors or inconsistences)

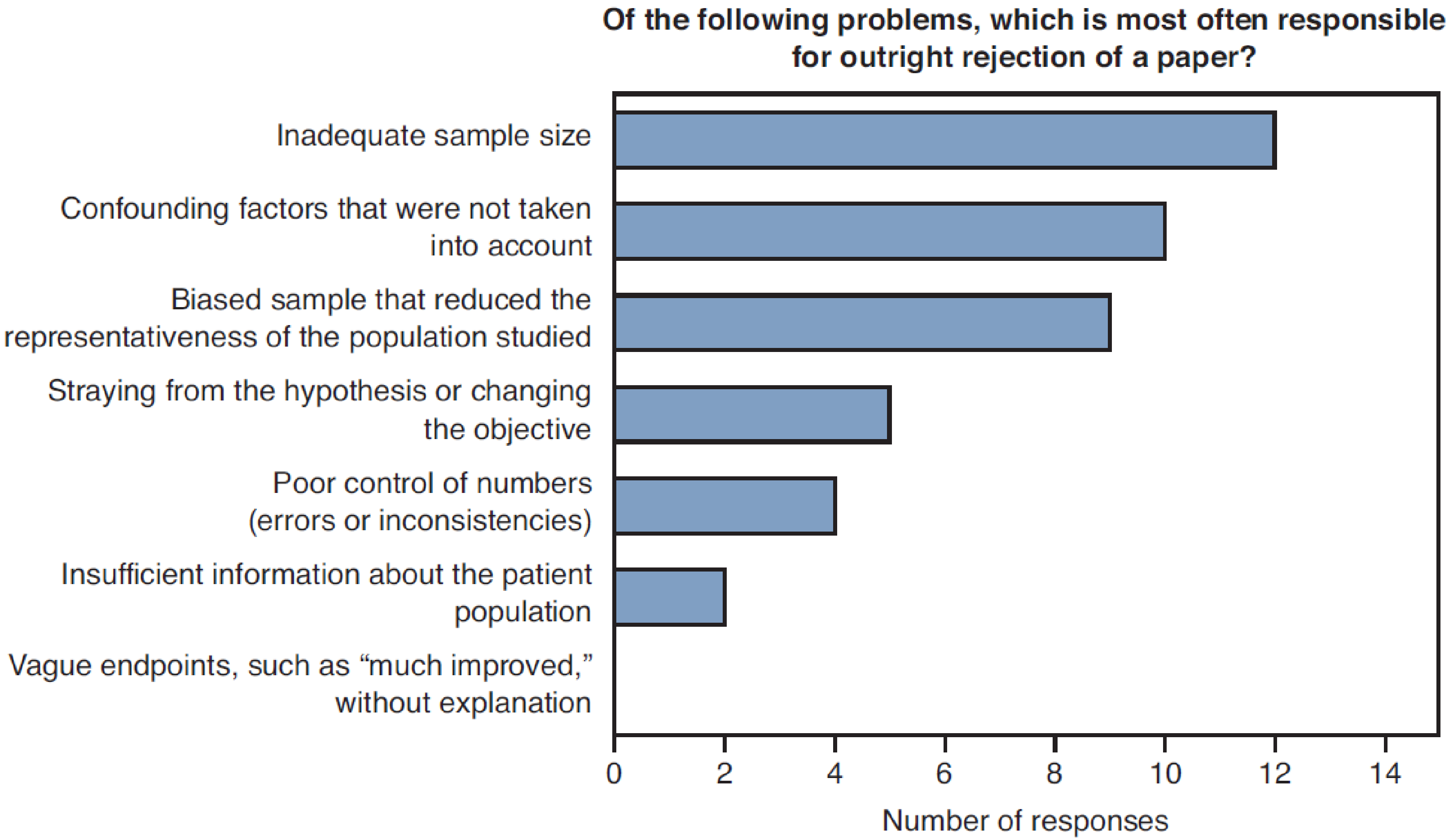



***FIGURE 23.6.*** Research design problems and rejection. From question 24 of the Peer Review Questionnaire (Appendix B). $P = .054$ based on a chi-square test.

