MEDICAL UNIVERSITY – PLEVEN
FACULTY OF PUBLIC HEALTH

DEPARTMENT OF PUBLIC HEALTH SCIENCES

DAY 2 INTERNSHIP

DEMOGRAPHIC APPROACHES TO HEALTH ASSESSMENT

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We can study population in two main directions:

Population statics
Population dynamics

Population statics – includes population size and composition by sex, age, residence, etc. at a given point of time

Population dynamics - includes changes in population size and composition as a result of:

1. Different types of migration

2. Natural events – births, deaths, marriages, divorces

POPULATION STATICS

1. POPULATION NUMBER AND GROWTH

The best tool to study population statics is the CENSUS.

Most countries have established a practice to conduct regularly census of their population - usually at 10-years intervals.

Classification of countries according to their economic development -The UN:

DEVELOPED WORLD:

- Developed market economies

- Economies in transition

DEVELOPING WORLD

- Least developed countries

- Developing countries - excluding least developed countries

Population size

- World population clock

https://www.worldometers.info/world-population/

POPULATION STRUCTURE

BY SEX

- % of men or women
- Sex Ratio = $\frac{\text{the number of females}}{\text{the number of males}}$

By residence

- Growing **urbanization** is a recent phenomenon in developing countries. In developed countries urbanization has already become a fact.

By age

1. Based on comparison of 3 groups: 0-14, 15-49 and 50+.

	0-14	**15-49**	**50+**
progressive	30	50	20
stationary	25	50	25
regressive	20	50	30

2. Based on the proportion of people over 60 years or over 65 years

	60+	65+
young age structure	<5	<10
at the beginning of ageing	5-10	10-15
ageing population	>10	>15

3. DEPENDENCY RATIOS

Based on 3 groups: 0-14, 15-64 and 65+.

Youth = 0-14 / 15-64

Elderly = 65^{+} / 15-64

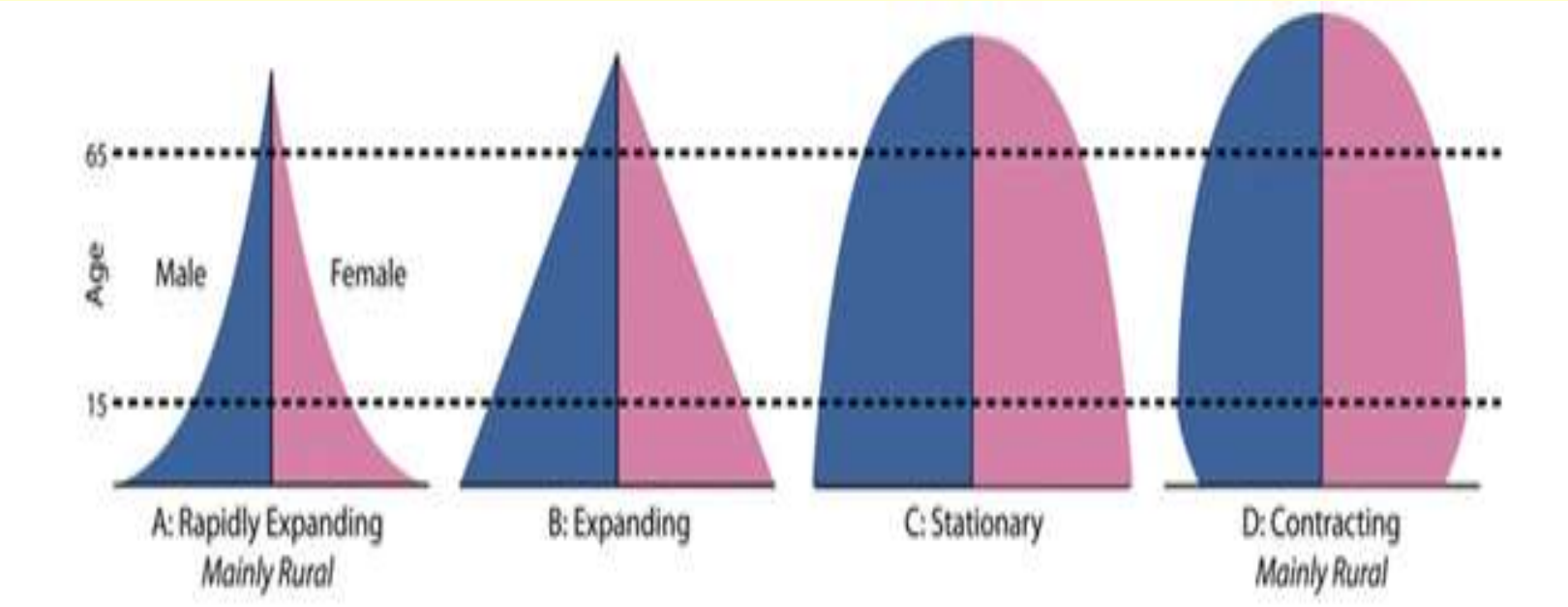
Total = 0-14 + 65^{+}/ 15-64

Ageing index = 65^{+}/ 0-14

4. Age pyramid

The age pyramid represents the distribution of population by age and sex at the same time period

