About Reading
Scientific Studies
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About Reading Scientific Studies

Why are these skills important?

- Scientific studies provide current findings, which have gone through an extensive peer review; however, they also provide ideas and data that can be researched further. Having the ability to effectively critique scientific studies allows the reader to determine whether the study warrants further investigation.

Create a Checklist

Introduction

- In this topic, we will cover each of the sections of a scientific paper. During the process, we will also generate a checklist, which will indicate items to consider when appraising a scientific study. Not surprisingly, all papers will have a different look and feel, but most successful publications will have essential qualities in common.

- The following are the sections that will be covered:

  1) Abstract
  2) Introduction/Objectives
  3) Methods
  4) Statistical Analysis
  5) Results
  6) Discussion

Abstract

- The abstract concisely summarizes the study, while addressing the following:

  - purpose
  - methods
  - sample
  - results
  - conclusions
In essence, the abstract allows the reader to determine whether the study is of interest to him/her.

**Background**

In the introduction, background information should:

- Be wide-ranging, but concise
- Consider a number of previous scientific sources
- Justify conducting the study and give a strong theoretical layout for the study

The remainder of the introduction should include:

- A clear purpose to the study
- Identification of any relevant variables
- Clarifying definitions of scientific terms
- Well-defined hypothesis(es) and/or research question(s)
- Objectives that are Specific, Measureable, Achievable, Realistic and Time-oriented (aka SMART objectives)

**Methods**

Below is a list of questions to consider when reading the methods section of a study:

- Does the design of the study suit its purpose?
- Are the sample size and sampling method appropriate?
- Are there criteria for inclusion in the sample?
- Has the study met ethics requirements?
- Is the setting of the study suitably reported?
- Was there any reasoning behind the selection of study instrument(s), where applicable?
- Have the instruments being used been shown to be valid and reliable? Is there evidence in support of this?
- Are the pros and cons of the instrument(s) outlined?
- Do the authors mention how they administered the instrument(s)?
- Has the instrument(s) been used in a pilot study?
- Is the data collection employed appropriate to the study?
**Statistical Analysis**

- The statistical techniques used should be:
  - Relevant to the study data (e.g. when more than one explanatory variable is present, a multiple regression is undertaken)
  - Transformed if the data does not follow a normal distribution
  - Described and any assumptions made plainly outlined

**Results**

- Data in tables and graphs should have:
  - Clear, descriptive labelling
  - Appropriate scaling
  - A legend
  - The ability to stand on their own, without need to refer to the text

- Additionally, one might ask:
  - Are the results clear, unbiased and sufficiently detailed?
  - Is the number of tables/figures adequate?
  - Are the results internally consistent?

**Discussion**

- Consider the following questions when reading the discussion section of a study:
  - Is the significance of the findings discussed?
  - Are the findings associated with the theoretical framework?
  - Are the findings related back to previous research?
  - Are the conclusions related to the study hypothesis and objectives?
  - Are the future implications of the research mentioned?
Determining Study Design

Study Designs

- There are 5 basic study designs that will be discussed in this section. It is important to understand the differences between study designs, in order to determine whether the researchers made the appropriate choice in terms of their objectives and study goals. There are also pros and cons of each design that you need to be aware of when critically appraising scientific studies. The 5 basic study designs being discussed are:

  1) Case-series (clinical and population)
  2) Cross-sectional
  3) Case-control
  4) Cohort (prospective and retrospective)
  5) Trials

Case-Series Studies

- The essential concept governing case-series studies is to quantify "cases" and to relate them back to population data.

- Clinical case-series are typically developed by individual clinicians and represent a register of cases.

- Population case-series represent a register of cases for ALL clinicians in the location of interest.

- Case-series designs are of value in that they illustrate patterns of disease, allowing hypotheses to be developed. However, they are often open to interpretation, due to the number of clinicians providing data.

Cross-Sectional Studies

- A cross-sectional study considers information on a sample at a single point in time. Further, the study will ideally focus on a particular geographic area.
• Cross-sectional studies permit the researcher to calculate incidence (i.e. the number of new cases of a disease/condition at a given time). Unfortunately, these studies only provide a "snapshot," making it difficult to measure long-term effects.

**Case-Control Studies**

• The essential concept governing case-control studies is to compare the similarities and differences between lists of cases and non-cases.

