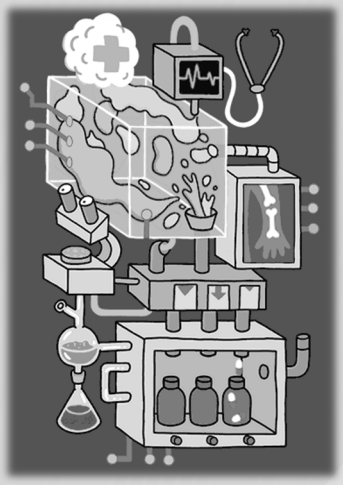
What study design is right?



Brenda Morrow
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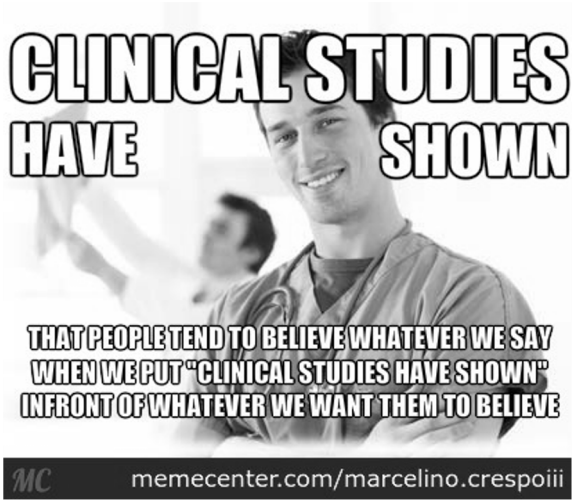

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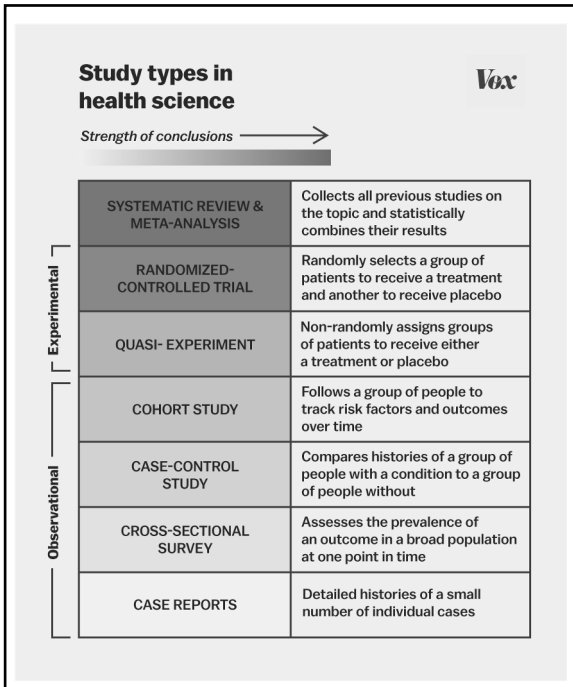
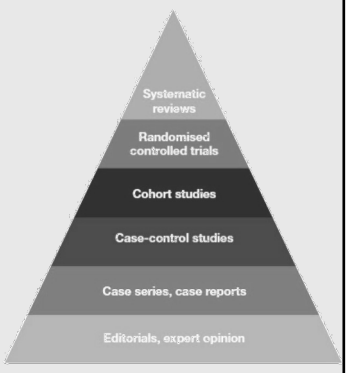