# Part II – Skills Needed to Publish Your Medical Research

# What are the 6 steps of the scientific method?

# The 6 Steps of the Scientific Method

- 1. State the problem.
- 2. Formulate the (null) hypothesis.
- 3. Design the study.
- 4. Collect data.
- 5. Analyze the results.
- 6. Draw conclusions.

# What is the Key Question to Answer in Each of the 4 Sections?

- Introduction
- Methods
- Results
- Discussion

# The Key Question to Answer in Each of the 4 Sections…

- Introduction – Why did you perform this study?
- Methods – What did you do?
- Results – What did you find?
- Discussion – What do your results mean?

# Spreadsheet from Hell

| | A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **Comparison of Drug A and Drug B** | | | | | | | | | | |
| 2 | **Drug A** | **Age of** | **Patient** | **Height** | **Weight** | **24hrhct** | **Blood pressure** | **Tumor** | **Race** | **Date** | **Complications** |
| 3 | | **Patient** | **Gender** | **(inches)** | **(pound)** | | | **stage** | | **enrolled** | |
| 4 | | | | | | | | | | | |
| 5 | 1 | 25 | Male | 61” | >350 | 38% | 120/80 | 2-3 | Hispanic | 1/15/99 | no |
| 6 | 2 | 65+ | female | 5’8” | 161 | 32 | 140/90 | II | White | 2/05/1999 | yes |
| 7 | 3 | ? | Male | 120cm | | 12 | >160/110 | IV | Black | Jan 98 | yes, pneumonia |
| 8 | 4 | 31 | m | 5’6” | obese | 40 | 140 sys 105 dias | ? | African-American | ? | |
| 9 | 5 | 42 | f | >6 ft | normal | 39 | missing | =>2 | W | Feb 99 | |
| 10 | 6 | 45 | f | 5.7 | 160 | 29 | 80/120 | NA | B | last fall | n |
| 11 | 7 | unknown | ? | 6 | 145 | 35 | normal | 1 | W | 2/30/99 | n |
| 12 | 8 | 55 | m | 72 | 161.45 | 12/39 | 120/95 | 4 | African-American | 6-15-00 | y |
| 13 | 9 | 6 months | f | 66 | 174 | 38 | 160/110 | 3 | Asian | 14/12/00 | y |
| 14 | 10 | 21 | f | 5’ | | | | | | | |
| 15 | | | | | | | | | | | |
| 16 | **Drug B** | | | | | | | | | | |
| 17 | 1 | 55 | m | 61 | 145 | normal | 120/80 120/90 | IV | Native American | 6/20/ | 3 |
| 18 | 2 | 45 | f | 4”11 | 166 | ? | 135/95 | 2b | none | 7/14/99 | n |
| 19 | 3 | 32 | male | 5’13” | 171 | 38 | 140/80 | not staged | NA | 8/30/99 | n |
| 20 | 4 | 44 | na | 65 | ? | 40 | 120/80 | 2 | ? | 09/01/00 | n |
| 21 | 5 | 66 | fem | 71 | 0 | 41 | 140/90 | 4 | w | Sep 14th | y, sepsis |
| 22 | 6 | 71 | unknown | 172 | 199 | 38 | >160/110 | 3 | b | unknown | y, died |
| 23 | 7 | 45 | m | ? | 204 | 32 | 140 sys 105 dias | 1 | b | 12/25/00 | n |
| 24 | 8 | 34 | m | NA | 145 | 36 | 130 | 3 | w | July 97 | n |
| 25 | 9 | 13 | m | 66 | 161 | 39 | 166/115 | 2a | w | 06/06/99 | n |
| 26 | 10 | 66 | m | 68 | 176 | 41 | 1120/80 | 3 | w | 01/21/58 | n |
| 27 | | | | | | | | | | | |
| 28 | **Average** | 45 | | 65 | 155 | 38 | | | | | |

***FIGURE 14.3.*** Spreadsheet from hell. An example of the improper way to enter data for a medical research project.

## Ten Data Entry Commandments

1. Enter all, or most, of the data as numbers. Avoid entering letters, words, string variables (e.g., NA, 22%, <3.6), or anything that resembles a cartoon curse word grawlix (*&#%!@?!,). In Excel, all columns, with the exception of names and text comments, should be formatted as numbers or dates (not as general or text).

