Standardization

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اللّهم صلّ وسلّم على سيّدنا محمد

Written by: Zuyain Bilal

*We have faced a major issue in Jordan during COVID19 for not knowing STANDARIZATION very well.

إذا بتتذكروا وقت كورونا كان كل يوم ينزلوا على مواقع إشي اسمه Global meter : عدد الحالات وترتيب الأردن حسب الحالات.

This is Purely Non scientific, if you look for eg for the new cases in Bahrain (with a population of 1 million) (New cases : 1000) & compare it with a country like Egypt (with a population of 100 million) (New cases : 1000) Although we have the same number of cases, but looking at the total population we see a huge difference.

يعني لو احنا نقارن حالات كورونا في مصر اللي عدد سكانها ١٠٠ مليون بالبحرين اللي عدد سكانها مليون لنفس عدد الحالات (١٠٠٠ حالة) أكيد مارح نحكي عن وضع منتشر بمصر مثل ما هو بالبحرين.

مشان هيك فكرة نرتب الدول على حسب عدد الحالات المبدئية بدون ما تقارنها بعدد السكان فكرة غير علمية.

From this point, some people suggested to look at the

Crude rates:

الكلام اللي بالأزرق من عندي مشان الفهم

معنى "Crude rates" معدل لظاهرة معينة بغض النظر عن العوامل الثانية مثلاً لما نحكي death crude rate of death هون بنقصد معدل الوفيات اللي صارت في منطقة معينة لكل ... ١ شخص بغض النظر عن عمر وجنس.

so when we say the death crude rate is 40 per 1000 in Jordan we mean, In Jordan, out of each 1000, we have 40 deaths regardless their age or gender

التوضيح مو ضروري لكل ... ١ ممكن لكل مليون ، مثال ↑ فقط للتوضيح

lets go back to the doctor's notes:

When we want to update a new treatment, do an action, inspection for an ICU risk for eg, we see that after intervention crude rate is calculated, like the mortality rate in Jordan.

* لما يكون عندي Prevalence + death rate ← بعرف

إنهم يزيدوا مع زيادة العمر فلما أحكي عن بلد زي الأردن (٣٪ من السكان أكبر من ٦٥) - إيطاليا مثلاً (٢٥٪) - إنجلترا (٢١ - ٢٢٪)

فيا بقارن mortality rate للناس الي عمرهم +٦٥ أو بعمل standarization

↳ Combination to age groups like 21-30, 31-40, 41-50

وأعمل adjustment وأقارن لهدول الثلاث بلدان على أساسها،

يعني لما أقول death rate in Jordan ← ٣٪ أنا بشتغل كل الفئات

العمرية فالأفضل إني أثبت عامل العمر وأقارن. لأنه مثل ما

بنعرف ، كل ما العمر يزيد الـ risk factors تختلف وحتى معدل

الإصابة بأمراض مزمنة بكوه أعلى ، فالفكرة بال standardization هي إني
أثبت العوامل و أقارن بينهم لشعوب على أساس عامل واحد بس
وفي حالتنا هون ٢ العامل هو العمر

That means crude death rate is used to compare
2 population with almost same age distribution

← رح توضح مع الملاحظات أكتر

إذا بدي أقارن معدل الوفيات بين عمّان والعقبة أو أي مدينة مع مدينة ثانية

1) We should know that the distribution of Population is different

2) In the two populations, we have different age groups.

طرح الدكتور مثال: لو قارنا بين مدينة وقرية من حيث وجود مرض معين مثل Hypertension، طبعًا رح يطلع نسبة وحالات بالقرية أعلى كتير بالعادة القرى اللي عدد سكانها قليل، بكون أغلبهم كبار بالسن فبالتالي ما بصير أحكم على البلد كاملة من هاي القرية

بلد A

بلد B

أو شيء أقارن الوقيات بين المزارعين والإداريين هذا خطأ؟؟

farmers have an older mean age (office works refire mostly at the age of 50)

Demography

- “Study of populations, especially with reference to size and density, fertility, mortality, growth, age distribution, migration, and vital statistics, and the interaction of all these with social and economic conditions” John Last

1- Population size : a very imp factor, the population in jordan changed from 3M → 9M → 11M (currently) + expected to increase with time.

مع تزوف كيف عدد السكان بيتغير مثلان نهيئ حالنا لتجهيز مستشفيات أكتر وخدمات أفضل.

factors that play a role in prevalence:

1) curable disease, ↓ prevalence
2) not curable or the country doesn't provide better health care, ↑ prevalence
3) IN Migration (Immigration) of cases: ↑ prevalence
4) Death, OUT Migration (emigration) of cases ↓ prevalence.

شرح بالعربي لنقاط ال Prevalence :

زي ما بنعرف Prevalence هو عدد الحالات / كل السكان كيف نقدر أزيده ؟؟

لما يكون المرض الشفاء منه قليل أو معاه ناس معها المرض تهاجر على هذا البلد

كيف أقلل؟

شفاء منه سريع , ناس معها المرض تهاجر برا هذا البلد , الوفيات كبيرة

Population in Jordan = Current population + Birth − Death + immigration − emigrants

Population size

- The scale and nature of health problems are determined by the size and characteristics of the population in which they occur.

- Population size is determined by the outcome of the continuous interplay of birth, death, migration according to the following model:
- P2=P1+B-D+IM-EM
- (P=population, B= births, D= deaths, IM immigrants, EM= emigrants)
- Natural increase occurs when B>D therefore P2>P1
- Natural decrease occurs when D>B therefore P2<P1

Population doubling time

How many years do we need to have double population size

- The population can only increase if the number of births exceeds the number of deaths
- Population growth rates are described either in terms of annual percentage increase or in term of population doubling time (PDT)
- PDT: Number of years it will take for the population to double in size

المقصود: الوقت اللي بحتاجه سنان أخلي عدد السكان يزيد للضعف

Population doubling time

- PDT=

$$\frac{70}{\text{Annual percentage increase}}$$

نسبة الزيادة المئوية في السنة

For example:

Population growing at 2% per annum will double in size in 35 years

Population growing at 3% per annum will double in size in 23 years

Sources of demographic information

مصادر بيانات

- 1. Census: (تعداد سكاني)

كل عشر سنوات يروح على البيوت وأحد الناس

a. Decennial: poll count on 100% sample held every 10 years

b. Midcensus sample: poll count on 10% sample held every 10 years between censuses

يعمل تعداد لـ ١٠٪ فقط في نفس الـ ١٠ سنوات

(Decennial) census —midcensus (can be once or more)→ census

10 years

census in developed countries is GREAT because we can get many information from it like: demography, social factors.

