Reading the Dental Literature: Just the Basics

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Introduction

Original research, literature reviews, expert opinions, and editorials contribute to the advancement of clinical professions. To remain current, dental professionals must have a good understanding of new knowledge related to oral health. Therefore professionals must have the ability to evaluate the value of various publications, and determine the relevance to clinical practice.

The purpose of this course is to give a brief overview of critical review of scientific publications. This course is not intended to be an in-depth study in the scientific method or the science of producing and reporting research. Rather, it is intended to lay the foundation for interpreting current, relevant dental research so that clinicians can use appropriate publications for clinical decision making. More information on critical literature review is available from:


Publication Fundamentals

Parts of a Research Article

Most scientific publications follow a standard format:

- Introduction/Background
- Methods and Materials
- Results
- Conclusion/Discussion

There will be variations depending on the topic and journal. Readers should be aware of the different types of information that are typically included in each section.

Review “Parts of a Research Article” for a summary and considerations for each section \(^1,2\).
## Parts of a Research Article

<table>
<thead>
<tr>
<th>Part</th>
<th>Includes</th>
<th>Purpose</th>
<th>Look For</th>
</tr>
</thead>
</table>
| **Introduction**    | 1. Problem statement  
2. Background or previous research  
3. Basic assumptions  
4. Research question | 1. Create interest in the study  
2. Lay the foundation  
3. Identify the gaps in the current knowledge and the need for the research | 1. Adequate foundation: are the references current?  
2. Basic assumptions  
3. Clear purpose for the study  
4. Evidence of bias |
| **Method and Materials** | 1. Subjects  
2. Method of subject selection  
3. Indices, scales, methods of measurement  
4. Sample size  
5. Relevant information about sample  
6. Description of process followed by researchers | 1. Identifies attempts to control threats to internal and external validity  
2. Allows the research to be replicated  
3. Allows evaluation of appropriateness of statistical tests and conclusions | 1. Clear description of methods  
2. Threats to internal validity: bias, errors  
3. Is the sample representative?  
4. Sample size  
5. Method of sample selection  
6. Location of the study  
7. Standards/ Definitions |
| **Results**         | 1. Sterile report of findings  
2. Charts  
3. Graphs | 1. Shows the researchers' findings without comment  
2. Allows reader to evaluate the findings | 1. Clear report  
2. Statistical methods-appropriateness |
| **Conclusion/ Discussion** | 1. Draws conclusions from results section  
2. Relates results to previous research  
3. Speculates on meaning of findings | 1. Provides an answer to research question  
2. Identifies relevance of research  
3. Identifies further gaps in the knowledge | 1. Are the conclusions supported by the data?  
2. Was the research question answered?  
3. Which conclusions are supported by the research and which are speculation? |

Table 1
Where is the Article Published?

The highest publication standard for scientific studies is the peer reviewed journal. Peer reviewed means the manuscripts have been sent to experts who have evaluated the study design and strength of the conclusions. Comments are frequently sent to the authors for consideration and revision before the study is published. Check the journal for a list of the Editorial Board. Articles in peer reviewed journals have the advantage of a strict evaluation process by experts in the field. This process increases the potential scientific merit but these articles should still be read with a critical view.

Other publications or media such as commercial professional publications or the popular press may have value, even if the articles have not been peer reviewed. The reader should evaluate the scientific merit of each article. There may be a valuable commentary on a process or expert opinion. In some cases the articles in non-peer reviewed publication will have a solid study design with very valid conclusions.

Examples of:

Peer Reviewed Journals:
- Journal of the American Dental Association
- Journal of Public Health Dentistry

Commercial Professional Publications
- Dentistry Today
- Dental Economics
- RDH magazine

Popular Press
- Newspapers
- Television or radio
Types of Articles

In scientific literature, there are two basic types of articles: primary and secondary. The most obvious distinction is that a primary article reports original research and a secondary article summarizes or comments on original research. Of course, this greatly oversimplifies publication types, and there are subcategories within each publication type. Systematic reviews have some features of both primary and secondary research. Common types of publications are listed in the summary below with related strengths and weaknesses of each.