Not all studies are created equal…



https://www.vox.com/2015/1/5/7482871/types-of-study-design

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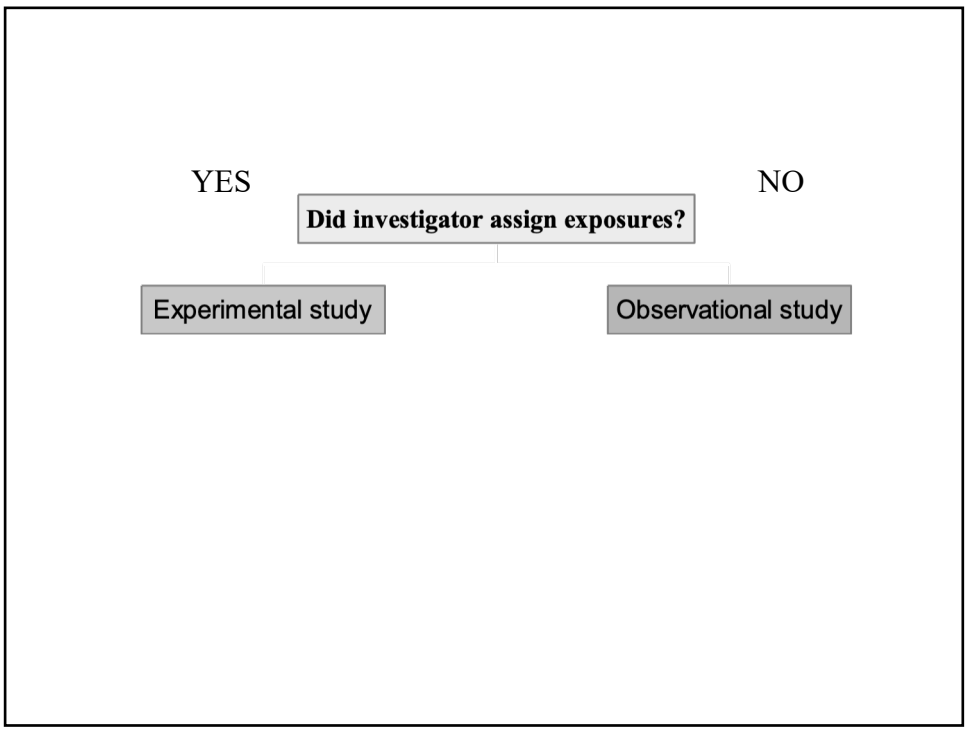

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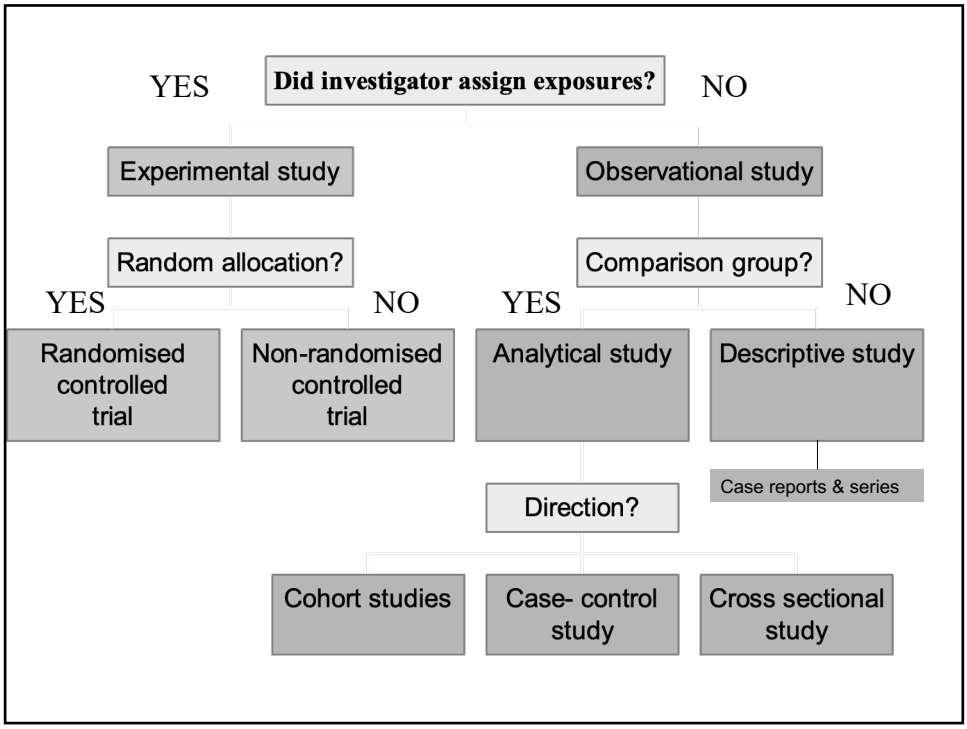