Sources of demographic information

المشكلة فيه أحيانا ما بكون (complete) خلصت في المناطق اللي هو متطورة

1. Census:

Limitations:

- Censuses are costly and slow.
- Research has shown that Censuses in developed countries are accurate and complete. On the other hand Censuses in developing countries are held but are likely to be inaccurate and incomplete.

Sources of demographic information

2. Population registers:

More or less equivalent to continuous census.

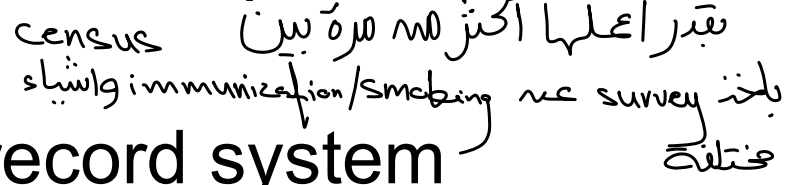
3. Registration of vital events:

Births, Death, marriage, stillbirth, adoption, divorce

4. Sample household survey

5. Governmental and private record system

Health services, education, armed forces, social security, insurance



2. Population registers:

In UK for eg: if you're staying for more than 3 weeks → you need to be in contact with the general practioner → to get access to health care.

شو أهميتها؟

ما أعمل cervical cancer screening في جيرة مثلًا أكون متأكدة إنه كل حد هناك

الا نفس الفرصة إنه يتلقى دعوة. (ولكنه للأسف بالأردن ما في هيك اشي)

Types of population data

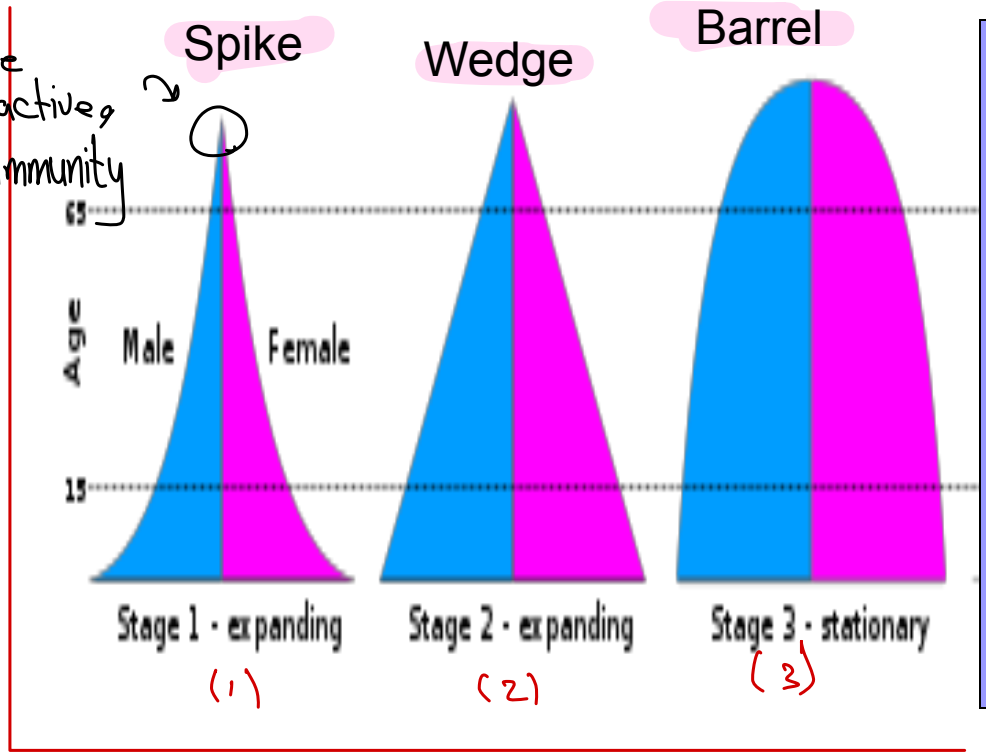
1. Population size
2. Mortality- death rates
3. Fertility: Birth rate, fertility
4. Residential mobility
5. Composition
6. Geographic distribution of the population
7. Population characteristics – marital and family status, education, occupation, income

(انتقال الناس يحدد شو نوع الدراسة اللي الحقيت منها
الناس كيف بتنقلوا فيها

Population pyramids

- Age and sex composition of a population influences its pattern of mortality and natality more than any other factor
- These characteristics pyramid shapes occur naturally

People are physically active, Stronger immunity



Common shapes of population pyramids (We have different shapes)

y-axis: Age

x-axis: number of people

spike(1): ↑birth rate, newborns↑, death rate↑ [like african countries, many infections, high death rate]

wedge(2): like Jordan, ↑birth rate, ↓death rate

stationary(3): ↓birth rate, ↓death rate [live longer, Developed countries, UK Japan]

Why did we say that the stationary phase has birth rate?

