



**Level 2**  
**Semester 4**  
**Module 7B**  
**Research**



# Observational Analytic study Cohort study



- **Contact:**
- **email:**
- **Mobile:**
- **Academic hours:**
  - .....day: 00:00-00:00 AM
  - .....day: 00:00-00:00 AM



# Contents of the Lecture

- **Types of epidemiological studies (overview)**
  - **Definition of cohort, cohort study.**
  - **Steps of cohort study..**
  - **Basic analysis of cohort study.**
  - **Example of cohort.**
  - **Differences between two types of cohort study.**
  - **Differences between case-control & cohort studies.**



# Learning outcomes

**At the end of the lecture, the students should be able to:**

- **enumerate types of epidemiological studies.**
- **define cohort study.**
- **identify steps of conduction of cohort study.**
- **analyze cohort study results.**
- **compare between two types of cohort study.**
- **Differentiate between case-control & cohort studies.**



# Case scenario or Clinical Correlate

- Framingham cohort study:





# Case scenario or Clinical Correlate

## Framingham cohort study:

This cohort study was initiated in 1948 in Framingham.

It was an industrial town with a population of 28,000.

This Framingham Heart Study recruited 5209 men and women (30–62-year-old) to assess the factors associated with cardiovascular disease (CVD).



# Case scenario or Clinical Correlate

- The researchers also recruited second generation participants (children of original participants) in 1971 and the third general participants in 2002.
- This has been one of the landmark cohort studies and has contributed immensely to our knowledge of some of the important risk factors for CVD.
- The investigators have published 3064 publications using the Framingham Heart Study data.