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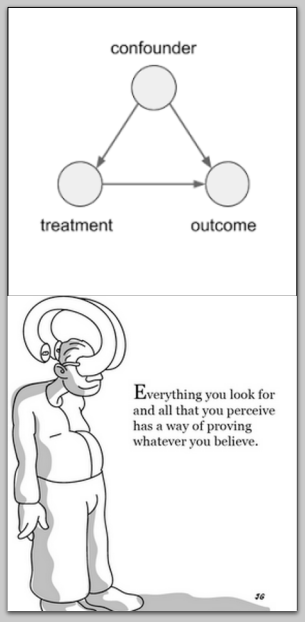

Bias = deviation from truth

- all observational studies have bias
  - Selection
  - Information/measurement
  - Confounding
  - Performance
  - …

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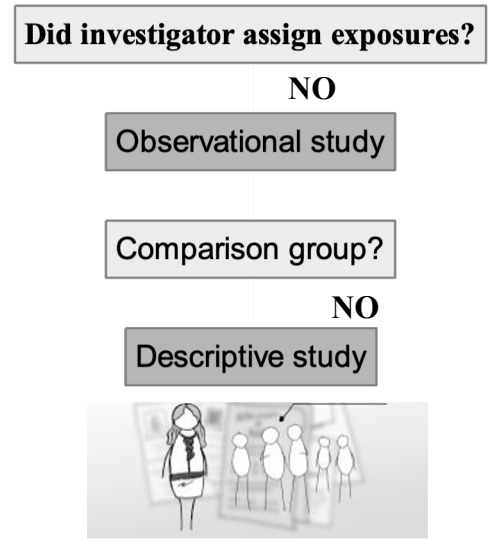
Descriptive studies

- Case reports
- Case series



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- Least publishable unit in medical literature
- Single observation that may prompt further investigation
  - Early signals of benefits, harms, value
  - Recognising new / rare conditions
- Unrepresentative of population
- BUT sometimes important!

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Case series

Multiple individual cases in one report
May generate hypotheses for further research
Not generalisable
Often retrospective
No control group

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Descriptive studies:

Advantages	Disadvantages
Data often already available	Unclear temporal associations
Inexpensive	No control grp
Few ethical difficulties	No cause/effect conclusions
Useful for rare conditions	Built in bias
Powerful advocacy tools	

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McBride WG *Thalidomide and congenital abnormalities. Lancet 1961;ii:1358*

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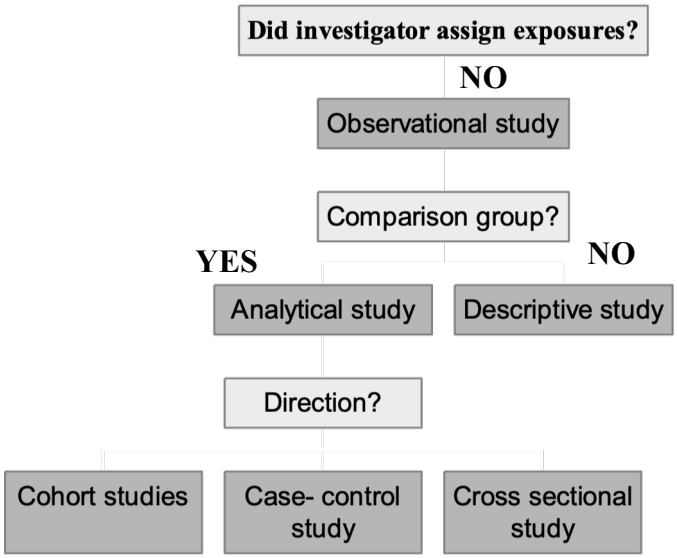
Analytical studies