Look at the number of people from age 0-15 [almost constant]

Go to the Population Pyramid in Jordan

Population pyramids

The spike shape:

- is characterised by a wide base that narrows rapidly depicting a high BR and high DR at all ages
- High BR. High DR, low growth rate
- Typical of an under-developed country in primitive demographic equilibrium

Population pyramids

Barrel shape:

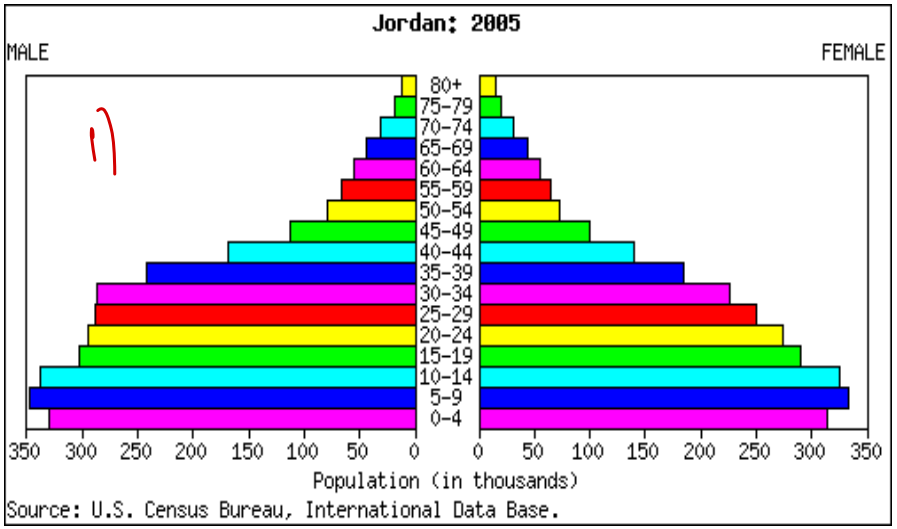
- Characterised by a narrow base with little further narrowing until the apex, depicting low BR and low DR at younger ages
- Typical of developed country in evolved demographic equilibrium

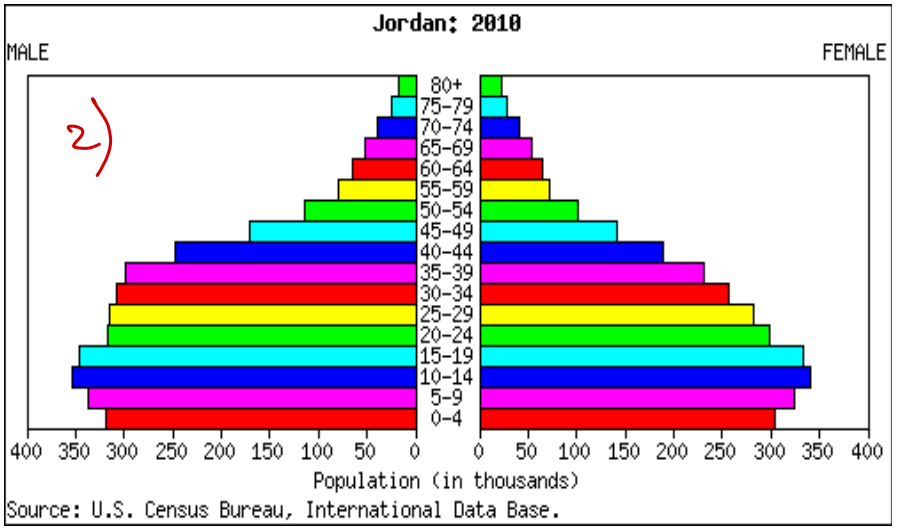
Population pyramids

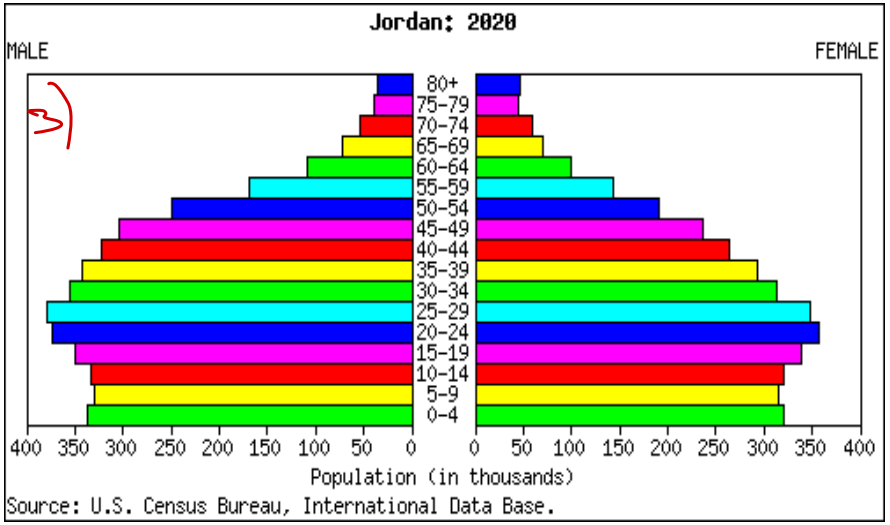
Wedge shape:

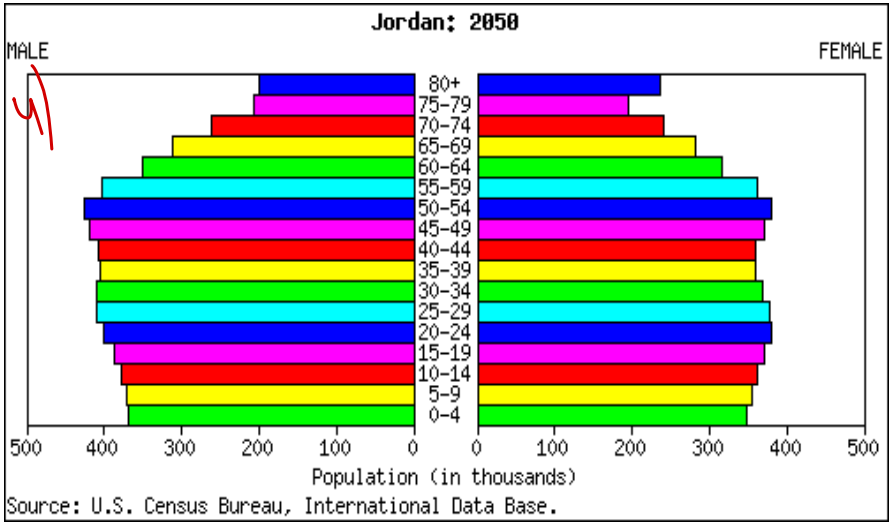
- Wide base and gradual arrowing depicting high BR and low DR, high growth rate
- Typical of a country in demographic transition with rapidly growing population, marked imbalance of its dependency ratio and severe socio-economic stress

Population pyramids- Jordan









Notes: 1) Birth rate is decreasing throughout the years (2005 → 2050)

2) year 2005 ⟶ spike

3) 2005 → 2010 → 2020 → 2050

يزيد نسبة الناس اللي عمرهم 65

صار الشكل يشبه Barrel

وشو المشكلة هون؟؟

Although we have changes in lifestyle, we must remember that age is an independent variable for many diseases which causes changes in incidence.

