

Statistical Literacy Textbook: Chapter 2 Slides

Statistical Literacy: Critical Thinking about Everyday Statistics **Kendall-Hunt 2023**

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[www.StatLit.org/pdf/
2023-Schild-StatLit-Ch2-Slides.pdf](http://www.StatLit.org/pdf/2023-Schild-StatLit-Ch2-Slides.pdf)

CARE:

Confounder Solutions

Confounder: Anything that provides an alternate explanation for an association.

CONFOUNDER SOLUTIONS

Inside the Data	Mental: Simple*
Effect Size	Selection
Controlled Study	Ratios
Study Design	Standardization
----- Hypothetical thinking -----	

* Advanced: Regression (linear, logistic, etc.)

2.4.1 Confounder Solution: Effect Size

Effect size: size of an arithmetic comparison.

- The *larger* the effect size, the *fewer* the # of confounders that can influence an association.
- The *smaller* the effect size, the *more likely* the association is influenced by confounding.

A study that doesn't present the effect size:

- probably has a small effect size.

Confounder Resistance: Control Group; Study Design

Resisting confounder influence (warding off confounders)

- *controlled study* is better than an uncontrolled study
- *experiment* is better than an observational study.

STUDY

CONTROLLED	UNCONTROLLED
Has a control group*	Lacks a control group

Confounder Resistance based on Type of Study

Experiments	Observational Studies
"Hard" Science	"Soft" Science
Predictor typically variable	Predictor typically fixed
Confounder Resistance: B	Confounder Resistance D
Crude association can control for both fixed and variable confounders	Crude association cannot control for both fixed and variable confounders

Types of Studies: Experiments vs. Observational

Doing

versus

just Seeing

Experiment

Researcher assigns/intervenes

Repeatable: Scientific experiment

Randomized: Clinical trial

Other: Quasi-Experiment

Observational

Researcher observes/responds

Movie: Longitudinal Study

Snapshot: Cross-sectional study

Someone says: Anecdotal

Experiment #1: Ideal Experiment

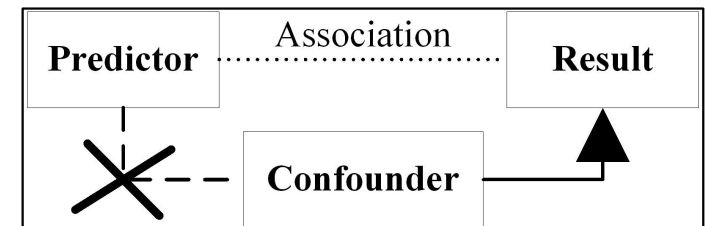
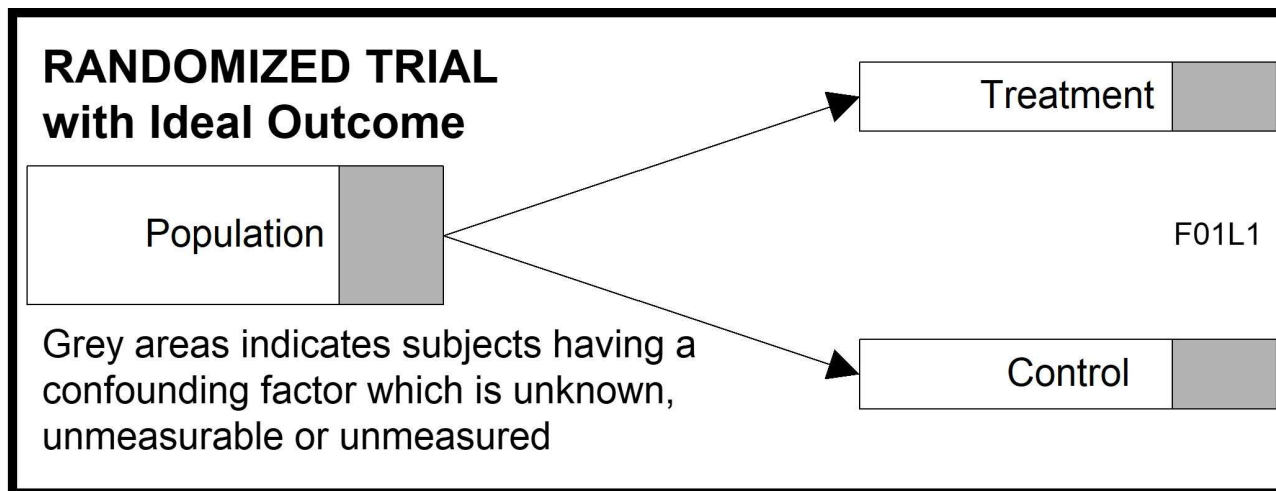
The subjects:

- are homogeneous (alike internally)
- have no memory of being treated
- can be switched: treatment and control.

Examples: most laboratory assignments in physics, chemistry or biology.