2. Give each column a unique, simple, one-word name, eight characters or less with no spaces, beginning with a letter, and place this name in the first row.

3. Put only one variable in a column. Do not combine variables in the same column.

4. Enter each patient (or unit of analysis) on a separate line, beginning on the second line/row.

5. Give each research participant or patient a unique case number (1, 2, 3, etc.) in the first column. Delete patient name, SS#, MR#, and any identifying information before sending it to a biostatistician. Always save the spreadsheet with a password.

6. Enter cases and controls in the same spreadsheet. Use one variable to define the control group (TREATED: 0 = no, 1 = yes).

7. Quantify. Enter continuous measurements when possible.

8. Create a simple guide (or key) using a word processor to explain variable abbreviations, value coding, and how missing values were entered. Be consistent.

9. Think through the analysis before collecting any data.

10. Have a biostatistician or other methodologist review the coding before data entry and again after the first 10 patients have been entered.

***FIGURE 14.2.*** Ten data entry commandments. Guidelines for data entry.

# Spreadsheet from Heaven

| | A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | CASE | GROUP | AGE | SEX | HT | WT | HCT | BPSYS | BPDIAS | STAGE | RACE | DATE1 | COMPLIC |
| 2 | 1 | 1 | 25 | 1 | 61 | 350 | 38 | 120 | 80 | 3 | 3 | 1/15/1999 | 0 |
| 3 | 2 | 1 | 65 | 2 | 68 | 161 | 32 | 140 | 90 | 2 | 1 | 2/5/1999 | 1 |
| 4 | 3 | 1 | 25 | 1 | 47 | 150 | 38 | 160 | 110 | 4 | 2 | 1/15/1998 | 1 |
| 5 | 4 | 1 | 31 | 1 | 66 | 161 | 40 | 140 | 105 | 2 | 2 | 4/1/1999 | 0 |
| 6 | 5 | 1 | 42 | 2 | 72 | 177 | 39 | 130 | 70 | 2 | 1 | 2/15/1999 | 0 |
| 7 | 6 | 1 | 45 | 2 | 67 | 160 | 29 | 120 | 80 | 1 | 2 | 3/6/1999 | 0 |
| 8 | 7 | 1 | 44 | 1 | 72 | 145 | 35 | 120 | 80 | 1 | 1 | 2/28/1999 | 0 |
| 9 | 8 | 1 | 55 | 1 | 72 | 161 | 39 | 120 | 95 | 4 | 2 | 6/15/2000 | 1 |
| 10 | 9 | 1 | 0.5 | 2 | 66 | 174 | 38 | 160 | 110 | 3 | 4 | 12/14/2000 | 1 |
| 11 | 10 | 1 | 21 | 2 | 60 | 155 | 40 | 190 | 120 | 2 | 2 | 11/14/2000 | 0 |
| 12 | 11 | 2 | 55 | 1 | 61 | 145 | 41 | 120 | 80 | 4 | 5 | 6/20/1999 | 1 |
| 13 | 12 | 2 | 45 | 2 | 59 | 166 | 39 | 135 | 95 | 2 | 1 | 7/14/1999 | 0 |
| 14 | 13 | 2 | 32 | 1 | 73 | 171 | 38 | 140 | 80 | 1 | 1 | 8/30/1999 | 0 |
| 15 | 14 | 2 | 44 | 2 | 65 | 155 | 40 | 120 | 80 | 2 | 2 | 9/1/2000 | 0 |
| 16 | 15 | 2 | 66 | 2 | 71 | 145 | 41 | 140 | 90 | 4 | 1 | 9/14/1999 | 1 |
| 17 | 16 | 2 | 71 | 1 | 68 | 199 | 38 | 160 | 110 | 3 | 2 | 1/14/1999 | 1 |
| 18 | 17 | 2 | 45 | 1 | 69 | 204 | 32 | 140 | 105 | 1 | 2 | 12/25/2000 | 0 |
| 19 | 18 | 2 | 34 | 1 | 66 | 145 | 36 | 130 | 75 | 3 | 1 | 7/15/1997 | 0 |
| 20 | 19 | 2 | 13 | 1 | 66 | 161 | 39 | 166 | 115 | 2 | 1 | 6/6/1999 | 0 |
| 21 | 20 | 2 | 66 | 1 | 68 | 176 | 41 | 120 | 80 | 3 | 1 | 1/21/1998 | 0 |

