Scientific Writing Development Series

Anne Marie Weber-Main, PhD
Dept of Family Medicine & Community Health
Office 421
717 Delaware St. Building
weber005@umn.edu
612-624-5864
I have no financial relationships to disclose.

I will not discuss off label use and/or investigational use in my presentation.
Session 3 Objectives

1. Explain readers’ expectations for the content and organization of methods and results sections.

2. Identify common problems in methods and results sections.

3. Apply specific writing/revision strategies to improve methods and results sections.
In real estate, what matters most is location, location, location.

In scientific review, what matters most is methods, methods, methods.
Methods

- What advice have you been given — or would you give to others — for writing this section?

- What questions do you have about writing this section?
Methods - Readers’ expectations

**Complete:** Enough detail to enable a trained researcher to evaluate or repeat your work.

“That experiments are unlikely to be reproduced is beside the point; the potential for reproducing the same or similar results must exist, or your paper does not represent good science.”

Methods - What info? How much detail?

Commonly missing or inadequately described

- **Context** - where and when study was conducted

“We enrolled patients seen from 1994 to 1996 at the San Jose Veterans Affairs Medical Center, a 100-bed quaternary care center specializing in the treatment of patients with pituitary tumors.”

Methods - What info? How much detail?

*Commonly missing or inadequately described*

- **Identification as a substudy or secondary data analysis**

  This study involved an analysis of data from the first 137 subjects who completed 30 days of a protocol for a larger, longitudinal smoking cessation trial.

Methods - What info? How much detail?

Commonly missing or inadequately described

- Selection criteria

“Loose” criteria

Participants were a consecutive sample of patients admitted to the intensive care unit with the diagnosis of sepsis.

Methods - What info? How much detail?

- Selection criteria -
  Pereira MA et al., Effects of low-glycemic load diet on resting energy expenditure and heart disease risk factors during weight loss. JAMA 2004;292(20):2482-2490

Stricter criteria

- Aged between 18 and 40 years
- BMI of at least 27 and weight of less than 135 kg
- Change in body weight of less than 10% during past year
- Good general health
- No medical conditions or medications that might affect body weight, appetite, or energy expenditure
- Nonsmoker
- Not regularly engaged in heavy/vigorous physical activities
Selection Criteria, continued

- Not currently following a special diet
- No history of an eating disorder
- No allergies or aversions to food on the study menu
- Not taking dietary supplements
- Willing to abstain from alcohol consumption
- Able to come to research unit on a daily basis
- Normal laboratory screening test results, including:
  - complete blood cell count
  - serum electrolytes
  - thyroid-stimulating hormone
  - blood glucose
  - glycosylated hemoglobin
  - urinalysis
  - liver functions
Methods - What info? How much detail?

- **Selection criteria** – include *definition* if needed

  “From May 1 to October 31, 2006, all consecutive patients with a suspected TIA [transient ischemic attack] were prospectively evaluated…. *TIA was defined on the basis of the World Health Organization standards.*"^{13}"

*Stroke. 2008;39:297-302*
Methods - What info? How much detail?

- **Selection criteria** – include *rationale* if needed

*Because this test may give false positive results in the presence of active infection, we excluded patients who were febrile (>37.5 degrees C) or who had been treated with antibiotics during the previous 2 weeks.*

---

Methods - What info? How much detail?

*Commonly missing or inadequately described*

- **Variables**
  - What - independent/dependent variables
    - Clear, precise definitions
    - Nominal, categorical
    - Hierarchy – primary outcome, secondary
  - How - survey, chart review, interview, lab test
  - Scoring, calculations
Methods - What info? How much detail?

*Commonly missing or inadequately described*

- **Variables**

  **Vague**
  
  Condom use

  **Specific**
  
  Participants were asked if and how often they used condoms during anal or vaginal intercourse with their primary or other partner(s) during the last three months.
Methods - What info? How much detail?