TYPES OF AGE PYRAMIDS



Population dynamics

Fertility

$$\textbf{Crude Birth Rate} = \frac{Number\ of\ \textit{live births}\ during\ the\ year}{Mid\text{-}year\ population\ in\ the\ same\ year} \times 1000$$

- **SCALE FOR ASSESSMENT :**
  low - under 15 ‰
  average - 15 - 25 ‰
  high - over 25 ‰

General Fertility Rate (GFR)

$$GFR = \frac{\text{number of live births during the year}}{\text{mid-year female population aged 15-49 in the same area and in the same year}} \times 1000$$

GFR is a better measure of fertility than CBR because the denominator is restricted to the number of women in the child-bearing age.

CBR:GFR = 1:4

Age-specific Fertility Rate (ASFR)

$$\text{ASFR} = \frac{\text{number of live births in a year to women in a specific age-group}}{\text{mid-year female population in the same age-group}} \times 1000$$

SPECIFIC REPRODUCTION INDICATORS:

1. TOTAL FERTILITY RATE (TFR)

2. GROSS REPRODUCTION RATE (GRR)

3. NET REPRODUCTION RATE (NRR)

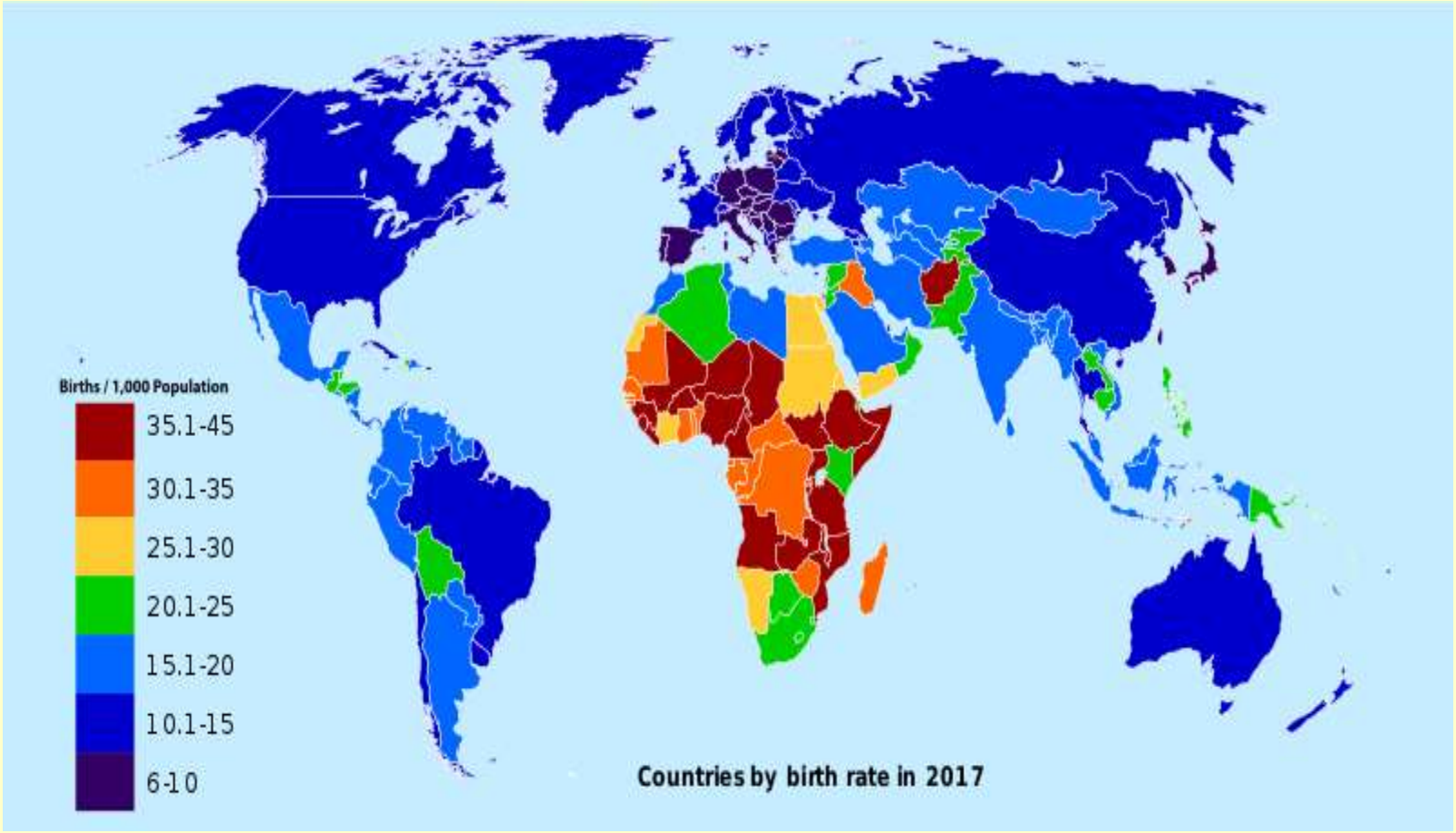
TFR - THE AVERAGE NUMBER OF CHILDREN A WOMAN WOULD HAVE IF SHE WERE TO PASS THROUGH HER REPRODUCTIVE YEARS BEARING CHILDREN AT THE SAME RATES AS THE WOMEN NOW IN EACH AGE GROUP, IF AGE-SPECIFIC FERTILITY RATES REMAIN UNCHANGED.