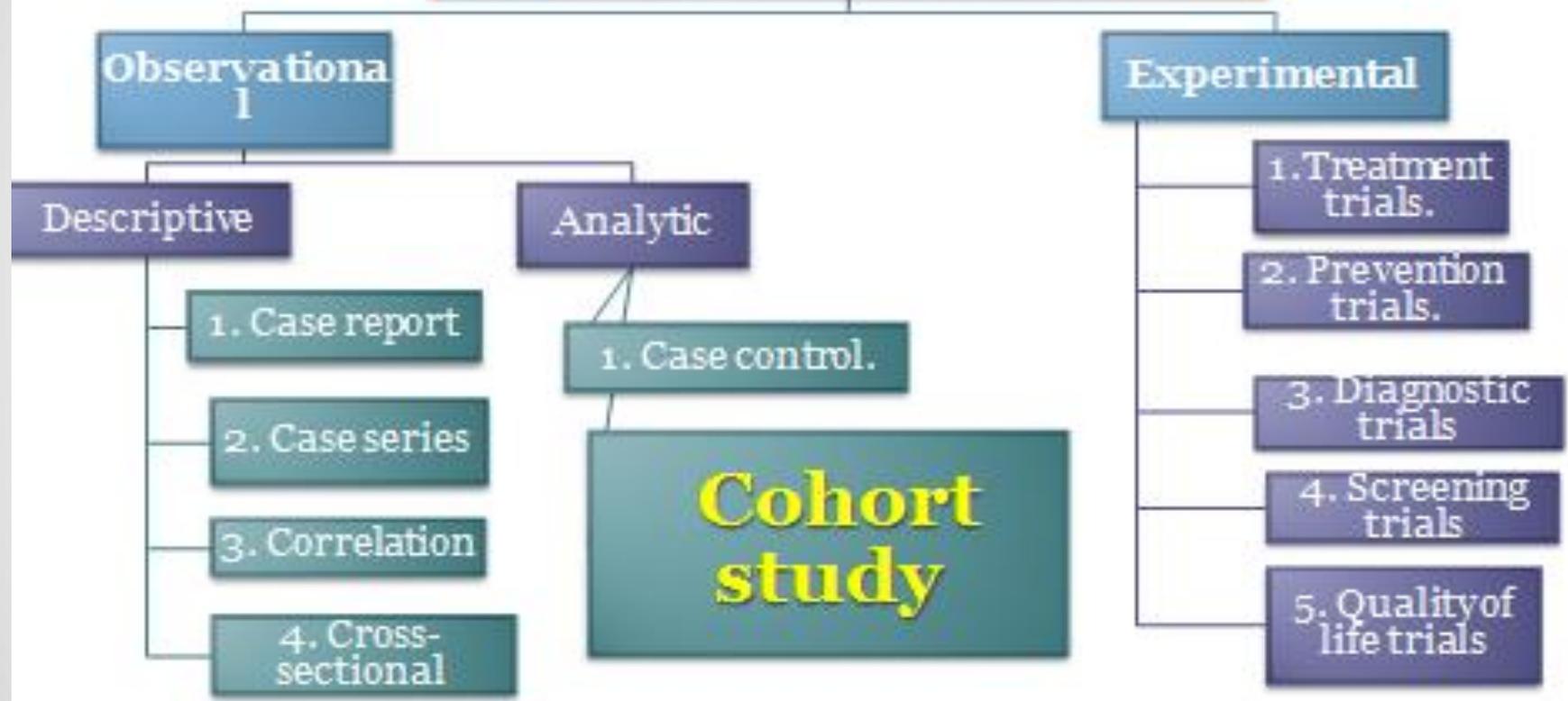
# LO 1-

**At the end of the lecture, the students should be able to:**

- **enumerate types of epidemiological studies.**



## Types of epidemiological study design





## LO 2-

**At the end of the lecture, the students should be able to:**

- **define cohort study.**



# Definition

- ❑ Cohort is a group having a common characteristic, e.g. a smoker's cohort means all are smokers in that group.
- ❑ An observational prospective (longitudinal or follow up) study in which we compare
  - ❑ exposed group (individuals with a risk factor) with
  - ❑ non exposed group (others without the risk factor)as regards the incidence of a disease over time.



## LO 3-

**At the end of the lecture, the students should be able to:**

- **identify steps of conduction of cohort study.**



# Steps of cohort :

مينفءش ناخذ ناس مصابة بالمرض اللي احنا بنحاول ندرسه  
(في ال cohort بندرس ناس أصحاء)

1. First we exclude cases of disease under investigation.
2. The free cohort, divided into 2 groups:
  - Exposed group: individuals exposed to risk factor.
  - Control group: individuals not exposed to this factor.



# Steps of cohort :

ال cohort ( مجموعة الناس اللي بندرسهم ) لازم يبقوا متوفرين طول الوقت ومستقرين في مكان عشان احنا بندرسهم على فترة طويلة

3. Both groups are followed up over a sufficient period of time. Therefore the cohort should be stable, cooperative & accessible to the investigator.
4. If the incidence of disease among exposed group is higher than its incidence among non exposed group, this supports the etiological hypothesis.



