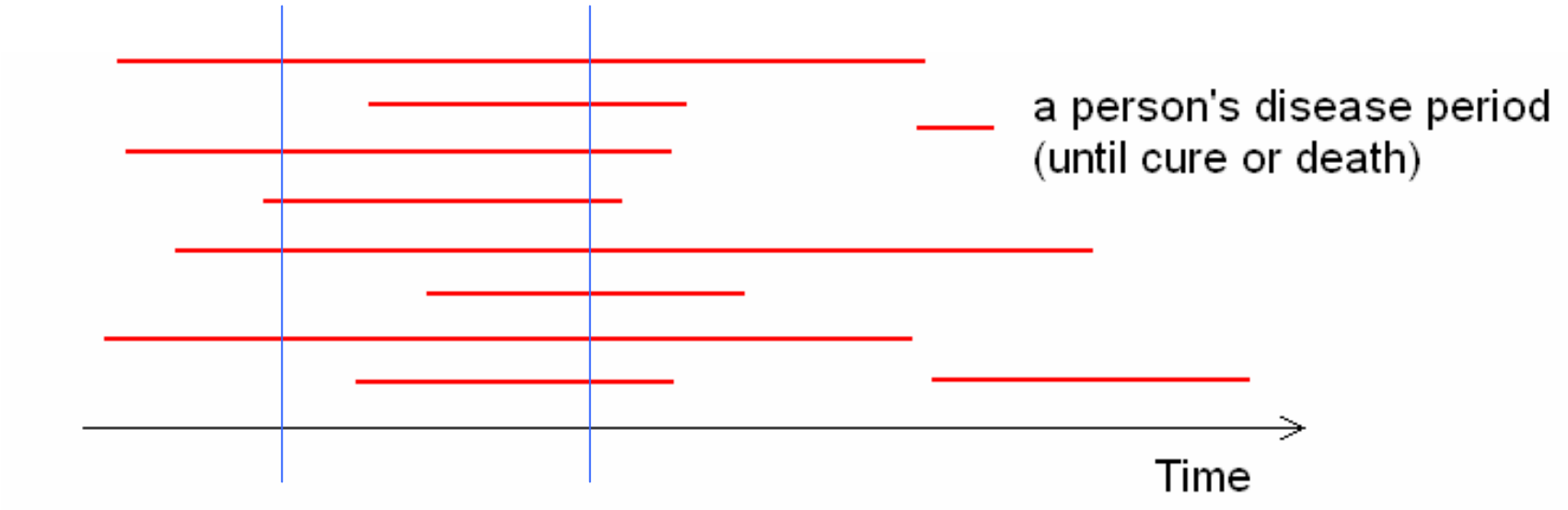
Incidence and prevalence

Occurrence of disease (or condition of interest) has its dynamics in the population.



Cross-sectional, longitudinal, and register-based studies reflect to quite different aspects of this dynamics.

In a **cross-sectional** study, you can calculate the **proportion of those with the disease** at a particular time point.

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What should be added?

- When? (Give the time point of the study)
- How is „old" meant? (Specify the study population)
- What is regarded as high blood pressure? (Specify exactly the condition of interest)

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120 per 100,000 is the observed **sample prevalence**. 95% **confidence interval for the population prevalence** is from 20 to 380 per 100,000.

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In this case the experienced sample prevalence is called the **apparent prevalence** while the prevalence corrected for test sensitivity and specificity is called the **true prevalence**.

$$prev_a = prev_t \cdot Se + (1 - prev_t) \cdot (1 - Sp)$$

$$prev_t = \frac{prev_a + Sp - 1}{Se + Sp - 1}$$

If a screening test has *Se*=99% and *Sp*=75%, then 40% apparent prevalence results in just 20.2% true prevalence.

In a register-based study, one can count the **new cases in a particular time period**.

Incidence (also called **incidence rate** or **cumulative incidence**) is the number of new cases

- per time period (year, month, etc.)
- per 100,000 people **at risk (in the study population)**

„Incidence of breast cancer in the UK in 2004 among females aged 40-44 was 20 cases per month per 100,000."

Relation between incidence and prevalence

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(mean) **prevalence** = (mean) **incidence** · (mean) **duration**

Association, prediction, and causality

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- ice cream consumption and incidence of drowning deaths
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What could be the third factor?