GRR - AVERAGE NUMBER OF GIRLS A WOMAN WOULD HAVE IF SHE EXPERIENCES THE CURRENT FERTILITY PATTERNS THROUGHOUT HER REPRODUCTIVE SPAN (15-49 YEARS), ASSUMING NO MORTALITY, I.E. AGE-SPECIFIC FERTILITY RATES REMAIN THE SAME.

NRR - THE AVERAGE NUMBER OF GIRLS A WOMAN WOULD HAVE DURING HER REPRODUCTIVE PERIOD IF THE AGE-SPECIFIC FERTILITY RATES AND AGE-SPECIFIC MORTALITY RATES REMAIN UNCHANGED

NRR is used to evaluate the replacement level of a population:

NRR = 1 - stationary level
NRR < 1 - below the replacement level
NRR > 1 – extended reproduction


Births / 1,000 Population
35.1-45
30.1-35
25.1-30
20.1-25
15.1-20
10.1-15
6-10
Countries by birth rate in 2017

MORTALITY

$$CDR = \frac{\text{Number of deaths during the year}}{\text{Mid-year population}} \times 1000$$

SCALE FOR ASSESSMENT :

low - under 10 ‰

average - 10 - 15 ‰

high - over 15 ‰

- CDR is influenced by population age structure.
- It is not comparable for the populations that differ by age, sex, race, etc.
- In such situations we use STANDARDIZED DEATH RATES (SDR).

STANDARDIZATION by age removes the confounding effect of different age structures and allows to come to a single standardized or adjusted rate, by which the total mortality experience can be compared directly.

World standard population

Age Group	WHO World Standard (%)
0–4	8.860
5–9	8.690
10–14	8.600
15–19	8.470
20–24	8.220
25–29	7.930
30–34	7.610
35–39	7.150
40–44	6.590
45–49	6.040
50–54	5.370
55–59	4.550
60–64	3.720
65–69	2.960
70–74	2.210
75–79	1.520
80–84	0.910
85–89	0.440
90–94	**0.150**
95–99	0.040
100+	0.005
Total	100.035

European standard population

European standard population (Waterhouse et al., 1976)

Age group (years)	European standard population
0	1 600
1-4	6 400
5-9	7 000
10-14	7 000
15-19	7 000
20-24	7 000
25-29	7 000
30-34	7 000
35-39	7 000
40-44	7 000
45-49	7 000
50-54	7 000
55-59	6 000
60-64	5 000
65-69	4 000
70-74	3 000
75-79	2 000
80-84	1 000
85+	1 000
Total	**100 000**

Death rate by age

$$\frac{\text{Number of deaths in age group 50 - 59 during a year}}{\text{Mid-year population in the same age group}} \times 1000$$

The same way of calculation could be used for each age group

Death rate by cause

$$\frac{\text{Number of deaths due to CVD during a year}}{\text{Mid-year population}} \times 1000$$

Proportional mortality

$$\frac{\text{number of deaths due to CVD in a year}}{\text{total number of deaths in that year}} \times 100$$

