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Section B

Counterfactual Analysis: Choices!

Choice of Counterfactuals

- Murray and Lopez (1999) suggest:
  - Theoretical minimum
  - Plausible minimum
  - Feasible minimum
  - Cost-effective minimum

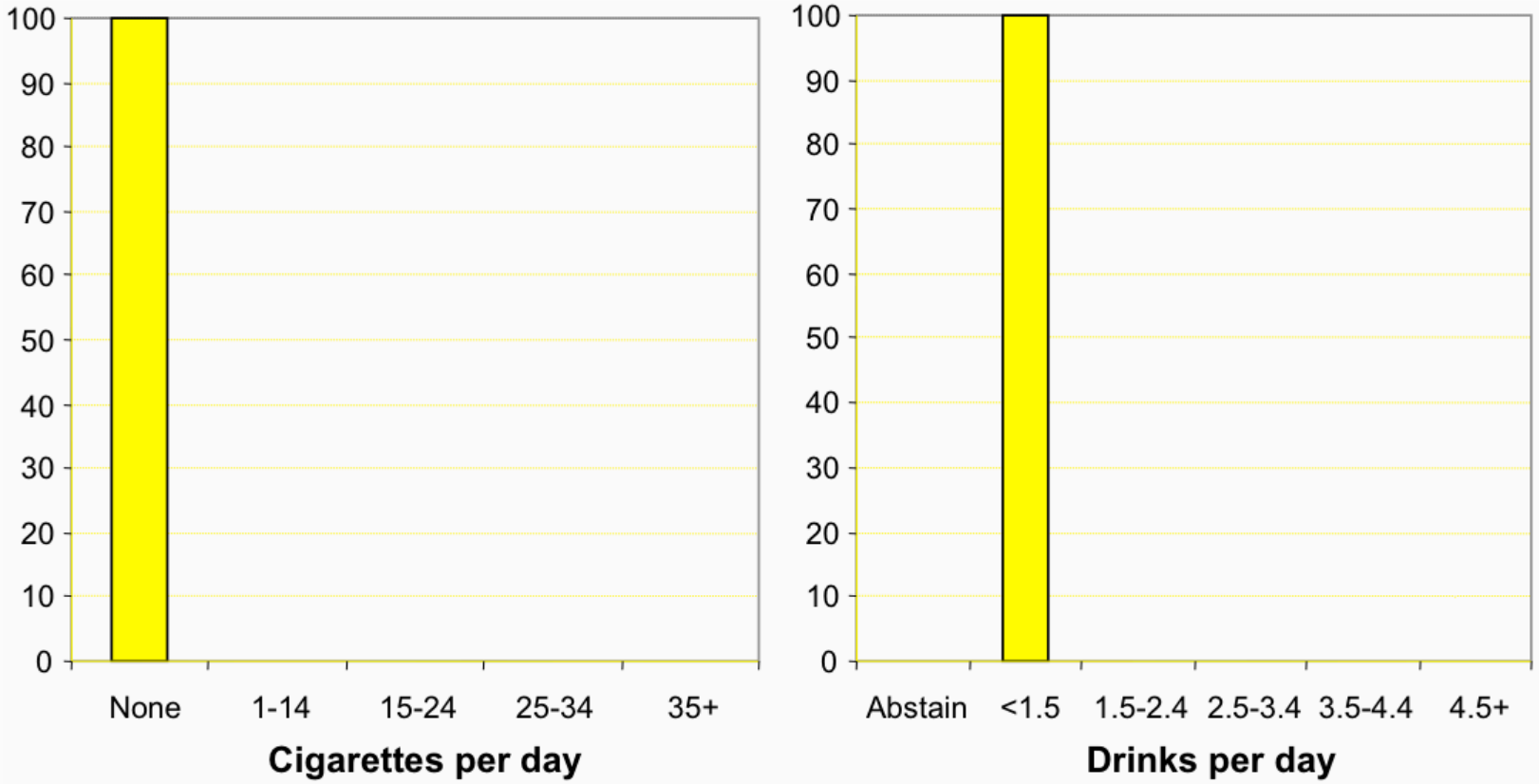
- Other counterfactuals based on criteria of equity

