Research Minute

Measurement

Issue 5

Sandra Burge, Ph.D.

Most research seeks to understand ***the relationship between two phenomena***, like...

- Do group visits with families (Phenom 1) improve children's BMI (Phenom 2) ?
- Does clinic-wide training (Phenom 1) improve Zoster immunization rates (Phenom 2)?
- Is the complexity of an office visit (Phenom 1) associated with medical errors (Phenom 2)?

In research design, "***measurement***" is the method of defining concepts (Phenom 1 and Phenom 2) and assigning numbers to presence/absence/quality/severity/pathology. Measurement moves the research question from ***abstract concepts*** (such as "complexity of visits") to ***concrete definitions*** (such as "number of diagnoses") to ***numbers***, and it organizes data collection to be analysis-friendly. Good research design pays close attention to how phenomena are measured, and how they will be reported when the project is finished.

Measurement is not just about numbers. It might define a characteristic (ethnicity, gender) or a diagnosis (present or absent). Blood pressure can be measured with a pair of numbers or with a description of high or normal. Symptom severity is often measured along a scale of none-low-medium-high. We often scale pain along a continuum of 1 to 10.

Types of Scales

Categorical Scales—Nominal

This refers to variables that are defined by a description, not a number. (*Remember "nominal" = "name."*) Nominal variables include gender, ethnicity, diagnosis = present or absent, lab values = high or normal. Applying numbers to nominal scales, like ethnicity, make no sense. We cannot calculate a mean ethnicity!

Categorical Scales—Ordinal

This refers to variables that are measured in a sequence of low to high. *(Remember "ordinal" = "ordered.")* An example would be symptom severity = none-low-medium-high. We know that "medium" is higher than "low"—but how much higher? Is "high" twice as severe as low? We apply numbers to each level of severity (0-1-2-3), but the numbers are not useful as numbers. The *sequence* of points is important, but the distance between the points on the scale is not.

Continuous Scales—Interval

This refers to variables that are measured on an numeric scale, where the intervals between points are equal. You can add and subtract along the scale, but you can't divide. Examples include calendar dates and the Fahrenheit Scale. A 10-degree difference has the same meaning anywhere along the scale. But we cannot say that 80 degrees is twice as hot as 40 degrees, nor that the 4th of July is twice as late as … some other date. These scales have no 'true' zero (only arbitrary ones).

Continuous Scales—Ratio

Ratio scales have a true zero point; they are numbers on a real number scale. Ratio scales include: age, height, weight, volume, household size, annual income, blood pressure, etc. You can add, subtract, multiply, divide and those numbers will have meaning.

Tip: *When your research information is numeric, always record the actual number, rather than a range. For example, record numeric BMI rather than "underweight-normal-overweight-obese." You can always create categories from numbers, but you can't go the other way.*

Quick guideline to simple statistics, considering measurement scales

Phenom 1	Phenom 2	Statistic
Categorical	Categorical	Chi-Square
Categorical	Continuous	T-test or ANOVA
Continuous	Categorical	T-test or ANOVA
Continuous	Continuous	Correlation

burge.researchminutes@gmail.com

Art by Brian Hischier