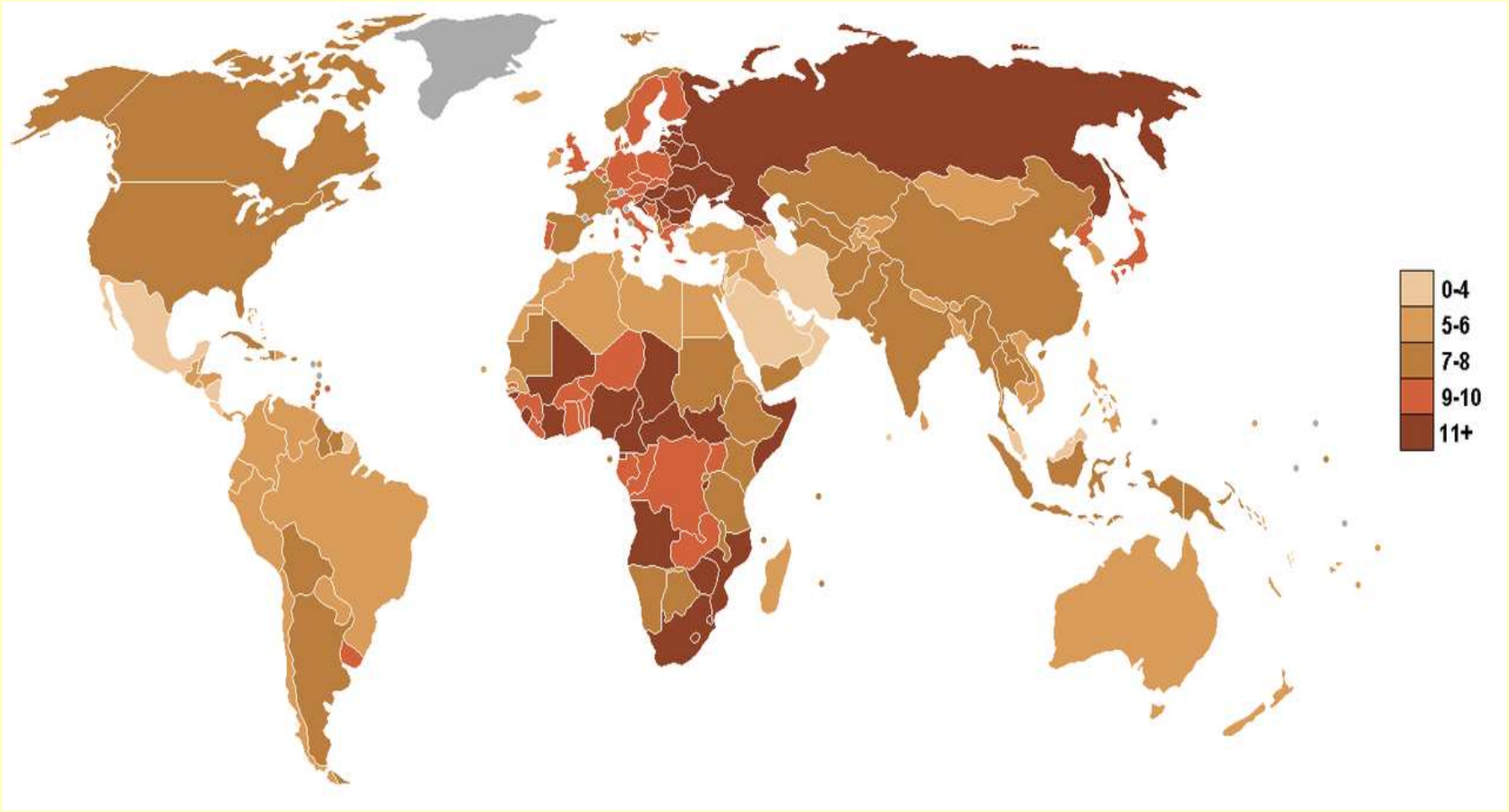
LEADING CAUSES OF DEATH

Developed countries	Developing countries
1. Cardiovascular diseases	1. Infectious diseases
2. Malignant neoplasms	2. Cardiovascular diseases
3. Chronic pulmonary diseases	3. Malignant neoplasms
