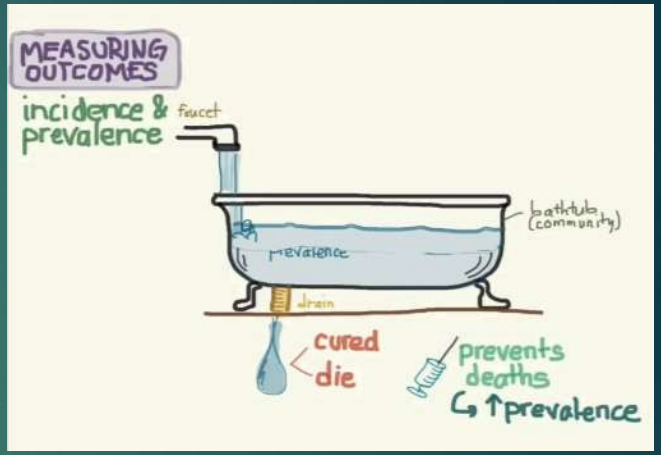
MEASURING DISEASE OCCURRENCE

INCIDENCE AND PREVALENCE (MORBIDITY MEASURES)

In this lecture we will talk about measuring disease occurs , how much disease in the population, how we quantify that.

we called them morbidity measures which are: incidence and prevalence, they are very important in epidemiology.



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How do we measure diseases?

Four *quantitative* descriptors to measure disease occurrence:

- Numbers
- Ratios
- Proportions
- Rates

First we would like to know about some quantifiers for disease occurrence and we should know the difference between ratios, proportions, and rates because we use them a lot in medicine and public health

Descriptors

We can express number of cases or quantity of disease what is the population by:

Numbers: **the easiest way** Use of actual number of events **we count the number of cases for example: number of persons who died with Covid-19 Yesterday, number of people who get vaccinated.**

e.g 100 cases of TB in community A

Ratios: Quantifies the magnitude of one occurrence X *nominator* , in relation to another event Y **denominator** as X/Y **here X and Y are two different populations**

e.g Ratio of TB cases in community A to B is 1:10

This ratio means that in community B (the denominator المقام) we have 10 times the cases found in Community A.

Descriptors

Proportions: a ratio in which the numerator is included in the denominator. البسط يكون جزء من المقام

e.g proportion of TB cases in community A is 10% **from all community A in the denominator there are only 10% who have TB.**

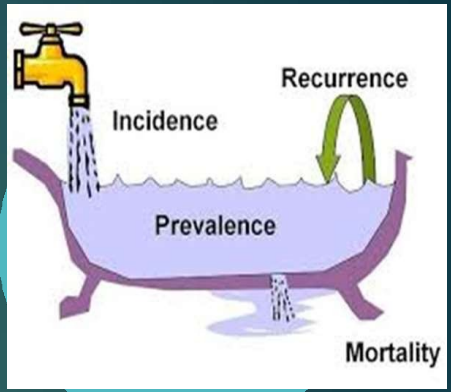
Usually in proportions we convert it into percentage by multiplying it with 100% Because the percentage is more informative

Rates: a proportion **(nominator is part of the denominator)** with time element **usually it would specify a certain period of time**

It measure the occurrence of an event overtime

e.g US measles cases in 2000/US population in 2000. **Death rate, mortality rate in Jordan in the year of 2000, fertility rate**

Measurement of Disease Occurrence Morbidity measures



Morbidity rates are rates that are used to quantify the magnitude الحجم/frequency of diseases (rates of certain disease in a population)

Two common morbidity measures:

Incidence rates (Cumulative incidence easier to do, incidence density More complex but more accurate)

Prevalence (Period prevalence, point prevalence) they do not differ in the way we calculate them both are easy in calculating.

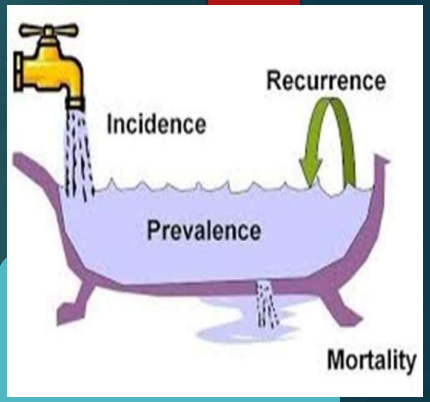
Incidence rate

incidence measures the new cases of disease discovered in a certain period of time

- The proportion of a population that develops a disease overtime
- The risk/probability of an individual developing a disease overtime
- The rapidity with which new cases of a disease develop overtime سرعة انتشار/ حدوث الحالات
- The proportion of unaffected individuals who on average will contract the disease overtime to calculate incidence we start with healthy people not affected with the disease Who will be then developing the disease in certain period of time
- Case fatality rate and attack rate are incidence.