If we adjust for these risk factors, and focus on age only, cases above 50-55 are increasing.

In jordan we have 5 thousand new cases of cancer (اكبر من ٥٠) ٪٣ سنس بنفس الوقت عنا عدد الكبار في السن تقريبًا موزي UK (١٥ - ٢٠٪).

* Our system faces difficulties in calling these patients.

In the UK for example, cases above 65 with arthritis wanting to undergo hip replacement are on the waiting list up to 1 year.

Sometimes, they even die from medications they take while they wait for surgery

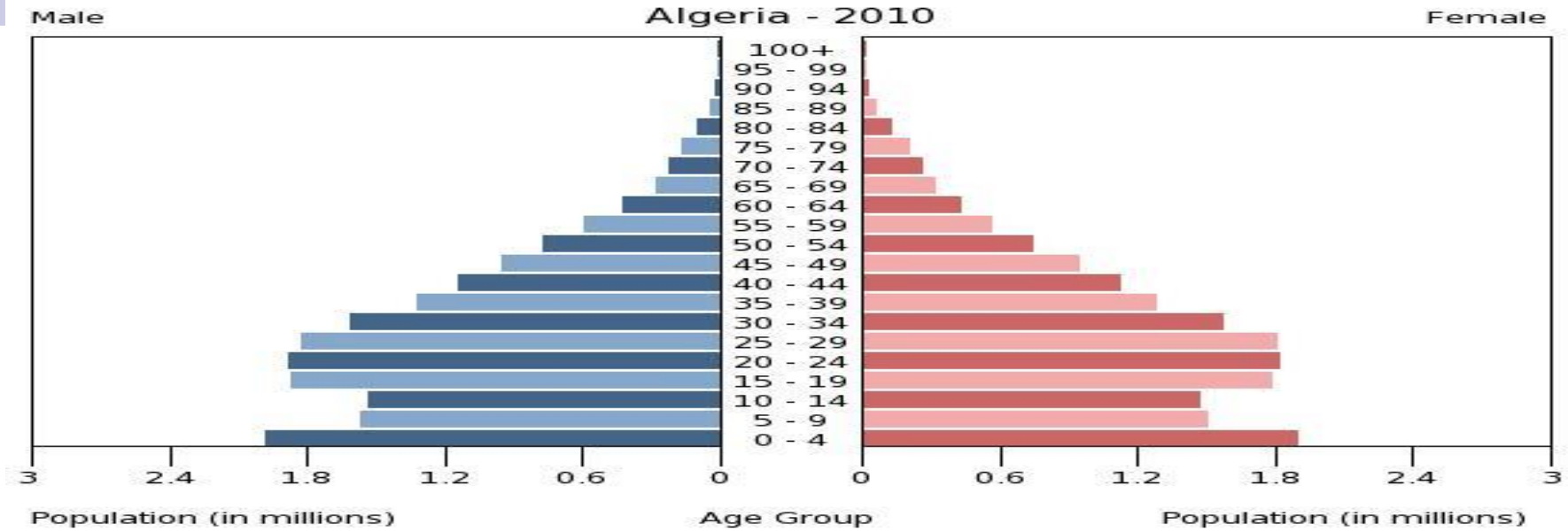
We don't have this problem in Jordan at the moment bec. the # of 65+ are ↓ but in a few years, we'll have these waiting lists.

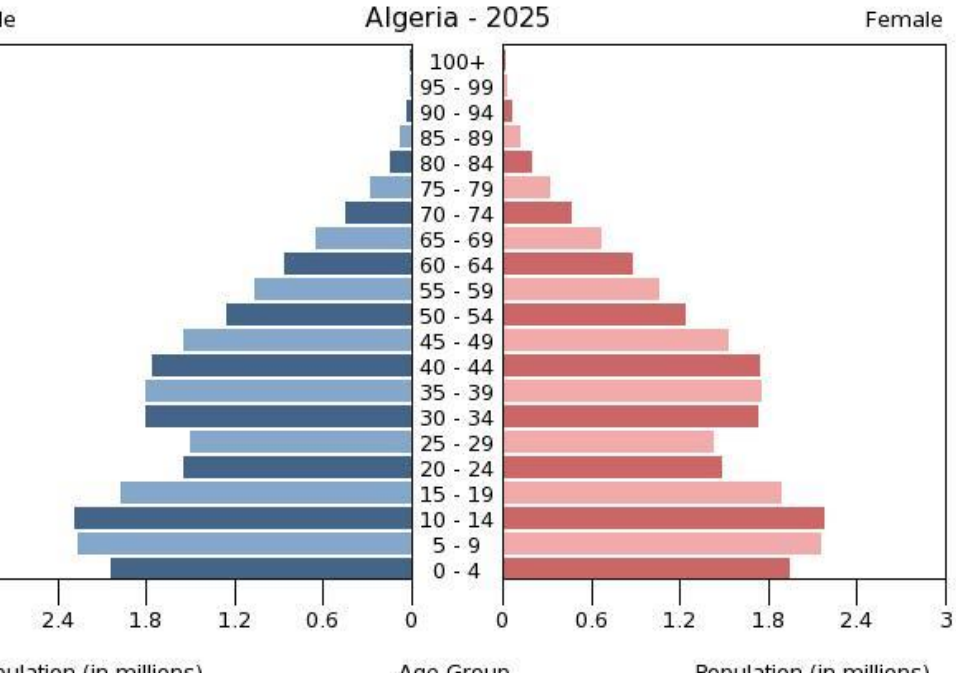
* مثال هيك كانم ندرس التغيرات اللي بتصير في أرقام سنان أجهزة الرعاية والخدمات.