***FIGURE 14.4.*** Spreadsheet from heaven. An example of the proper way to enter data for a medical research project.

# What is regression to the mean?

# Regression to the Mean

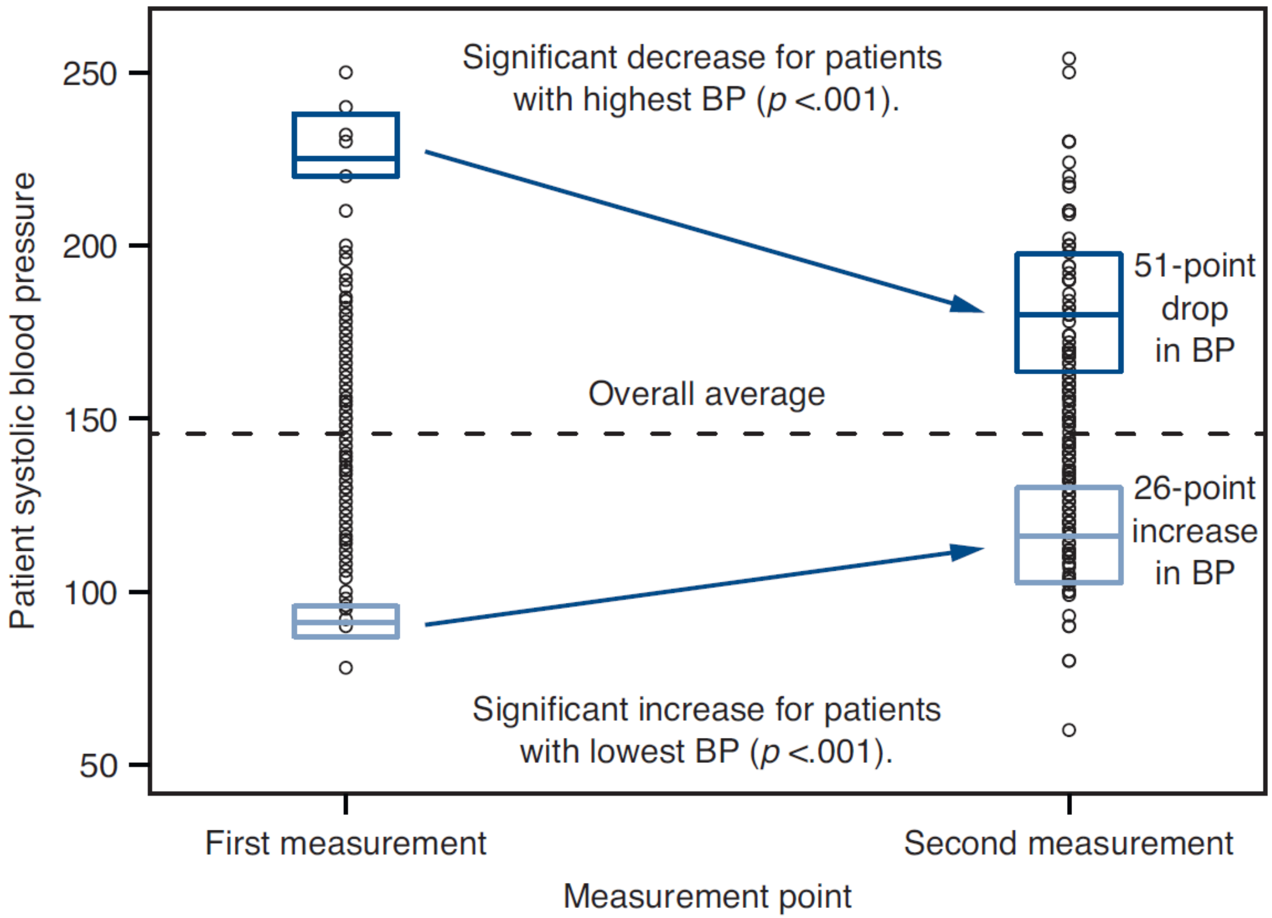



***FIGURE 4.1.*** Regression to the mean. This graph illustrates the statistical phenomenon of regression to the mean in which extremely high or low values will move closer to the average on a second reading. This effect will happen without any intervention. Note that