4. Injuries	4. Chronic pulmonary diseases

Maternal mortality ratio

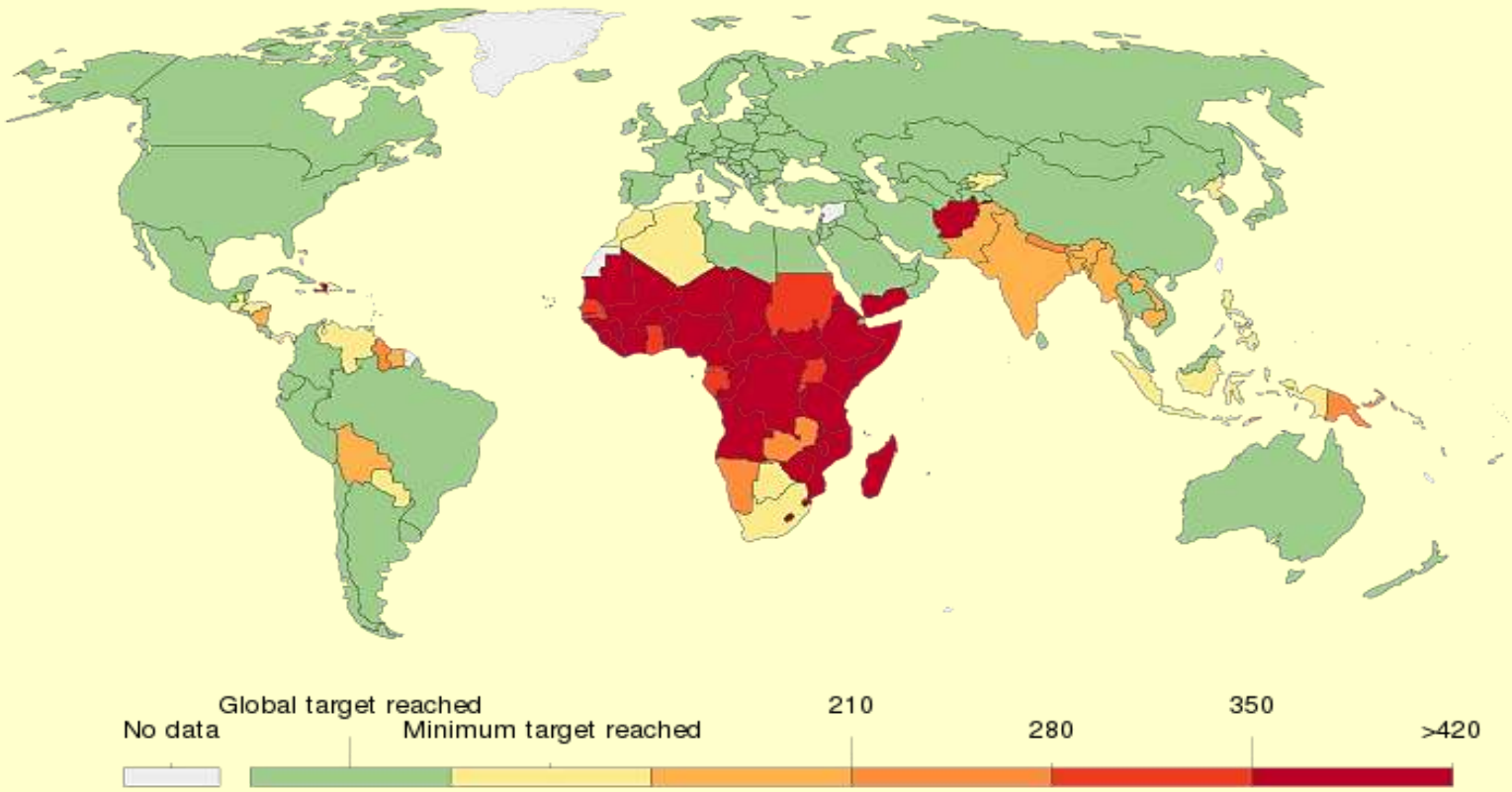
$$= \frac{\text{Number of deaths of women during pregnancy, delivery and within 42 days after termination of pregnancy}}{\text{Live births}} \times 100{,}000$$