### Article Type Summary

<table>
<thead>
<tr>
<th>Source</th>
<th>Example</th>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>1. Original Research</td>
<td>1. Includes a full description of research</td>
<td>1. Scope is limited</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Focused</td>
<td>2. May not be generalizable to other populations or times</td>
</tr>
<tr>
<td>Secondary</td>
<td>1. Review articles</td>
<td>1. Includes relevant material from other studies</td>
<td>1. Unable to evaluate appropriateness of study</td>
</tr>
<tr>
<td></td>
<td>2. Commentary</td>
<td>2. Presents studies conducted over a period of time</td>
<td>2. May present only one point of view</td>
</tr>
<tr>
<td></td>
<td>3. Review of procedure</td>
<td></td>
<td>3. Slow to change</td>
</tr>
<tr>
<td></td>
<td>4. Text books</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systemic Reviews</td>
<td>1. Clinical Queries</td>
<td>1. Evaluates the quality of the studies</td>
<td>1. Few studies meet inclusion criteria</td>
</tr>
<tr>
<td>Have features of both</td>
<td>2. Systemic Reviews</td>
<td></td>
<td>2. Frequently does not include strong recommendations</td>
</tr>
<tr>
<td>primary and secondary</td>
<td>3. Meta-analysis</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2
Study Design

The term “study design” refers to the methods and materials used by the researchers. The “gold standard” study design is the randomized clinical trial (RCT). This is the preferred design for clinical questions because it addresses a focused and precise clinical question, participants are randomized into experimental and control groups, and the participants are followed through time. Conclusions drawn from a RCT are very strong and usually demonstrate cause and effect.

However, not all research questions can be addressed through a RCT. This type of study is very expensive, may be unethical, may not be the best design to investigate social phenomenon, or may not represent a real life situation. In such cases, quasi-experimental designs may be used.

Each study design has strengths and weaknesses. There are no perfect studies that address all possible validity threats. See Table 3 for a summary of the most commonly used study designs and the related strengths and weaknesses.

Study Design Considerations

Consider the following research question:

*What is the impact of a nighttime bottle on Early Childhood Caries?*

Because most dental professionals agree that nighttime bottles contribute to ECC, it would be unethical to randomized children into “Bottle” and “No-bottle” experimental groups. Therefore, researchers may select a quasi-experimental design, such as a case control study, to test various hypotheses. In a case control study, cases (children with ECC) and controls (children without ECC) would be included in the study. Parents would be questioned about previous behaviors including nighttime bottles and other known risk factors for ECC. The data would then be analyzed to see if reported nighttime bottle use was different in the cases and controls.

In other cases, the randomized clinical trial may not be appropriate to answer the research question. Consider this research question:

*Is the dental workforce adequate to serve the population?*

In this case a descriptive study of the number of dental offices and dental professionals within a geographic location is needed. Researchers may also choose to include related questions such as: type of practice (specialty or general), years in practice, type of insurance accepted, or types of practitioners (dentists, hygienists, expanded function auxiliaries, other). Each of these would add depth to the study, but it would still be a
descriptive design. Often, descriptive studies are considered surveillance and not true research. However, this type of surveillance is often reported in professional journals.

**Qualitative Designs**

The major difference between quantitative and qualitative research is that the first answers the question *What happened?* The second answers the questions *How or Why did something happen?* Quantitative design uses deductive reasoning, qualitative uses inductive reasoning. Qualitative studies usually have a small number of subjects, those subjects are not representative of a larger group, and are selected purposefully (not randomly). The results of qualitative research are used to validate a theory, identify previously unknown risk factors, explain common behaviors, or generate a new theory to be tested.

Some research may report some unexpected findings. To explain such unexpected results, researchers may choose a qualitative design, such as Grounded Theory. This type of study would not start with pre-determined assumptions or a hypothesis. Rather, researchers would gather data on a topic of interest from open ended interviews, focus groups, observations, case studies with common features, or other flexible sources. Researchers may then identify common themes to generate a hypotheses that can be tested through quantitative designs.