## LO 4-

**At the end of the lecture, the students should be able to:**

- **analyze cohort study results.**



# Basic analysis of cohort

## study:

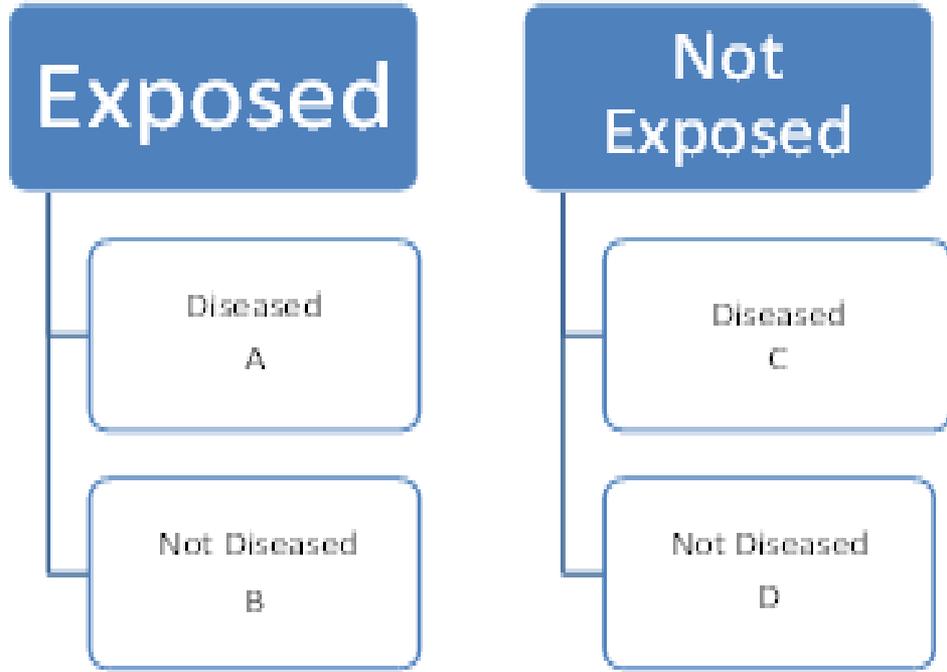
ازاي نقرأ الجدول؟ لو **case control**  
هندور على ال **cases** وبعدين نشوف ال **exposure**  
لو **cohort** بنبدأ بال **exposure** ونمشي معاها

Level 2- Semester 4- Module Research

| Exposure | Disease status                          |  | Total                          |
|----------|---|--|--------------------------------|
|          | Present                                 | Absent                                     |                                |
| Yes (+)  | (a)<br>with exposure<br>with disease    | (b)<br>with exposure<br>without disease    | (a+b)<br>Total exposed         |
| No (-)   | (c)<br>Without exposure<br>with disease | (d)<br>without exposure<br>Without disease | (c+d)<br>Total non-<br>exposed |
| Total    | (a+c)<br>Total with<br>disease          | (b+d)<br>Total without<br>disease          | (a+b+c+d)<br>Grand total       |



## Analysis of cohort studies:





# Basic analysis of cohort study:

Basic analysis involves: calculation of:

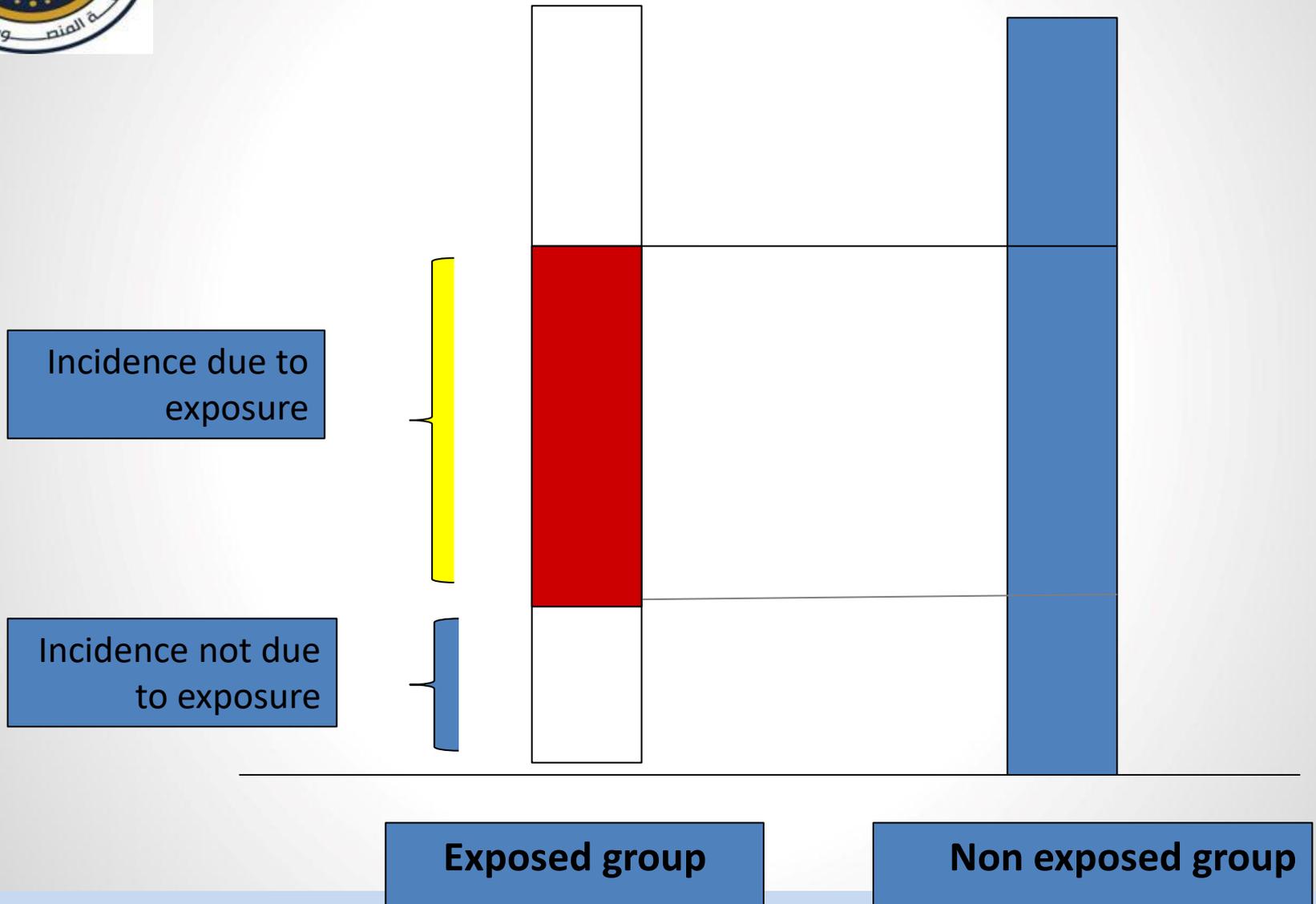
- 1) Overall **incidence** =  $a + c / a+b+c+d$  ← يساوي الـ cases مقسومة على الـ total
- 2) Incidence rate among the exposed ( **$I_e$** ) =  $(a/a+b)$  ← نقسم الـ cases اللي كانوا exposed على كل الـ exposed
- 3) Incidence rate among the non-exposed ( **$I_n$** ) =  $(c/c+d)$  ← نقسم الـ cases اللي مش exposed على الـ non exposed
- 4) Relative risk (**RR**) = Incidence among exposed ( $I_e$ )  
Incidence among non exposed ( $I_n$ ) ← نقسم الاتنين اللي فاتو على بعض

RR answers the question: "How many times exposed person is at risk of developing disease compared to non-exposed?" 



## 5) Attributable risk (AR) $= (I_e - I_n) / I_e \times 100$

- AR answers the question: "How much of the studied disease can be attributed to exposure".
- "Proportion of disease in a population that would be eliminated if risk factor is eliminated".





## Interpretation of Relative Risk (RR):

- ❑ **RR = 1: No association between exposure & disease.**
- ❑ **RR > 1: Positive association (increased risk) i.e. exposed group has higher incidence than non-exposed group.**
- ❑ **RR < 1: Negative association (protective effect) i.e. non-exposed group has higher incidence.**



# Interpretation of the Relative Risk results (RR)

**RR = 1**

Exposure is not associated with outcome or disease

**RR > 1**

- Increased exposure accompanies increased outcome

**RR < 1**

- Increased exposure accompanies decreased outcome



# Example

|             | Develop CHD     | Do not Develop CHD | Total |
|-------------|-----------------|--------------------|-------|
| Smokers     | 84 <sup>a</sup> | <sup>b</sup> 2916  | 3000  |
| Non-smokers | 87 <sup>c</sup> | <sup>d</sup> 4913  | 5000  |