Death rates by regions



Maternal mortality ratio, 2015

Maternal mortality ratio is the number of women who die from pregnancy-related causes while pregnant or within 42 days of pregnancy termination per 100,000 live births. SDG Target 3.1 is to reduce global maternal deaths to less than 70 per 100,000 live births and all countries less than 140 per 100,000 live births.



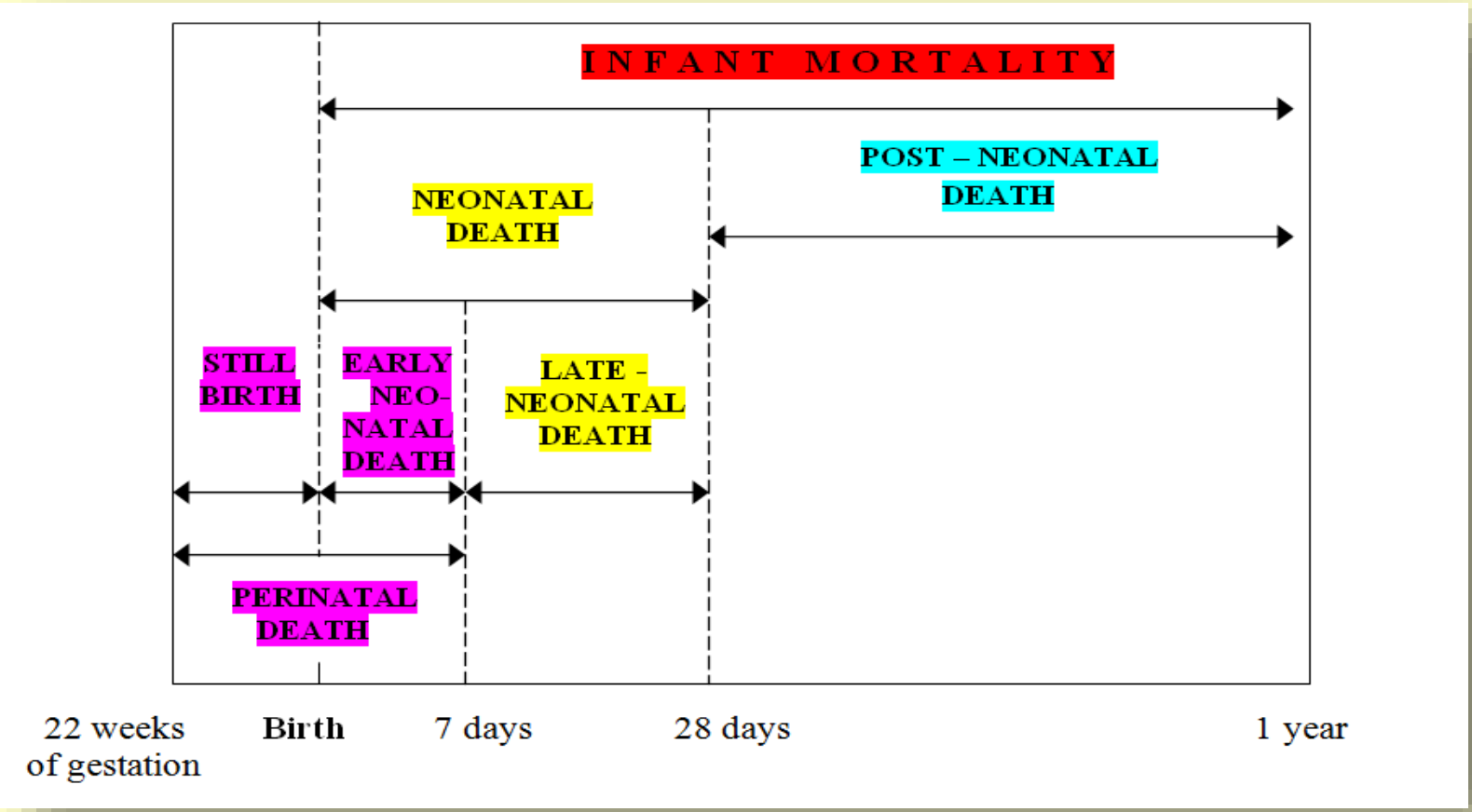
Source: World Bank

Infant mortality

$$IMR = \frac{\text{Number of deaths of children at age 0 – 1 year in a given year}}{\text{Total number of life births in the same year}} \times 1000$$

SCALE FOR ASSESSMENT :
very low – under 5 ‰
low – 5 -10 ‰
average - 10 - 25 ‰
high – 25 - 50 ‰
very high – over 50 ‰

Periods


INFANT MORTALITY
POST – NEONATAL DEATH
NEONATAL DEATH
STILL BIRTH
EARLY NEO-NATAL DEATH
LATE - NEONATAL DEATH
PERINATAL DEATH
22 weeks of gestation
Birth
7 days
28 days
1 year

Neonatal mortality rate

number of deaths of children under 28 days of age in a year

NMR = ----------

total livebirths in the same year

Post-neonetal mortality rate

number of deaths between 28 days and one year in a given year

PNMR = ----------

total live births in the same year surviving 28th day

Perinatal mortality rate

Stillbirths + early neonatal deaths in one year

PMR = ---------- x 1000

Live births in the same year

LEADING CAUSES OF INFANT MORTALITY

Developed countries	*Developing countries*
1. Perinatal causes – asphyxia, hypoxia, injuries, low birth weight *2. Congenital abnormalities* *3. Respiratory diseases*	*1. Immunopreventable diseases – diphtheria, tetanus, whooping cough, measles, tuberculosis, poliomyelitis* *2. Diarrhea* *3. Acute respiratory infections*

$$\text{U5MR} = \frac{\text{Number of deaths of children at age 0 – 5 year in a given year}}{\text{Total number of life births in the same year}} \times 1000$$

SCALE FOR ASSESSMENT :