Types of Counterfactual Distributions: 1

- Theoretical minimum risk: distribution of exposure that would minimize population risk—desirable, but not imaginable

Theoretical Minimum Risk

- Counterfactual distribution of exposures for tobacco and alcohol—theoretical minimum risk

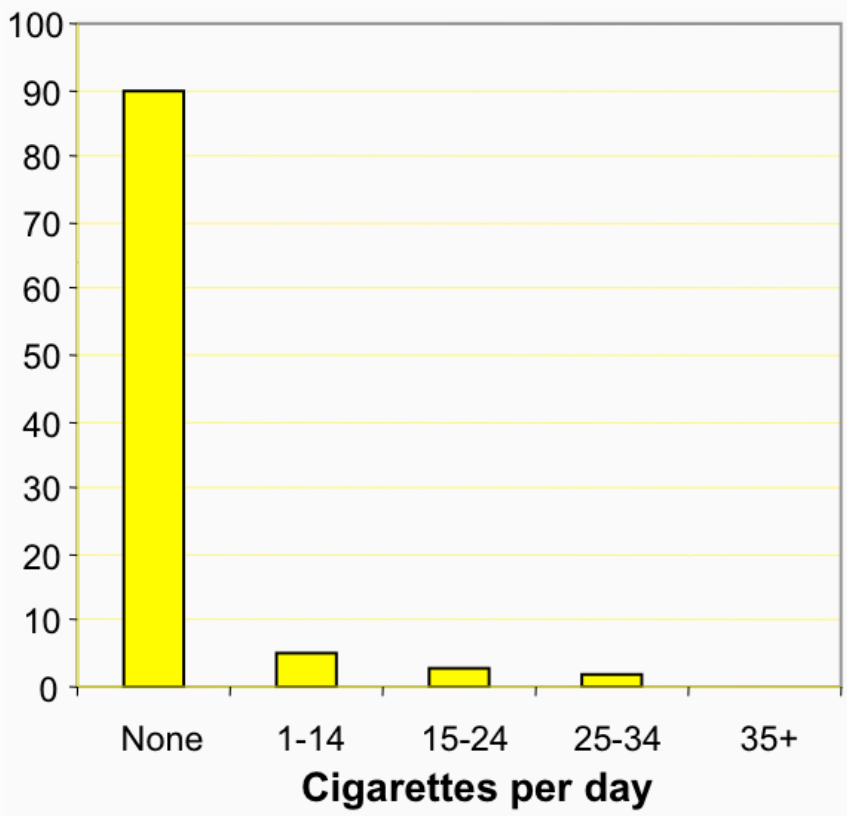


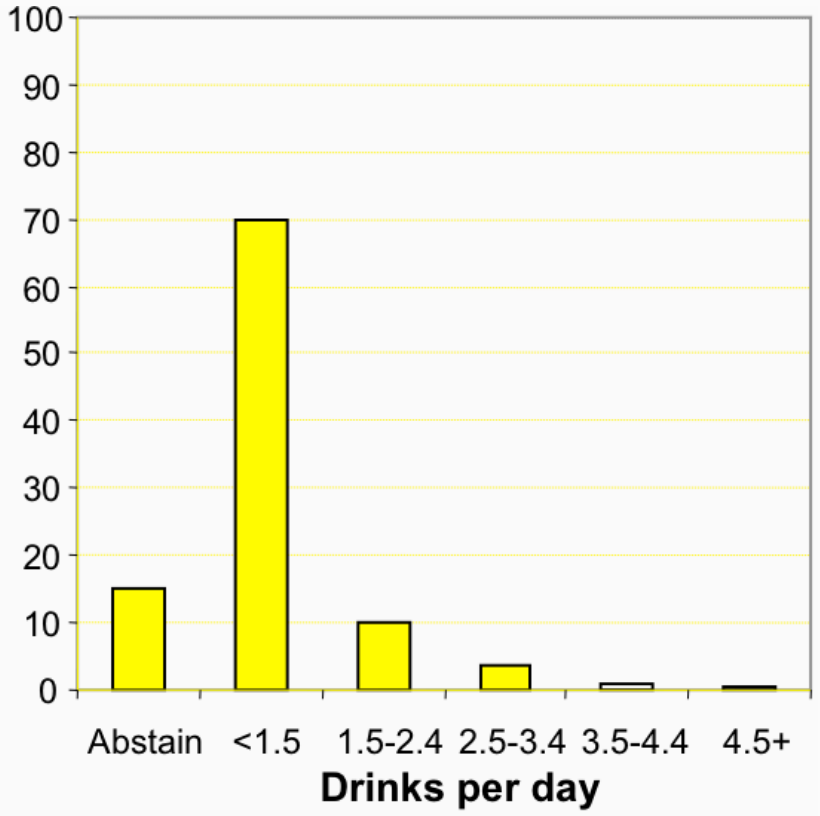
Counterfactual Distributions: 2

- Plausible minimum risk: distribution of exposure that is conceivable or possible, and which would minimize population risk
  - Not necessarily likely or feasible within a given time frame
  - Shape of distribution can be observed in some population

Plausible Minimum Risk

- Counterfactual distribution of exposures for tobacco and alcohol—plausible minimum risk