• Cases and controls are paired, such that the pairs are as alike as possible (e.g. cases are often matched for age and sex with controls to reduce the risk of confounding). Risk factors (e.g. odds ratios) are computed after having compared cases to controls.

• Pairing cases and controls reduces the number of confounding variables, but there is a chance of "overpairing", which can cause some associations to be overlooked.

**Cohort Studies**

• A cohort study follows the study population over an extended period of time (days, weeks, years). Synonyms for this type of study include longitudinal and prospective studies.

• The concept is to follow the potential of a particular disease or risk factor(s) in the subjects, leading to the common description of cohort studies as being analytic. Along these lines, cohort designs can be a tool for determining incidence rates.

• When using historical data to establish the cohort, the study is known as a retrospective one.

**Trials**

• Trials are interventions used within a population, with results being measured during a later follow-up.
• Trials have a similar design to cohort studies, with one key difference: the researcher has intentionally changed the exposure aspect of the study.

• Trials involve selecting a study sample from the target population, and splitting it into an intervention group and a control group. Random assignment to groups can be made through "blinding," in which neither the investigator nor the study participant is aware of group assignments. This is known as a blind, randomized, controlled trial.

**Introduction to Validity and Reliability**

*Validity and Reliability: An Introduction*

• In considering the methods section of a scientific paper, one must weigh the measures/instruments used.
  
  -Are they VALIDATED?
  -Are they RELIABLE?

• VALIDITY judges the precision of a measure.

• RELIABILITY judges the consistency of a measure.

*Types of Validity*

• Face Validity: A subjective judgment of whether, on its "face," the study measures what it purports to measure.

• Content Validity: A measure of the ability of a study to represent all of the content of a certain construct.

• Jury Opinion: A determination of whether particular measurements are appropriate to the study, as decided by a panel of knowledgeable researchers.
• Criterion Validity: A measure of correlation between a study measurement and measurement known to accurately measure the desired variable. This is broken over two types:
  1) Concurrent Validity: Compares the measurement device being used to some existing measurement device.
  2) Predictive Validity: Considers the ability of a measurement device to predict some future event.

**Types of Reliability**

• Typically, a valid measure is considered to be reliable; however, reliability is often measured as a form of support to validity.

• Test-Retest: This involves administering the same measure to the same sample at two points in time. This provides two scores on the measure, which can be correlated to find their association. What is known as "Multiple testing effects" may happen if test subjects recall their responses to the first measurement.

• Multiple Forms: This is used in testing the reliability of multiple scales. Two or more different, but equivalent, scales are developed (e.g. different questions). These scales are then administered consecutively in one session.

• Split-Half: A single scale is administered in a single session, and then randomly divided into even halves. Following the division, each half is treated as a separate scale, in measuring reliability.
Statistical vs. Practical Significance

Statistical vs. Practical Significance: An Introduction

- Results deemed to be statistically "significant" may not be "significant" in a practical sense. Regardless of whether or not the results of a test are statistically significant, examining a confidence interval will be useful in determining the magnitude of the effect. The width of the confidence interval communicates the uncertainty of the results in the given sample.

Can you believe what you read in the news?

- "A recent study has just revealed that taking a calcium supplement every day reduces the risk of breast cancer!"

If this sounds too good to be true, it probably is! Before trusting announcements of major breakthroughs, ask the following:

- Is there strong evidence of a causal relationship?
- Is practical significance evidenced?
- Is the chosen sample representative of the target population?

Warning Signs

- The word "significant" may be used in an attempt to suggest that the effect or relationship found is an important one; however, it is necessary to distinguish between the use of "significant" in a practical sense versus the use of "significant" in a statistical sense.

- For studies having used a large sample size, relationships that are statistically significant may not be practically significant. As a general rule, almost any null hypothesis can be rejected if the sample size is large enough.

- For a study having found "no difference" or "no relationship," determine the sample size used. Barring the use of a large sample size, an important relationship may well exist in the population, with the data collected being insufficient to have identified it.
● When you can, know what confidence interval coincides with the hypothesis test, if any. This will hopefully give you a better idea of the magnitude of the potential difference or relationship.

● The media tends to have a bias toward "sexy" findings, while ignoring results in opposition to the findings. Be vigilant when reading reports on multiple studies, in which only a few results are identified as being "significant."
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<tr>
<th><strong>Glossary</strong></th>
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