* In britain, concern increased bec. smoking ↑
In jordan, smoking is increasing

We expect the prevalence of the disease to increase so we must assess screening programmes.

* for eg. in Egypt it's very difficult to manage screening because of the ↑↑ population → they mainly depend on the opportunistic screening


Male
Algeria - 2010
Female
100+
95 - 99
90 - 94
85 - 89
80 - 84
75 - 79
70 - 74
65 - 69
60 - 64
55 - 59
50 - 54
45 - 49
40 - 44
35 - 39
30 - 34
25 - 29
20 - 24
15 - 19
10 - 14
5 - 9
0 - 4
3 2.4 1.8 1.2 0.6 0
0 0.6 1.2 1.8 2.4 3
Population (in millions)
Age Group
Population (in millions)


Algeria - 2025
Female
100+
95 - 99
90 - 94
85 - 89
80 - 84
75 - 79
70 - 74
65 - 69
60 - 64
55 - 59
50 - 54
45 - 49
40 - 44
35 - 39
30 - 34
25 - 29
20 - 24
15 - 19
10 - 14
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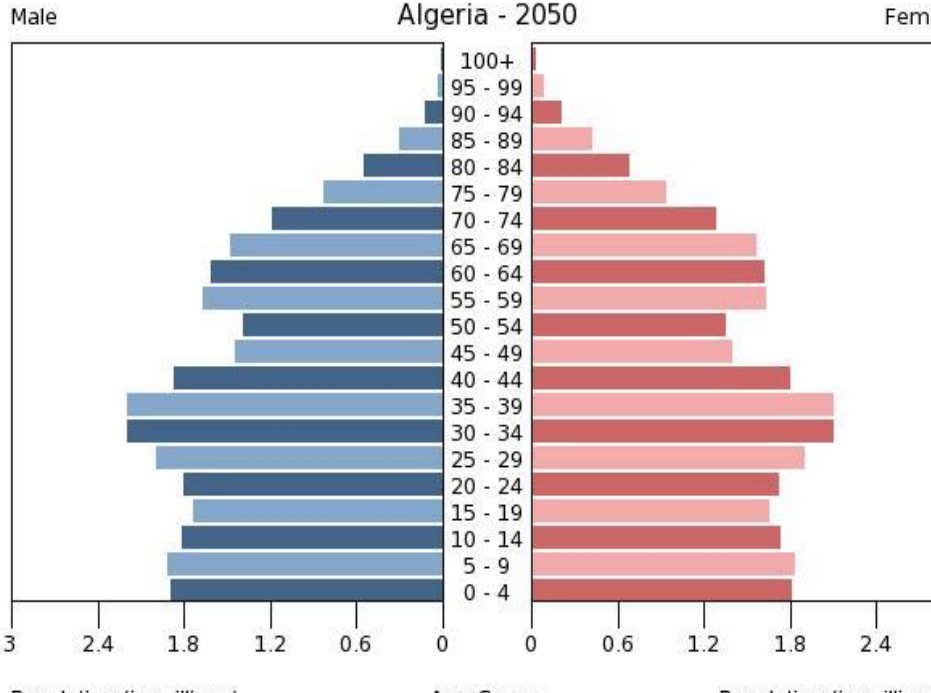
Male
Algeria - 2050
100+
95 - 99
90 - 94
85 - 89
80 - 84
75 - 79
70 - 74
65 - 69
60 - 64
55 - 59
50 - 54
45 - 49
40 - 44
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25 - 29
20 - 24
15 - 19
10 - 14
5 - 9
0 - 4
3 2.4 1.8 1.2 0.6 0
0 0.6 1.2 1.8 2.4

Factors affecting mortality

1. Age structure: main determinant
2. Environment
3. Economic development
4. Technological advance
5. Medical services/science and development of public health

That's why we have ↑ mortality rate

Common causes of death

varies between countries, for eg malaria in Africa is in Jordan most death cases Ischemic heart disease (35%) and cancer (15%) (sbincancer)

- Primitive society: Plaque, Cholera, typhus, smallpox, i.e. epidemic infectious diseases
- Developing society: Endemic infectious diseases- dysntery, tuberculosis, pneumonia
- Modern societies: Chronic diseases mainly cancer and ischamic heart disease

Population health status comparison

- Crude death rate
- Age specific death rate
- Standarised death rate
- Standarised mortality ration (SMR)

compare death rate like Jordan & US from cancer
we should compare the same age group
WE CANT COMPARE WITH COUNTRIES WITH DIF. AGE DISTRIBUTION

الشرح بدل الصحيح

I can compare an age group in 2 populations, sometimes they ask you about 1 figure not all age groups

↳ I look for Incidence, Prevalence, mortality

الدكتور ذكر مثال حلو دراسة [Prevalence of hypo/hyperthyroidism: عن في الأردن لقيت ١٠٪ subclinical hypo. ← ٣٪ overt hypothy. ← (+ ١١ إناث) hypothy. نصهم عندهم (+ ٥٠ إناث)]

الفكرة إنه hypothyroidism أعراضها خداعة (insidious) ممكن يشمل:

Palesbin, + weight, fatigue

وهاي الأعراض ممكن الشخص يتجاهلها لأنه بفكر إنها بسبب زيادة الحمل فا بروحوا الطبيب

* Its imp. to look at distribution, and to assess screening for pts with family history.

Standarized death rate

Direct Standarization (classical/ideal way)

I need to have death rate / Incidence rate for each age group

Indirect Standarization

If I have observed death rates for the whole population

Table 1 presents crude mortality data for two hypothetical populations (countries A and B).

The overall crude mortality rate is higher for country A (10.5 deaths per 1,000 person years) compared with country B (7 deaths per 1,000 person years), despite the age-specific mortality rates being higher among all age-groups in country B.

Table 1. Crude mortality rates stratified by age for two hypothetical populations.