# Answer

❑ **Incidence in smokers** =  $84/3000 = 28 /1000$       $I_e = a / ( a+b )$

❑ **Incidence in non-smokers** =  $87/5000$       $I_n = c / ( c+d )$   
=  $17.4/1000$

❑ **Relative risk** =  $28/17.4 = 1.6$  (smokers are at a higher risk of developing CHD 1.6 times than non-smokers).      $RR = I_e / I_n$

❑ **Attributable risk %** =  $28-17.4/28 = 37.8\%$  (37.8% of CHD cases among smokers is attributed to their smoking).      $AR = (I_e - I_n) / I_e * 100$



## LO 5-

**At the end of the lecture, the students should be able to:**

- **compare between two types of cohort study.**
- **Differentiate between case-control & cohort studies.**



# Differences between two types of cohort study

## Prospective cohort

- Exposure occurred, but disease (outcome) did not occur at the time the study begins.

- Begins in the present and continues into the future.

- Time consuming. ↔
- Expensive. ↔

## Retrospective cohort

- Both Exposure & disease occurred when the study is initiated.

- Begins in the past and continues to the present.

- Quick.
- Cheap.



# Differences between two types of cohort study

Prospect in retrospect  
اسم آخر لهذا النوع تحديدا

## Prospective cohort

### ■ Example:

A prospective cohort study (Framingham study) began in 1948. Included all the men aged 30 to 62 old living in Framingham at risk of cardiovascular disease from that time to the present.

معلومة إثرائية 😊: أشهر دراسة للـ CVD والتي منها طلعت معظم الإحصائيات الخاصة بالـ CVD

## Retrospective cohort

### ■ Example:

Workers who were exposed to asbestos in the building of US Navy ships during World War II compared to other workers not so exposed.

Cancer was much more common in those exposed to asbestos than in the others, after controlling for the frequency of smoking in the two groups.



## LO 6-

**At the end of the lecture, the students should be able to:**

- **Differentiate between case-control & cohort studies with clarification of their advantages and drawbacks .**



# Differences between case-control & cohort studies

Case-Referent / trohoc / retrospective case control  
كلها أسامي تانية لل

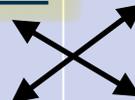
Prospective / follow-up Longitudinal cohort  
كلها اسامي تانية لل

| Case-control studies   | Cohort studies   |
|--|--|
| Proceeds from outcome to cause (from disease to risk factor).  | Proceeds from cause to outcome (from risk factor to disease).                                |
| Compares people with disease & those without disease.  | Compares exposed to non-exposed.   |
| <u>Retrospective.</u>  | <u>Prospective.</u>  |
| Aim to prove or disprove that suspected cause occurs more frequently in those with diseased than non diseased. | Aim to prove or disprove that disease occurs more frequently in exposed than in not exposed. |



# Differences between case-control & cohort studies

| Case-control studies  | Cohort studies   |
|---|--|
| <p><b><u>Advantages:</u></b></p> <ol style="list-style-type: none"><li>1. Cheap &amp; quickly done.</li><li>2. Does not require large samples.</li><li>3. Useful in study of rare diseases.</li><li>4. Study <u>several risk factors</u>.</li><li>5. <u>Can estimate risk (odds ratio)</u>.</li></ol> | <p>لأنها مش بتعتمد على ذاكرة الناس<br/>وال exposure قبل ال disease</p> <ol style="list-style-type: none"><li>1. <u>Less bias</u> in selection of control.</li><li>2. Methods can be <u>standardized</u>.<br/>لان احنا بندرس ال exposure هل ممكن يوصلنا ل disease ولا لا<br/>فبالتالي مش محتاجين retrospective data</li><li>3. Study <u>several outcomes</u>.</li><li>4. Valuable in <u>rare</u> exposures.</li><li>5. <u>Incidence rate &amp; relative risk</u> can be calculated.</li></ol> |





