

MEDICAL RESEARCH



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Week 5 Descriptive studies part 2

cross-sectional studies and ecological studies

Ecological studies

Are studies in which information on the characteristics and/or exposures of individual members of the population groups are generally not obtained. Existing statistics are used to compare the mortality or morbidity experience of one or more populations with some overall index exposure. care is needed to avoid the ‘ecological fallacy’ where inappropriate conclusions are made from ecologic data

THE whole communities not patients, we have data about them. we have data at the World Bank data , the WHO and different bodies. To study the risk factors and the correlation between different variables.

Ecological studies

- These studies are used to describe disease or drug use problems in relation to some factor of interest.

Comparing cigarette consumption with rates of cancer.

Comparing Alcohol consumption with coronary heart disease mortality.

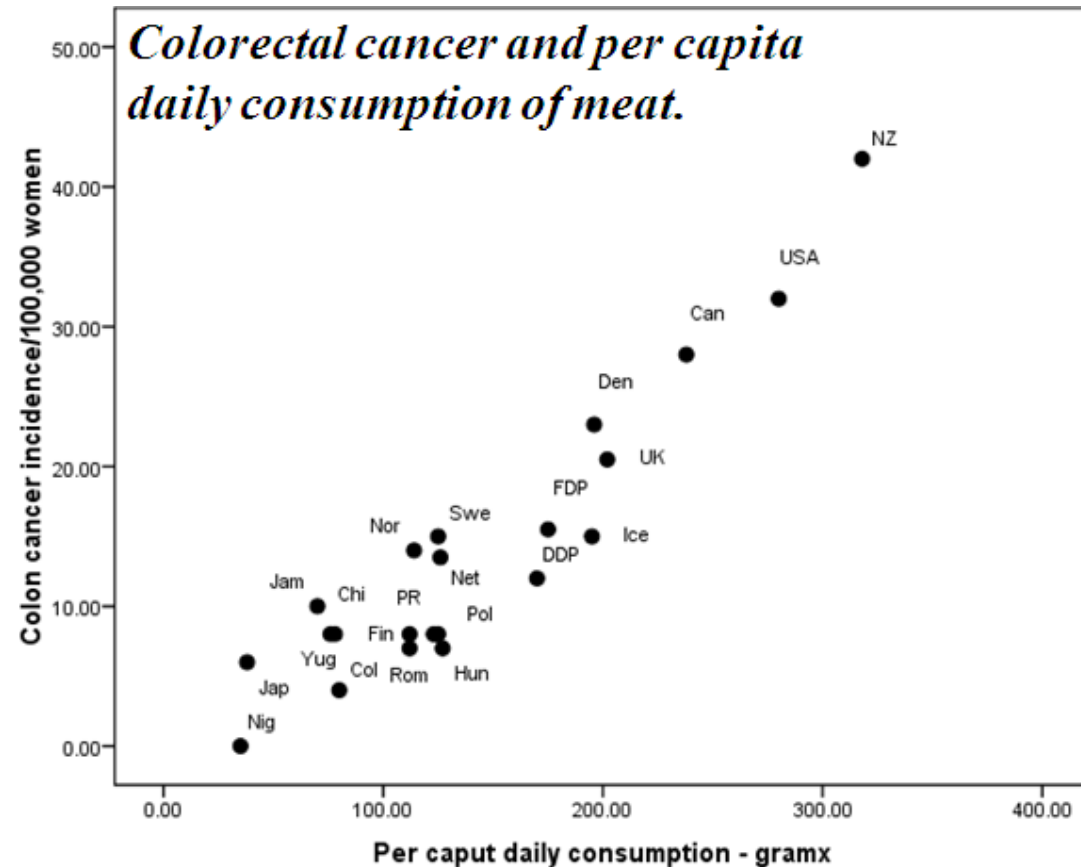
- Ecological studies are the first identified strong relationships between disease and behavior.

