EPIDEMIOLOGIE

Attribution of risk

relative risk
absolute risk difference
attributable risk fractions

Risk/rate

- Measures the strengths of association between the risk factor and disease
- Incidence rate or Risk in exposed (r_1)
- Incidence rate or Risk in unexposed (r_0)

Relative measures of effect (**relative** risk)

We have 2 groups of individuals:

- An **exposed** group (group with risk factor of interest) and **unexposed** group (without such factor of interest)
- We are interested in comparing the amount of disease (mortality or other health outcome) in the exposed group to that in the unexposed group

Risk ratio

- we calculate the risk ratio (RR) as:

$$RR = r_1 / r_0$$

Risk difference

- the absolute difference between two risks (or rates)

$$RD = r_1 - r_0$$

Relative risk

Example: cohort study of oral contraceptive use and heart attack

	Myocardial infarction		
	Yes	No	Total
OC use			
Yes	25	400	425
No	75	1500	1575
Total	100	1900	2000

Risk (exposed) = 25/425=0.059
Risk (unexposed) = 75/1575=0.048

Relative risk = 0.059/0.048 = 1.23

Odds ratio

- Alternative measure of risk

The odds of disease is the number of cases divided by the number of non-cases

$$\text{Odds} = \frac{\text{Cases}}{\text{Non cases}}$$

Odds ratio (**OR**) is ratio of odds of disease among exposed ($odds_{exp}$) and odds of disease among unexposed ($odds_{unexp}$)

$$\mathbf{OR = odds_{exp} / odds_{unexp}}$$

	Myocardial infarction		
	Yes	No	Total
OC use			
Yes	25	400	425
No	75	1500	1575
Total	100	1900	2000

We can calculate

- Odds (exposed) O_{exp}=25/400
- Odds (unexposed) O_{unexp}=75/1500

- Odds ratio OR = O_{exp} / O_{unexp} = 1.25

Odds ratio as an approximation to the risk ratio

- For a rare disease, odds ratio is approximately equal to the risk ratio (because denumerators are very similar)
- For a common conditions, OR overestimates the true RR

Absolute risk difference (attributable risk)

Risk ratio

- we calculate the risk ratio (RR) as:

$$RR = r_1 / r_0$$

Risk difference

- the absolute difference between two risks (or rates)

$$RD = r_1 - r_0$$

Example: cohort study of oral contraceptive use and heart attack

	Myocardial infarction		
	Yes	No	Total
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Risk (exposed) = 25/425=0.059
Risk (unexposed) = 75/1575=0.048

Risk difference = 0.059 - 0.048 = 0.011 = 1.1%

Interpretation

- Risk difference = 1.1% (=1.1/100 persons)
- Women using OC had 1.1% higher risk of heart attack than women not using OC
- If we compare 100 women on OC vs. 100 not using OC, there will be 1.1 more heart attack in the OC group.

Attributable risk fraction (ARF, AR%) (risk difference %, etiological fraction)

Proportion of disease among exposed that is attributable to the exposure

$$AR\% = \frac{AR}{\text{Incidence in exposed}} = \frac{0.059-0.048}{0.059} = 0.19 = 19\%$$

Interpretation:

If OC cause heart attack, about 19% of heart attacks among women using OC can be

- attributed to their OC use.
- eliminated if they did not use OC

Measures of population impact

- **Population attributable risk (PAR)** is the absolute difference between the risk (or rate) in the whole population and the risk or rate in the unexposed group

$$PAR = r - r_0$$

Example: cohort study of oral contraceptive use and heart attack

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Risk (exposed) = 25/425=0.059
Risk (unexposed) = 75/1575=0.048
Risk (whole population) = 100/2000 = 0.05

PAR = 0.050 - 0.048 = 0.002 = 0.2% = 2/1000

PAR interpretation

- If OC use were stopped, the excess annual risk of heart attack in ALL women would be reduced by 2/1000.

- Please note: 2/1000 = 200/100,000 = 2,000/1,000,000

- Not negligible!

Population attributable risk fraction (PARF or PAR%)

- It is a measure of the proportion of all cases in the study population (exposed and unexposed) that may be attributed to the exposure, on the ***assumption of a causal association***
- It is also called the aetiologic fraction, the percentage population attributable risk or the attributable fraction

- If r is rate in the total population

$$\mathbf{PAR = r - r_0}$$

$$\mathbf{PAF = PAR/r}$$

$$\mathbf{PAF = (r\text{-}r_0)/r}$$

Example: cohort study of oral contraceptive use and heart attack

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Risk (exposed) = 25/425=0.059
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Risk (whole population) = 100/2000 = 0.05

PARF = (0.050-0.048)/0.05 = 0.002/0.05 = 0.04 =4%

PARF interpretation

- If OC use were stopped, the excess annual risk of heart attack in ALL women would be reduced by 4%.

- Please note: 4% of a common disease can be a large number of events

- Not negligible!

Alternative formula for PARF

$$PARF = \frac{p\,(RR - 1)}{p\,(RR - 1) + 1}$$

Example: lung cancer and smoking

- Prevalence of smoking = 30%
- RR ~10

$$PARF = \frac{0.3(10-1)}{0.3(10-1)+1} = \frac{0.3x9}{0.3x9+1} = \frac{2.7}{3.7} = 0.73 = \mathbf{73\%}$$

73% of all lung cancers in the population could be prevented if smoking is eliminated

Measure of effect	Use of the measure	How to interpret results
Risk Difference (AR, PAR, AR%, PARF)	Public Health Interested in excess disease burden due to factor (“Attributable risk”) Important for prevention action	Close to 0 = little effect Large difference = large effect
Risk Ratio	Epidemiology Causation “This factor doubles the risk of the disease”	Close to 1 = little effect Large ratio = large effect Close to 0 = large effect!
Odds Ratio	As for Risk Ratio “This factor doubles the odds of the disease” Only possibility (case-control study) More advanced statistical methods (logistic regression)	