# Differences between case-control & cohort studies

| Case-control studies  | Cohort studies  |
|---|---|
| <p><b><u>Drawbacks:</u></b></p> <ul style="list-style-type: none"><li><input type="checkbox"/> Liable to bias.</li><li><input type="checkbox"/> Not useful in rare exposure.</li><li><input type="checkbox"/> Uncertain data due to incomplete records of past events &amp; unstandardized observation.</li><li><input type="checkbox"/> Difficulty to be sure that a correlation is causal or not.</li><li><input type="checkbox"/> Cannot calculate prevalence rate, incidence rate or relative risk.</li></ul> | <ul style="list-style-type: none"><li><input type="checkbox"/> Expensive &amp; time consuming.</li><li><input type="checkbox"/> Needs a very large population even with common diseases.</li><li><input type="checkbox"/> Delayed results if latent period is long.</li><li><input type="checkbox"/> Prolonged follow up can cause drop out of cases &amp; loss of standardization.</li><li><input type="checkbox"/> Cannot absolutely prove that a factor is causal.</li></ul> |



# Case Report

- A cohort study was designed to assess the impact of sun exposure on skin damage in beach volleyball players.
- **During a weekend tournament, players from one team wore waterproof, SPF 35 sunscreen, while players from the other team did not wear any sunscreen.**
- At the end of the volleyball tournament players' skin from both teams was analyzed for texture, sun damage, and burns.



Comparisons of skin damage were then made based on the use of sunscreen



- **Exposure:- use of sun screen.**
- **Outcome:- skin damage.**



# Questions

## (At least 5 questions with answers and explanations)

**Q1. In a cohort study, an exposure is assessed and then participants are :-**

- A) followed prospectively to observe development of the outcome.
- B) asked retrospectively to check occurrence of the outcome.
- C) divided into groups according to outcome.
- D) treated from the outcome.
- E) randomly divided into groups.

Answer :- **A**



# Questions

**Q2. Cohort Studies generally look at which of the following?**

- A) Determining the sensitivity and specificity of diagnostic methods.
- B) Identifying patient characteristics or risk factors associated with a disease or outcome.
- C) Variations among the clinical manifestations of patients with a disease.
- D) The impact of blinding or masking a study population.
- E) Impact of intervention on the outcome.

Answer :- **B**



# Questions

**Q3. A Study involved 100 contraceptive pills users and 100 non users, both were followed up for 10 years to study relationship between oral contraceptive pills and breast cancer. Among pills users group, there were 20 cases reported for breast cancer while 15 cases were reported in non-pill users group. The correct calculated relative risk is:**

- A)  $RR=3/4$**
- B)  $RR=1/2$**
- C)  $RR=4/3$**
- D)  $RR=1/5$**
- E)  $RR= 2/5$**

• **Answer: C**



# Questions

**Q4. A Study involved 100 contraceptive pills users and 100 non users, both were followed up for 10 years to study relationship between oral contraceptive pills and breast cancer. Among pills users group, there were 20 cases reported for breast cancer while 15 cases were reported in non-pill users group. The correct calculated overall incidence is:**

- A) 20/100
- B) 15/100
- C) 35/100
- D) 35/200
- E) 5/100

• Answer: **D**



# Questions

**Q5. A Study involved 100 contraceptive pills users and 100 non users, both were followed up for 10 years to study relationship between oral contraceptive pills and breast cancer. Among pills users group, there were 20 cases reported for breast cancer while 15 cases were reported in non-pill users group. The correct calculated attributable risk is:**

- A) 20/100
- B) 15/100
- C) 35/100
- D) 35/200
- E) 5/100

• Answer: **E**



# Questions

**Q6. In a cohort study, the risk ratio of developing diabetes was 0.86 when comparing consumers of tea (the exposed) to those who did not drink tea (the unexposed). Which one statement is correct?**

- A) The tea drinkers have lower risk of developing diabetes.**
- B) The tea drinkers have higher risk of developing diabetes.**
- C) Based on the information given we cannot tell if the observed difference in disease risk is the result of chance.**
- D) The risk ratio is close to the value one, so there is no difference in disease risk between the two group.**
- E) The tea drinkers have equal risk of developing diabetes.**

Answer :- **A**



# Questions

Q7. An investigator takes a sample of healthy individuals, record their ongoing solar exposure, and relate that to the subsequent occurrence of skin cancer in the same group.