Confounding

We are interested in exploring the relationship (some kind of association) between the variables *X* and *Y*.

Confounding is experienced if a third variable *Z* modifies the relationship so that

- it generates an apparent association between *X* and *Y*
- it masks (hides) an existing association between *X* and *Y*
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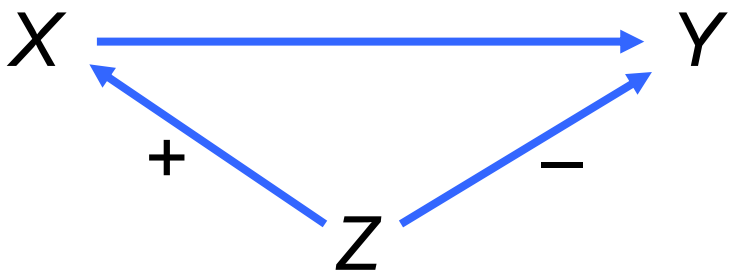
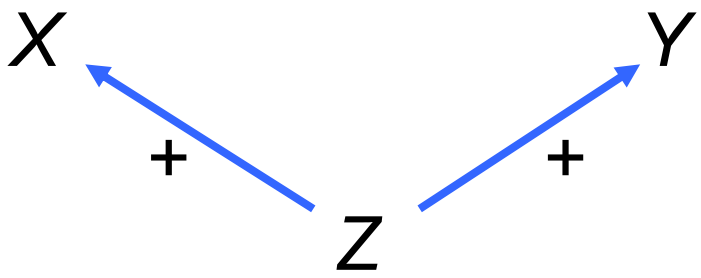
Of course we want to eliminate the confounding effect of *Z* to see the pure (direct) relationship between *X* and *Y*.

But there may be further confounders as well...

Any *Z* can be a confounder only if it is associated (or correlated) with both *X* and *Y*.



masked existing correl.



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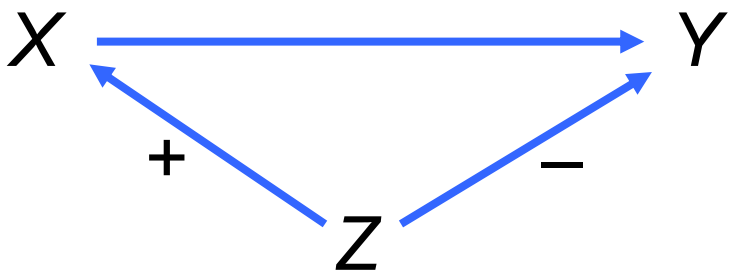

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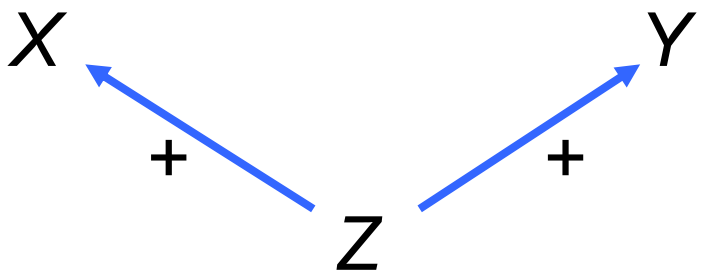
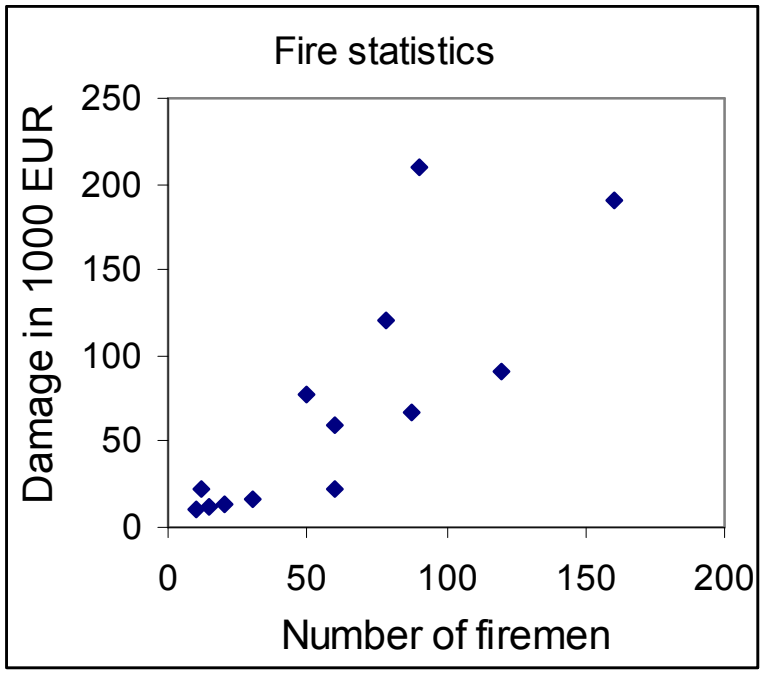