Even though qualitative studies seem less structured than quantitative, researchers follow strict study protocols and reporting mechanisms. Readers should evaluate qualitative research with the same critical eye to determine the scientific merit of the study. 5

Hierarchy of Quality for Scientific Information

Study design will affect the ability to make cause-effect conclusions and the strength of those conclusions. The generally accepted hierarchy of study designs from strongest to weakest is:

1. Randomized clinical trials (RCT)
2. Experiments with concurrent controls, but without some elements found in RCT
3. Well controlled cohort and case-controlled studies
4. Clinical trials without concurrent controls
5. Retrospective cross-sectional studies without controls
6. Descriptive studies
7. Case reports
8. Personal opinions or editorials

In 2002 the Agency for Healthcare Research and Quality rated the strength of evaluating research findings from strongest to weakest as:

1. Systematic reviews
2. Randomized clinical trials
3. Observational studies
4. Diagnostic test studies

Ecological Fallacy

At times researchers will examine the characteristics of a community to determine population based risks. Results from these descriptive studies can indicate clusters of disease or risk factors and are often used to generate hypotheses for studies to determine individual’s risks. However, conclusions from such population based studies CANNOT be applied to individuals. This practice is called the Ecological Fallacy. This occurs when population statistics are used to predict risks in individuals. The fallacy assumes that individuals in the population have average characteristics observed in the larger group. But within a group, great variations occur between individuals, so even accurate descriptions of a group may not describe each individual in the group.

Example: A fluoridated city has high cancer rates therefore fluoride increases the risk of cancer.

Other questions:
How long did cancer patients live in the area? Did they drink the fluoridated water? What were their other risk factors? What types of cancer occurred? Comparing individuals with equal exposure to fluoridated water, was there increased risk of cancer?
## Basic Study Designs

<table>
<thead>
<tr>
<th>Study Design</th>
<th>Examples</th>
<th>Characteristics</th>
<th>Strengths</th>
<th>Weaknesses</th>
<th>Purpose</th>
</tr>
</thead>
</table>

Table 3
Study Design Definitions

Experimental

Pretest-Intervention-Posttest

Participants are evaluated at the beginning and the end of the study. Subjects are assigned to intervention or control groups. This design is commonly used to measure knowledge, attitudes, or behaviors. Multiple interventions or contributing factors can be tested using this design.

Randomized Clinical Trial

This is considered the gold standard for clinical research. Subjects are randomly assigned to intervention or control groups. The focus is typically very narrow and focused. Ethical considerations are the primary obstacle to using this method. Subjects cannot be ethically randomized to groups that withhold effective treatment, or expose subjects to known risks.

Cross Over

Subjects are assigned to experimental and control groups. After a time period, the intervention is discontinued. Then subjects are assigned to the other group. This is commonly used for reversible conditions such as gingivitis.

Quasi-Experimental

Cohort

A group of people with a common characteristic is followed through time. Commonly studied cohorts are birth cohorts (people born in the same year or same decade), exposures (people with a common exposure such as smokers), or employment (people working under similar working conditions such as coal miners).

Case-Control

Individuals with a condition or disease (cases) are compared to individuals without that condition or disease (controls). The cases and controls should be as similar as possible in all other respects (same age groups, socioeconomic status and education levels, and live in similar locations). Previous exposures are then examined to determine if those exposures differ between the cases and controls.

Time Series

Similar cross sectional studies or surveys are repeated at regular time intervals. Differences in findings may be compared to environmental, social, or political changes.
For example, a surveillance survey conducted every 3 years will show changes in decay rates. Comparing those changes to other events, such as beginning water fluoridation or a sealant program, may indicate an association between those events and changing health status. Such associations may not be conclusive, but could be used to develop hypotheses that can be tested through more definitive study designs.

**Case Series or Reports**

These reports are used for new or unusual diseases or conditions. These may be a clinical report of one or more patients, or it could be a report of a community. Typically the reports include all of the relevant clinical findings. Case reports have successfully identified emerging disease trends. It was early reports of men with compromised immune systems that lead to a deeper understanding of HIV/AIDS. Case reports may have features more common in qualitative then quantitative research.

**Descriptive**

These studies are sometimes considered surveillance or public health practice rather than true research. Descriptive reports are an important part of the body of scientific literature and are frequently included in professional journals. Epidemiological surveys, oral health status surveys, manpower investigations, and some cross sectional studies describe, rather than determine causality. If trends are revealed in surveys, researchers may use that information to generate a hypothesis to test through experimental or quasi-experimental means.

**Qualitative Designs**

- **Phenomenology**
  
  Examines a particular event or life experience.

- **Ethnography**
  
  Examines the influence of culture or location.

- **Grounded Theory**
  
  Evidence is gathered without the framework of a pre-existing theory. Researchers then examine the data and either match the findings to an existing theory or develop a new theory based on observed findings.