Commonly missing or inadequately described

Variables

Vague

Relapse to smoking

Specific

Relapse was defined as a relapse from continuous abstinence (i.e., a single puff from a cigarette; Hughes et al., 2003).
Methods - What info? How much detail?

*Commonly missing or inadequately described*

- **Assessment of blinding**

  “To evaluate patient blinding, the questionnaire asked patients to evaluate which treatment they believed they had received (acupuncture, placebo, or don't know) at 3 points in time… If patients answered either acupuncture or placebo, they were asked to indicate what led to that belief …”.

*Arch Otolaryngol Head Neck Surg. 1999;125:567-72*
Methods - What info? How much detail?

*Commonly missing or inadequately described*

- **Data quality**

  **Scale validity**

  Validity of the PEP [Personal Experience of Prejudice] scale is supported by a significant correlation \( r = .78 \) with a measure of perceived racism (Green, 1995).”

  Nursing Research 2007;56(3):175-184

  **Rater agreement**

  The study neurologist and radiology report had to agree on each finding. If disagreement, consensus had to be reached by discussing discrepancies.

  Stroke. 2008;39:297-302
Methods - What info? How much detail?

Commonly missing or inadequately described

- Statistical Methods
  - State tests you used, reference obscure ones.
  - Note program and version (SAS 9.1)
  - Justify tests – why did you choose this analytic method? Are assumptions met?
  - Did you transform any data? If so, why?
  - How did you determine effect size?
  - How did you evaluate statistical significance?
  - Which subjects were in which analysis?
  - Which hypothesis is being tested with which analysis?
Methods - What info? How much detail?

Commonly missing or inadequately described

- Ethical considerations

“Ethics approval for human subjects research was provided by institutional review boards at both hospitals. All participants gave written informed consent before enrollment.”

JAMA 2004;292(20):2482-2490
Methods - Writing Strategies for Completeness of Content

1. Take advantage of resources such as:

- ICMJE Guidelines: www.icmje.org
- CONSORT – Randomized controlled trials www.consort-statement.org
- Equator network: www.equator-network.org
- MOOSE - Meta-analysis of observational studies
- STARD - Studies of diagnostic accuracy
- STROBE - Observational studies
- QUOROM - Systematic reviews and meta-analyses
Methods - Writing Strategies for Completeness of Content

1. Take advantage of resources such as:


- Your own article reviews and rejections!
Methods - Writing Strategies for Completeness of Content

1. Take advantage of resources such as:

- Instructions to authors for target journal

*Journal of Dental Research – Methods*

Present descriptive information about large numbers of experimental reagents, microbes, test materials, primer sequences, in tabular form with a brief explanation in the text.

*American Journal of Public Health - Methods*

Generic names of drugs and pesticides are preferred; if trade names are used, the generic name should be given at first mention.
Methods - Writing Strategies for Brevity

2. Use tables, figures, appendices to reduce length and improve clarity, as appropriate

*Examples*

- theoretical model
- survey items
- flowchart of protocol
- non-standard equipment, apparatus
- definitions
### Methods - Writing Strategies for Clarity, Fluency

#### 3a. Use a logical organization

<table>
<thead>
<tr>
<th>Typical</th>
<th>Tailored*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td>Study sample</td>
</tr>
<tr>
<td>Participants</td>
<td>Antihypertensive treatment</td>
</tr>
<tr>
<td>Intervention</td>
<td>Outcome variable</td>
</tr>
<tr>
<td>Measurements</td>
<td>Classification of comorbid conditions</td>
</tr>
<tr>
<td>Analysis</td>
<td>Other covariates</td>
</tr>
<tr>
<td></td>
<td>Statistical analyses</td>
</tr>
</tbody>
</table>

---

Methods - Writing Strategies for Clarity, Fluency

3b. When possible, use same (or similar) subheadings in methods and results

<table>
<thead>
<tr>
<th>Methods</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety assessments</td>
<td>Safety</td>
</tr>
<tr>
<td>Analyses</td>
<td>Results</td>
</tr>
</tbody>
</table>

- Latency to relapse → same
- Point prevalence → same
- Post hoc analyses → same

Remember: Must be a method for every result, a result for every method!
4. Use brief, intuitive, consistent labels for:

- **Groups**
  - low-fat diet group, high-fat diet group
  - Current HRT users, former HRT users
  - Control (usual care)
  - Treatment (intervention)

- **Variables** (aggression, aggressive behavior)

- **Scales**
5. Include reason for statistical analyses

**Example**

“To evaluate whether the effect of comorbid conditions differed for physicians with varying workloads, we fit 4 models for each quartile of physician workload.”