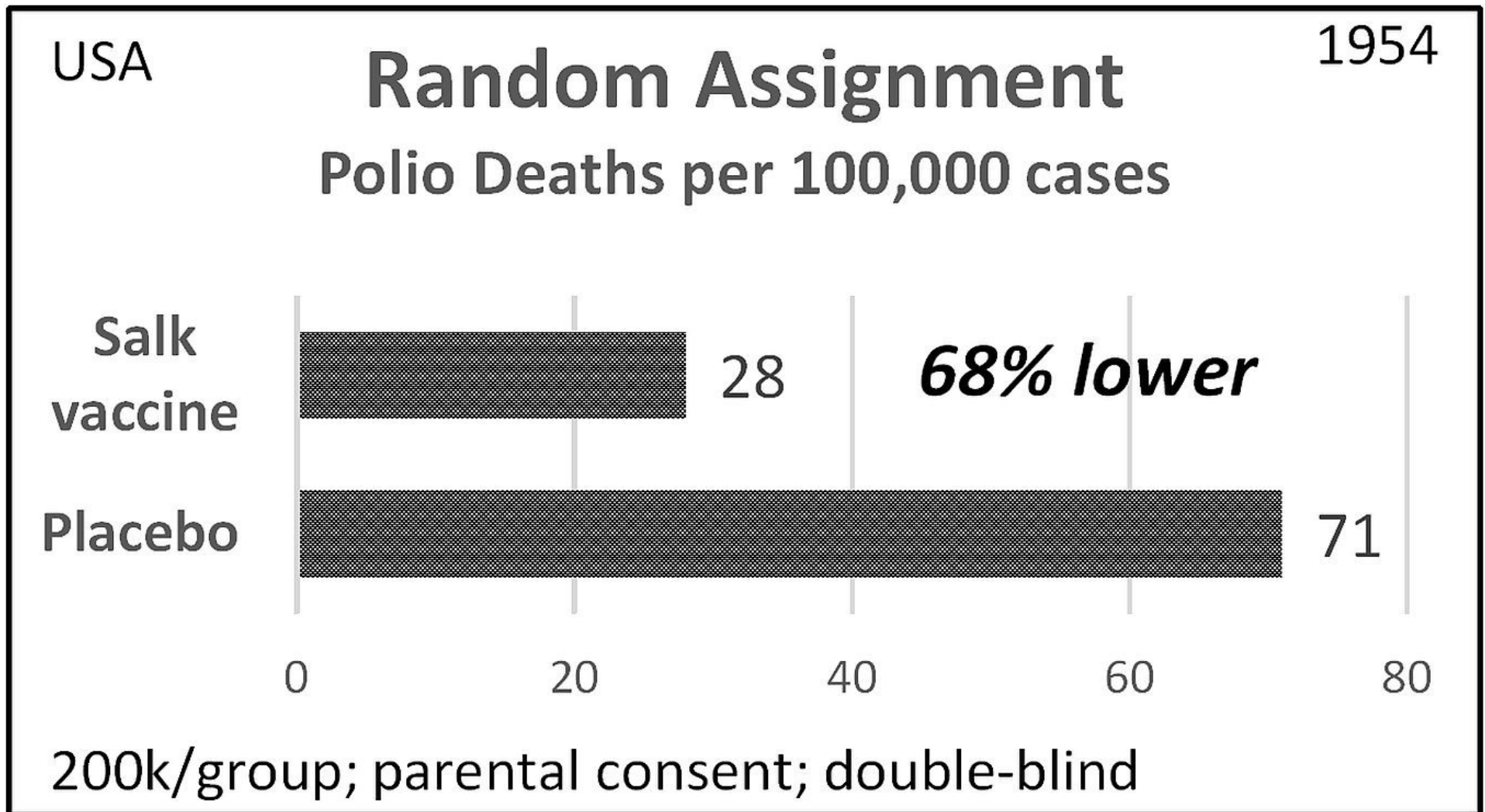
Experiment #2: Randomized Clinical Trial

Best way to create two groups balanced on known and unknown factors without looking.



Randomizing: breaks predictor-confounder link
Shuffle cards (randomize) to get 'equal' hands

Randomized Clinical Trial Salk Vaccine



Experiment #3: Quasi-Experiments

Quasi-experiments: experiments that involve pre-existing groups.

