

HSM 470
Research Methods and Data Analysis in Health Sciences

Research Variables

HSM 470 Research Variables 1

Unit Objectives

- Upon completion of this unit, the student will be able to:
 - Define concepts, conceptual definitions, and primitive terms.
 - Compare and contrast conceptual and operational definitions.
 - Compare and contrast dependent and independent variables.
 - Describe the major types of relationships between variables.
 - Explain the purpose and use of control variables.
 - List and describe 3 confounding relationships that can mimic a causal relationship.
 - Compare and contrast discrete and continuous variables.
 - Define the 4 levels of measurement of data.

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Conceptualization

- The process of formulating abstract ideas
- Examples of concepts
 - Good health
 - Neurologically intact
 - Survivability
 - Improved health

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Conceptualization continued

- Conceptual definitions
 - Example
 - Power – the ability of an actor to persuade another to perform some task the latter would not otherwise do
 - This definition of the concept of power is defined by other concepts such as persuasion and performance.
 - The concepts of persuasion and performance may be further defined by still other concepts.
 - When we reach a conceptual definition using terms that can no longer be defined by other concepts, these terms are called primitive terms.

Operational Definitions

- When primitive concepts cannot be observed directly, the empirical existence of the concept has to be inferred. Inferences of this kind are made with operational definitions. Operational definitions provide concepts with empirical referents.
- Example
 - Health improvement – perfusion status
- The researcher must operationalize all of the variables in a study such that they are unambiguous and measurable.

Dependent Variable

- The variable the researcher wishes to explain (also called the outcome variable or criterion variable)

Independent Variable

- The variable expected to explain change in the dependent variable (also called the predictor variable or explanatory variable)

Dependent and Independent Variables continued

- In mathematics, the dependent variable is the variable that appears on the left-hand side of the equation: $Y = f(x)$
- Here, Y, the dependent variable, is a function of x, the independent variable.

Dependent and Independent Variables continued

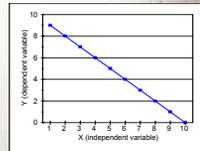
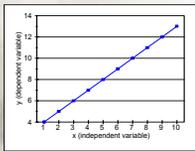
- | | |
|----------------------|--------------------------|
| • Dependent | • Independent |
| - NREMT scores | - Weekly study hours |
| - CPR survival | - Early defibrillation |
| - IV infection rates | - Alcohol/betadine preps |
| - Trauma survival | - On-scene time |
| - Professionalism | - Uniform styles |

Relationships Among Variables

- In research, we hope to define the relationship between two variables. We may or may not infer causality.
- Examples
 - Smoking leads to cancer. (causality inferred)
 - Older firefighters disapprove of medical first response. (association but not causality)
- Causality ($X \Rightarrow Y$) if:
 - There is a relationship between X and Y
 - The relationship is asymmetrical
 - A change in X leads to a change in Y, regardless of other factors.
 - Time order – a change in X occurs before the change in Y

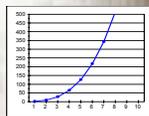
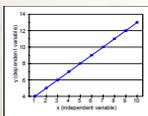
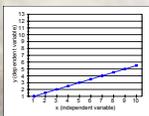
Relationships Among Variables continued

- Kinds of Relationships
 - Direction



Relationships Among Variables continued

- Kinds of Relationships
 - Magnitude



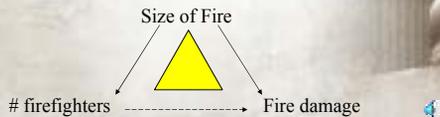
Control Variables

- The purpose of control variables is to reduce the risk of attributing explanatory power to independent variables that in fact are not responsible for the occurrence of variation in the dependent variable. Research control is concerned with holding constant possible influences on the dependent variable under investigation so that the true relationship between the independent and dependent variable can be understood.
- Examples
 - Dependent (outcome) variable – cardiac arrest survival to discharge
 - Independent (explanatory) variable – time to defibrillation
 - Control variables – witnessed arrest, bystander CPR, patient age

Control Variables continued

- Confounding Relationships
 - **Spurious Correlation** – where a relationship between two variables appears correlated but actually each variable is driven by a third variable.

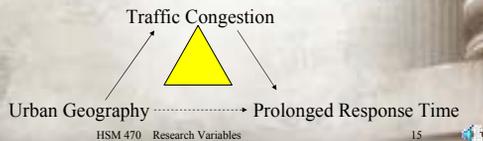
Example – the number of firefighters at the scene of a fire increases the amount of fire damage.



Confounding Relationships continued

- **Intervening Variable** – where relationship between two variables appears correlated, but actually the first variable causes a change in an intervening variable that causes a change in the second variable.

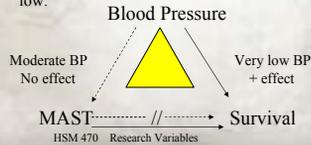
Example: Urban areas cause prolonged emergency response times.



Confounding Relationships continued

- *Suppressor Variable* – measurement of variable A and variable B finds no relationship, but actually some relationship does exist under some circumstances.

– Example: No improvement in survival following application of MAST. But, there is some evidence that MAST improves survival when blood pressure is very low.



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Confounding Relationships continued

- Control variables are used to eliminate alternative explanations for relationships.
- Statistical analyses are performed on the relationship between the dependent and independent variable(s), "controlling for" possible alternative explanations.

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Measuring Variables

- Continuous – can be infinitely subdivided (weight, length, BP, time)
- Discrete – exist only as whole numbers and cannot be subdivided (pulse, CBC, census)

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Measuring Variables continued

- Levels of Measurement

1. Nominal (categorical) – assignment of numbers merely to classify characteristics or assign groups

Example: male = 1, female = 2

- no conveyance of magnitude
- no conveyance of order
- no mathematical analysis is possible
- mutually exclusive and collectively exhaustive
- lowest level of measurement

Measuring Variables continued

- Levels of Measurement continued

2. Ordinal – categorization with a relationship

Example: glasgow coma scale

- attributes categorized and sorted based on relationship to each other on some criterion (there is order)
- no indication of magnitude between values (1 < 2, but by how much?)

Measuring Variables continued

- Levels of Measurement continued

3. Interval – can specify both rank ordering of objects on an attribute and the distance between them

Example: temperature

- does not provide absolute magnitude (is 30 twice as cold as 60?)
- arbitrary zero

Measuring Variables continued

- Levels of Measurement continued
 4. Ratio – provides information on rank ordering, interval between objects, and the absolute magnitude between the objects.
 - Has an absolute zero
 - Highest level of measurement



**Use the highest level of measurement possible.
Each level can be collapsed into the levels below it.**