- **Single or Multiple Case Studies**
  
  Report new or unusual cases that do not conform to existing knowledge or theory. Can be used to test the application of current theories or generate a new theory.
Validity

Internal Validity- The degree to which the study tested what was intended \(^4,7\).

Most common threats to internal validity\(^4\):
- **Selection Bias**- the sample chosen is not representative of the population from which it is drawn or one group is systematically different from the another group
  - Examples:
    1. A telephone survey would systematically eliminate all people without phones or with unlisted numbers
    2. A search using insurance data would systematically eliminate all people without insurance coverage
    3. Non-randomization- people might be assigned to the experimental or control group systematically- other factors might affect the outcome

**Measurement Error**- study does not measure what was intended
- Examples:
  1. Measurement instruments are not accurate or do not measure the area of interest of the study (probing depths would indicate periodontal disease history but not measure active disease)
  2. Failure to calibrate examiners may yield systematically different results
  3. Failure to set well defined parameters may lead to different interpretations by different examiners or by the same examiners at different times
  4. Failure to include all relevant risk factors
- **Recall Bias**- People do not accurately remember events- especially a problem in case control studies
- **Ambiguity about the Direction of Causal Inference**: Which came first, the chicken or the egg?
  1. Is there a temporal difference?
  2. Does it make sense biologically?
  3. Is there a dose response?

Other threats to Validity:
- **History**: Other events happening at the same time of the study influence the results
- **Maturation and Testing**: People become older, wiser, or more experienced during the course of the study or get better at taking the tests
- **“Hawthorne Effect”**: Subjects act differently because they are a part of a study
External Validity - How generalizable are the results of the study?

Even with excellent internal validity, the results may not be applicable to your population of interest due to systematic differences.

Considerations for External Validity:

- Populations:
  1. Can the results be generalized across the population?
  2. Can the results be generalized to certain subpopulations within the study population?
  3. Can the results be generalized to different age groups within the same population?

- Settings:
  1. Was the study done in a particular setting? e.g. prisons, schools, inner city
  2. How was selection affected by setting? (volunteers, paid subjects)

- Temporal:
  1. Can the results be generalized to different points in time? Are there differences in disease rates, treatment or prevention for the disease, medical knowledge, insurance coverage, access to care, attitudes toward health or responsibility
Efficacy vs Effectiveness

Efficacy is how well an intervention works under ideal test conditions. Effectiveness is how well the intervention works under routine conditions.

Why does that matter?
A study may report reliable results when the intervention was highly supervised, ensuring that the dosages and procedures were strictly followed. This would demonstrate efficacy, or the intervention has the potential to work. But, will the intervention perform as well in day-to-day conditions?

Clinicians may read about highly efficacious interventions in the scientific literature. Then in clinical decision making, the clinician must use his/her own knowledge and experience to decide if similarly effective results can reasonably be expected under normal, routine conditions.

Example:
Xylitol gum reduces dental decay in school children when the gum is chewed for 5 times a day for 5 minutes. This ensures a minimum dose of xylitol exposure each day. If the gum is distributed to pregnant women who are instructed to chew the gum daily, can you expect the same outcome? The difference in results would be the difference between efficacy and effectiveness.

Incidence vs Prevalence

Incidence is a measure of NEW CASES, and prevalence is a measure of ALL EXISTING CASES. Clinicians should consider the disease/condition under study to decide which of these measures has greater meaning.

Example 1:
If an intervention seeks to reduce the INCIDENCE of early childhood caries, that means the percentage of children that NEVER HAD A CAVITY will increase. In a Basic Screening Survey incidence of decay would be reported a “Caries History” or a DMFT of 0.

If the researchers measure Decayed, Missing, and Filled Teeth (DMFT) or dmft greater than 0, they are measuring the PREVALENCE of decay, or how much decay history exists within the population.