	Country A			Country B		
Age group	No. of deaths	Population	Rate per 1,000 pyrs	No. of deaths	Population	Rate per 1,000 pyrs
0-29	7,000	6,000,000	1.2	6,300	1,500,000	4.2
30-59	20,000	5,500,000	3.6	5,000	550,000	9.5
60+	120,000	2,500,000	48	6,000	120,000	50
Total	147,000	14,000,000	10.5	15,300	2,170,000	7

Standarized mortality ratio

← go to this slide ↓

Comparing disease and health event rates

- **Disease and mortality rates can be used to compare:**
  - disease/mortality rates between populations
  - the same population over time.
- **When comparing rates we should be aware of the characteristics of the population(s) that may affect the rates.**
- **The age and sex structure of two populations being examined may differ and these differences will affect the rates.**

Standardisation of rates

- **Crude rates do not allow comparison in Space (region or countries) or time**

For example for death rates, the differences observed between two populations' crude death rates could only be due to the demographic differences between the population studied.
A population with a higher proportion of elderly people will have a higher number of total death than a young population.

Standardized mortality rate

- **we know that:**
  - death is closely related to age
  - the age structure of the a some groups could be different to that of the total population
- **Therefore we need to adjust for the effect of the age structure to make a meaningful comparison.**
- **This can be done using** standardization

Methods of Standardisation

Age is a factor that is frequently adjusted for in epidemiological investigations, particularly in comparative mortality studies, since the age structure of a population will greatly affect the population's overall mortality.

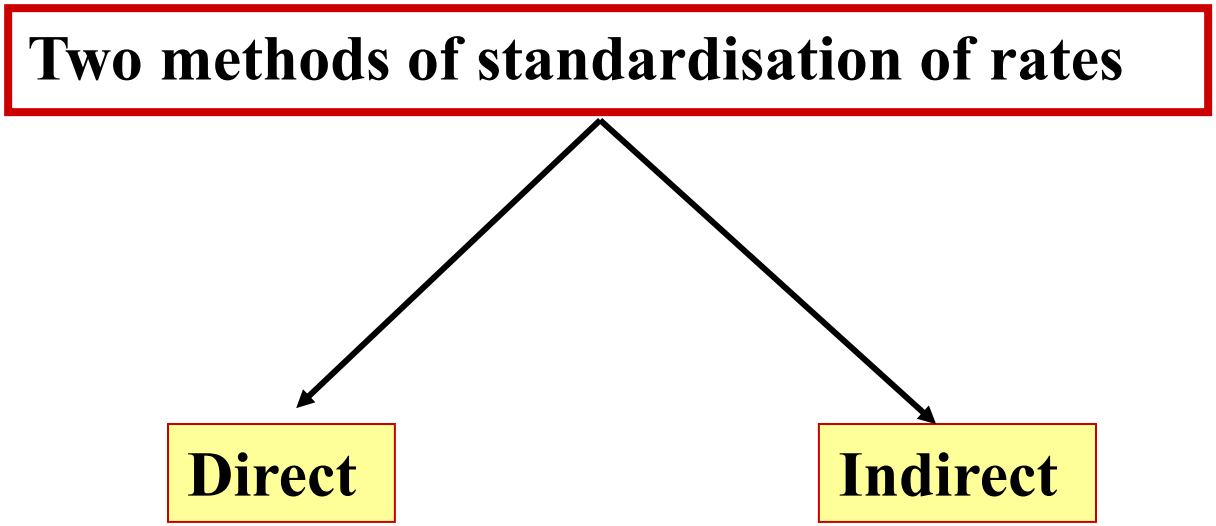
To illustrate the methods of both direct and indirect standardisation, the age specific mortality rates for two hypothetical populations are compared below.

Methods of Standardisation

- There are two methods of standardisation commonly used in epidemiological studies, and these are characterized by whether the standard used is a population distribution **(direct method)** or a set of specific rates **(indirect method).**

- Both direct and indirect standardisation involves the calculation of numbers of expected events (e.g. deaths), which are compared to the number of observed events.

- **Standardisation of rates is a method of weighting the rates on one factor which has an influence on the rate, such as age or sex. Once the influence of that factor has been eliminated with the standardisation the rates can be compared.**



Direct Standardisation

- **is used to compare large populations**
- **uses a standard reference population to compare both populations**
- **applies the age-specific disease/death rates of the population of interest to the standard population**
- **allows us to compare death rates, by calculating what their death rates would be if the populations of interest had the same age population structure as the reference population.**

Direct standardisation

Direct standardisation uses a standard *population demographic structure.*

- **one of the populations studied**
- **or a combination of both.**

The result obtained is an age standardised rate which would represent the rate in the study population if the age structure of that population was the same as the reference population. The standardised rates can then be compared, but this standardised rates have no absolute meaning, they are only meaningful in the context of the reference population used. Using a different reference population will give a different standardised rate.

Calculation

$$\text{Age standardized rate} = \left(\begin{array}{l} \text{Overall rate in standard population if} \\ \text{the age} - \text{specific rates were the same} \\ \text{as those of the population of interest} \end{array} \right) = \frac{\sum w_i \times \lambda_i}{\sum w_i}$$

w_i are the weights

λ_i rates

Direct method of standardisation

- Table 1 presents crude mortality data for two hypothetical populations (countries A and B). The overall crude mortality rate is higher for country A (10.5 deaths per 1,000 person years) compared with country B (7 deaths per 1,000 person years), despite the age-specific mortality rates being higher among all age-groups in country B.

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Total	**147,000**	**14,000,000**	**10.5**	**15,300**	**2,170,000**	**7**

Crude death rate for this population (A)

Crude death rate for this pop B.

Country B is better than country A.

THIS IS WRONG - XXX

why?? we said in order to compare the crude rate, we need to have the same age distribution.

	Country A			Country B		
Age - group	No. of deaths	Population	Rate per 1,000 pyrs	No. of deaths	Population	R py
0-29	7,000	6,000,000	1.2	6,300	1,500,000	4.
30-59	20,000	5,500,000	3.6	3,000	550,000	5.
60+	120,000	2,500,000	48	6,000	120,000	5(

But see here ↑ ↑, we don't have the same age distribution.

