Demographics and Vital Statistics – PH310

Demography is a science that studies human population with respect to size, distribution, composition and how things change within the population. It then looks at how this affects the condition of the population with respect to health, economic and social conditions.

It is the application of statistics to human populations.

For example, demographics can tell you that the population is ageing, that is over time, there will be a greater number of elderly in the population. This then affects health care (eg. Number of hospitals you need), economics (cost of looking after elderly and loss of workforce) and social conditions (impact on families etc).

Some key terms in Demography:

Size: number in the population at a given time. The size of the population of Jordan is 6.49 million.

Distribution: Where is the population based in the country? Eg. Most of Jordan's population is concentrated in Amman.

Composition: How many males and females? How many children? How many under 5 years old? How many over 70 years old?

Change: what things change the population make up? These include **births, death and migration.**

So when we look at demographics, we need to understand birth, fertility (how many children is the population having), death and migration.
What things affect these variables? You can say that education, socioeconomic status (wealth), religion, place of birth (urban or rural), marital status, age of marriage can affect these, so it is important to also collect data on these factors.

How do we collect demographic data?

There are three main ways;
1. Census data
2. Sample surveys
3. Registration of Vital Events

1. The Census.
This was done in Jordan on 30 November 2015. It is a nationwide counting of the population. All people are counted. It is a large and complicated undertaking.

In Jordan all people who were present in the country on the day of the census were counted, whether they were visitors or permanent residents.

Information to be collected can include:
Sex, Age, marital status, educational attainment, economic characteristics, place of birth, language, living conditions, etc.

The census should be done in a well defined time period (eg one day), and in a well defined area (eg all of Jordan).. And it should be repeated periodically, say every 10 years so that you can compare changes.

What are the advantages for doing a census?

Gives a complete and valid picture of the population composition and characteristics
Provides vital statistics
Can give detailed information on variables (number of people living in a house)
Can be used for planning and welfare of people – eg schools, hospitals, houses

What are the disadvantages?

Expensive to do – requires a lot of resources
Can miss people or over count
People can be dishonest or forgetful in their answers – eg over estimate educational attainment

2. **Surveys**

Use a sample to try and represent the whole population. It does not usually have regular periodicity, and has all the biases associated with using a sample to represent a population. Eg. If your sample was done in Aqaba this would not represent all of Jordan. Or if your sample was done in working hours, and at homes it would not represent working people.

3. **Registration of vital events (births and deaths)**

This includes official registration of births, marriages and deaths. It is a system whereby all births, marriages and deaths are registered officially and compiled by a central body. A certificate is given for every birth and death.

There are four main characteristics of such a system;
-comprehensiveness
-a legal requirement
-compiled centrally
-registration is done continuously

What do you think might be some difficulties for this system?

Do you think that all death certificates are accurate? What things can affect the accuracy of a death certificate?

Vital Statistics

So what type of statistics do we collect and analyse about populations?

We look at **Ratios**. Ratio is the quantitative relationship between two variables.

For example **Sex Ratio**, is the total number of male population per 100 of female population.

$$SR = \frac{M}{F} \times 100$$ where M and F are total number of male and

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So it tells us what the balance is between the male and female members of the population.

If you think about it the sex ratio for a country should be around 1. That is almost the same males as females in a country. China has a sex ratio of 1.19 – that is a lot more males than females. Can you think of why?

Proportion
This is a type of ratio that looks at occurrences in relation to the population.

For example the proportion of heart attacks among inhabitants of a certain area.

Rate
This is a proportion over time. Each the rate of births per year. If you just give the births without a time period this is not a rate.

$$Rate = \frac{\text{Number of demographic events of interest}}{\text{Population at risk}} \times k$$

where K is a constant mainly a multiple of 10 (100, 1000, 10000, etc.).

Population at risk can be the population at a particular time (eg start of the year), or say for prostate cancer it would be the adult male population. Depending on what you are measuring population at risk changes.
For example, you could look at the number of childhood cancers as the demographic event of interest, and the denominator would be the number of

children in the population. Normally you would look at the number of new cases of cancer over one year, and say you would choose to look at the number of new cases per 1000 children.

Rates are normally given in a yearly value.

A rate can be CRUDE or SPECIFIC.
A crude rate looks at the rate in the whole population without looking at a smaller subgroup. It is sensitive to the population make up. For example crude birth rate is the number of births per entire 1000 people. There is no subgrouping, the denominator is the whole population.