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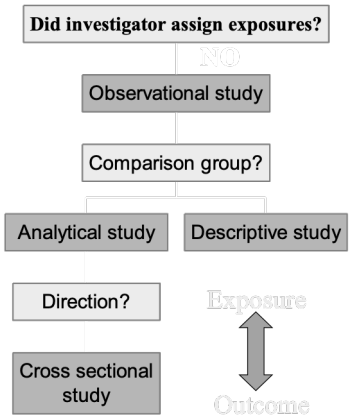
Cross-sectional studies

"Snap-shot in time"

Prevalence - describes the health of populations.

Outcome and exposure at the same time



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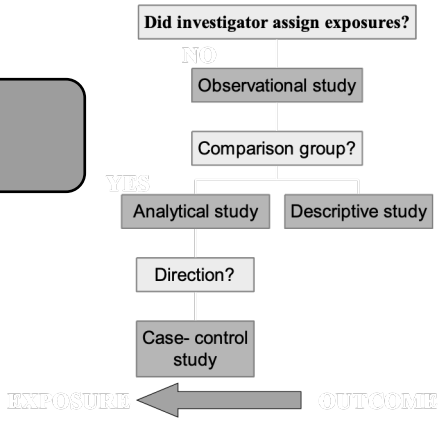
Case-control studies

"Thinking backward"



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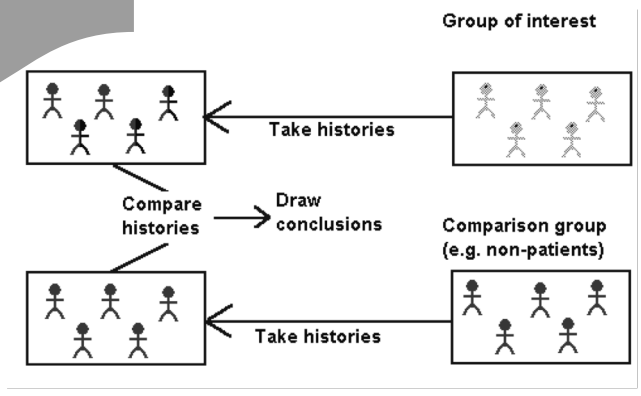
Case-control studies



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Case-control studies

Advantages

- efficient: time, money, effort
- Can examine multiple risk factors/exposures
- Useful if outcome is rare
- …and in diseases with long latency period

Disadvantages

- Recall/information bias
- Survivor bias
- Difficult selecting controls
- Cannot determine rate of disease
- Inefficient if exposure rate low

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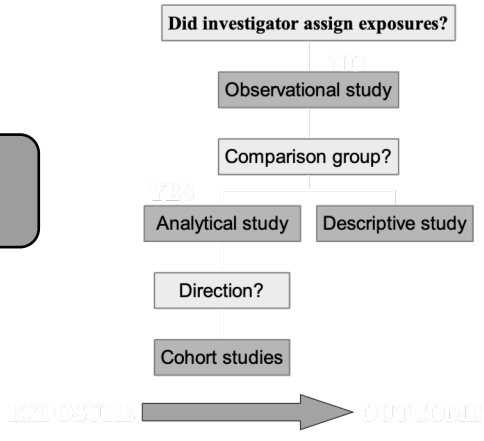
Cohort studies

"Looking forward in time"



