

Causal Effect of A

is the difference between

A Fact. The disease experience of the exposed individuals
and

A counterfactual. The disease experience of the exposed individual had s/he not been exposed.

Inobservable

A proxy of the counterfactual: Frequency of disease in unexposed.

What makes a good proxy?

Exposed and unexposed are alike in all causes of disease except for the exposure.

Full comparability.

Basic Quantifications in Epi

Measures of Disease Frequency. \rightarrow # of New cases during a period of interest.

Risk. (aka incidence)

Rate

Odds

prevalence.

Metrics of Comparison

Ratio

Difference.

\rightarrow Risk / (1-Risk) \rightarrow Risk.

\rightarrow The # of existing cases at a point in time or during a period of interest.

INUS: Insufficient But Necessary Component of Unnecessary but

sufficient cause

* in Case-Control study. Odds ratio - exposure = odds ratio disease

But one cannot calculate disease odds, since case-control studies are conditioning on disease. We cannot estimate the disease odds in exposed and the disease odds in unexposed.

Specific type of incident

when ID is better than []
different periods of time

Cumulative incidence
an estimate of risk.

Incident density rate

the proportion of a fixed population that becomes diseased during a stated period of time.

The Average Incidence Rate for a population at risk during a period of time ($t_0 \rightarrow t$).

the probability of risk of developing a disease over the stated period of time

of New Disease Events
Total Person-time
at risk.

of New Disease events
During a specific time period
Population at risk
at the beginning of the time period

Average Rate per unit of time.

Assumption: All non cases are followed for the entire duration of the follow-up period. (few pp withdraw from study or dying from competing risks or other causes of death).

Prevalence

point prevalence
the prevalence at a specific point in time.

Period prevalence.

the prevalence over a specified period of time.

$$\text{prevalence} = \text{Incidence rate} \times \text{Average Duration} \quad P = IDR \cdot \text{time} = ID$$

Risk

→ Risk Difference

$$\text{Excess rate: } IR - I = \frac{I_1}{I_0} - 1$$

Absolute Risk

The probability that an individual will develop a disease or other health condition during a stated period of time, conditioned on that individual's not dying from any other disease during the period.

Cumulative Incidence
(with no attrition due to other causes)
(Risk)

Relative Risk

$\frac{\text{Risk in } E}{\text{Risk in } E^-}$

$$\frac{IDR_{smokers}}{IDR_{non-smokers}}$$

$$\frac{0}{E^-}$$

Incidence density ratio.
Generally provide more accurate estimates of absolute risk than measures that use the population at risk at the denominator.

$$(\text{Rate}).$$

$$\text{Risk}(t_0, t) = 1 - \exp(-ID(t-t_0))$$

the ratio of two proportions.

proportionate mortality ratio (PMR) or PIR

Attributable Risk

$$PAR = \frac{P(D-E)}{P(D-E)+P(E)} = \frac{\lambda_1}{\lambda_0}$$

PAR %

$$AR = \frac{\text{Rate}_E - \text{Rate}_{E^-}}{\text{Rate}_{E^-}}$$

AR%

$$\frac{\text{Rate}_E - \text{Rate}_{E^-}}{\text{Rate}_{E^-}}$$

$$\text{e.g. } 63/100,000$$

$$7/100,000$$

$$= 56/100,000$$

56 lung C per year per 100,000 smokers were attributable to smoking

Amount or proportion of disease in a population that can be attributed to the exposure

$$PAR = \frac{\text{Rate}_{population} - \text{Rate}_{(E)}}{\text{Rate}_{population}}$$

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$$\text{e.g. } \frac{63-7}{63} = 89\%$$

89% of Lung cancer among smokers was attributable

to their smoking

If smoking was eliminated, 89% of the lung cancers that occurred among the smokers would have been eliminated.

Eg. 17 lung cancers per year per 100,000 persons in this entire population were attributable to smoking

ARR and ARI: measure the potential benefit to be expected among exposed persons if they could eliminate their exposure.

Health Education Program.

PR and PR% measure the potential benefit to be expected in the entire population. If the exposure of interest could be eliminated.

Preventable Risk

$$\rightarrow PR = \frac{Rate(E) - Rate(\bar{E})}{Rate(\bar{E})}$$

the proportion of events in the non-exposed population that could have been prevented if they had been exposed to the protective factor.

In clinical trials: Absolute Risk Reduction (ARR).
Relative Risk Reduction (RRR).

treatment.

Number Needed to Treat

NNT: the # of individuals that would need to be treated to prevent a single case

$$NNT = 1 / ARR$$

$$NNT = 1 / PR$$

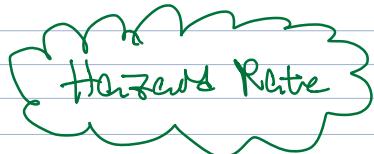
$$NNT = 1 / ARR$$

... Smokers would

? interpretation.

need to be non-smokers
to prevent one lung cancer
per year

of exposed persons or
of general persons ...



Definition

probability of disease
in the very short
time period, given
the free of disease
at the beginning of
the time period
(or probability)

$$HR = \frac{P[D=1 \text{ in } (t, t+dt)]}{D=0 \text{ at } t} \quad (\text{with } dt \rightarrow 0)$$

formula.