Quasi (Queasy)-Experiment

Nature or humans intervene on pre-existing groups

Nature intervenes

Epidemics

Plagues, outbreaks

Natural disasters

Earthquakes, tornadoes

Humans intervene

Wars/Politics

Change laws & policies

Business/Education

Change pricing/teaching

Quasi-Experiment

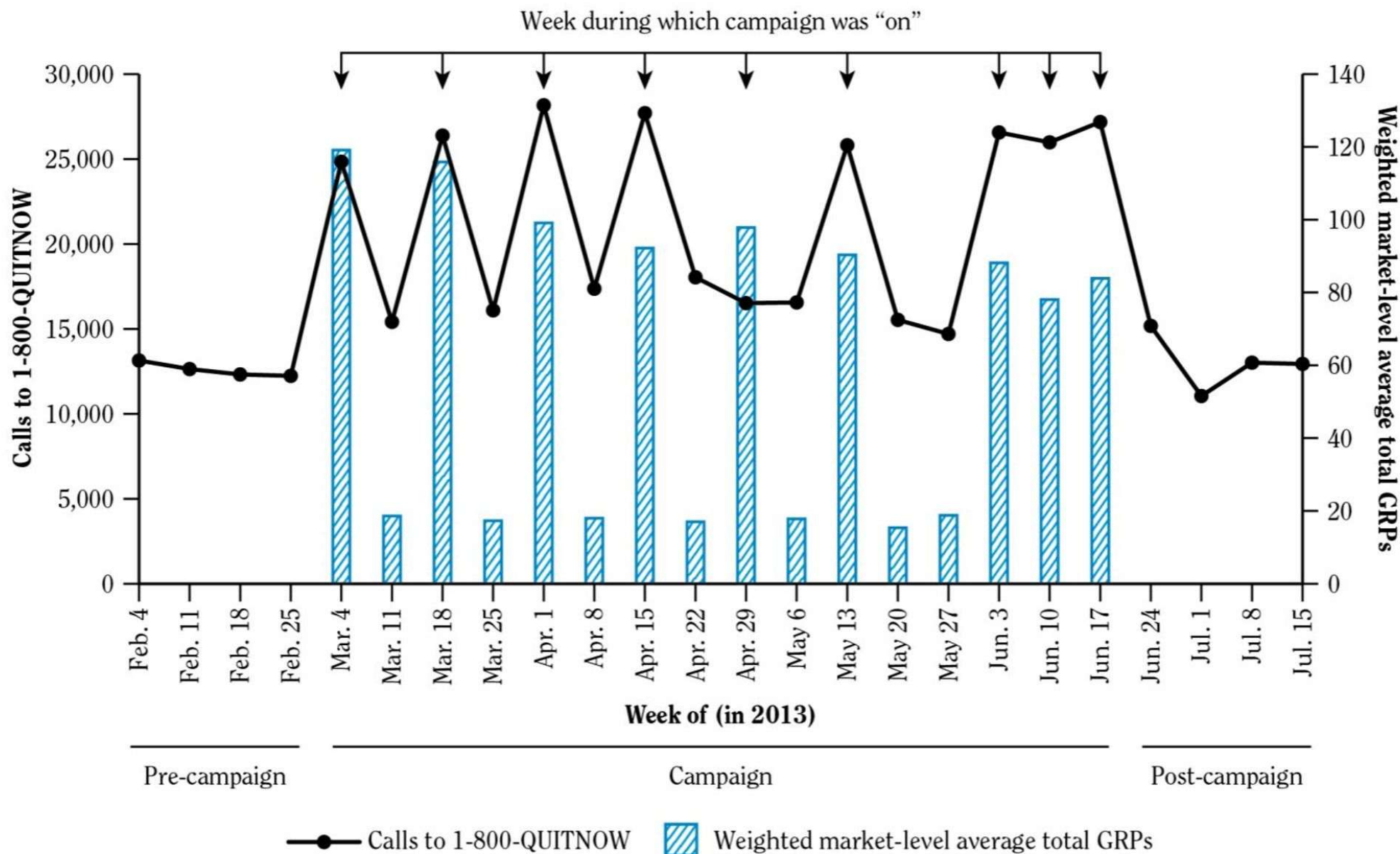


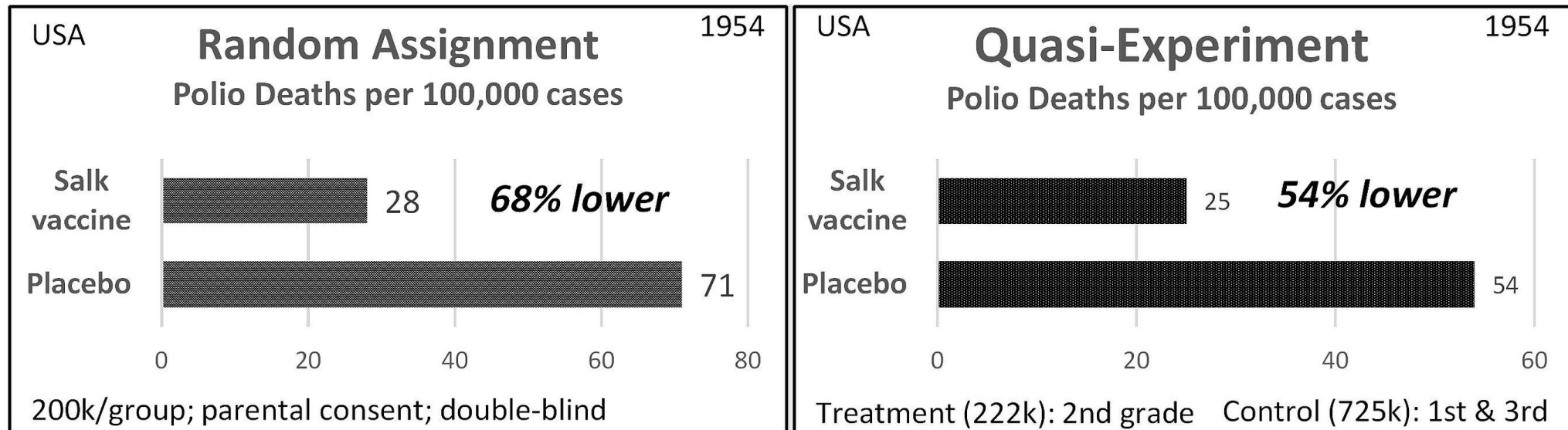
Figure 7.2 in *Smoking Cessation 2020: a Report of the Surgeon General*.