apparent positive correl.

Example:

Strong positive correlation can be observed between the number of firemen and the damages of fire.

Isn't it perhaps worth at all calling the fire brigade?



Prevalence rates, mortality rates etc. can differ between two populations (regions or countries) purely due to the different age structures in the two populations.

	Popul. A		Popul. B	
	Preval.	Age structure	Preval.	Age structure
Young (<30)	5%	20%	5%	40%
Medium (30-60)	15%	40%	20%	40%
Old (>60)	35%	40%	40%	20%
Total	21%		18%	

In each age group

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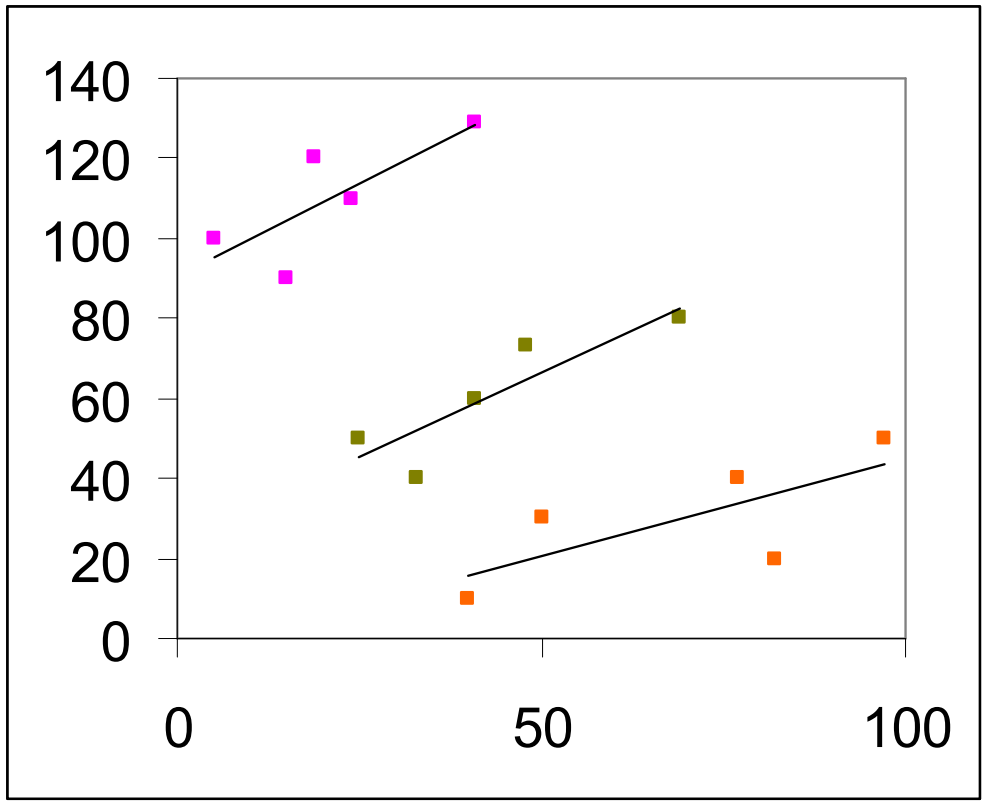
Standardization of rates helps avoid such problems!

It may occur that there is a positive correlation between *X* and *Y* in each of some groups, but the pooled sample exhibits a negative correlation. Then the grouping variable is a confounder and should be included in the model.



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Further variables that can be taken into account as confounders: severity of disease, center (in multicenter studies), time (children are growing, environment is changing, etc.).

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If you observe an association or correlation that is nonsense, look for a potential confounder!

Also, if an association that should be there is missing!