Ecological studies

■ In ecological studies the unit of analysis is some aggregate individuals rather than individual persons

■ Geographic areas or time period are often used as a basis for defining aggregates

■ The analysis centers on determining whether the ecological units with a high frequency of exposure are also unit with a high frequency of disease (+ve correlation) or a low frequency of disease (-ve correlation)



Adapted from: *Int. J. Cancer* 15:617, 1973

This study shows the relation between consumption of meat and colorectal cancer in countries. where they have lowered meat consumption like **Nigeria , Japan**. If we have higher consumption ,we have higher incidence of cancer like **New Zealand, USA**. while countries with low consumption, they have lower incidence so we can do the hypothesis that red meat consumption could be a risk factor for Coral cancer we can look at different factors and draw correlations .

We can't draw a straight line here on the points , consistent relationship we see, so we can generate hypothesis that red meat consumption could be a risk factor.

Now we need to do analytical studies to prove or disprove this hypothesis, this is a Factor we can be we can look at preventive factor maybe you look here at physical activity , countries with low physical they have low incidence of cancer and the care will be like. This way when we have more physical activity participation will have lower incidence of cancer or chemical disease diabetes. so, you can have positive correlation or negative correlation.

We have the limitations. I'm looking at red meat consumption in the USA or New Zealand for the whole population at one point of time but maybe the coralcancer patients they have low red meat consumption, so this is the main limitation of these fact. you know there's seasonal variations also inconsumption activity. ڤ

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The second point is the confounding factors, confounding factor maybe countrieslike New Zealand USA they have low fiber diet they have high obesity they have limited physical activity, so this is the risk factor for cancer not meat consumption.

the classical example of compounding factors is the heavy alcohol intake and lung cancer, this analytical study found that heavy alcohol drinkers have high incidence of lung cancer, and the relative risk was high compared with non-alcohol drinkers and made the conclusion that heavy alcohol drinking is a risk factor for lung cancer. Let's look at smoking rate if there's a correlation between smoking and alcohol drinking.

So, what they did they split the groups into two groups , we have heavy alcohol drinkers, heavy smokers AND a group of heavy alcohol drinkers – nonsmokers. the first group who are smokers and heavy alcohol drinkers the relative risk increase in higher incidence while the group with nonsmokers although they are heavy alcohol drinkers , the relative risk drops down. To the general population, it's not significant anymore . this means that heavy alcohol drink is a compounding Factor while the true risk factor is smoking.

In our lovely case. Example of New Zealand and USA , maybe the high low fiber diet , the physical activity and other factors ,etc..

So, the main two limitations for curricular studies as first one we mentioned that we are looking at the whole population not the individuals with the disease , second point the confounding factors.

these studies are great, and we can donate hypothesis and we can test them in analytical studies.

Ecological (correlational studies)

- look for associations between exposures and outcomes in populations rather than in individuals.
- They use data that has already been collected.
- The measure of association between exposure and outcome is **the correlation coefficient r** .
- This is a measure of how linear the relationship is between the exposure and outcome variables. (Note that correlational is a specific form of association and requires two continuous variables)

Ecological (correlational studies)

Advantages of an ecological study

1. An ecological study is quick and cheap to conduct.
2. It can generate new hypotheses.
3. It can identify new risk factors.

Ecological (Correlational studies)

Disadvantages:

- 1.It is unable to control for confounding factors. This is often referred to as 'ecological fallacy', where two variables seem to be correlated but their relationship is in fact affected by cofounding factor(s).**
- 2.It cannot link exposure with disease in individuals as those with disease may not be expose.
- 3.Its use of average exposure levels masks more complicated relationships with disease.
- 4.Its units of study are populations not individuals. Therefore, the disease rates linked with population characteristics and the association observed at group level does not reflect association at individual level.

Ecological (correlational studies)

Prostate cancer and sugar consumption case.

we can correlate that can see there is a line...

the lower countries with low sugar consumption they have low prostate cancer. As simple as that.