A) Case-control study.

B) Ecological study.

C) Cohort study.

D) Cross-sectional study.

E) An intervention study.

السؤال ده غلطة 😊

( إجابته عموما هتبقى descriptive longitudinal study )

Answer :- **C**



# Summary and wrap-up

- Cohort design is a type **observational** study design.
- The participants **do not have the outcome** of interest to begin with. They are selected based on the exposure status of the individual.
- They are then followed over time to **evaluate for the occurrence of the outcome** of interest.
- **Examples** (1) Framingham Cohort study, (2) Swiss HIV Cohort study, and (3) The Danish Cohort study of psoriasis and depression.



# Summary and wrap-up

- These studies may be **prospective, retrospective, or a combination** of both of these types
- If the exposure **is rare**, then a cohort design is an efficient method .
- A **retrospective** cohort study can be completed **fast and is relatively inexpensive** compared with a prospective cohort study.
- **Losses during Follow-up of the study** participants is very important source of **bias**.
- These studies are used to estimate the **incidence rate**.



# Discussion

## 10 minutes

# Case-Control Versus Cohort Studies

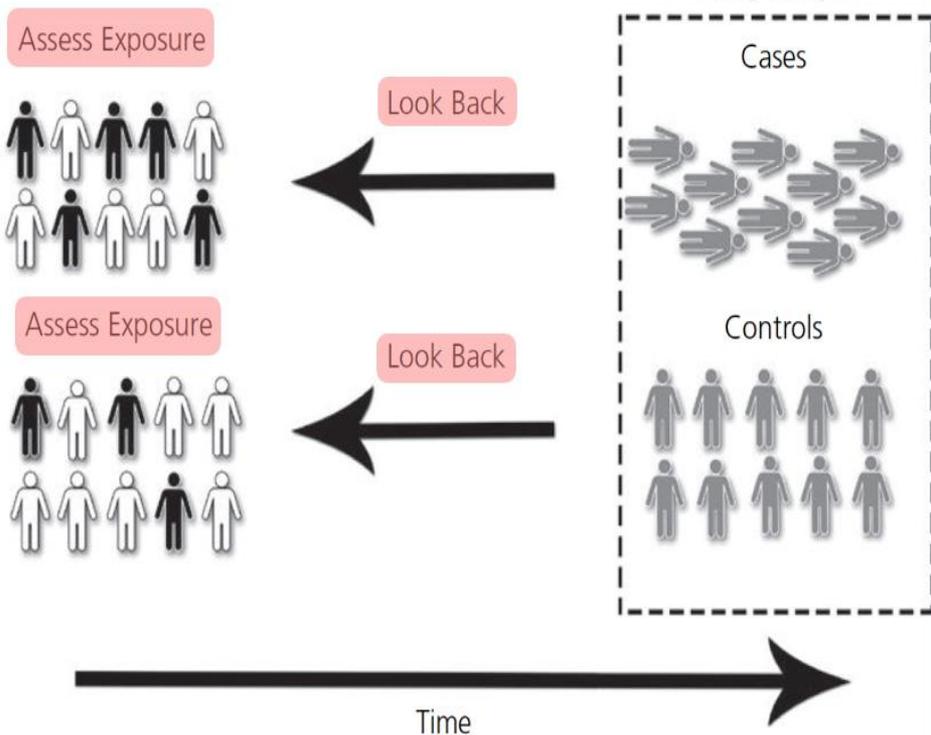
## Similarities

- Both Are Analytical
- Both Can Examine Associations

## Case-Control Study (Differences)

- Track *Backward* From Outcome To Exposure
- Are Inherently Retrospective (Past)

Case-Control Studies



## Cohort Study (Differences)

- Track *Forward* From Exposure To Outcome
- Can Be Retrospective (Past) Or Prospective (Future)