Source: <https://stacks.cdc.gov/view/cdc/84557>

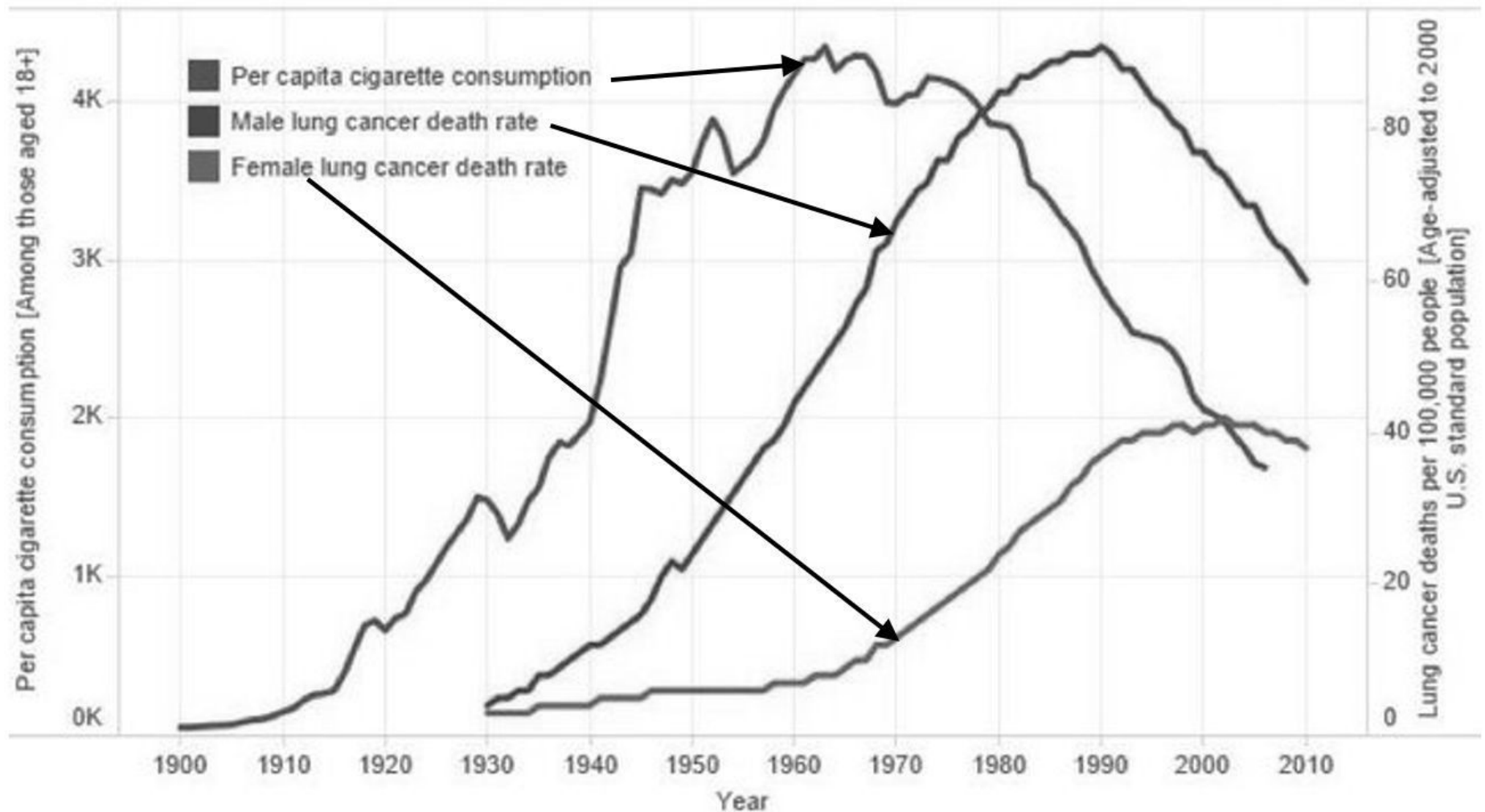
Comparison: Clinical Trial vs Quasi-Experiment

Researchers trusted the clinical trial.

Parents trusted the quasi-experiment.



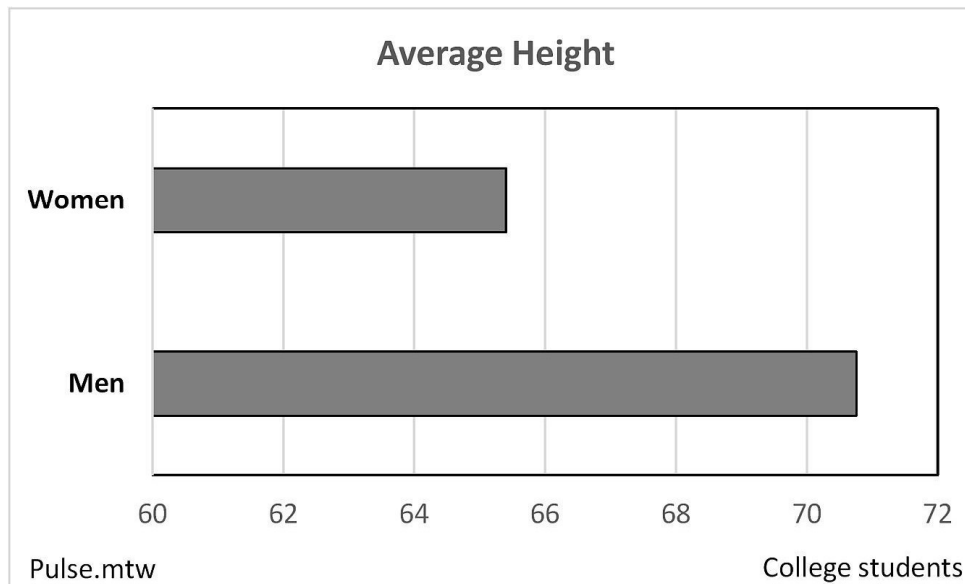
Observational study #1: Longitudinal (movie)