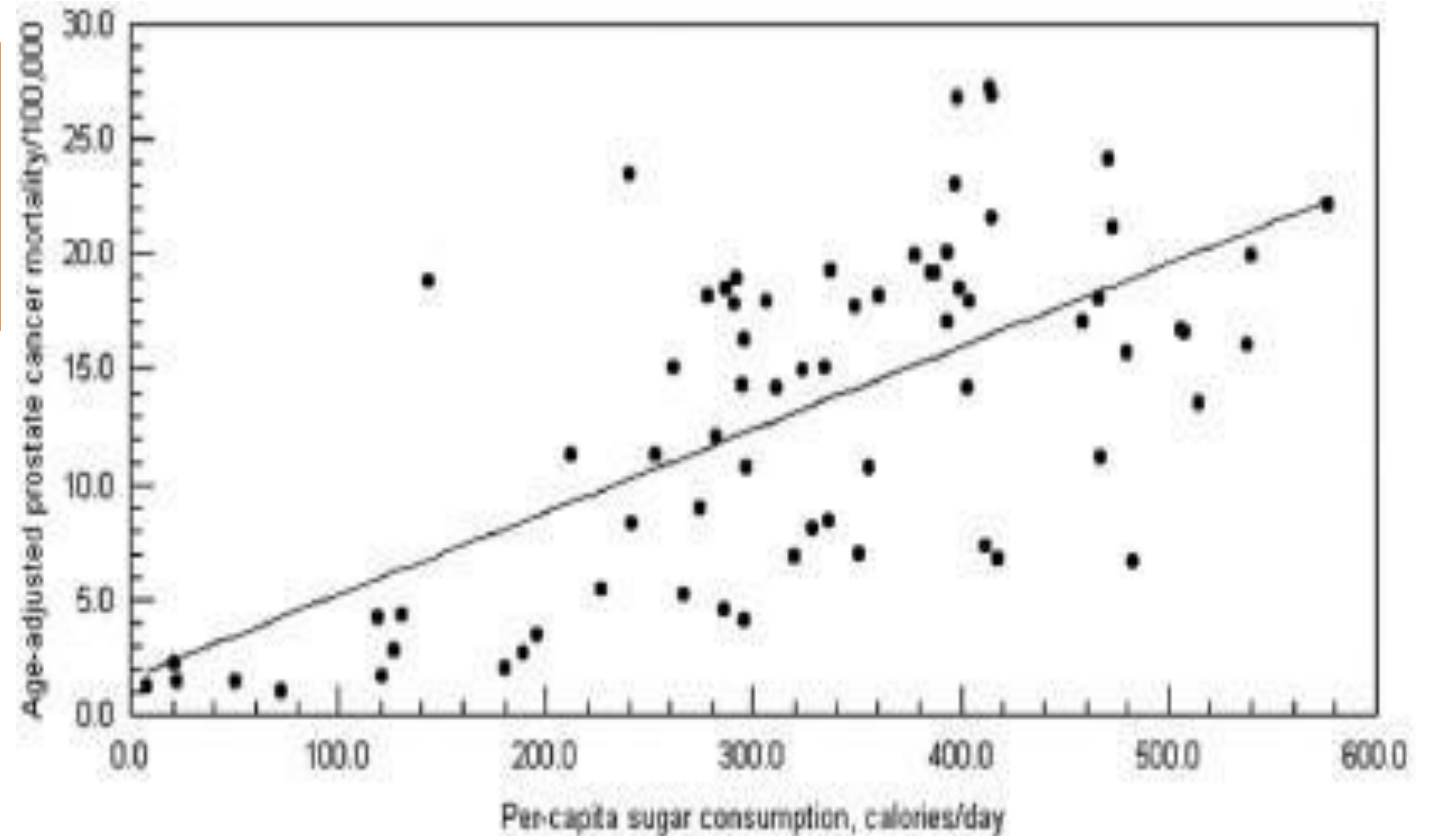


Fig. 1. Prostate cancer mortality versus sugar consumption in 71 countries.

Descriptive epidemiology

- There are many problems with descriptive methods.
- In case reports and case series, there is no control group.
- For correlation studies: there are confounding factors that might mask the true impact of risk factors.
- Correlation studies present only a snapshot of the problem, such as disease or drug use, in a population.

For the mentioned limitations, we need the analytical study to prove or disprove the hypothesis.

for example, we are studying correlation between smoking and hypothyroidism. if the permanent smoking on hypothyroidism patient is 70% while general population 20% this mean that this could be a factor when we need to proceed with the analytical studies.

for example, you found the permanent smoking is 50% among hypothyroidism patient and 50% among general population there is no need to do something.

