Nursing Research Series

Essentials of Science:
Methods, Appraisal and Utilization

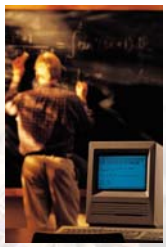
Southern California Nursing Research

Nursing Research Series
Part 12 of 20

Data Collection
Validity and Reliability

The Buck Stops Here

- Scientific Rigor
  - Function of Methods Used
    - To define the problems and develop an evidence based aims and hypothesis
    - To measure the variables with attention to potential sources of measurement error and bias.
    - To use and interpret statistical and other analysis precisely.
    - To limit generalizations.



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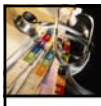
Objectives

- Describe measurement error and its impact on the research process.
- Identify how item analysis can assist in maintaining rigor of measurement instruments.
- Describe reliability & validity strategies.
- Explain the concept of responsiveness and its associated techniques.
- Clarify sensitivity and specificity.

The Reality

- No amount of enthusiasm makes up for lack of scientific rigor
- Written research proposals are chains of reasoning
- Assessing validity & reliability involves critical thinking in regards to the preponderance of the evidence.



Item Analysis

- Not usually reported in the literature unless the study is one that seeking to establishing the psychometric properties of an instrument.
- An instrument that has to many items will artificially increase the scores used in reliability testing as well as respondent fatigue.
- Goal
  - To determine that each item is measuring the concept that it intents to measure.
  - To delete items that are redundant or are measuring another concepts.
- Technique: Item to Total Correlation
  - Items that score a correlation score >0.70 are redundant of other items on the scale
  - Items that score a correlation score <0.30 are measuring a different concept from the main body of items.

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Measurement Error

- An measurement's results varies as a result of accuracy in the measurement (true scores) and other factors (commonly called error)
- The degree of deviation between true scores and obtained scores when measuring a characteristic
- Observed Data = True Score + Error ($X_O = X_T +\_ X_E$)
- Too much error can lead to misleading conclusions about study findings

Errors of Measurement

- Error score does not necessarily mean "wrong" score
- Error component is a composite of other factors that are also being measured by the researcher
- Error score includes other factors
- Example: Pain score (how much of the score is from "anxiety" around pain)?

Types of Error

- Random Error
  - Inconsistent, random variation
  - Error without qualification
  - Cannot find a pattern in error
- Systematic Error
  - Consistent error, not random
  - Bias
  - Has a consistent pattern

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Sources of Measurement Error

- Situational Contaminants
  - Was there disruptions during the measurement?
- Response-Set Bias
  - Where a respondent always chooses the same answer or one that they believe the investigators want
- Transitory Personal Factors
  - Such as a headache, or increased stress
- Administration Variations
  - Are score different at different times of the year?
- Instrument Clarity
  - Was the instrument written at the correct literacy level?
- Response Sampling
  - Was the convenience sample biased in some way such as all female?

Reliability: Data Collection

- Degree of consistency with repeated measurements

Categories of Reliability

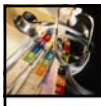
- Stability
  - Used with same people (patients) on separate occasions (over time) and get same answers
- Internal Consistency
  - All subparts/items are measuring same general thing
- Equivalence
  - Equitable results from two or more instruments or observers

Reliability: Stability

- Sometimes called test, re-test reliability
- Is the agreement of measuring instruments over time.
- To determine stability, a measure or test is repeated on the same subjects at a future date.
- Results are compared and correlated with the initial test to give a measure of stability.
- Typically the Spearman-Brown coefficient.
- Scores equal to or greater than 0.70 are usually considered sufficient.

Reliability: Internal Consistency

- This form of reliability is used to judge the consistency of results across items on the same test.
- Essentially, you are comparing test items that measure the same construct to determine the tests internal consistency.
- Statistical Techniques
  - Split-Half
    - Items are divided into 2 sections, then a correlation between the two sections is determined.
  - Cronbach's Alpha
    - The average of all possible split half reliabilities for a set of items
    - By convention, a lenient cut-off of .60 is common in exploratory research; alpha should be at least .70 or higher to retain an item in an "adequate" scale; and many researchers require a cut-off of .80 for a "good scale."