↳ standarization لازم اعمل ← مشان هيك

We have 2 options : worldbank (WHO) made a standard population as a reference

so we have to choose either the reference population made by the world bank

or when you compare two countries (وحدة دولة مع دولة)

ملخص: ما بدك تقارني بين شعبين لازم تقارن على أساس ثابت أو على مرجع معين، فيا إما باخذ قائمة جاهزة من worldbank أو لما أقارن دولتين أخلي وحدة منهم المرجع..

Table 2. Direct method of standardisation - calculation of the number of expected deaths for countries A and B applied to a standard population.
(Here the rate is divided back by 1000 to give the basic rate; e.g. 1.2 becomes 0.0012 for the purposes of the formula.)

اقرأ تحت ثم ارجع

0-29	100,000
30-59	65,000
60+	20,000
Total	185,000

	Country A	Country B
	Expected deaths (rate × standard pop)	Expected deaths
0-29	0.0012 x 100,000 = 120	0.0042 x 100,000 = 420
30-59	0.0036 x 65,000 = 234	0.0055 x 65,000 = 357.5
60+	0.048 x 20,000 = 960	0.05 x 20,000 = 1,000
Total expected deaths	1,314	1,777.5
Age adjusted rate	**1,314/185,000 = 7.1 per 1,000 pyrs**	**1,777.5/185,000 =9.6 per 1,000 pyrs**
Age standard rate ratio (B:A)= 9.6/7.1 = 1.35		

هوه بنقدر نحكي: الوفيات في B أكثر

Directstandarization

كيف بقدر أوحّد ؟

١ * إذا اعطاك : standardPop. اعقد على اساسها وإذا ما اختار اللي بدك إياه.

٢ * الفكرة إني أخلي عدد ال Population نفسه في الحالتين كأنو اللي بالعجلي بنسبة الوفاة مو عدد الناس.

* هون اخترت Population مو عندي

0-29	100,000
30-59	65,000
60+	20,000
Total	185,000

النقطة مو عندي بس لشان التوضيح :)

٣ * - تتذكروا قانون $\text{deathrate} = \frac{\text{deaths}}{\text{population}}$ ؟؟

death rate x Population = Deaths ← خلو عدد الوفيات هو الموضوع القانون

↑ اللي معطى بالجدول الأصلي ولكن انتبه هون بدل تقسم على ألف

⊂ my reference Population

نجعل نفس الأشي لـ B بهدف ← أقارن النسبة لنفس العدد.

جربوا شوفوا الجداول وطبقوا الأسهم

The reason for the difference between the crude mortality rates between country A and country B is that these two populations have markedly different age-structures.

Country A has a much older population than country B. For example, 18% of the population in country A are aged over 60 years compared with 6% in country B.

Direct standardization

- In the direct method of standardisation, 'age adjusted rates' are derived by applying the category specific mortality rates of each population to a single standard population (table 3). This produces age standardized mortality rates that these countries would have if they had the same age distribution as the standard population.

Direct standardization

- **Note that the 'standard population' used may be the distribution of one of the populations being compared or may be an outside standard population such as the 'European' or 'World' standard population.**

- **The weighted average of the category-specific rates (with the weights taken from the standard population) provides for each population a single summary rate that reflects the numbers of events that would have been expected if the populations being compared had the same age distribution 1.**

Direct method of standardization

- Note that while the crude rates presented in table 1 represent the actual mortality experience of countries A and B, it is not possible to use these crude rates to make a valid comparison between the two countries because they have very different age distributions.

- However, by using the direct method of standardisation (while the values of the adjusted rate do not reflect the 'true' mortality experience of countries A and B), it enables us to calculate 'hypothetical' age adjusted rates that can be used to make a valid comparison of overall mortality between the two countries.

Advantages and disadvantages of direct age standardisation

Advantages

- **The direct method preserves consistency, between the populations being compared, i.e. if each age-specific rate in area A is greater than each of the corresponding age-specific rates in area B, then the directly standardised rate for area A will always be higher than that of area B irrespective of the standard population used. Consequently it is the preferred method for comparing a number of different populations against each other.**
- **Directly standardised rates can readily be compared over time provided the same standard population is used.**

Disadvantages

- **The direct method requires that the observed events in the subject population are available broken down by age. If this information is not available the directly standardised rate cannot be calculated.**
- **For small subject populations the age-specific rates of the subject population are based on small numbers and consequently are unstable. Small changes in the number of deaths in a particular age band may result in large changes in the directly standardised rate.**

Indirect standardization and SMRs

- **allows valid comparisons between populations with different age and sex structures**

- **Adjusts for differences in age by calculating the number of deaths 'expected' in a population, based on its age structure, if it had the same mortality experience as a reference population.**

Indirect standardisation

We use this when we don't know the death rate of each age group

- The indirect method of standardisation is mostly used in the standardisation of mortality rates (although not exclusively). It involves the calculation of the *standardised mortality ratio* or S.M.R.

- Indirect standardisation is easier to use
- permit some statistical calculations of probability (95% confidence intervals).
- The information necessary to calculate the S.M.R. is also often more easily available than for the direct method.

Indirect standardisation

- Useful in the presence of low death rate for example for younger age groups

Indirect method of standardisation

- The indirect method of standardisation is commonly used when age-specific rates are unavailable. For example if we did not know the age specific mortality rates for country B.
- In this method, instead of taking one population structure as standard and applying sets of rates to it to estimate expected events, a set of rates from a standard population (country A) is applied to each of the populations being compared to calculate standardized morbidity/mortality ratios.

The principle of its calculation uses standard age specific rates in a reference population. It then calculates the number of deaths (or cases) expected in the study population if the age specific rates in this study population were the same as in the reference population. The ratio of the number of observed death (or cases) to the number of expected and multiplied by 100 is calculated

$$SMR = \frac{Observed\ deaths}{Expected\ deaths} \times 100$$

Table 4. Indirect method of standardisation: Number of expected deaths if the population had the same age-specific mortality rates as Country A.