CROSS-SECTIONAL STUDY DESIGN

- Sometimes called *prevalence studies*.
- They are studies of total populations or population groups in which information is collected about the present and past characteristics, behaviors, or experiences of individuals.
- There are a number of advantages in performing a cross-sectional study.
- These studies involve a single data collection and, thus, are less expensive and more expedient to conduct.

we have 10,000 subjects; we asked the subject do you have hypothyroidism or not . for example 1,000 reported yes, we call them know **cases** . then we did TS screening and FT4 test and we find 500 more cases with hypothyroidism. The prevalence will be old cases plus new cases over total population.

means $1,000 + 500 = 1,500$ over 10,000 this mean that prevalence is 15% .

we can study the prevalence of disease ,different risk factors and complication, etc...

Cross-sectional (or prevalence) studies

Are studies in which a defined population is surveyed, and their disease or exposure status determined at one point in time.

- The prevalence rates of disease in the whole population as well as in those with and without the exposure under investigation can be determined.
- Cross-sectional studies are generally not suitable for a disease which is **rare**- I need ten millions for example to get 10.000 subjects, the best study here is *cohort study*- or of **short duration**- as **acute disease, fractures, MI or flu**- as few people will have the disease at any one point in time.

important: We have the burden and the risk factors of a disease: A- common

1- the burden: cross- sectional study

2- the risk factors: a case control study- **for long period of time-or cohort study.**

B- rare

1 the burden: cohort study.

2 the risk factor: case control study.

*****For short duration diseases we study the incidence not prevalence.**

**In cross sectional study, it is not enough to take self-report from the subjects either he has the disease or not. we need to investigate, because many subjects report that he doesn't have the disease while he actually does .

CROSS-SECTIONAL STUDY DESIGN

- ***Emphasis* is on differences between groups at one point in time.**
- **They provide a one-time glimpse at the study population, showing the relative distribution of conditions, diseases, and injuries—and their attributes—in a group or population.**
- **Point prevalence versus Period prevalence**

Point prevalence refers to the proportion of individuals in a population who have a specific condition at a particular point in time. **Example:** If, on January 1st, there are 100 cases of a particular disease in a population of 1,000, the point prevalence would be $100/1,000$ or 10%.

Period prevalence: refers to the proportion of individuals in a population who have a specific condition over a defined period of time. **Example:** If, over the course of a year, there are 200 cases of a disease in a population of 1,000, the period prevalence would be $200/1,000$ or 20%.

For example, if I do the follow up over six months, I have 100 cases , the incidence per year will be 200 , because I found in six months 100 cases so in one year, I will have 200 cases.if I identify 200 cases over two years the incidence will be 50 per year because **we need to look at the incidence over a period of time**

Prevalence is the number of cases old and new over the total population, we are not looking at a period of time.

Cross-sectional (or prevalence) studies

■ It is often difficult to separate cause and effect as the measurement of exposure and disease at any one point

in time. if we have cross-section study on patient with cancer, we don't know the initial process of the cancer started before or smoking status started before . so the we can't split the exposure and don't establish what we call temporary relationship.

Extra: Temporary relationship refers to the examination of associations or relationships between variables at a specific point in time. Cross-sectional studies are observational studies conducted at a single point or over a short period to assess the prevalence of a particular outcome and the association with potential risk factors or exposures.

Unlike longitudinal studies, cross-sectional studies do not establish a temporal sequence between the exposure and outcome.

■ Because of this limitation, cross-sectional studies are useful when investigating **exposures which do not change.** e.g genetic characteristics such as ABO blood group and HLA. **When study the ABO group and peptic ulcer. By Default, we know that ABO starts from birth- before establish the peptic ulcer. Like this the genetic disease.**

■ Cross-sectional studies are often used as an initial exploration of a hypothesis prior to conducting a case-control or follow-up study.

Cross-sectional studies

- More effective in identifying chronic diseases and problems
- Less effective in identifying communicable diseases of short incubation periods and short durations- [here we use cohort study-](#) .

CROSS-SECTIONAL STUDY DESIGN

- They provide information and data useful for the planning of health services and medical programs.
- Assessment of the burden of diseases or healthcare programs leads to setting priorities at the organization, local or national levels.
- They are based on a sample of the whole population and do not rely on individuals presenting themselves for medical treatment, **for example** I got small village in the average population, they are around 65 ,I found 40% of this group they have type two diabetes **it's not acceptable**, because I'm going to say that the prevalence of type II in Jordan is 40% but it not represented of the population, because this Village has mainly elderly so in order for me to have a study to the disease in the country, we need to have sample from middle ,north, south of the country, different socioeconomic areas and from villages to present also the rural and urban areas ... then I canmake a conclusion.