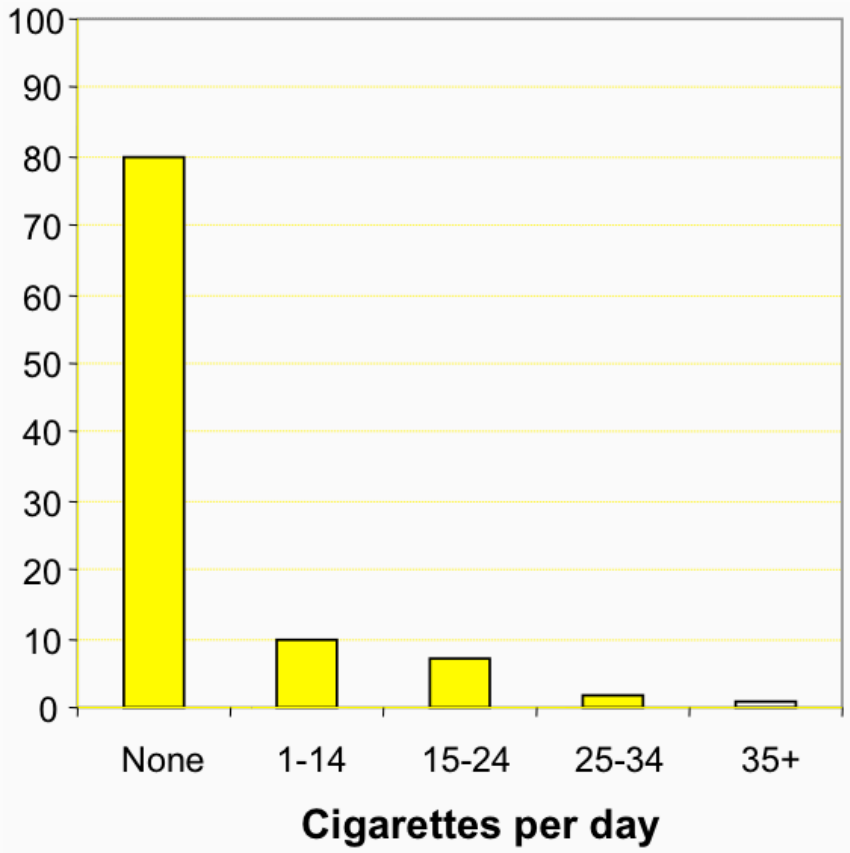


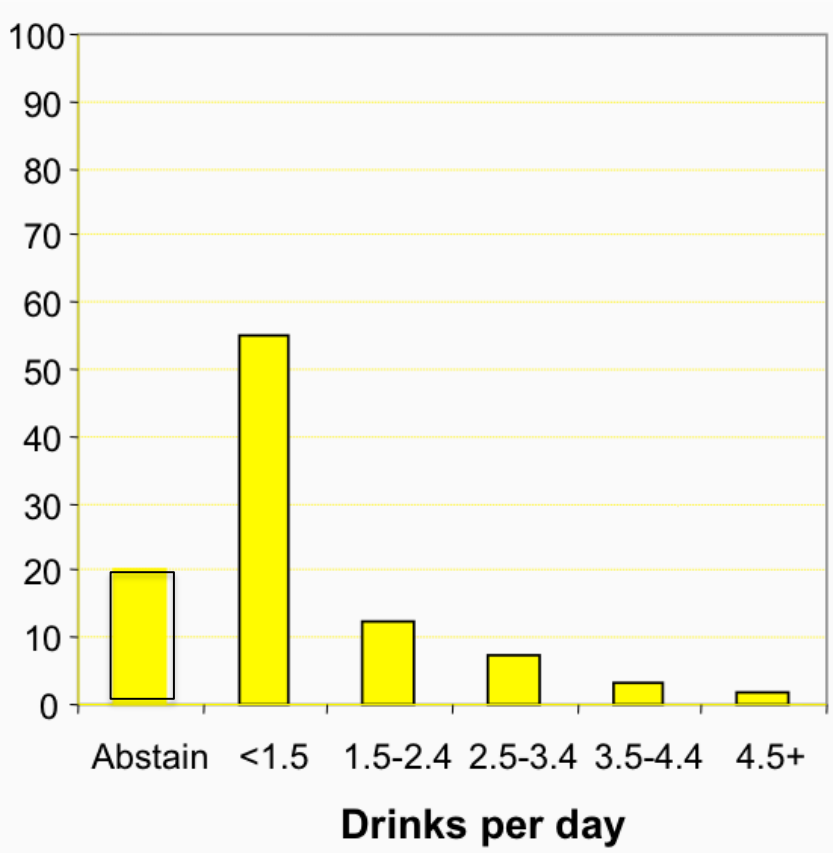
Counterfactual Distributions: 3

- Feasible minimum risk: distribution of exposure that would minimize population risk and which has been achieved in some population

Feasible Minimum Risk

- Counterfactual distribution of exposures for tobacco and alcohol—feasible minimum risk