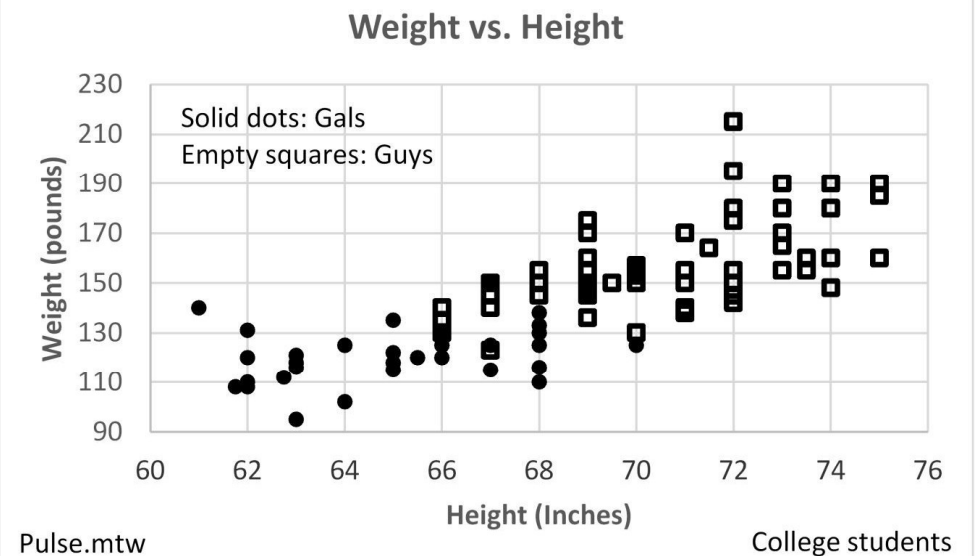
<https://www.researchgate.net/publication/340132064/figure/fig4/AS:872668408594434@1585071770802/Trends-in-per-capita-cigarette-consumption-and-age-standardized-lung-cancer-death-rates.jpg> CC BY 4.0

Observational study #2: Cross-Sectional (snapshot)