Cohort Studies

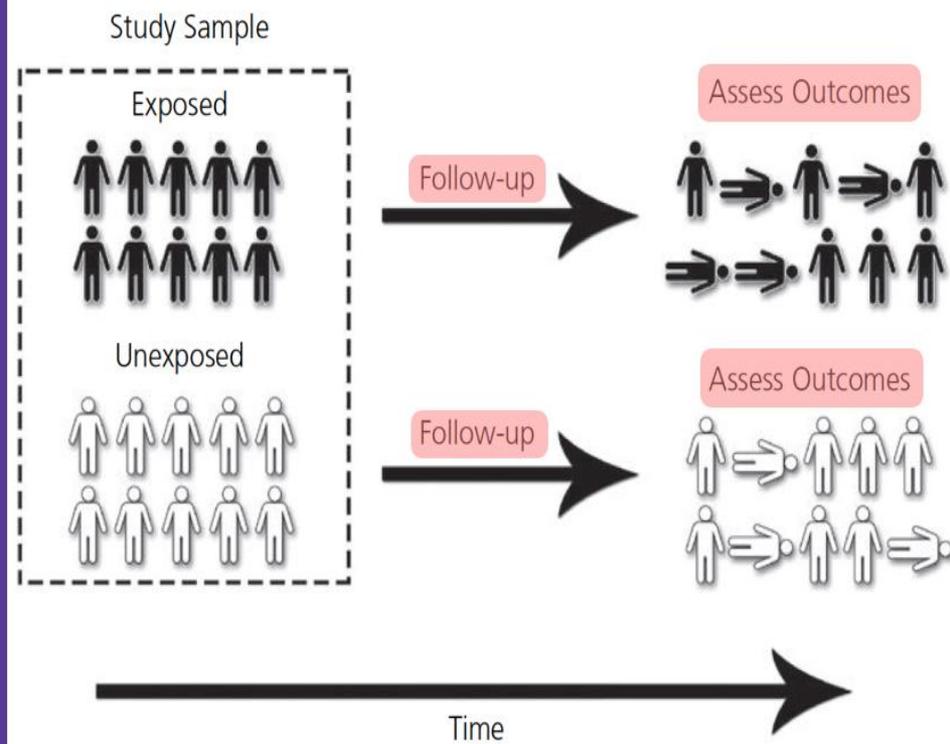


Figure 134.4. Structure of a case-control study.

Figure 134.3. The structure of a cohort study.



## Brain storming question or another related case scenario

- This prospective cohort study explored "the joint effects of sleep quality and sleep duration on the development of coronary heart disease." The study included 60,586 participants and an association was shown between increased risk of coronary heart disease and individuals who experienced short sleep duration and poor sleep quality. Long sleep duration did not demonstrate a significant association.
- So exposure is **short sleep duration and poor sleep quality**
- Outcome is **coronary heart disease**



# Feed back



# References

1. Hennekens CH, Buring JE. 1st ed. Philadelphia, USA: Lippincott Williams & Wilkins; 1978. Epidemiology in Medicine. [[Google Scholar](#)]
2. Egeberg A, Khalid U, Gislason GH, Mallbris L, Skov L, Hansen PR. Impact of depression on risk of myocardial infarction, stroke and cardiovascular death in patients with psoriasis: A Danish Nationwide Study. Acta Derm Venereol. 2015 DOI: 10.2340/00015555-2218. [[PubMed](#)] [[Google Scholar](#)]
3. Framingham Heart Study. [Last accessed on 2015 Nov 14]. Available from: <http://www.framinghamheartstudy.org/index.php> .
4. Jewell N. Boca Raton, US: Chapman and Hall/CRC; 2004. Statistics for Epidemiology. [[Google Scholar](#)]
5. Twisk JW. 2nd ed. Cambridge, UK: Cambridge University Press; 2013. Applied Longitudinal Data Analysis for Epidemiology. [[Google Scholar](#)]