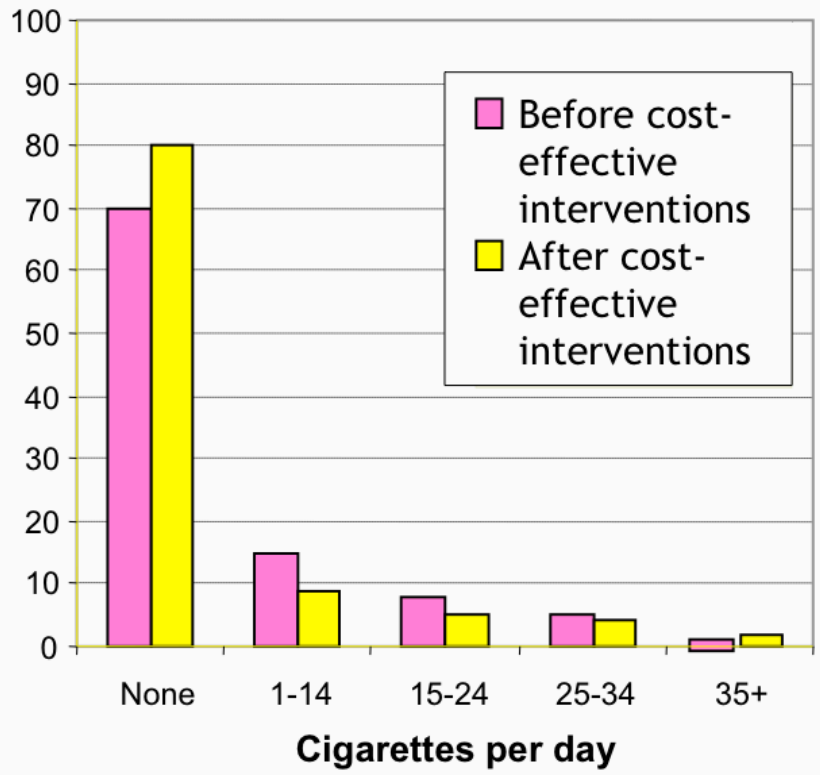
Counterfactual Distributions: 4

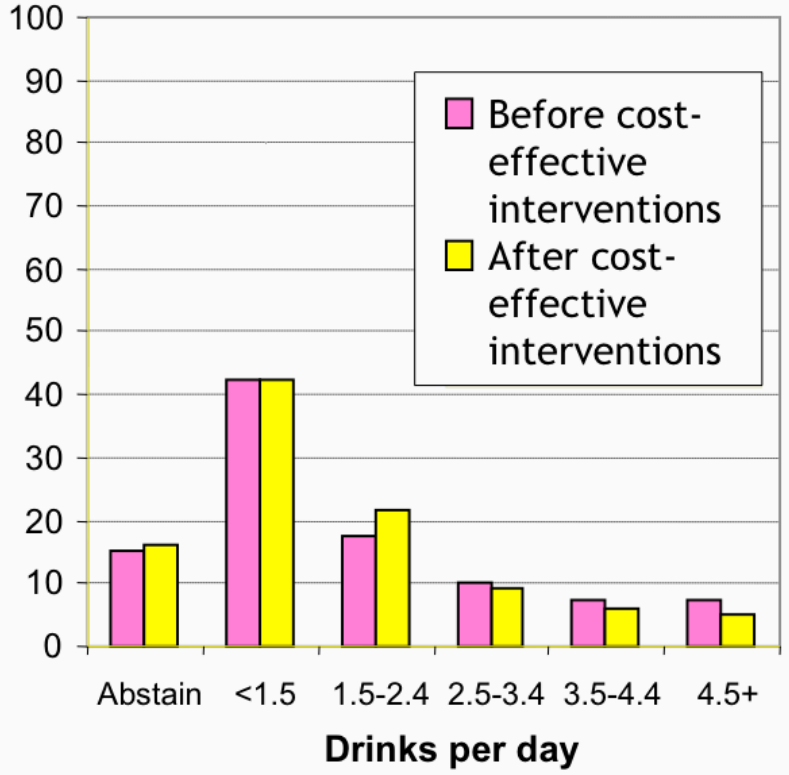
- Cost-effective minimum risk: minimum risk distribution of exposure achievable through implementation of cost-effective interventions

- Clearly context dependent

Cost-Effective Minimum Risk

- Counterfactual distribution of exposures for tobacco and alcohol—cost-effective minimum risk