Methods - Summary

1. Take advantage of writing resources
   - Reporting guidelines
   - Reference books
   - Your own reviews
   - Instructions for authors

2. Use tables, figures, appendices for brevity

3. Use a logical organization (subheads)

4. Use brief, intuitive, consistent labels

5. Include reason for statistical analyses
   
   Remember: No study is perfect
Methods

Questions and Comments
Methods
What did you do?

Results
What did you find?
Results - Readers’ expectations

- You will answer the research question(s) posed in the introduction.

- You will do this with clarity, simplicity, economy, accuracy, and fluency.
Results - Common Problems

As a writer,
what do you struggle with?

As a reader,
what are your pet peeves (complaints)?
Results - Common Problems

- No obvious organization
- No overall answer to purpose of the study
- Text duplicated by tables and figures
- Results included have no corresponding method
- Methods, especially statistical methods, included
Results - Common Problems

(cont)

- Breakdown of results that does not add up to total
- Raw numbers for percentages missing
- Use of statistical terms (e.g., significant, parameter) in non-statistical context
- Interpretation of data included
Guidelines for Using Text vs Tables vs Figures to Display Data


Uses of Text

- Present quantitative data that can be given concisely and clearly.
- Describe simple relationships among data.
To tabulate or not to tabulate?


<table>
<thead>
<tr>
<th>Organism</th>
<th>Growth under aerobic conditions</th>
<th>Growth under anaerobic conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Streptomyces griseus</em></td>
<td>+</td>
<td>_</td>
</tr>
<tr>
<td><em>S. coelicolor</em></td>
<td>+</td>
<td>_</td>
</tr>
<tr>
<td><em>S. nocolor</em></td>
<td>_</td>
<td>+</td>
</tr>
<tr>
<td><em>S. everycolor</em></td>
<td>+</td>
<td>_</td>
</tr>
<tr>
<td><em>S. greenicus</em></td>
<td>_</td>
<td>+</td>
</tr>
<tr>
<td><em>S. rainbowenski</em></td>
<td>+</td>
<td>_</td>
</tr>
</tbody>
</table>

*S. griseus, S. coelicolor, S. everycolor, and S. rainbowenski* grew under aerobic conditions, whereas *S. nocolor* and *S. greenicus* required anaerobic conditions.
Guidelines for Using Text vs Tables vs Figures to Display Data

Uses of Tables

- Present large amounts of detailed quantitative information in a smaller space than would be required in text
- Demonstrate detailed item-to-item comparisons
- Display many quantitative values simultaneously
- Display individual data values precisely
- Demonstrate complex relationships in data
Guidelines for Using Text vs Tables vs Figures to Display Data

Uses of Figures


- Highlight patterns or trends in data
- Demonstrate changes or differences over time
- Display complex relationships among variables
- Clarify or explain methods
- Provide visual data to explain findings (e.g., slides, photographs, maps)
- Illustrate concepts, mechanisms, pathophysiology
Results – Writing Strategies

1. Tables and Figures - Macro guidelines

- Present results as text, table, or figure. Avoid redundancy.
- If the result can be described clearly and succinctly in the text, then do so.
- Tables and figures must stand alone, independent of text.
- Every table and figure must have a clear purpose.
### Purpose of tables in clinical research

1. Report subject characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Men    (n=594)</th>
<th>Women (n=600)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body weight (kg)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>History of diabetes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>History of coronary artery disease</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Purpose of tables in clinical research