Example 2:
It is extremely difficult to measure incidence of periodontal disease by measuring periodontal pockets. If may be impossible to distinguish between new pockets (incidence) and historical or inactive pockets (prevalence).
Common Threats to Internal and External Validity by Study Design

<table>
<thead>
<tr>
<th>Study Type</th>
<th>Internal</th>
<th>External</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>Non-randomization</td>
<td>Population</td>
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<tr>
<td></td>
<td>Measurement Error</td>
<td>Temporal</td>
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<td></td>
<td>Hawthorne Effect</td>
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<td></td>
<td>Selection</td>
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<tr>
<td>Cohort (Prospective)</td>
<td>Measurement Error</td>
<td>Population</td>
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<tr>
<td></td>
<td>History</td>
<td>Setting</td>
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<tr>
<td></td>
<td>Maturation and testing</td>
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<td></td>
<td>Hawthorne Effect</td>
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<tr>
<td>Case-Control</td>
<td>Recall Bias</td>
<td>Population</td>
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<td>Selection</td>
<td>Age group</td>
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<td>Setting</td>
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<td>Time Series</td>
<td>Measurement Error</td>
<td>Population</td>
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<tr>
<td>Case series</td>
<td>Cause-Effect Ambiguity</td>
<td>Population</td>
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<tr>
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<td>Recall Bias</td>
<td>Setting</td>
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<td></td>
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<td>Temporal</td>
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<tr>
<td>Case Report</td>
<td>Cause-Effect Ambiguity</td>
<td>Population</td>
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<td></td>
<td>Recall Bias</td>
<td>Setting</td>
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<tr>
<td>Descriptive</td>
<td>Cause-Effect (Has none)</td>
<td>Population, subpopulations</td>
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<tr>
<td></td>
<td>Selection</td>
<td>Setting</td>
</tr>
<tr>
<td></td>
<td>Measurement Error</td>
<td>Temporal</td>
</tr>
</tbody>
</table>

Table 4
Statistics

Statistics that are reported in quantitative research usually reveal the probability that the observed outcome happened as a result of the interventions and not as a result of normal variations among the population to be studied or the study participants. Research rarely includes ALL of the possible test subjects. Normally a sample of subjects are chosen that represent the population of interest. Because the study includes only a small sample of the population, it is very important that that sample is representative, or does not systematically vary from the larger population. It is also important that the results of the study are attributable to the intervention, and not due to normal variations. In other words, statistics are used to measure the likelihood that the observed outcome is DUE TO the intervention, and did not happen by chance and chance alone.

Sample Size

All statistics report probability. Therefore a very small sample size is important because each data point will influence the outcome. With more data points, each individual data point has less influence.

An intervention may not reach statistical significance ONLY because the sample size was too small to detect small but consistent differences. Sometimes, only a meta-analysis that combines the results of several studies, will detect statistical significance.

Some types of dental studies, such as periodontal studies, frequently have less than 50 participants. It is important to consider the number of participants when evaluating the importance of the study results.

Statistical Significance

Statistical significance can be considered a consistent difference due to the influence of the intervention, even if the magnitude of that difference is very small. By convention, statistical significance has been set at .05, meaning that there is at least a 95% likelihood that the outcome happened because of the intervention, and would not have occurred simply by normal variations. If the statistics show a p value of .06, the researchers will often state the results, “approached significance”, but will not claim statistical significance.
Clinical Significance

Frequently a test will reach statistical significance, which means the result is BECAUSE of the intervention and not due to chance, but that result is not clinically significant.

Example:

A periodontal intervention will result in an attachment gain of 0.3mm. This result will happen almost every time, so the results are statistically significant, because the outcome will occur more than 95% of the time. This may be very important to researchers that want to test the reliability of an intervention. But, how much will a clinician care about a 0.3mm attachment gain? This has almost no clinical significance. So clinicians must decide if the statistically significant results have meaning in a clinical setting and if the study results can be used for clinical decision making.

Sensitivity and Specificity

Sensitivity and specificity may be reported in relation to screening or diagnostic tests. The reader must evaluate the relative importance of each of these.

Sensitivity: The likelihood that the test will reveal a true positive
Specificity: The likelihood that the test will reveal a true negative

Example:

Dental radiographs are an example of a test that has high sensitivity but low specificity. If a radiograph shows a carious lesion, it is very likely that a lesion truly exists. But, if a radiograph shows sound enamel, it is still likely that an undetected lesion exists. This may be due to the angle of the x-ray or the lesion is not visible because of an existing restoration.

Therefore, x-rays are sensitive (a positive is very likely to be positive), but not as specific (a negative is not necessarily negative).
Common Statistical Terms

It is very likely that other statistical tests will be used in reporting scientific results. The tests listed here represent the most commonly used statistical tests. It is beyond the scope of this course to explain how the test results are derived. The only intent of this section is to explain the utility of a particular statistical test and offer an explanation of how to read the results.