these changes are both statistically and clinically significant. *P* values based on the Wilcoxon signed-rank test. BP, blood pressure.

# What is the definition of each of the following 4 study designs?

- Prospective cohort
- Retrospective cohort
- Case-control
- Cross-sectional

# Flowchart of Study Designs

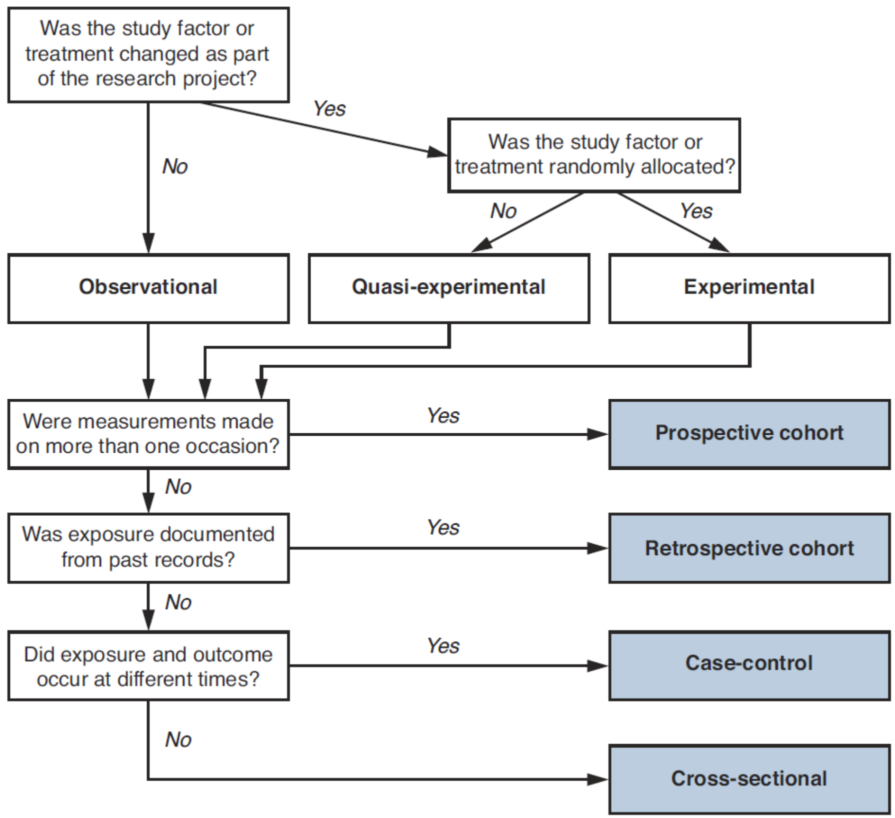



***FIGURE 3.4.*** Flowchart of study designs. These questions refer to what the investigators did as part of this research project.