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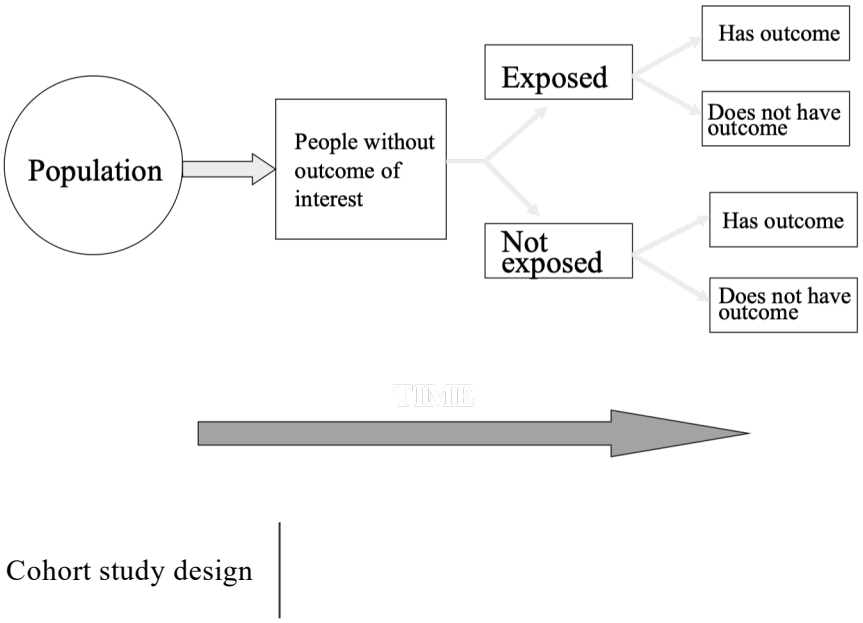

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Cohort studies:

Advantages	Disadvantages
Can investigate multiple outcomes of exposure	Need large numbers for rare exposures
Good for investigating rare exposures	Selection bias
↓ risk of survivor bias	Retrospective: Recall/information bias No control over variable/data collection
If prospective: allows calculation of incidence rates, relative risks and confidence intervals	Prospective: Loss to follow-up, Expensive Time consumptive

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Limitations of all observational studies

- Can usually only suggest **association** between a risk factor and an outcome (e.g. pARDS)
- Cannot *usually* attribute **causation**
  - Confounders = difficult-to-predict variables associated with both the cause and potential effect under study
  - Can *sometimes* **estimate** causal effects
    - Multiple regression
    - Propensity score analysis
      - Kurth et al 2006; Am J Epidemiol; 163:262-7
    - Sensitivity analysis: E-value
      - Haneuse et al JAMA 2019; 321:602-603
    - "Big data" – registries etc with very large n

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Types of causal structures

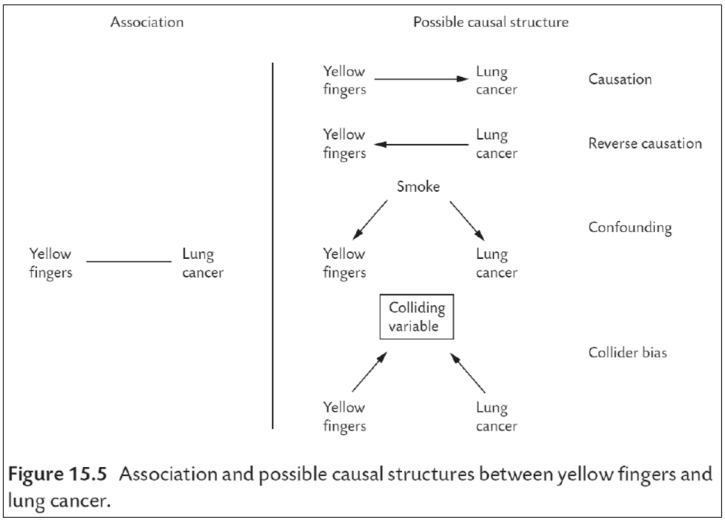

Figure 15.5 Association and possible causal structures between yellow fingers and lung cancer.