Methods to eliminate (or at least reduce) confounding

- Matching (for each case we assign a control person of same age, sex, etc.)
- Narrowing the range of inclusion criteria (we include only males aged 40 to 45 in the study)
- Stratifying by the potential confounders and either analysing within each stratum, or using combination methods (standardization of rates, Mantel-Haenszel, etc.)
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And what happens to the unknown (unmeasured) confounders?

Sources of bias

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An **estimation method is biased** if it (systematically) differs form the true parameter. Ignoring *Se* and/or *Sp* of the diagnostic test, prevalence estimate may be biased.

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The word bias is not a well-defined statistical term. It is used in several different meanings. These were just examples from the spectrum.

Interaction

Interaction qualifies the joint effect of two (or more) factors to a dependent variable.

In the simplest case, the joint effect is simply the sum of the two effects: this is called **additivity** of effects, or **no interaction**. Any other joint effect is called **interaction**.

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Assume that treatment *A* causes a decrease in blood glucose level by 3 mmol/l while treatment B causes an increase by 2 mmol/l.

If there is no interaction between the treatments, their joint application will reduce the blood glucose level by 1 mmol/l.

Another (equivalent) formulation of “no interaction”:

There is **no interaction** between the effects of treatments *A* and *B* if **the effect of *B* is same in each treatment category of *A***.

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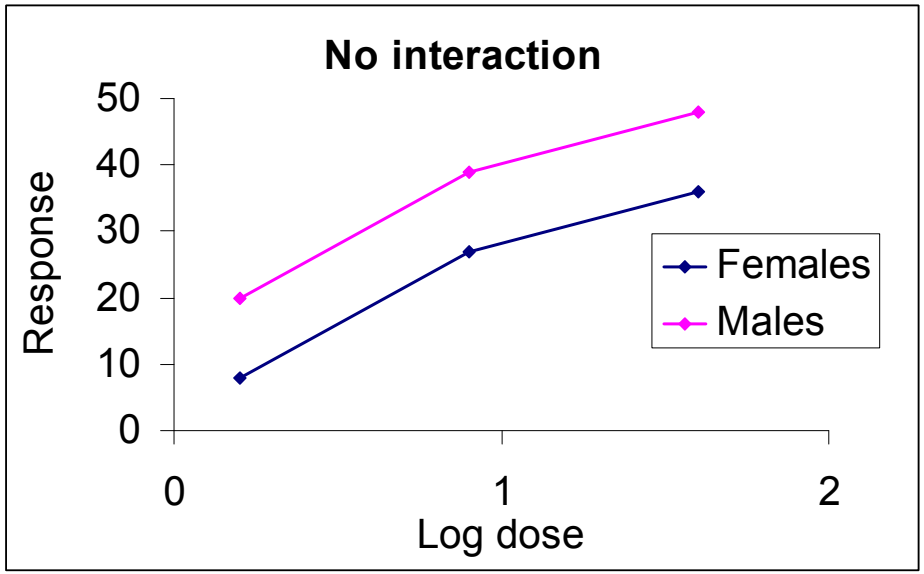
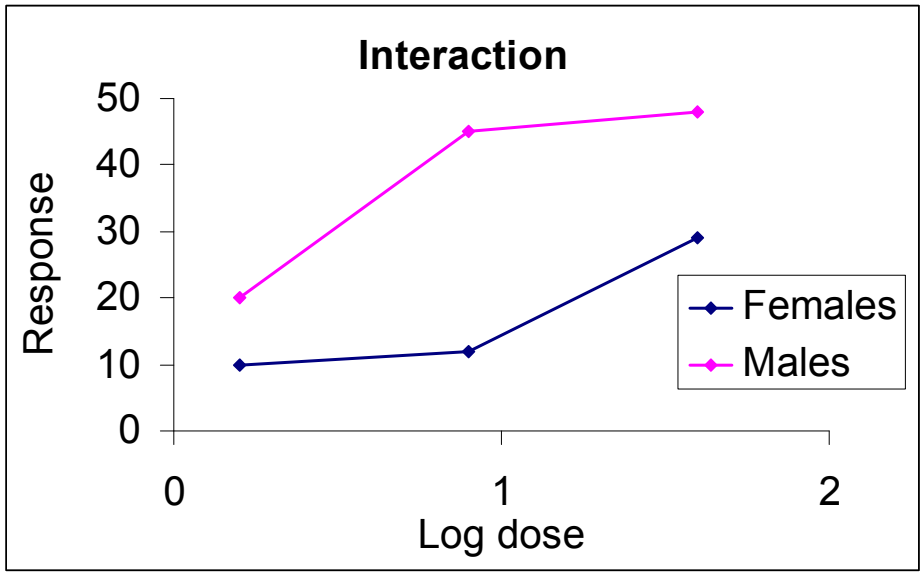
Assume *A* represents 3 doses of a drug, and *B* is sex. No interaction means, that the effect of sex, i.e. the difference in response between females and males is same for each dose.