# When are exposure and outcome measured in each of the following 4 study designs?

- Prospective cohort
- Retrospective cohort
- Case-control
- Cross-sectional

# When exposure and outcome are measured in each of the following 4 study designs.

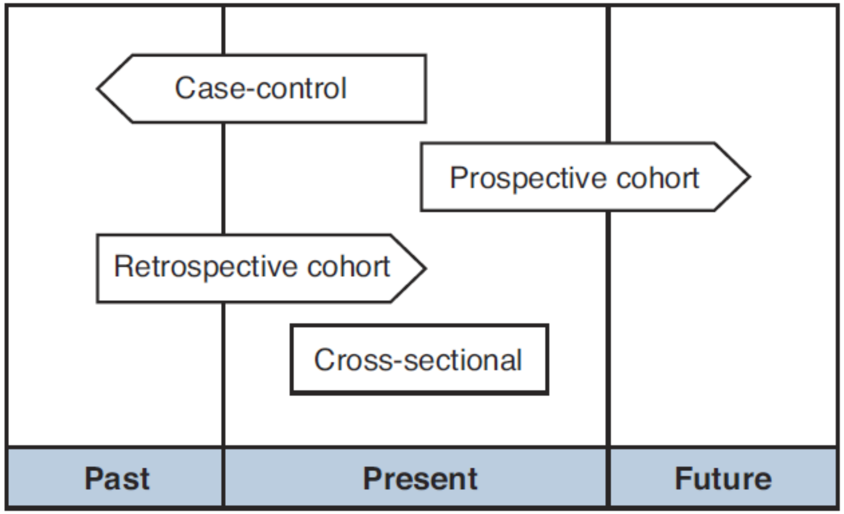



***FIGURE 3.5.*** Study design and time. In case-control studies, outcome is determined in the present and subjects are asked to recall whether they were exposed in the past. In prospective cohort studies, exposure is measured in the present and outcome is recorded at some point in the future. Randomized controlled trials are a specific type of cohort study. For retrospective cohort (or historical prospective) studies, exposure is determined from past records and outcome is determined in the present. For cross-sectional studies, exposure and outcome are measured at the same time.

# What are the 10 most prestigious medical and biomedical research journals?

## TABLE 12.5 A Selection of High-Profile Medical and Biomedical Research Journals

| Journal Title | Impact Factor[a] | Acceptance Rate (%) |
|---|---|---|
| 1. *The New England Journal of Medicine* | 55.87 | <5[b] |
| 2. *Science* | 33.61 | <7[c] |
| 3. *Nature* | 41.46 | 7.8[d] |
| 4. *JAMA (Journal of the American Medical Association)* | 35.29 | 9.5[e] |
| 5. *The Lancet* | 45.22 | 5[f] |
| 6. *Cell* | 32.24 | 10–20[g] |
| 7. *Annals of Internal Medicine* | 17.81 | 7[h] |
| 8. *Proceedings of the National Academy of Sciences of the United States of the America (PNAS)* | 9.67 | 18.0[i] |
| 9. *The Journal of Clinical Investigation* | 13.26 | 8.7[j] |
| 10. *Nature Genetics* | 29.35 | 5[k] |

What is the definition of impact factor?

Which journals have the highest impact factor?