Aspects of Reliability: Equivalence

- Equivalency reliability is the extent to which two observers or items measure identical concepts at an identical level of difficulty.
- Inter-Rater Reliability
  - Are different observers using the same instrument measuring the same phenomena equivalent?
  - A statistical measure of inter-rater reliability is Cohen's Kappa
    - Ranges from -1.0 to 1.0 where
    - Large numbers mean better reliability,
    - Values near zero suggest that agreement is attributable to chance, and
    - Values less than zero signify that agreement is even less than that which could be attributed to chance.
- Instrumental Equivalency
  - Are two (presumably parallel) instruments administered at about the same time equivalent?

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Validity: Data Collection

- Degree to which a data collection instrument measures what it is supposed to be measuring.
- Validity isn't determined by a single statistic, but by a body of research that demonstrates the relationship between the test and the behavior it is intended to measure.

Reliability & Validity

- Not totally independent of each other
- An instrument that is not reliable cannot possibly be valid
  - erratic, inconsistent, inaccurate
- However, an instrument can be reliable and not valid

Levels of Validity

- There are many types of validity:
  - Face validity
  - Content validity
  - Construct validity
  - Criterion-related validity

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Validity: Face Validity

- Face validity is concerned with how a measure or procedure appears.
- Does it seem like a reasonable way to gain the information the researchers are attempting to obtain?
- Does it seem well designed?
- Does it seem as though it will work reliably?
- Unlike **content validity**, face validity does not depend on established theories for support

Validity: Content Validity

- Content validity evidence involves the degree to which the content of the test matches a content domain associated with the construct.
- Ask experts, based on judgment
  - Adequacy of the "content" area
  - Do my questions adequately get to the area of interest?
    - Yes
    - No
    - Maybe
- Content Validity Index
  - Statistical measure of agreement among the experts.

Validity: Construct Validity

- Validity of a test or a measurement tool that is established by demonstrating its ability to identify or measure the variables or constructs that it proposes to identify or measure.
- The judgment is based on the accumulation of statistical findings, usually correlations, from numerous studies using the instrument being evaluated.
- Most common strategy: Factor Analysis
  - Types
    - Exploratory
    - Confirmatory
  - How many factors did the analysis reveal?
  - What variance was explained by all of the factors?
    - Usually want to explain more than 70% of the variance.

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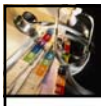
Validity: Criterion-related Validity

- A measure of how well one variable or set of variables predicts an outcome based on information from other variables.
- Criterion of comparison must be valid itself!
- Types
  - Concurrent (Known Groups)
    - A measurement/instrument is given to two divergent groups. If the measurement is valid, the scores should diverge.
  - Predictive
    - A measurements ability to predict scores on another measurement that is related or purports to measure the same or similar construct

Responsiveness

- Controversial as to whether or not this is separate from or just one type of validity.
- Looking for the effect size change of the instrument across time.
- For some investigators, it is also an assessment of an instruments:
  - Ceiling Effect
    - A ceiling effect occurs when test items aren't challenging enough for a group of individuals. Thus, the test score will not increase for a subsample of people who may have clinically improved because they have already reached the highest score that can be achieved on that test.
  - Floor Effect
    - The floor effect is when data cannot take on a value lower than some particular number. Thus, it represents a subsample for whom clinical decline may not register as a change in score, even if there is worsening of function/behavior etc.



Sensitivity & Specificity

- Assess the properties of a diagnostic instrument.
- Sensitivity and specificity describe how well the test discriminates between patients with and without disease.
- Sensitivity is the proportion of patients *with* disease who test positive.
- Specificity is the proportion of patients *without* disease who test negative.

Reliability and Validity in Qualitative Studies

Traditional Criteria for Judging Quantitative Research	Alternative Criteria for Judging Qualitative Research
internal validity	credibility
external validity	transferability
reliability	dependability
	conformability

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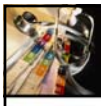

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