Two-group
Comparison

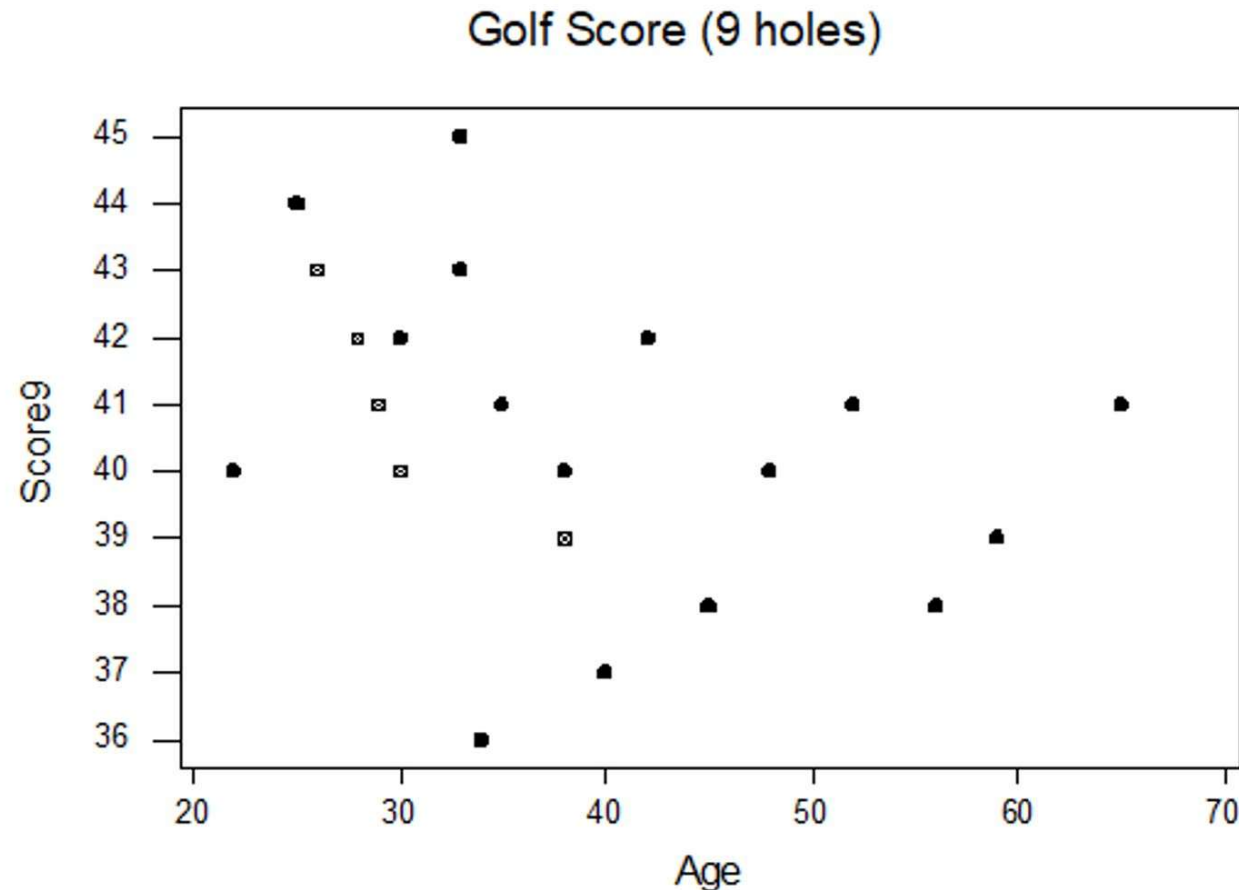


Two Factor
Co-variation



Cross-Sectional Study: Time-Related Snapshot

As age increases, golf scores improve???



Control Group (Review); Study Design: Graded

Control Group

Required	Optional
Ideal experiments Clinical trials	<i>Quasi-experiments</i> Observational studies

CONTROL OF CONFOUNDERS			
Physical Control (Grade = Quality)			
Experiment		Observational Study	
A+	Scientific	C	Longitudinal
A-	Random Assign	D	Cross-sectional
B	Quasi-Exper	F	Anecdotal story

Study Design: Hard vs. Soft.

‘Control of’ versus ‘Control for’

Science Says (Studies Say)

HARD Science	SOFT Science
<i>EXPERIMENTS</i> Seeing and Doing	<i>OBSERVATIONAL STUDIES</i> Just "Seeing"
Confounder Resistance: Strong Can control fixed AND variable	Confounder Resistance: Weak Controls fixed OR variable
A+ Ideal (repeatable) A- Clinical (randomized) trial B Quasi (group) experiment	C: Longitudinal (movie) D: Cross-sectional (snapshot) Schield

CONTROL		
Control of, control over		Control for, take into account
<i>Physical</i>		<i>Mental</i>

Confounder Solutions (Repeat)

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CONFOUNDER SOLUTIONS

Inside the Data	Mental: Simple*
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* Advanced: Regression (linear, logistic, etc.)

Mental Solution: Control For/Selection

CONTROL		
Control of, control over		Control for, take into account
<i>Physical</i>		<i>Mental</i>

Selection: simple way to control for the influence of a confounder. Convert mixed-fruit compare into an apples and apples comparison.

Predictor	Women	Men	Average
Non-smokers	123	155 (58%)	142
Smokers	126	162 (71%)	152

2.7 Error/Bias Influences: Review of Problems

CARE: ERROR

Bias	Wrong order	Other Errors
Subject	Comparisons	Prevarication
Measurement	Percentages	Weasel words
Sampling	Medical tests	Lies

Wrong order and Other Errors involve critical thinking (mental solutions). See Ch 4, 6 & 7.
There are physical solutions for Bias.

Bias Review: Synonyms

Subject (respondent) bias

- Acquiescence bias, social desirability
- Sponsor bias, please the person asking

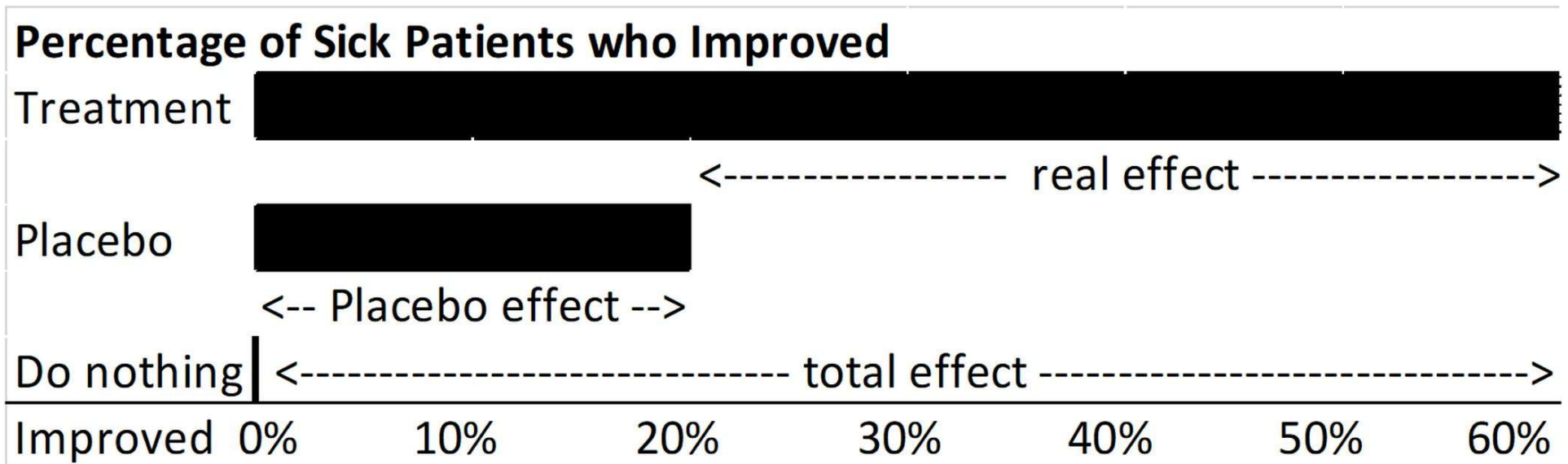
Measurement (researcher) bias

- Instrument bias
- Confirmation bias (select only what confirms)

Selection bias (sampling bias).