Analysis of Variance (ANOVA)

Measures the difference means (averages) of populations from several samples against how much a single variable differs over several categories. The test is a ratio of the variations within each group compared to variations between groups. Answers the question, “Is there significantly more variation among the groups that there is within each group?”

Why is that useful?

If the study is to test the effectiveness of an intervention in several different groups, then the researchers want to make sure the outcome is based on the difference in the intervention studied, not because the groups varied. If the ANOVA shows that the results were consistent within each group, but the groups themselves differed, then the logical conclusion is that the outcome is due to the intervention, not due to variation among test subjects within each group.

How to interpret:

A significant ANOVA (reported as a p value) means that the result is due to the different interventions done in each group, and not due to variations among test subjects within each group.

Chi Square ($\chi^2$)

Used with categorical data. Chi square tests for the difference between the expected values and the observed values. The expected values would be the normal distribution, without any outside influence.

How to interpret:

If there is a significance difference between expected and observed, (reported as a p value), then the observed outcome is likely due to the intervention, and not due to normally occurring variations.
Confidence Interval (CI)

An estimate of the probability that the average range of values for the entire population falls between an upper and lower point.

Example:

95% Confidence interval: -0.03 to .08

How to interpret:
There is a 95% probability that the average range of values in the general population, falls between -0.03 and 0.08.

Correlation

Measures for an association between two variables.

How to interpret:
A significant correlation (or association) between 2 variables (reported as a p value) means that they consistently occurred at the same time. Correlation DOES NOT imply causality because it does not account for cause and effect.

Linear Regression Analysis

A means of predicting the relative influence of several variables in a single model. Several variables can be tested (or controlled for) at one time. Both continuous and categorical data may be included in a single model.

Dependent variable- A continuous variable that is the variable of interest. Also called outcome variable. This is presented on the left side of the equal sign in the mathematic model.

Independent variable(s)- other variables that will affect the dependent variable. May be either continuous or categorical. Presented on the right side of the equal sign in the mathematic model.

R²- Tells the percentage of variation explained by the model. The larger the R², the more accurate the model

F-statistic- tells the overall significance of the regression model. The larger the F, the more accurate the model.

Partial F- tells how much each individual variable contributes to the overall model

Partial p- tells how significant each individual variable is the overall model
How to Interpret Regression coefficients and intercept:

Negative coefficients:
Indicates an inverse relationship (as one gets bigger, the other gets smaller)

Continuous variables:
Holding all other variables constant, a 1 unit increase in the independent variable will result in the coefficient’s value increase in the dependent variable

Indicator (categorical) Variables:
The value of the coefficient is the difference in the mean of the variable and the excluded group

Intercept- the value of the dependent variable if all of the independent variables were 0

Logistic Regression Analysis

Similar to linear regression analysis except that the outcome variable is dichotomous (0 or 1). The value of each coefficient is the log of the probability of success divided by the probability of failure.

How to Interpret coefficients:

Holding all other independent variables constant, with a 1 unit increase in the variable, the odds of success will change by the log of the coefficient.

Odds Ratio (OR)

The chance of getting a disease, regardless of exposure.

How to read:

An odds ratio of 2.1 would mean, “individuals in a certain group were 2.1 times more likely to develop the condition compared to the control group”
P-Value

The probability that the findings are from chance alone. A value of \( p < .05 \) means that there was less than a 5% chance of arriving at the findings by chance and chance alone. The usual conclusion is that the program or intervention created the difference. A value of .05 is accepted as a significant level by convention. The smaller the \( p \) value, the more significant it is.

**How to read:**

A \( p < .01 \) means, “there was less than a 1% probability that the results were due to chance and chance alone.” Therefore a logical conclusion is, “the observed outcome was very likely due to the intervention.”

Risk Ratio (RR)

The chance of getting a disease (or condition) if exposed to a risk factor.

**How to read:**

A risk ration of 2.1 would mean, “individuals exposed to a risk factor were 2.1 times more likely to develop the condition compared to the control group”

Standard Deviation (SD)

A measure of the spread of the observations.

**How to interpret:**

A large standard deviation means that the data varied greatly above and below the mean. A small standard deviation means that the data was very tight.

\( t \)-test

Tests for the significance of the difference in means. This significance of the difference will be reported as a \( p \) value.
References