A specific rate looks at particular events in a sub group – eg age group, sex, race, particular disease. Eg breast cancer rates in women from age 20 – 30 years old is a specific rate.

Measures of Fertility

Crude Birth Rate

$$CBR = \frac{\text{Total Number of live birth}^* \text{ in a year}}{\text{Mid - year population in the same year}} \times 1000$$

So you take the number of births for the whole year, and take the population of the country at the mid point of the year and calculate the crude birth rate.

A live birth includes any expulsion or extraction of products of conception from mother which shows signs of life (breathing, pulsation), at any period during the pregnancy.

Below is the crude birth rate for a number of countries;

India   20
Hungary 9
Somalia 44
Jordan 27
United Kingdom 12
Australia 13
Germany 9

What does this tell you?
Which country has the highest number of births? Which has the least?
If a country like Germany has a small crude birth rate, how else can it increase its population?

General Fertility Rate

Number of births in a specified period per 1000 women aged 15-49 years old.

$$GFR = \frac{\text{Total number of live births during a year}}{\text{Mid year female population aged 15-49 years}} \times 1000$$

This is general as we include all women of reproductive age.

Age Specific Fertility Rate

Number of live births in a specified period per 1000 women of a given age or age group. This does not look at the number of births per all females ages 15-49 years, but of a particular age, say women aged 25 – 30 years. It identifies which age group is giving more birth.

$$ASFR = \frac{\text{Total number of live births registered to women of a given age group during a year}}{\text{Mid year female population on the same age group during the same year}} \times 1000$$

Measure of Mortality

Crude Death Rate
Total number of deaths due to all causes occurring in a defined area during a defined period per 1000 mid year population in the same area during the same period.

$$CDR = \frac{\text{Total number of deaths due to all causes occurring in a an area in a given year}}{\text{Mid year population in the same area in the given year}} \times 1000$$

Crude death rate measures the rate at which deaths are taking place from all causes in a given population during a specified year.

Look at the following crude death rates for different countries

Jordan 4
New Zealand 7
Portugal 10
Sierra Leone 17
Ukraine 15
West Bank and Gaza 3
Japan 10

As you can see some results are surprising. As it is a crude rate it look at the entire population, so if you have a primarily elderly population (eg Japan) your crude death rate will be higher. IF you have a lot of disease and earlier death then your crude death rate will also be higher (Sierra Leone)

Age Specific Death Rate

Defined as total number of occurring in a specified age group of the population in a specified area.

$$ASDR_a = \frac{\text{Total deaths at age or age group a}}{\text{Mid year population at age or age group a}} \times 1000$$

Cause specific death ratio and rate

A cause specific death ratio represents the percent of all deaths due to a particular cause or group of causes.

$$\text{CSD ratio for cause } c = \frac{D_c}{D_t} \times 1000, \text{ where Dc is total deaths from}$$

cause c and D_t is total deaths from all causes in a specified time period.

So for example you wish to know the proportion of all deaths caused by cardiovascular disease. Dc is all total deaths in the population from cardiovascular diseases, and Dt is the total deaths from all causes.

Calculating Cause specific death ratio can help you determine the ranking of causes of death.
The following pie chart gives you percentages but gives you an idea of how it is useful to compare different causes of death.

The 10 leading causes of death in the world by percentage
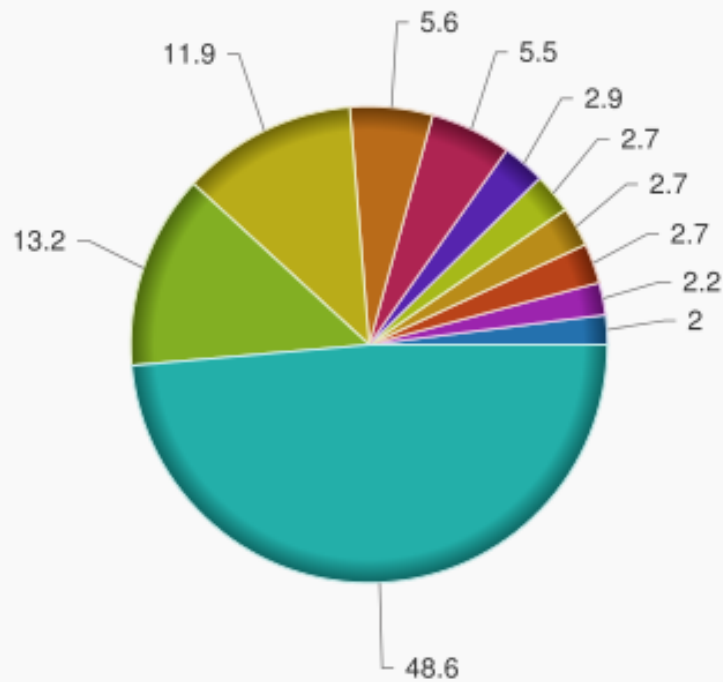
Legend:
- Hypertensive heart disease
- Trachea bronchus, lung cancers
- Ischaemic heart disease
- Road injury
- Diabetes mellitus
- Lower respiratory infections
- Other causes
- Diarrhœal diseases
- HIV/AIDS
- COPD
- Stroke