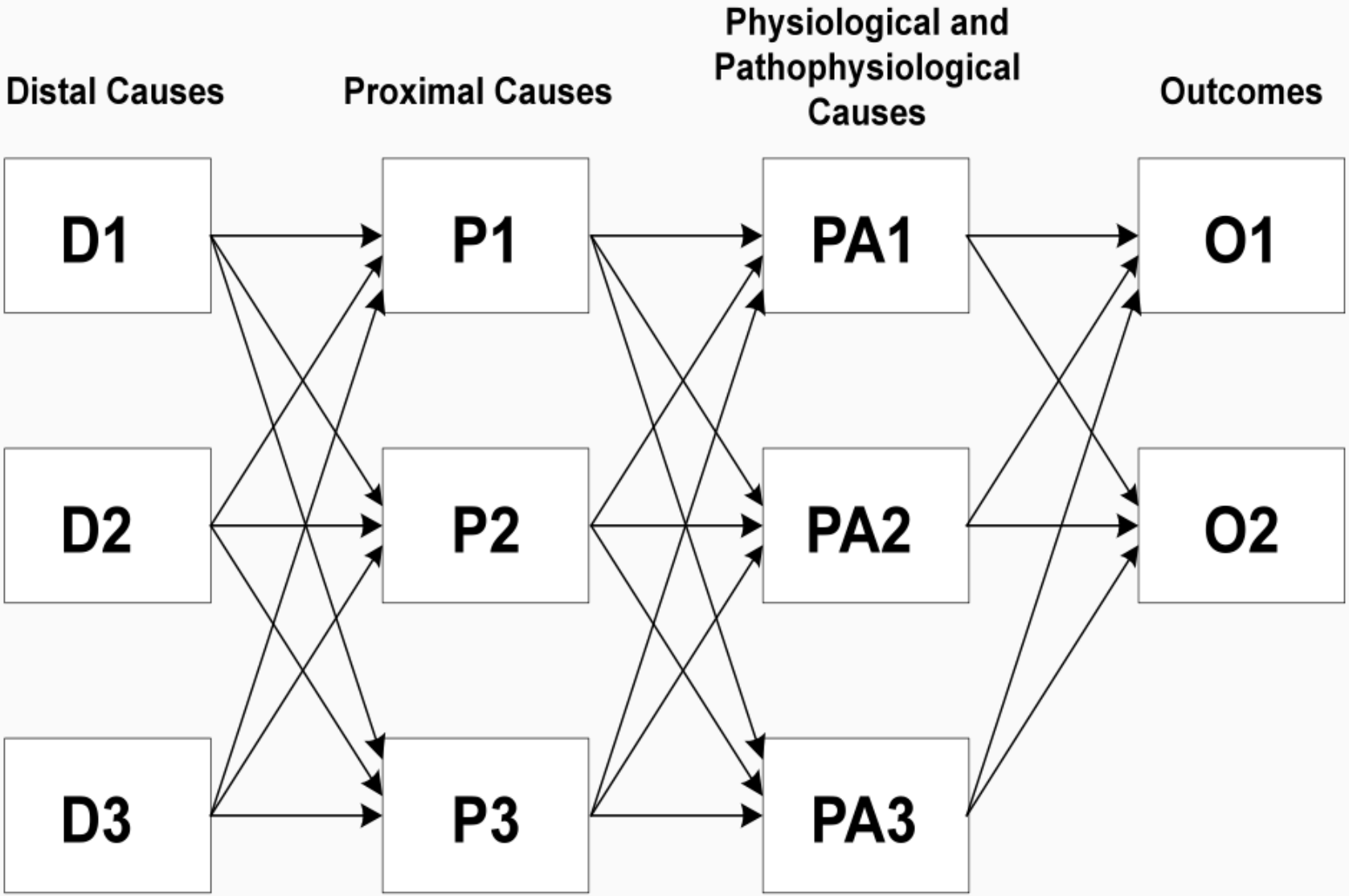




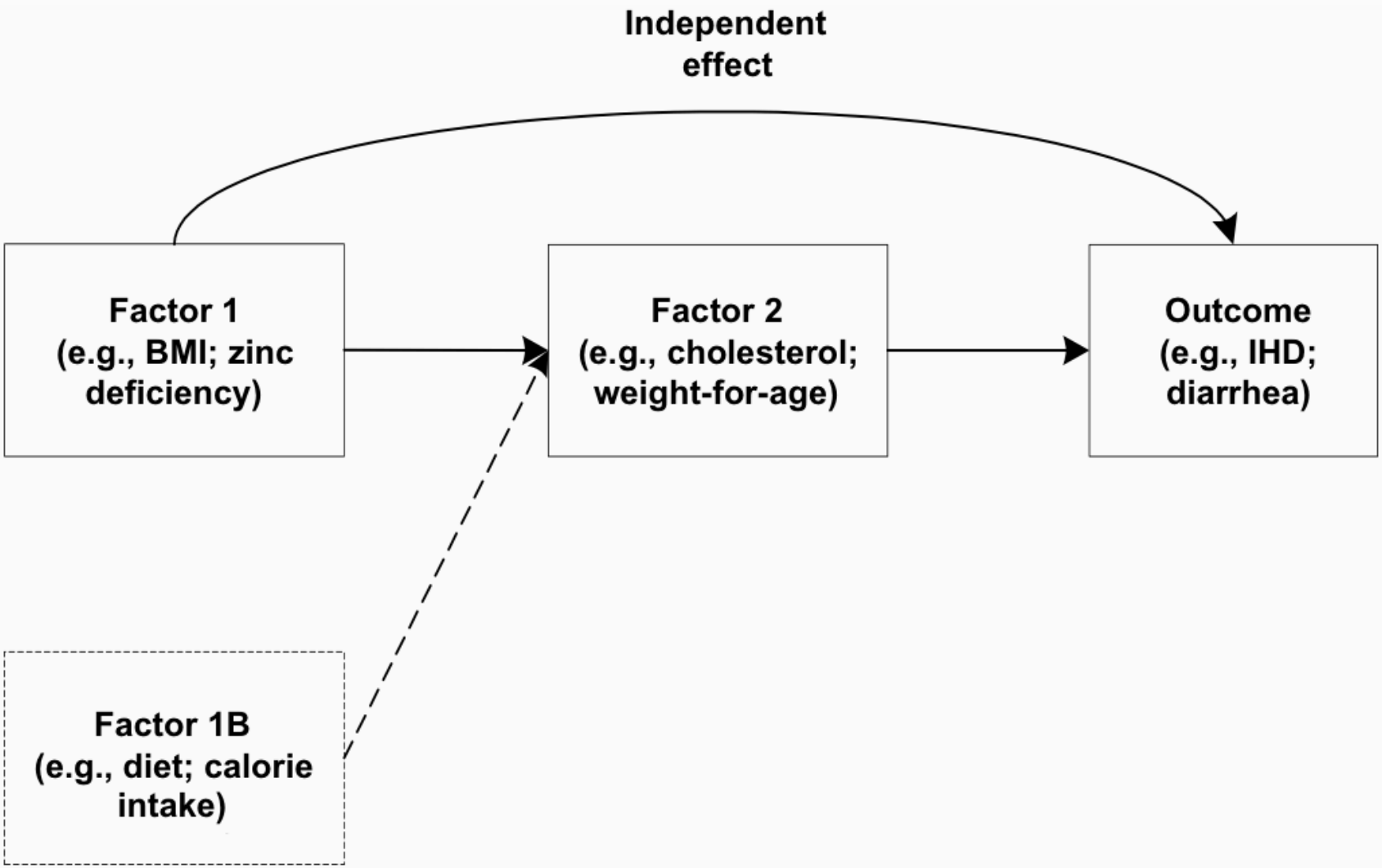
Cause and Effect

- Cautions

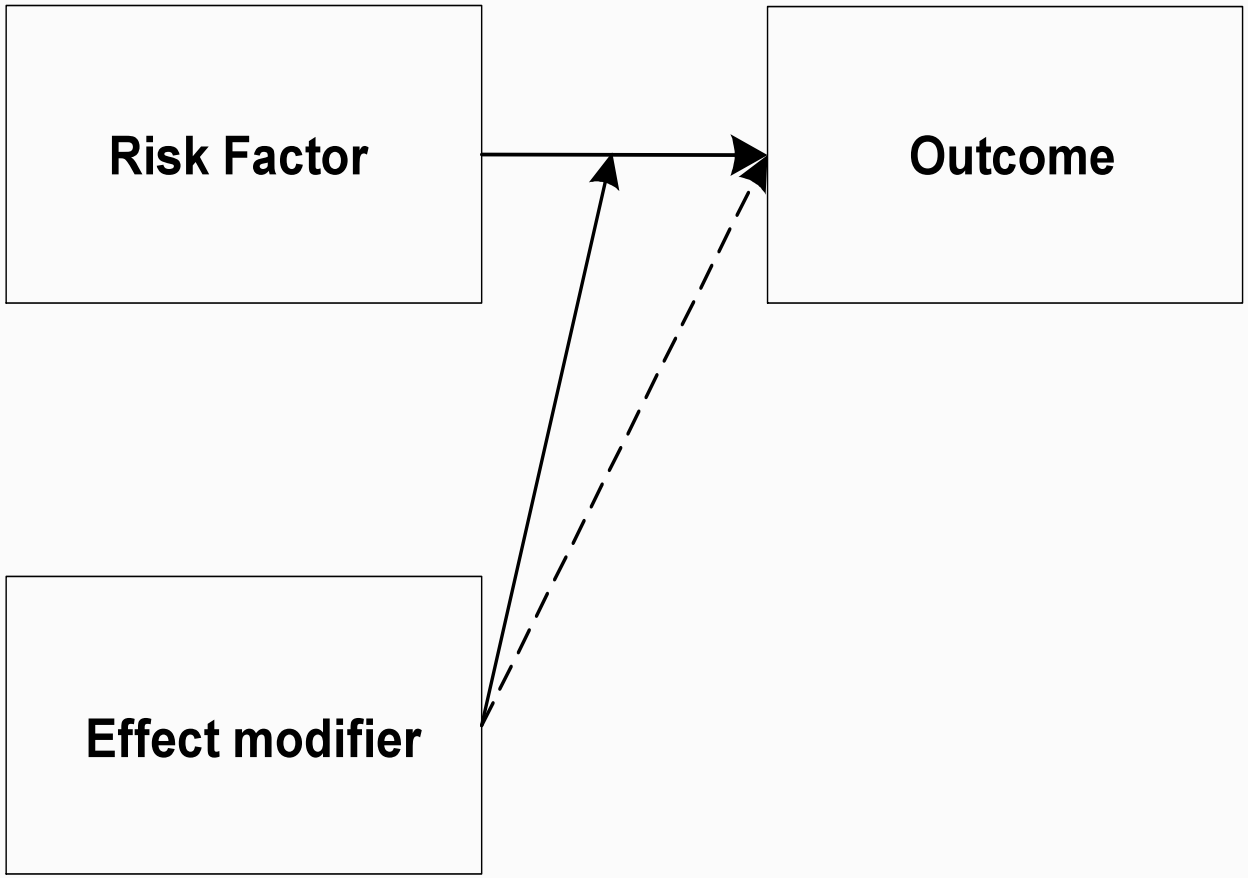
Simplified Causal Web



Mediated and Independent Effects



Effect Modification



Effect Modification Sources

- Use review of literature to identify studies that estimate effect modification (stratified hazards) for risk factor–disease pairs that were major contributors to burden
  - Vascular disease risk factors: some evidence of sub-multiplicative modification for BP and cholesterol
  - Tobacco: no evidence for effect modification by diet and indoor air pollution (Liu et al.) or when stratified on cholesterol

The CRA Process

- Steps in the CRA process

Stages of CRA Exercise

- Risk factors