Interaction plot serves as a nice tool to illustrate interactions.





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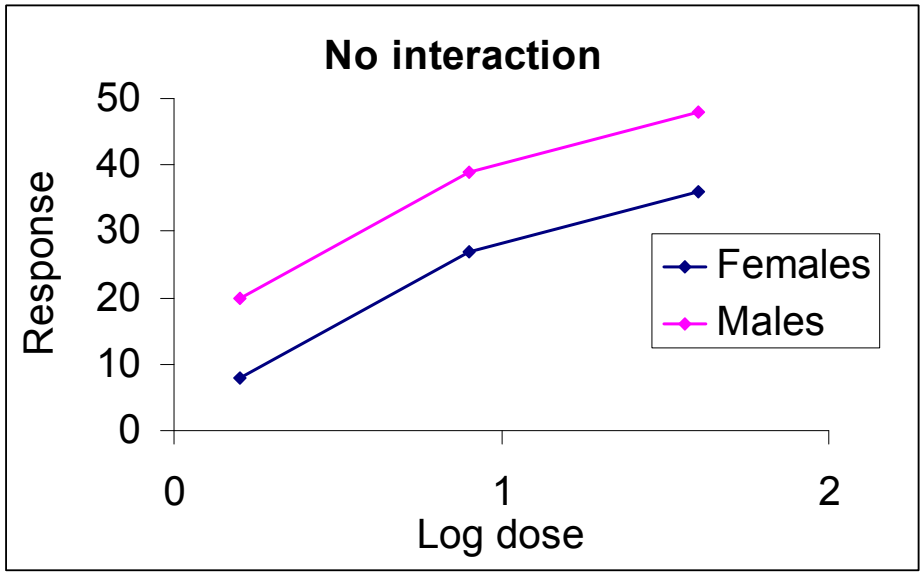

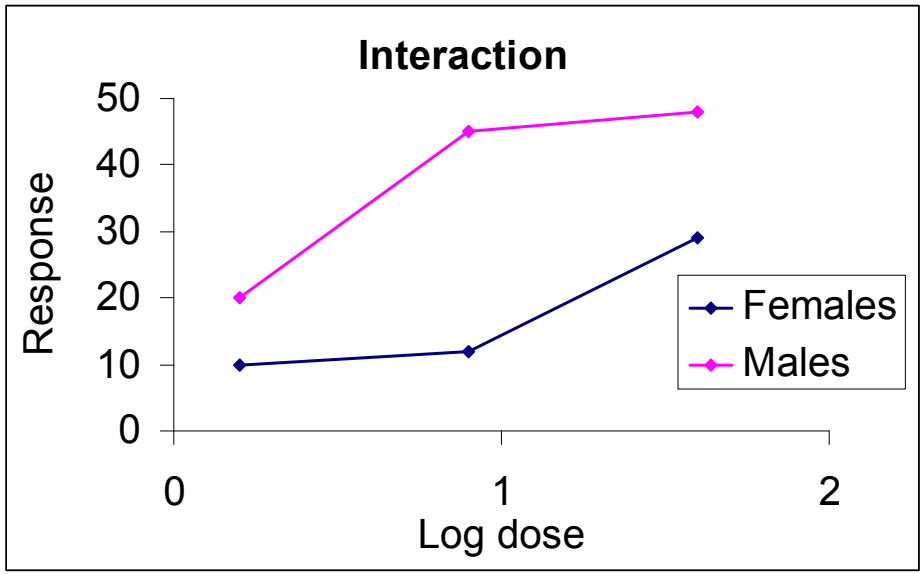

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Don't think that presence of interaction is needed for confounding!

Sex can be a confounder even if there is no interaction!