Cause Specific Death Rate

$$\mathrm{CSDR_c} = \frac{\text{Total deaths from a given cause c}}{\text{Population at risk}} \times 1000$$

Is the number of deaths from cause c during the year per 1000 of the mid year population at risk.
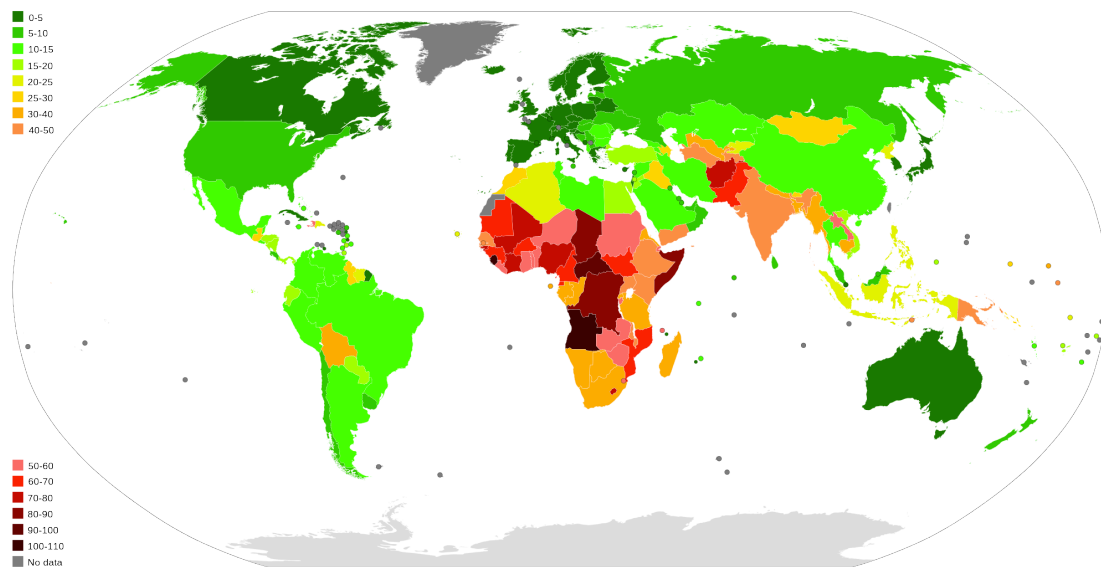
Infant Mortality Rate
Measures the risk of dying during infancy (ie the first year of life)

$$IMR = \frac{\text{Deaths of children under one year of age}}{\text{Total live births}} \times 1000$$

This is a very important indicator of the health and well being of a country – its health services and public health.

It gives the probability of dying between birth and age one per 1000 live births.

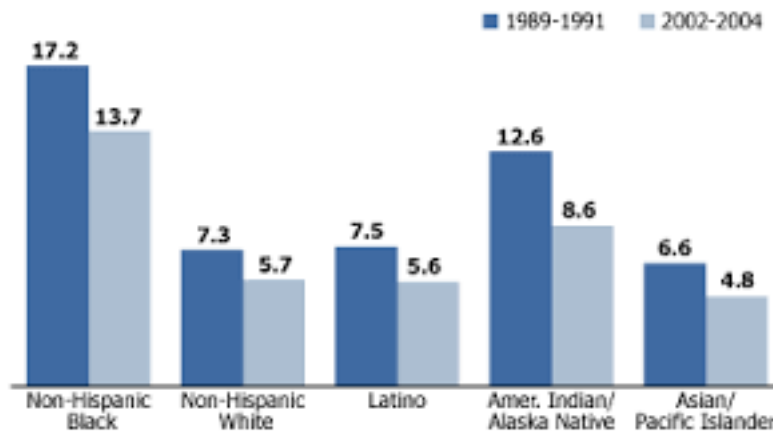This map shows different infant mortality rates around the world.