## TABLE 12.3 Impact Factor for a Selection of Medical Journals

| Journal | Impact Factor |
|---|---|
| *CA: A Cancer Journal for Clinicians* | 144.80 |
| *The New England Journal of Medicine* | 55.87 |
| *Chemical Reviews* | 46.57 |
| *The Lancet* | 45.22 |
| *Nature Reviews Drug Discovery* | 41.91 |
| *Nature Biotechnology* | 41.51 |
| *Nature* | 41.46 |
| *Annual Review of Immunology* | 39.33 |
| *Nature Reviews Molecular Cell Biology* | 37.81 |
| *Nature Reviews Cancer* | 37.40 |
| *JAMA (Journal of the American Medical Association)* | 35.29 |
| *Science* | 33.61 |
| *Cell* | 32.24 |
| *Nature Genetics* | 29.35 |
| *Nature Medicine* | 28.22 |
| *Journal of Clinical Oncology* | 18.44 |
| *Annals of Internal Medicine* | 17.81 |
| *BMJ (British Medical Journal)* | 17.45 |
| *Circulation* | 15.07 |
| *JAMA Internal Medicine* | 13.12 |
| *Proceedings of the National Academy of Sciences of the United States of America (PNAS)* | 9.67 |

NOTE: The first 10 journals are those with the highest impact factor; the others are a selection of notable journals.
Sources: ISI Web of Knowledge, Journal Citation Reports, 2014 JCR Science Edition, Thomson Reuters; or reported directly by the journal.

# What are the 3 levels of measurement?

# The 3 levels of measurement

**TABLE 10.1 Levels of Measurement**

| Level | Explanation |
|---|---|
| 1. Nominal (categorical variables) | Numbers are only labels for categories. |
| Examples: | 0 = no, 1 = yes<br>0 = nonsmoker, 1 = smoker<br>1 = White, 2 = Black, 3 = Hispanic, 4 = Asian, 9 = Other<br>0 = female, 1 = male (Note: Males are generally at increased risk.) |
| Note: | The categories can be numbered in any order without affecting the results:<br>1 = Black, 2 = Hispanic, 3 = Asian, 4 = Other, 9 = White |
| 2. Ordinal | Numbers are used to provide rank ordering (as in a horse race); these variables may be subjective. |
| Examples: | 1 = first, 2 = second, 3 = third<br>0–10 Apgar score<br>0 = nonsmoker, 1 = light smoker, 2 = moderate smoker, 3 = heavy smoker |
| 3. Interval (scale) (continuous variables) | Numbers have equal intervals between successive points; this type of measurement typically is more objective than the other types. |
| Examples: | Age<br>Hematocrit<br>Serum albumin level<br>Cigarettes smoked per day |

# Which statistical test should I use to …

- determine whether the in-hospital mortality differs between men and women following a hip fracture?
- determine whether the hospital length of stay differs between men and women following a hip fracture?

# Flowchart of Common Inferential Statistics

| Type of Test | Difference/ Association | Pairing | Dependent Variable | | No. of Groups | $N$ | Paired Links | Appropriate Statistical Method | Nonparametric Links |
|---|---|---|---|---|---|---|---|---|---|
| | | | Level of Measurement | Distribution | | | | | |
| Question 1 | Question 2 | Question 3 | Question 4 | Question 5 | Question 6 | Question 7 | | | |
| Univariate | Difference | Unmatched/ independent | Interval | Normal | 2 | | | Student's $t$-test | |
| | | | | | ≥2 | | | One-way ANOVA | |
| | | | Ordinal | Nonnormal | 2 | | | Mann-Whitney U test/ Wilcoxon rank-sum test | |
| | | | | | >2 | | | Kruskal-Wallis H test | |
| | | | Nominal | | 2 | <20 | | Fisher's exact test/LRT | |
| | | | | | ≥2 | ≥20 | | Chi-square | |
| | | | | Time-to | ≥2 | | | Kaplan-Meier, log-rank | |
| | | Matched/ paired | Interval | Normal | 2 | | | Paired $t$-test | |
| | | | | | ≥2 | | | Mixed-effects, repeated measures ANOVA | |
| | | | Ordinal | Nonnormal | 2 | | | Wilcoxon signed-rank test | |
| | | | | | >2 | | | Friedman test | |
| | | | Nominal | | 2 | | | McNemar's test/binomial/sign test | |
| | Association/ correlation | | Interval | Normal | | | | Pearson's r | |
| | | | Ordinal | Nonnormal | | | | Spearman's $r_s$ | |
| | | | Nominal/ordinal | | | | | Chi-square for trend test | |
| | | | Nominal/nominal | | | | | Kappa | |
| Multivariate | Association | Unmatched/ independent | Interval | | | | | Linear regression<br>ANOVA/GLM<br>ANCOVA | |
| | | | Ordinal | | | | | Ordinal regression | |
| | Difference | | Nominal | | ≥2 | | | Logistic regression | |
| | | | | | ≥2 | | | Mantel-Haenszel test | |
| | | | | Time-to | ≥2 | | | Cox proportional-hazards | |
| | | Paired | | | 2 | | | Conditional logistic regression | |