- Relevant diseases and injuries
- Appropriate exposure variable and data
- Risk factor–disease relationship
- Counterfactuals
- Analysis of uncertainty

1. Choice of Risk Factors

- Likely to be among the leading causes of disease burden
- Not too specific or too broad
- High likelihood of causality
- Reasonably complete data
- Potentially modifiable

GBD 2000 Risk Factors: 1

- Childhood and maternal under-nutrition
  - Underweight
  - Vitamin A deficiency
  - Iron deficiency
  - Zinc deficiency
- Other nutrition and physical activity
  - High blood pressure
  - High BMI
  - Physical inactivity
  - High cholesterol
  - Low fruit and vegetable intake
- Addictive substances
  - Alcohol
  - Illicit drugs
  - Tobacco

GBD 2000 Risk Factors: 2

- Sexual and reproductive health
  - Unsafe sex
  - Lack of contraception
- Environmental risks
  - Unsafe water, sanitation, and hygiene
  - Urban outdoor air pollution
  - Indoor smoke from solid fuels
  - Lead
  - Global climate change
- Occupational risks
  - Risk factors for injuries
  - Noise
  - Airborne particulates
  - Carcinogens
  - Ergonomic stressors

GBD 2000 Risk Factors: 3

- Other selected risks
  - Unsafe health care injections
  - Childhood sexual abuse
- More have been added since
- Distribution of risks by poverty

2. Choice of Disease and Injuries

- Evidence of causality
  - Temporality
  - Strength
  - Consistency
  - Biological plausibility and gradient
  - Experimental evidence
- Match with GBD disease list
- Knowledge of hazard

3. Exposure Variable and Data

- Meaningful indicator of health effects
- Match with epidemiological studies
- Data availability
  - Scientific literature (Medline, etc.)
  - Non-health sector (energy, agriculture/food, etc.)
  - WHO
  - Specialized groups (cancer society, environmental groups, etc.)
  - Authors of papers and experts

4. Risk Factor–Disease Relationship

- Systematic review of epidemiological studies
- Match with exposure variable
- Confounding and correction for bias
- Population-specific or meta-analysis?
- Extrapolation between age, sex, region groups

Stages of CRA Exercise (recap)

- Risk factors
- Relevant diseases and injuries
- Appropriate exposure variable and data
- Risk factor–disease relationship
- *Counterfactuals (done above)*
- *Analysis of uncertainty (sensitivity)*