Veierød MB, et al. Medical statistics in clinical and epidemiological research, Gyldendal Norsk Forlag 2012

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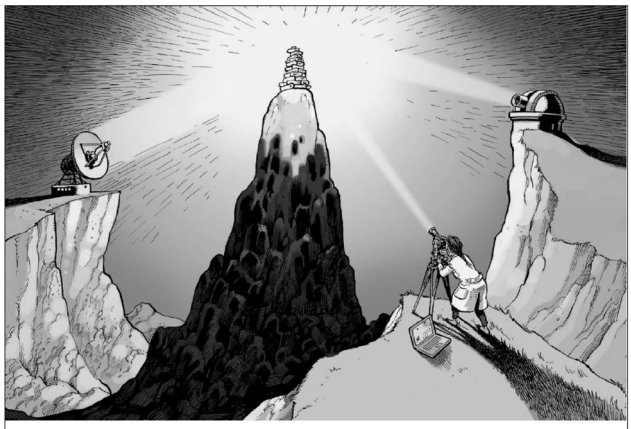

Repeating experiments is not enough

Verifying results requires disparate lines of evidence — a technique called triangulation. **Marcus R. Munafò** and **George Davey Smith** explain.

Nature 2018; 553: 399

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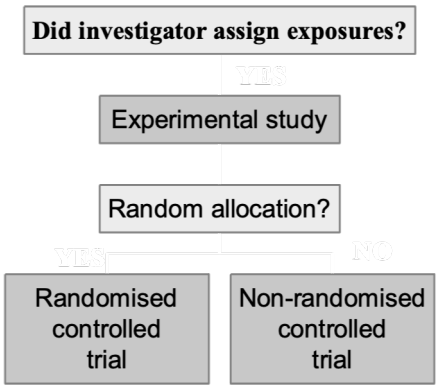
Experimental studies

Non-randomised trial: selection bias

Randomised controlled trial: Gold standard



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Non-randomised controlled trials

Resembles a cohort study.

Risk of selection bias

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Randomised controlled trials

- Only way to avoid selection and confounding biases
- assignment to control/case groups by chance
- Should have internal validity
- May not have external validity.
- Ethical issues

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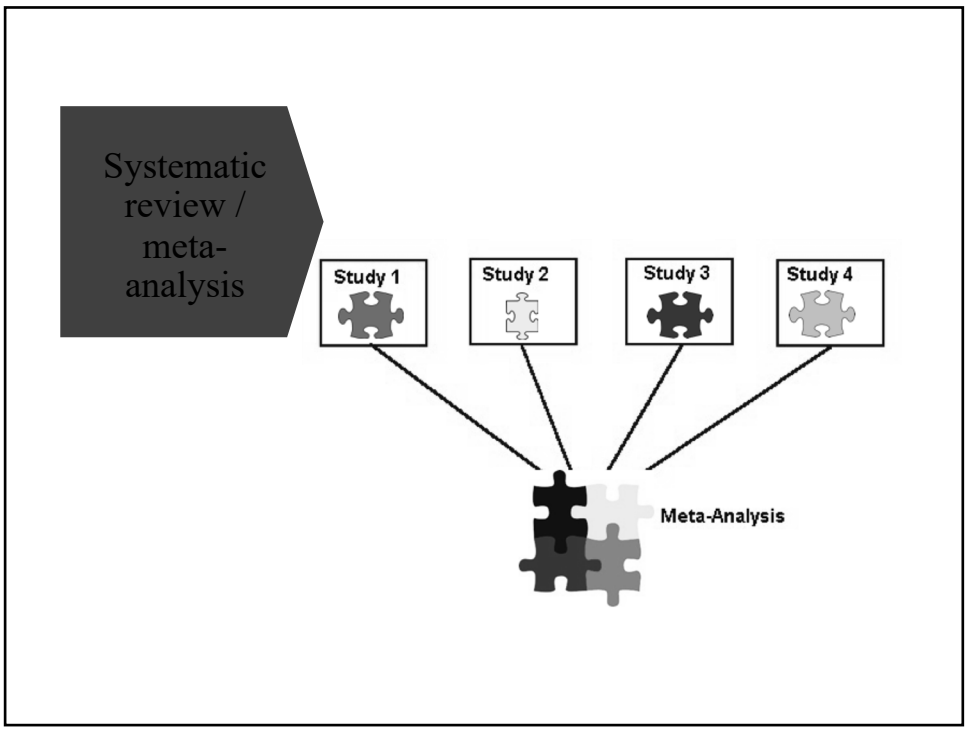