CROSS-SECTIONAL STUDY DESIGN

- Sample size:
 1. Question or primary & secondary outcomes.
 2. Population size.
 3. Prevalence of condition of interest in the population.
 4. Distribution of the condition (for example hypothyroidism is common among women age 50 to 70 but less common amongst men at this age group).

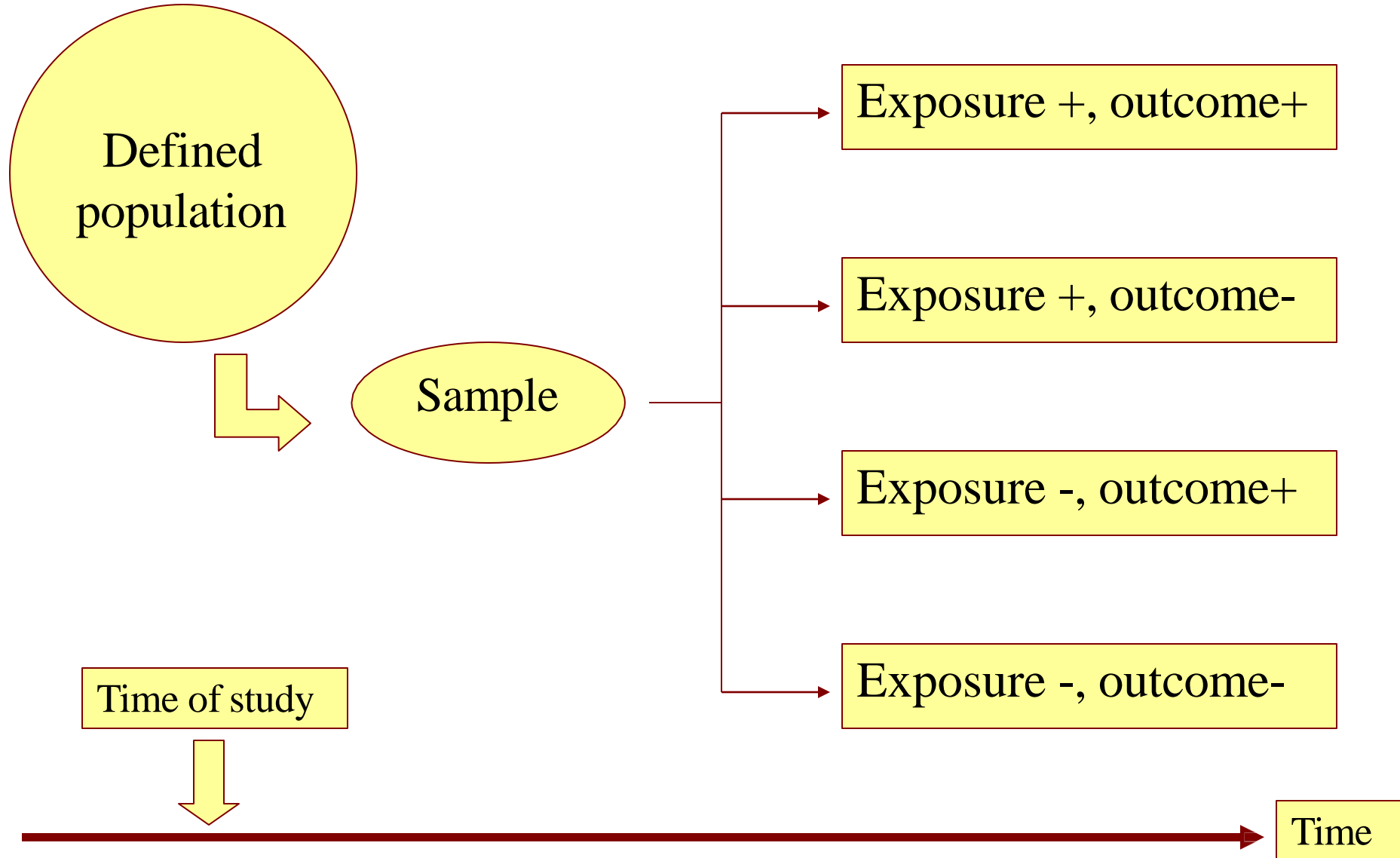
Therefore, we need a large sample from men in the general population to get men with hypothyroidism. In this case we stratify for gender.