2. Compare groups

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Asthma (n=51)</th>
<th>COPD (n=62)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forced expiratory volume (units)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak expiratory flow (L/min)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prednisone dose (mg/day)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Purpose of tables in clinical research

## 3. Report multivariate results

Table 1. Independent predictors of coronary heart disease among 2124 middle-aged subjects

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Relative risk</th>
<th>95% CI</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serum cholesterol (per 20 mg/dL)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systolic blood pressure (per 10 mm Hg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current smoker (vs. never smoked)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Tables

Before and After example
3. Tables and Figures - Macro guidelines

- Tables – Avoid data dumping from your research notebook.

- Figures – Ask yourself: What information is being conveyed? Is this the only or best way to present it?

- Combine similar tables; create “multipart” figures

- Preparation tips: see Lang and Secic (2006), Style Guides (AMA, APA), other readings
Results – Writing Strategies

2. Depth, level of detail - *Completeness*

- Raw data are seldom reported
- Instead, outcomes of appropriate statistical tests and calculations
2. Depth, level of detail - Completeness

- Take advantage of reporting guidelines

CONSORT SAYS: For an RCT, provide schematic summary of trial to identify number and disposition of participants at each stage of the study.
STROBE – Observational Results

Main results

- Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% CI). Make clear which confounders were adjusted for and why they were included.

- Report category boundaries when continuous variables were categorized.

- If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period.
3a. Organization (overall) - *Fluency*

- Typically most important to least important
  - Main question or outcome
  - Secondary aims or outcomes

- Sometimes chronological

- Follow order of methods
Results – Writing Strategies

3a. Organization (overall) - Fluency

- Use descriptive subheadings – Time points
  - Baseline (pre-test) sample characteristics
  - Pre-/post-test follow-up comparisons
  - Pre-test/three-month follow-up comparisons
Results – Writing Strategies

3a. Organization (overall) - Fluency

- Use descriptive subheads – Groups
  - Normal Volunteers
  - Stroke Patient Cohort

Results – Writing Strategies

3a. Organization (overall) - *Fluency*

- Use descriptive subheads – *Outcomes*
  
  - Patient characteristics
  - Effects on blood pressure
  - Effects on LDL cholesterol
  - Effects on Framingham risk score and estimated 10-year risk of coronary heart disease
  - Safety evaluation
  - Clinical laboratory test abnormalities

Results – Writing Strategies

3b. Organization (paragraph level) - Clarity

- Present general result in first sentence, then explanatory details.
- Focus on the overall finding. Subordinate numerical details that support the finding.
The 2 weight loss diets differed as intended in their effect on postprandial glycemia and insulinemia.

Incremental area under the curves for glucose (mean [SE], 2706 [394] vs 1070 [336] mg/dL per minute, \( P = .003 \)) and insulin (5581 [859] vs 2044 [733] \( \mu \)IU/mL per minute, \( P = .003 \)) were more than 2-fold greater for test meals from the low-fat vs low-glycemic load diet groups, respectively.
Example  JAMA 2004;292(20):2482-2490

Participants in the low–glycemic load group reported less hunger than those in the low-fat group in response to the question, asked each day before lunch, “How hungry have you been over the past 24 hours?” (mean [SD], 3.3 [0.28] vs 4.2 [0.3] units; \( P = .04 \)).
### Research paper as critical argument

<table>
<thead>
<tr>
<th>Section of research paper</th>
<th>Element of critical argument</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>Problem (question)</td>
</tr>
<tr>
<td><em>Results</em></td>
<td>Evidence <em>(the data); initial answer</em></td>
</tr>
<tr>
<td><em>Materials and methods</em></td>
<td>Credibility of evidence</td>
</tr>
<tr>
<td>Discussion and Conclusion</td>
<td>Your valid evidence; supporting evidence from others; contradictory evidence; final assessment of all evidence. Answer!</td>
</tr>
</tbody>
</table>

Evaluation!
Recommended Reading