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Systematic review / meta-analysis

- Comprehensive survey of a topic
- primary studies of highest evidence level are systematically identified, appraised and summarised
- explicit and reproducible methodology

- meta-analysis - results of included studies are similar enough statistically that the results are combined and entered as if it were one study.
- Better guide to practice than an individual study.

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Why choose an observational design?

Glymour MM, et al. . Am J Epidemiol 2019; 188: 836-9
Harper S. Am J Epidemiol 2019; 188: 840-5

Experimental studies too expensive, unethical, or unfeasible

Build hypotheses …

May give answers

Building block to the next step

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STROBE Statement

Strengthening the reporting of observational studies in epidemiology

	Item No	Recommendation
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
Methods		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(a) Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls
		(b) For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding
		(b) Describe any methods used to examine subgroups and interactions
		(c) Explain how missing data were addressed
		(d) If applicable, explain how matching of cases and controls was addressed
		(e) Describe any sensitivity analyses
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
Outcome data	15*	Report numbers in each exposure category, or summary measures of exposure
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(b) Report category boundaries when continuous variables were categorized
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period

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Planning your research… like baking a cake!

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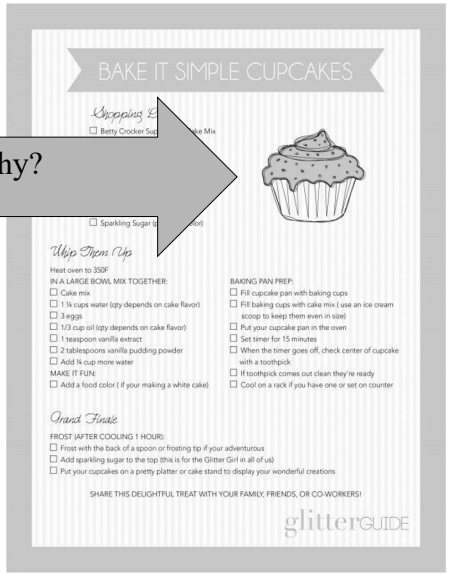
… like baking a cake!

What do you want to bake and why?


BAKE IT SIMPLE CUPCAKES

Shopping List

☐ Betty Crocker Sup… Mix

☐ Sparkling Sugar (…ional)

Whip Them Up

Heat oven to 350F

IN A LARGE BOWL MIX TOGETHER:

☐ Cake mix
☐ 1 ¼ cups water (qty depends on cake flavor)
☐ 3 eggs
☐ 1/3 cup oil (qty depends on cake flavor)
☐ 1 teaspoon vanilla extract
☐ 2 tablespoons vanilla pudding powder
☐ Add ¼ cup more water

MAKE IT FUN:

☐ Add a food color (if your making a white cake)

BAKING PAN PREP:

☐ Fill cupcake pan with baking cups
☐ Fill baking cups with cake mix (use an ice cream scoop to keep them even in size)
☐ Put your cupcake pan in the oven
☐ Set timer for 15 minutes
☐ When the timer goes off, check center of cupcake with a toothpick
☐ If toothpick comes out clean they're ready
☐ Cool on a rack if you have one or set on counter

Grand Finale

FROST (AFTER COOLING 1 HOUR):

☐ Frost with the back of a spoon or frosting tip if your adventurous
☐ Add sparkling sugar to the top (thk is for the Glitter Girl in all of us)
☐ Put your cupcakes on a pretty platter or cake stand to display your wonderful creations

SHARE THIS DELIGHTFUL TREAT WITH YOUR FAMILY, FRIENDS, OR CO-WORKERS!

glitterGUIDE

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PICO(T) Format

Population	• Characteristics: Age, gender, ethnicity • Health issue: diabetes, access to healthcare
Intervention	• Ex: drug, surgery, ed program, policy • Setting, geography
Comparison	• Ex: no intervention, common practice • optional
Outcome	• Ex: blood glucose, BMI • timing
Type of studies	• Type of questions • Type of studies

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… like baking a cake!