Cumulative incidence

$$\text{Cumulative Incidence} = \frac{\text{Number of new cases of a disease during a specified period}}{\text{Population at risk at baseline or at the starting point of the Period}}$$



If we have a certain month, year, or period we start with the size of population at the beginning of that Period
We have to make sure that we know the population at risk meaning that we should not count the people who already have the disease

If I want to calculate the incidence of diabetes in Jordan in 2022 the denominator must be the population and we subtract The people who already have diabetes because they are not at risk of developing the disease

This open tap with water coming out is the incident cases (new cases added to the population during a certain time) and the prevalence will be all cases of the disease in the population.

Cumulative Incidence

Table 2.4. Relationship between cigarette smoking and incidence rate of stroke in a cohort of 118 539 women[13]

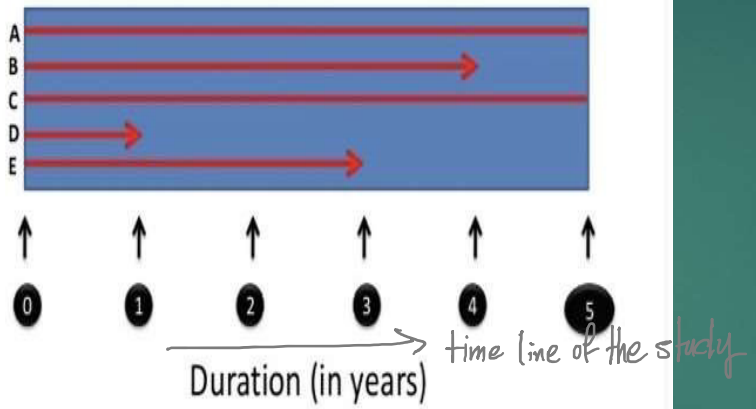
Smoking category	Number of cases of stroke	Person-years of observation (over 8 years)	Stroke incidence rate (per 100 000) person-years)
Never smoked	70	395 594	17.7
Ex-smoker	65	232 712	27.9
Smoker	139	280 141	49.6
Total	274	908 447	30.2

Cumulative incidence rate
= (274/118539)x1000
= 2.31 cases per 1000 women

This table shows the relationship between cigarette smoking and incidence rate of stroke in a cohort off hundred and 18,539 women (that is the total population) and the total number of stroke cases is 274 during the time period under study

Then we calculated as shown in the picture
Which is the new cases divided by the total population (healthy who do not have that disease).

Incidence Density



A 5 years

B 4 years

C 5 years

D 1 year

E 3 years

Total p-y = 18

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Incidence= (3/18)x1000 = 166.67 per 1000 person-years

This is a little bit more complex but it's more accurate because during the observation period Will you measure for every case what time did this person spend under this study until he become a case

Here we have 5 persons understudy A,B,C,D,and E
Persons A,C stayed healthy and did not develop the disease all the 5 years of the study
B Developed the disease at year 4
D developed the disease at year 1
E developed the disease add year 3

We are not required to know the calculation

Other types of **Incidence**

We usually use these types in short terms epidemics (food poisoning)

- **Attack rate can be calculated as the number of people affected divided by the number exposed**. How many people ate from that cake?? all of them. How many people get the health problem?? 2.

It is used instead of incidence during a disease outbreak in a narrowly defined population over a short period of time. Usually the next day when people start having The symptoms leading them to visit the physicians.

- **Case fatality is the proportion of cases with a specified disease who die within a specified time. It measures disease severity. Expressed as percentage** among all children who have measles how many of them die because of measles. Calculated by: number of deaths divided by number of cases how get the infection

Practical challenges in measuring incidence rate

1. Identification of population at risk Meaning that in the denominator we should not include people who already diagnosed with the disease in the population.

   Population at risk constitutes all those free of the disease and susceptible to it

2. Population is not static (they are changing over time)/it fluctuates/as a result of births, deaths and migration

3. People are at risk only until they get the disease and then no more at risk

Prevalence

It measures the proportion of a population with a disease during a specified period or at a point in time. We can calculate a point prevalence at day ex. Today what's the point of prevalence of TB in Jordan?. Or we could ask for a period of prevalence, What is the period of prevalence of TB in Jordan for the month of July?.

It describes current burden of disease in a population in order to It's important for public health and health authority to facilitate planning and resource allocation how much does it cost.

e.g. What is the prevalence of cognitive disorder among school children in Jordan?

What is the prevalence of anxiety disorder among JU medical students?