ANOVA = analysis of variance; LRT = likelihood ratio test; GLM = generalized linear model; ANCOVA = analysis of covariance.

# Answer these Questions to Select the Correct Statistical Test.

1. Which type of test do you need: univariate or multivariate? (Start with a univariate test and then proceed to a multivariate test to adjust for confounding factors and regression modeling.)
2. Do you want to test for a difference between groups or for an association between variables? An example of an association between variables is the following: "Is length of stay in the hospital associated with age?"
3. Were the groups matched (paired) or were they unmatched (unpaired - independent)?
4. What is the level of measurement for the dependent (outcome) variable? Is it nominal (categorical), ordinal, or interval (continuous)?
5. Is the dependent (outcome) variable normally distributed? If your histogram forms a bell-shaped curve, assume that it is normal; otherwise, assume that it is not normal. Note: This is the classical method of selecting a statistical test. A more modern robust method is to assume nonnormal for all variables and use nonparametric methods. When analyzing time to death (or some event that has not occurred for all patients), select time-to methods.
6. How many groups are there for the independent (predictor) variable?
7. What is the total sample size?

# What are the most commonly used inferential statistical techniques in modern medical research?

## TABLE 16.1 Most Commonly Used Inferential Statistical Techniques in Modern Medical Research

| Rank | Test |
|---|---|
| 1. | Kaplan-Meier method |
| 2. | Logistic regression |
| 3. | Cox proportional-hazards |
| 4. | Log-rank test |
| 5. | Chi-square (Pearson $\chi^2$) |
| 6. | Fisher's exact test |
| 7. | Wilcoxon rank-sum test/Mann-Whitney U test |
| 8. | Student's *t*-test or unpaired *t*-test |
| 9. | Mantel-Haenszel method |
| 10. | Linear regression analysis |
| 11. | Poisson regression |
| 12. | Mixed-effects models |
| 13. | Analysis of covariance (ANCOVA) |
| 14. | Generalized estimating equations (GEEs) |
| 15. | Chi-square test for trend |
| 16. | Kruskal-Wallis one-way analysis of variance (ANOVA) by ranks procedure |
| 17. | Paired *t*-test |
| 18. | One-way ANOVA |
| 19. | Wilcoxon signed-rank test |
| 20. | ANOVA (two-way) |
| 21. | Kappa statistic/weighted kappa |
| 22. | McNemar's chi-square test |
| 23. | Likelihood-ratio chi-square test |
| 24. | Ordinal logistic regression |
| 25. | Conditional logistic regression |
| 26. | Pearson's product-moment correlation |
| 27. | General linear model/generalized linear model |
| 28. | Repeated measures ANOVA |
| 29. | Pooled logistic regression |
| 30. | Binomial test |

Based on a review of original articles and their protocols in the online supplementary appendix published in *The New England Journal of Medicine* in 2015, Volume 372, Issues 1–26.

Which words and phrases should avoid starting a sentence with?

# Don’t Start a Sentence With…

- It
- There
- However
  - (move it in a few words …, however,…)
- More importantly
  - Change to “More important…”
- 150 patients
  - Change to “A total of 150 patients…”
- In order to
  - Change to “To…”
- Y’all

# For More Detail See https://www.amazon.com/dp/1496353862