Participants…

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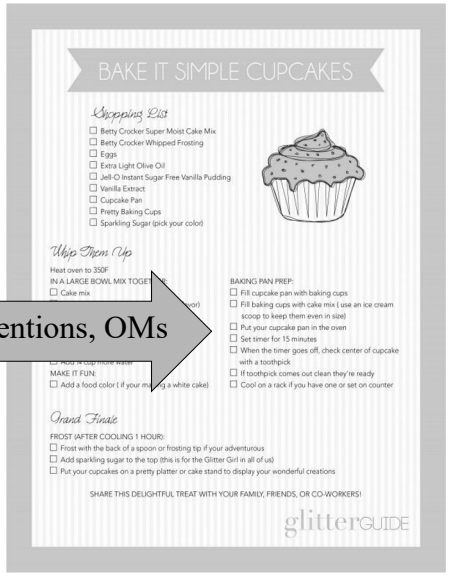
… like baking a cake!

Procedures: research design, interventions, OMs



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research… like baking a cake!

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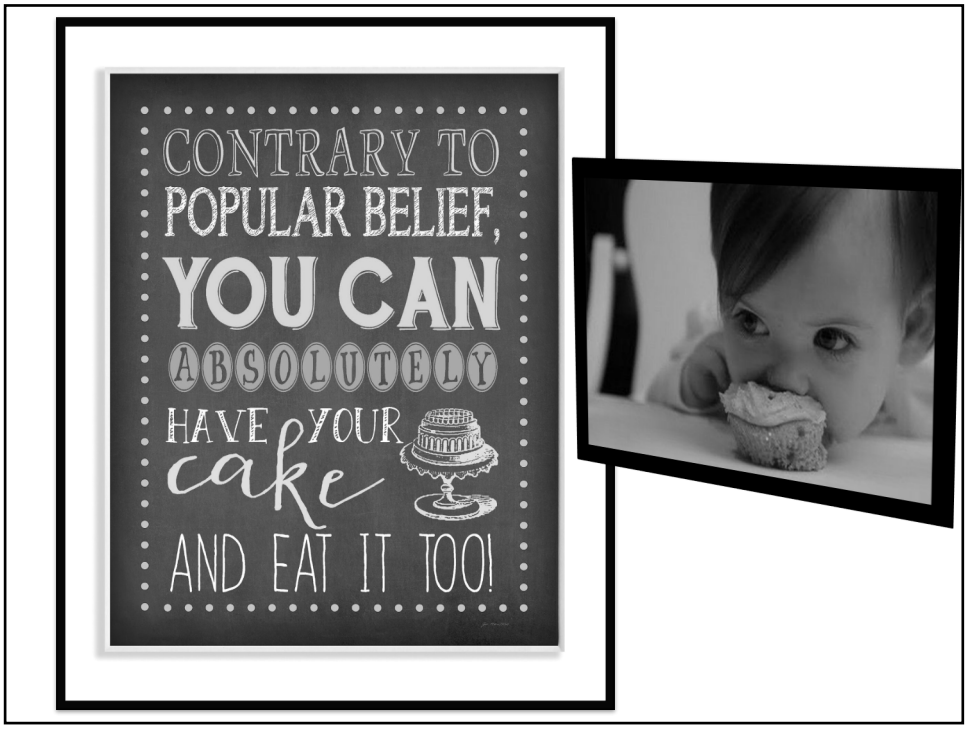
CONTRARY TO
POPULAR BELIEF,
YOU CAN
ABSOLUTELY
HAVE YOUR
cake
AND EAT IT TOO!

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