- Self-selection bias, non-response bias
- Survivor bias, publication bias

Subject-Bias Solution: Single Blind: Placebo



What is the effect of treatment: 60 point cure?

Placebo: a fake treatment! Mind is powerful!

What is the effect of treatment: 40 point cure.

To control subject bias: 'blind' the subject.

Researcher-Bias Solution: Double Blind Both

To avoid researcher bias: blind the researcher

To avoid subject & researcher bias, double-blind.

Double-blind: blind subject and researcher.

Any study that could double-blind and does not is immediately suspect of bias – if not of error.

Sampling-Bias Solution: Random Selection or Assignment

To avoid sampling bias in selecting, select subject randomly: *random selection*.

To avoid sampling bias in creating, assign the subjects randomly: *random assignment*. This statistically controls for pre-existing confounders. See clinical trials.

Note: Randomness can be both an unwanted influence (a problem) and a desired solution (random selection or random assignment).

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*Statistical Literacy:
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Randomized: Clinical trial	Snapshot: Cross-sectional study
Other: Quasi-Experiment	Someone says: Anecdotal

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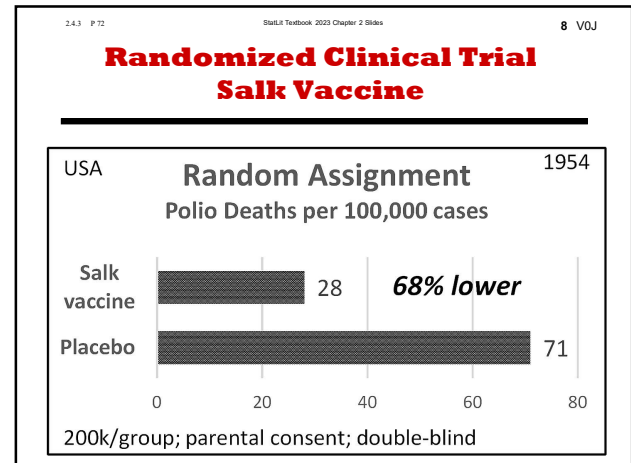
Best way to create two groups balanced on known and unknown factors without looking.

RANDOMIZED TRIAL with Ideal Outcome

Grey areas indicates subjects having a confounding factor which is unknown, unmeasurable or unmeasured

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Shuffle cards (randomize) to get 'equal' hands