prevalence

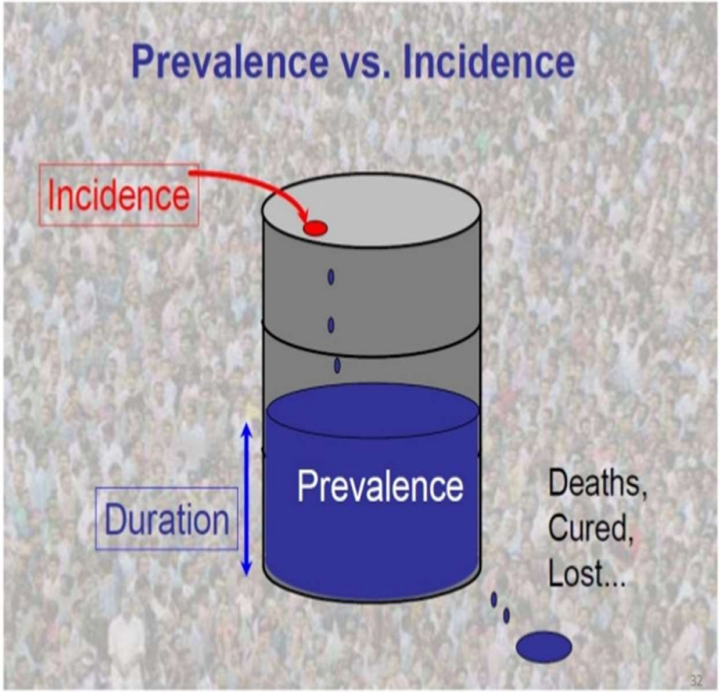
Measures the proportion of a population with a disease at a point in time

prevalence =All persons with a disease /Total population

Here we don't look at the risk instead we take all the population

Important

It is not a rate, but a true proportion



The same as the 🛁 🛁 example

The prevalence is increasing with is the duration of the disease

So for chronic diseases like Cardiovascular disease, People who had been diagnosed with the disease Will stay the whole life having medications and needing medical help.

So this make the prevalence for chronic diseases very high in a population because those who are diagnosed they stay as cases For a long time because the duration is long

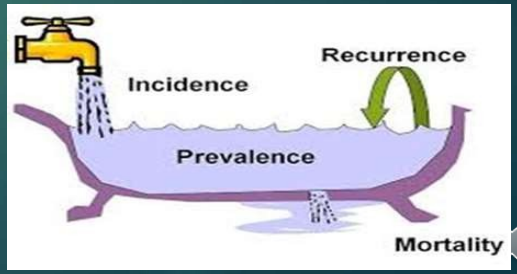
What things can reduce prevalence?? People who die from this disease and they are no longer existing in the population, Cured people who can no longer stay with the disease cases, even lost people like if they get migrated, they are subtracted from the prevalence pool.

Relationship between prevalence & incidence rates

So the larger the duration of the disease, the greater prevalence

Prevalence= Incidence x duration

An increase in prevalence may not necessarily be due to an increase in incidence rate, it could be due to an increase in average duration of a disease due to decrease in death and/or recovery rates.



Prevalence = Incidence Rate x Average Duration

If: the frequency of disease is rare don't have high frequency in the population **(i.e., <10% of the population has it).**

- ✓ If the average duration of disease remains constant, then **preventive measures that reduce the incidence** of disease would be expected to result in a decreased prevalence.
- ✓ Similarly, if the incidence remained constant, then developing a **cure** would reduce the average duration of disease, and this would also reduce the prevalence of disease.
- ✓ **In the late 1990s anti-retroviral therapy was introduced and greatly improved the survival of people with HIV. However, they weren't cured of their disease, meaning that the average duration of disease increased. As a result, the prevalence of HIV increased during this period.** they can live longer with the disease.

Prevalence = Incidence Rate x Average Duration

- ✓The relationship can be visualized by thinking of inflow and outflow from a reservoir. The fullness of the reservoir can be thought of as analogous to prevalence, and Raindrops might represent incidence, or the rate at which new cases of a disease are being added to the population, thus becoming prevalent cases.
- ✓Water also flows out of the reservoir, analogous to removal of prevalent cases by virtue of either dying or being cured of the disease.

Calculation …

A survey of respiratory disease was conducted and the results are presented in the table below.
Calculate the prevalence of chronic bronchitis in each age group and in the total group.

Prevalence of chronic bronchitis, by age, in a sample of 2383 employed men: , 1981.			
Age (years)	Number Surveyed	Frequency	Prevalence (%)
45-49	496	18	3.6
50-54	672	18	2.7
55-59	1215	18	1.5
Total	2383	54	2.3
$\chi^2 = 0.983$, p = 0.612			

Total Population →

Prevalence = 54 / 2383 = 0.0226 x 100% = 2.3%
= 0.0226x 1000= 22.6 cases/ 1000 pop.

A study was conducted to examine the incidence of Carpal Tunnel Syndrome (CTS) among computer operators in a certain corporation. An initial survey was given to 12 administrative assistants. Two of the 12 administrative assistants had symptoms and 10 did not reveal signs or symptoms equivalent to CTS. The administrative assistants who did not reveal signs or symptoms equivalent to CTS were then recruited into a study and followed for 4 years. The findings are listed below

3 of the 10 administrative assistants developed CTS during the 4 year follow-up period ……Calculate Cumulative Incidence (per 1,000).

Subjects	Follow-up Time(yrs)	CTS
1	1	yes
1	2.5	yes
1	3	yes
2	2	fired
1	1	transferred
4	4	no

developed the disease

Cumulative Incidence= 3/ 10 = 0.3 x 100% = 30%

= 0.3 x 1000 = 300 cases per 1,000 population