Continued>>

Cross-sectional study

- Exposure and outcome are assessed simultaneously among individuals in a defined population, thus at one point in time
- No sampling of individuals based on a exposure or an outcome

Cross-sectional study



Two by two table

Exposure	Outcome		Total
	Yes	No	
Yes	a	b	a + b
No	c	d	c + d
Total	a + c	b + d	a + b + c + d

Prevalence of outcome in exposed = $a / a + b$

Prevalence of outcome in non-exposed = $c / c + d$

Prevalence Rate Ratio (PRR) = $\frac{a / a + b}{c / c + d}$

Cross-sectional study

Prevalence of and Factors Associated With Persistent Pain Following Breast Cancer Surgery

JAMA. 2009;302(18):1985-1992

Objective To examine prevalence of and factors associated with persistent pain after surgical treatment for breast cancer.

Design, Setting, and Patients A nationwide cross-sectional questionnaire study of 3754 women aged 18 to 70 years who received surgery and adjuvant therapy (if indicated) for primary breast cancer in Denmark between January 1, 2005, and December 31, 2006. A study questionnaire was sent to the women between January and April 2008.

Cross-sectional study

Chemotherapy	Outcome		Total
	With pain	Without pain	
Yes	664	556	1220
<i>No</i>	879	1088	1967
Total	1543	1644	3187

Prevalence of pain among chemotherapy = $664 / 1220$
= 54.4%

Prevalence of pain among *no* chemotherapy = $879 / 1967$ = 44.7%

Prevalence Rate Ratio (PRR) = $54.4 / 44.7$ = 1.22

**Cross-sectional survey of CHD
among male by physical activity**

	Number examined	Number with CHD	prevalence
Not physically active	89	14	157.2/1000
Physically active	90	3	33.3/1000

From: [BRCA1 and BRCA2 genes mutations among 200 high risk breast cancer patients in Jordan](#)

The doctor just previews the paper

Category	Number of patients	Prevalence (total 200)
Recurrent mutations		
BRCA1 Positive	15	7.50%
BRCA2 Positive	14	7.00%
BRCA1 or BRCA2 Positive	29	14.50%
Possible (recurrent and novel) mutations		
BRCA1 Positive	7	3.50%
BRCA2 Positive	14	7.00%
BRCA1 or BRCA2 Positive	21	10.50%
Recurrent and novel (VUS and pathogenic) mutations		
BRCA1 Positive	15	7.50%
BRCA2 Positive	21	10.50%
BRCA1 or BRCA2 Positive	36	18.00%

Abu-Helalah et al. <https://www.nature.com/articles/s41598-020-74250-2>

Cross-sectional studies

- Seasonal variations of disease are not well represented in cross-sectional studies except if the duration of the study allows such **comparison- we can't make seasonal-variation conclusion. To make seasonal variation we need a cross sectional study for a year. To avoid this long duration, make a cohort study.**
- In the example below, studying RTA in October would not provide a valid result for incidence of RTA in whole year and does not allow identifying seasonal variations in the RTA
- Road traffic accidents by month of accident, Slovenia, average 2003-2006



Cross-sectional studies: advantages

- *Relatively quick*
- Data on all variables is only collected once.
- *Sample size depends on the question*
- Standard measures used
- Prevalence estimated
- **The prevalence of disease or other health related characteristics are important in public health for assessing the burden of disease in a specified population and in planning and allocating health resources.**
- *Good for descriptive analyses and for generating hypotheses.*

Cross-sectional studies

Disadvantages:

- They cannot show cause–effect relationships.

Difficult to determine whether the outcome followed exposure in time or exposure resulted from the outcome.

- If the sample is not representative, results are representative only of the individuals who participate in the study

Example prevalence of sickle cell anaemia in the Easter region of the KSA does not represent the who country.

- Not suitable for studying rare diseases or diseases with a short duration.
- Unable to measure incidence
- Associations identified may be difficult to interpret.
- Susceptible to bias due to low response and misclassification

V2

Explaining the point.