Generally around the world infant mortality is improving
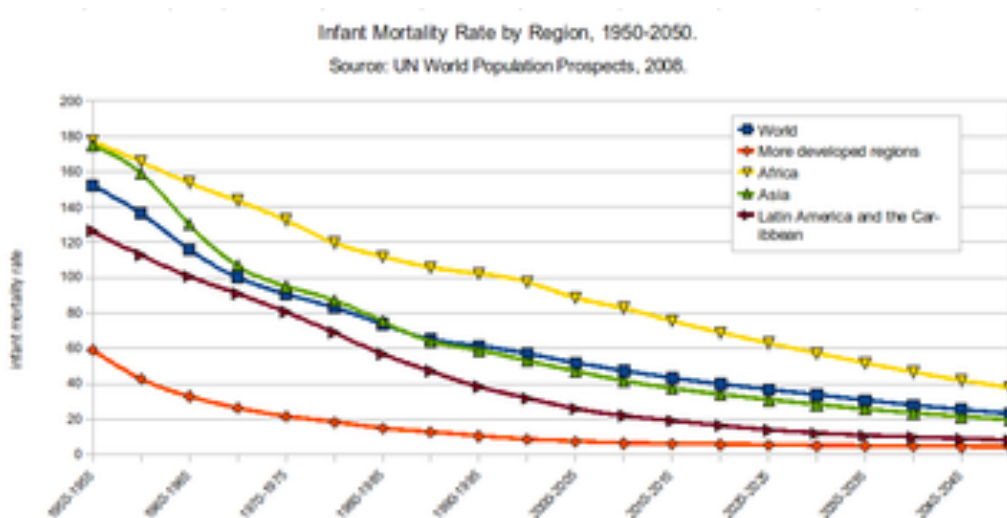
When looking at all these vital statistics it is important to look at subgroups to see if there are 'at risk' groups
For example look at infant mortality in the US. See the difference between the Black population and the White population.

Below are Infant mortalities for different countries. In which country does your child have more probability of surviving?

Afghanistan 115 deaths per 1000 births (that is more than 1 child per 10 born dies before he/she turns one year old).
Somalia 99 deaths per 1000 births
South Sudan 66 deaths per 1000 births
Pakistan 55 deaths per 1000 births
Yemen 49 deaths per 1000 births
Iraq 37 deaths per 1000 births
Morocco 23 deaths per 1000 births
Egypt 21 deaths per 1000 births
Jordan 15 deaths per 1000 births
Thailand 9 deaths per 1000 births
Lebanon 7 deaths per 1000 births
Sweden 2.6 deaths per 1000 births

What is the difference in probability for an infant to survive until 1 year of age if he was born in Afghanistan or in Sweden?

Neonatal Mortality Rate

The definition of a neonate is a infant less than 28 days old, thus the neonatal mortality rate is

$$NMR = \frac{\text{Deaths of children under 28 days of age}}{\text{Total live Births}} \times 1000$$

Maternal Mortality Rate

This is another very important indicator of the health of a country. This is defined as the number of deaths of mothers due to maternal causes ie complications of pregnancy, child birth, and peurperium per 100 000 live births in a year.

Maternal death is the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes. To facilitate the identification of maternal deaths in circumstances in which cause of death attribution is inadequate, a new category has been introduced: Pregnancy-related death is defined as the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the cause of death.

Live birth refers to the complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of the pregnancy, which, after such separation, breathes or shows any other evidence of life - e.g. beating of the heart, pulsation of the umbilical cord or definite movement of voluntary muscles - whether or not the umbilical cord has been cut or the placenta is attached. Each product of such a birth is considered live born.

$$MMR = \frac{\text{Deaths of Mothers due to maternal causes in a year}}{\text{Total live births in the same year}} \times 100{,}000$$

MMR measures the risk of mothers dying from maternal causes. Ideally the denominator should not just include live births but all deliveries and abortions. Say a mother and baby both die in delivery, as this is not a live birth in the formula above she would not be included, but she should be.
Also say a pregnant women dies in a car accident, she would not be recorded in the maternal mortality rate, especially if there was no connection with her pregnancy and her death.

Look at this data sheet
http://data.worldbank.org/indicator/SH.STA.MMRT

What is the Maternal Mortality in Jordan?

What is the worst country to deliver your baby in?

Rate of Population Growth

The Crude Birth Rate – Crude Death Rate = crude rate of natural increase

When the net effect of migration is added on then that is the total increase.