	Country A	**Country B**
	Expected deaths	Expected deaths
0-29	0.0012 x 6,000,000 = 7,200	0.0012 x 1,500,000 = 1,800
30-59	0.0036 x 5,500,000 = 19,800	0.0036 x 550,000 = 1,980
60+	0.048 x 2,500,000 = 120,000	0.048 x 120,000 = 5,760
Total expected deaths (E)	147,000	9,540
Total observed deaths (O)	147,000	15,300
Standardised Mortality Ratio O/E x 100	100	160

	Country A			**Country B**		
Age - group	No. of deaths	Population	Rate per 1,000 pyrs	No. of deaths	Population	Rate per 1,000 pyrs
0-29	7,000	6,000,000	1.2	6,300	1,500,000	4.2
30-59	20,000	5,500,000	3.6	3,000	550,000	5.5
60+	120,000	2,500,000	48	6,000	120,000	50
Total	**147,000**	**14,000,000**	**10.5**	**15,300**	**2,170,000**	**7**

standardized mortality ratio (SMR),

- An overall summary measure can then be calculated, that is, the standardized mortality ratio (SMR), which is the ratio of the observed number of deaths to the expected number of deaths.
- SMR = $\frac{\text{Observed number of deaths (O) X 100\%}}{\text{Expected number of deaths (E)}}$
- SMR = $\frac{160}{100}$ = 1.6 X 100 = 160
- SMR is calculated as 160, which means that the number of observed deaths in Country B is 60% higher than the number we would expect if Country B had the same mortality experience as Country A.

Indirect Standardisation

Go to the table 4

1. Select standard (reference) population (A)
2. Identify Populations of Interest (B)
3. Identify age groups breakdown
4. Calculate the age-specific death rates for the standard population
5. Calculate expected deaths for population by multiplying the age-sex specific rates for the reference population (A) by the corresponding age-sex specific populations for study population (B)
6. Calculate total expected deaths by summing the expected deaths for study population (B)
7. The Standardized Mortality Ratio (SMR) for the study population (B) is calculated by dividing the actual number of deaths for study A population by the expected number of deaths for this population (B) x 100.

$$SMR = \frac{d}{\sum n_i R_i} \times 100$$

d is the number of deaths in the study population,
n_i is the number of people in the i^{th} group of the study population,
R_i is the crude death rate in the i^{th} group of the standard population.

Confidence interval for SMR
The 95% CI for an SMR is obtained by
CI=SMR±(1.96xSE)
Where SE=SMR/√d
d=number of observed deaths

The S.M.R. is a ratio, it has no unit and can take any value between 0 and infinity.

- **SMR =100**

  The study population has the same mortality rate as the reference population.
- **SMR >100**

  The study population has a mortality higher than the reference population.

e.g. SMR=120 means that the mortality in the study population is 20% higher than in the reference population

- **SMR <100**

  The study population has a mortality lower than the reference population.

e.g. SMR=50 means that the mortality in the study population is 50% less than in the reference population.

Example

Calculation of standardised mortality ratio (S.M.R.) for two occupational groups in England using the whole population of England as a reference population (Original data 1959-63)

فقط هذا معطى

Occupation	Number in Occupational group	Observed death	Crude death rate per 1000 per year
Farmers, foresters and fishermen	705910	20973	5.9
Armed force	301120	4282	2.8

كتنسى ماعيير نقارن بين 2 crude إلا إذا الفئات العمرية متطابقة

هو ما يكون هنا معدل الوفيات لكل agegroups (يعني عدد الناس لكل agegroups بـ
ما يعني معدل الوفاة لكل agegroups سنوف لجدول ↑↑.

سنوا حل؟ Indirect standarization.

* الخطوة الأولى أخذ population حقهم وهون رح تكون دولتي.
* look at the expected death. *
* ask myself, is the observed death ↑ or ↓ than the expected death? *

if it was higher that means we have an issue [standarized >100]
if it was lower [standarized <100] I'm doing well.

Lo well talked about it in amin.

① إذا نحيد: أنا بطبق هاي الفرقة طالما بكون عندي عدد كل شخص بكل agegroup بـــ
ماعندي Deathrate for each agegp .

② رح اخذ عدد سكان الدولة تاعتي بحيث
بكل: باخذهن دولتي عدد الوفيات السنوي لكل فئة عمرية و باخذ عدد الناس بمجموعاتي
Annual death rate in Jordan/1000
groupA: ----
groupB: ---
وبس اضربهم ببعض بعطيني معدل الوفيات المتوقع Expected death rate

③ ثم تقارنه بينها وبين observed وفي الحالة المثالية لازم يكونوا متساويين وبكده موشرط.

٤) إذا قسمت $\frac{\text{observed}}{\text{expected}} \times 100$ وهذا يطلع standardized mortality ratio

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e.g. SMR=50 means that the mortality in the study population is 50% less than in the reference population.

هاي الطريقة تستخدم بالعادة للمقارنة بين مجموعتين أو وظيفتين في بلد ما.

Calculation of expected number of deaths using the age specific death rates of England as a reference

Age	Annual death rates/ 1000 in England	Farmers, foresters, fisher men		Armed Force	
		Number in occupation	Expected deaths 1959-1963 (Annual death rate × number of deaths/1000)	Number in occupation	Expected deaths 1959-1963
15-24	5.139715	134560	691.6	165030	848.3
25-34	5.589847	124100	693.7	73240	409.4
35-44	12.05491	132220	1593.9	42250	509.3
45-54	35.36006	160110	5661.5	15930	563.3
55-64	108.5502	154920	16816.6	4670	506.9
Total expected deaths			25457.3		2837.2

Calculation of S.M.R.

Farmers, foresters and fishermen:

SMR=20973/25457.3*100=82.4

Armed forces

SMR=4282/2837.2*100=150.9

Conclusions

- The SMR of the Farmers etc is lower than the one of the Armed force.
- The SMR of the farmers etc is less than 100
- The SMR of the armed force is more than 100
- The mortality rate of the farmers is lower than the average for England by 17.6%. The mortality of the armed force is higher than the average in England by 50.9%.

Best of luck ♡