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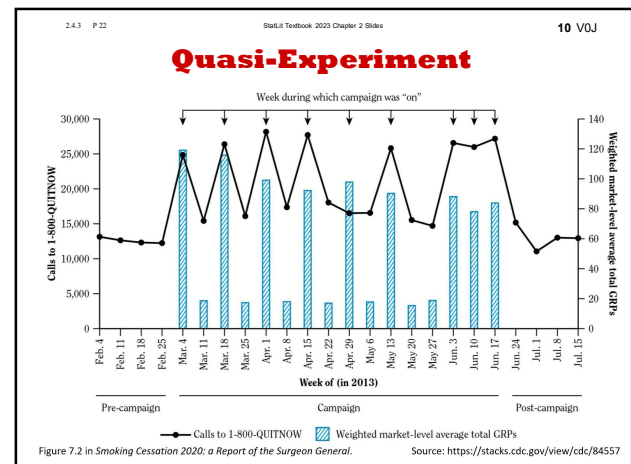
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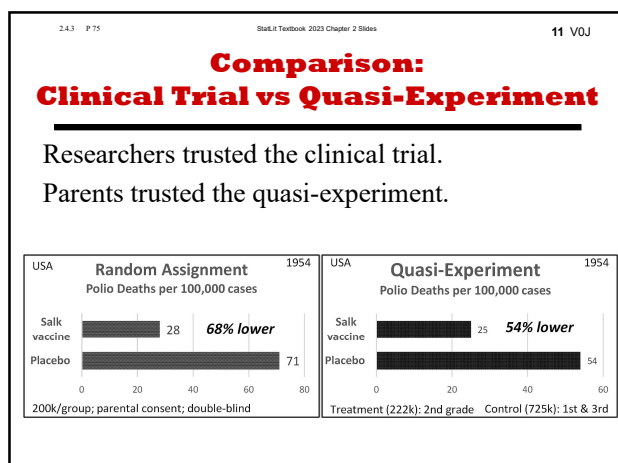
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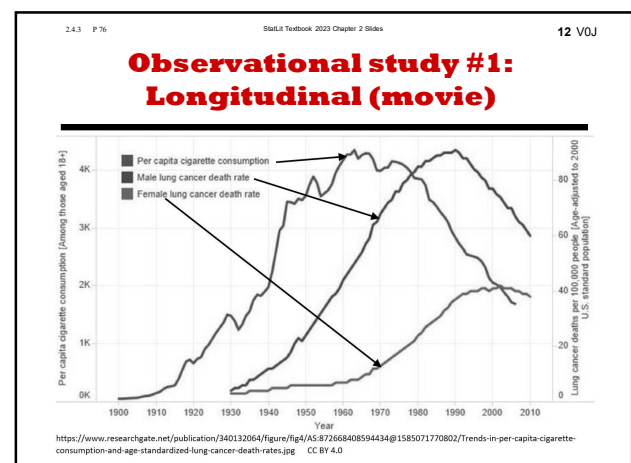
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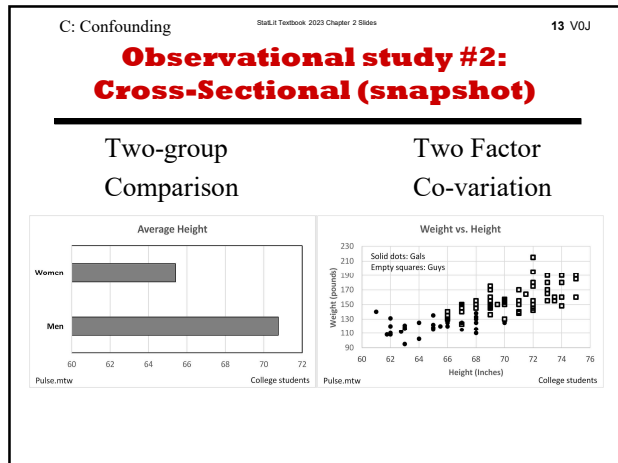
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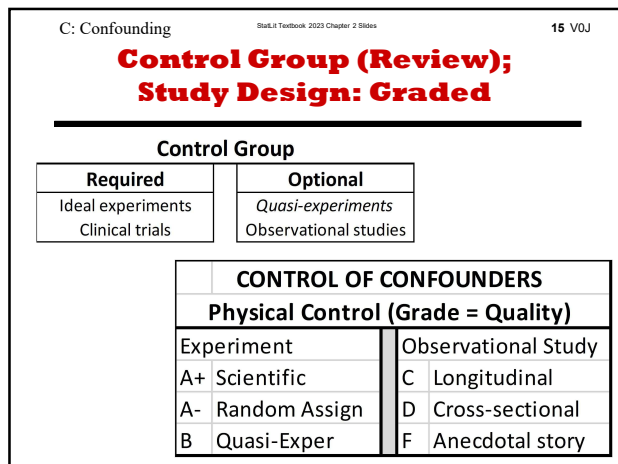
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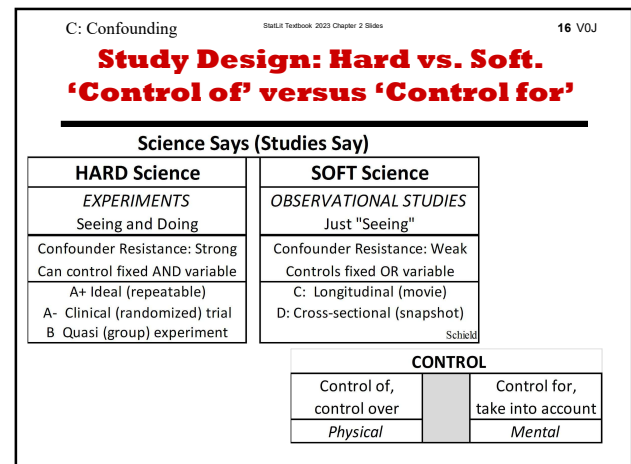
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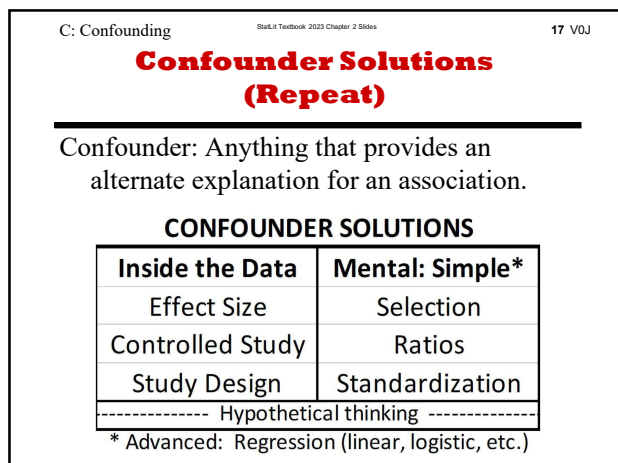
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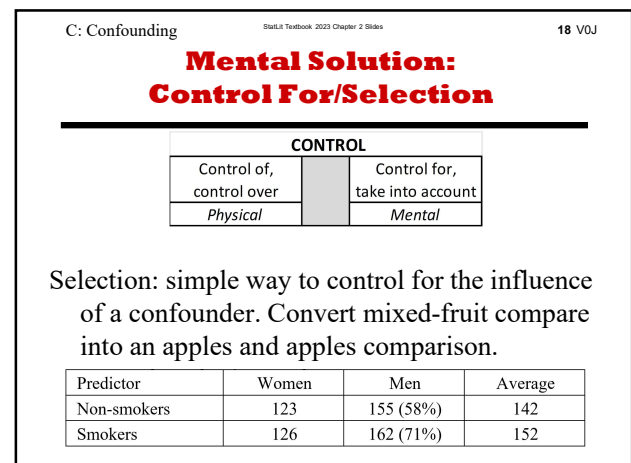
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Subject-Bias Solution: Single Blind: Placebo

Percentage of Sick Patients who Improved

Treatment 60% <----- real effect ----->

Placebo 20% <-- Placebo effect -->

Do nothing 0% <----- total effect ----->

Improved 0% 10% 20% 30% 40% 50% 60%

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