very low – under 10 ‰

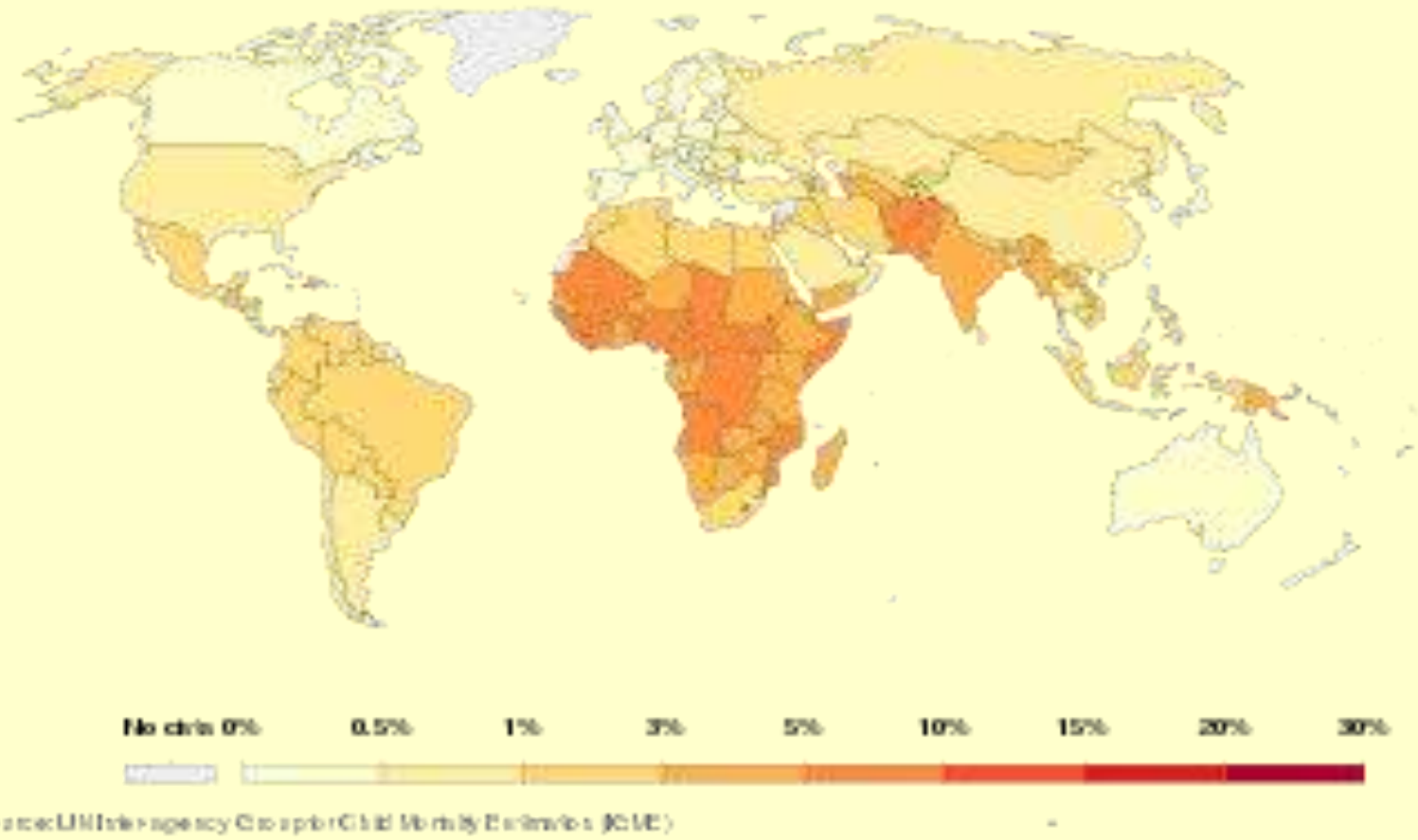
low – 10 -20 ‰

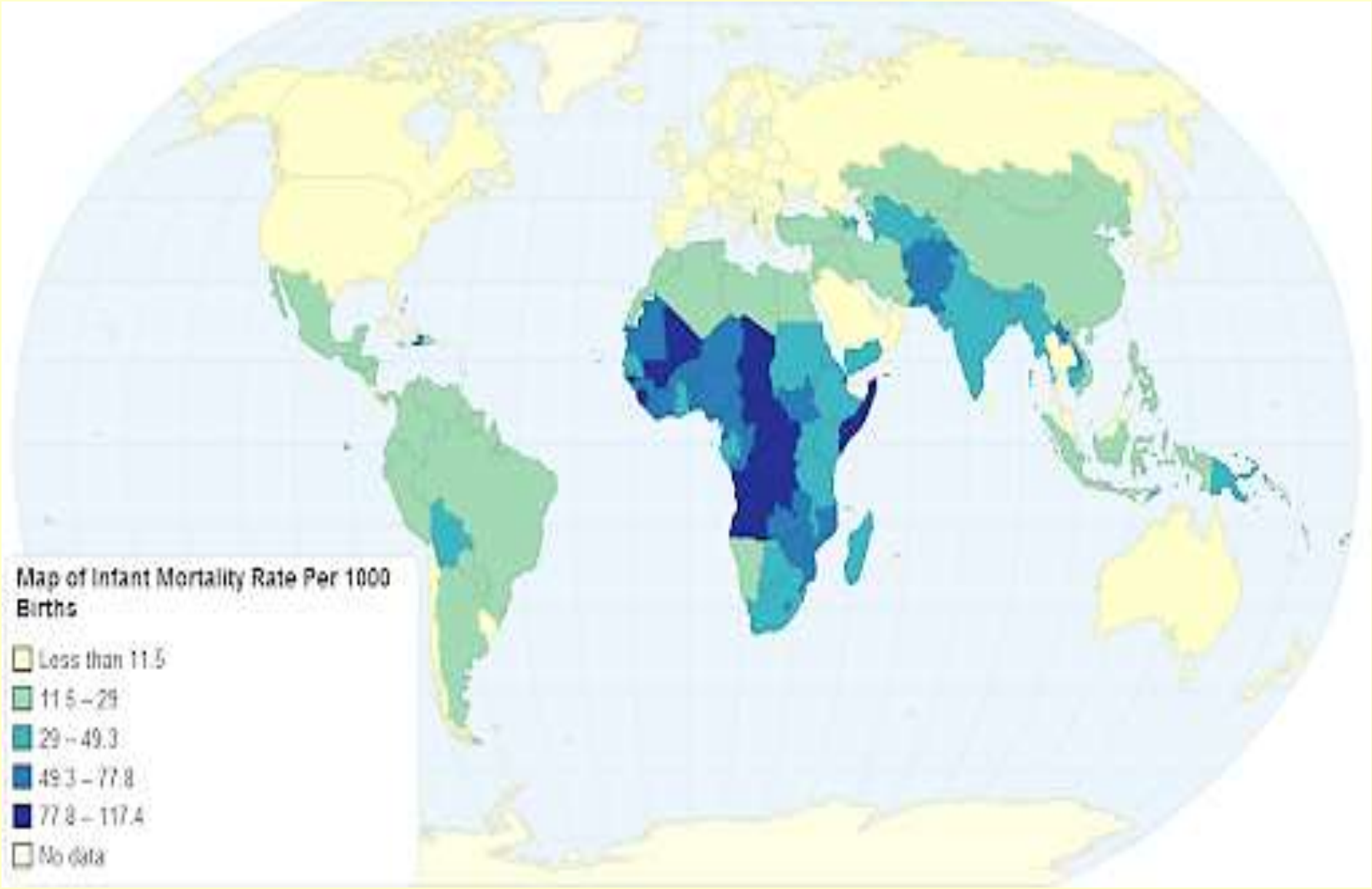
average - 20 - 50 ‰

high – 50 – 100 ‰

very high – over 100 ‰

Infant mortality, 2017





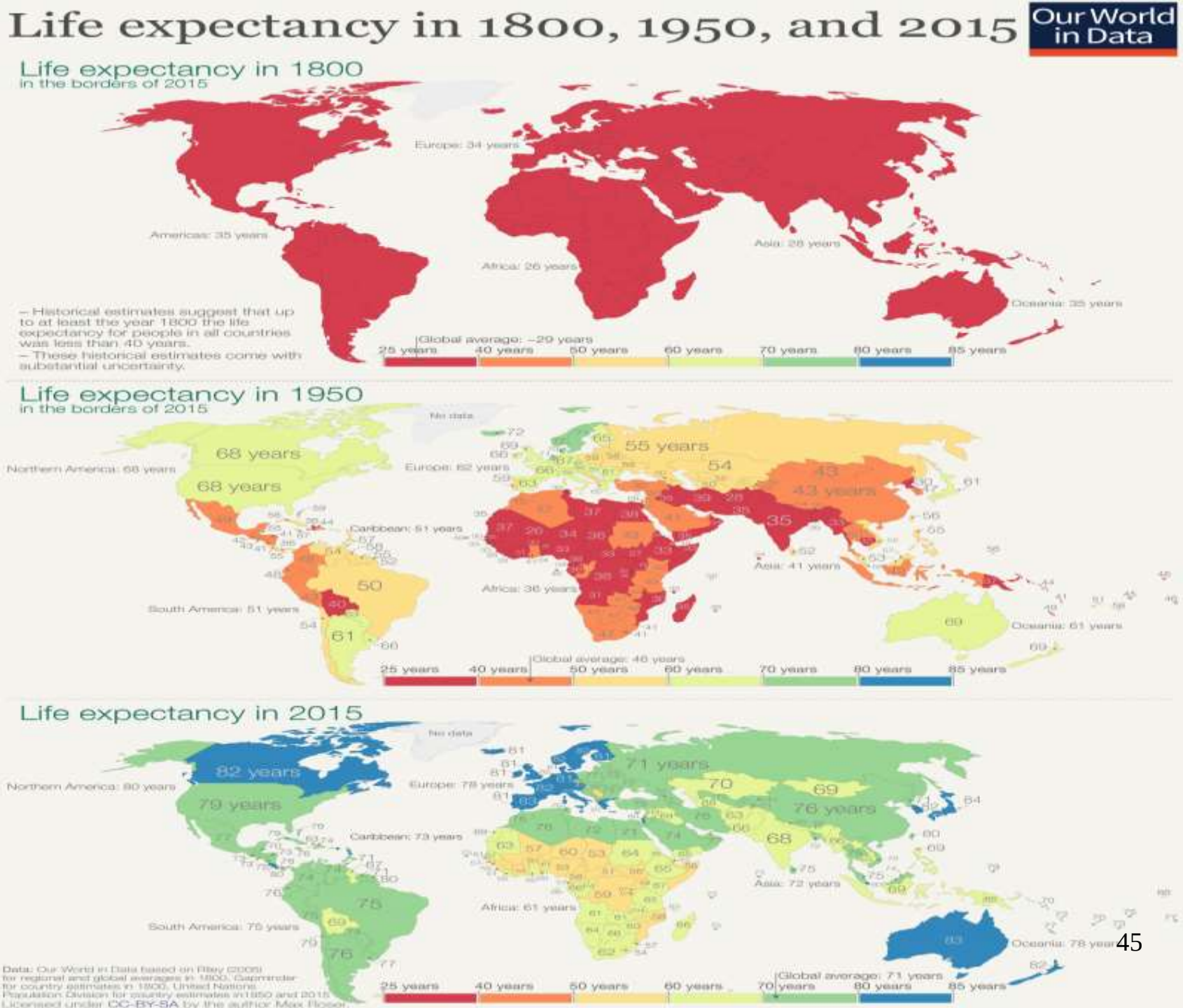
List of countries according to U5MR, 2018

Life expectancy

The average number of years which a person (or a generation) of a given age may expect to live if the age-specific mortality rates would remain the same.

Characteristics of life expectancy

- The best indicator of public health in a country
- Reflects very well the level of overall socio-economic development
- Hypothetical indicator.
- Calculated using mortality tables.
- Higher for women, than for men (few exceptions)
- The higher the life expectancy, the bigger the difference between women and men.


Life expectancy in 1800, 1950, and 2015
Our World in Data
Life expectancy in 1800
in the borders of 2015
Europe: 34 years
Americas: 35 years
Asia: 28 years
Africa: 26 years
Oceania: 35 years
– Historical estimates suggest that up to at least the year 1800 the life expectancy for people in all countries was less than 40 years.
– These historical estimates come with substantial uncertainty.
Global average: ~29 years
25 years
40 years
50 years
60 years
70 years
80 years
85 years
Life expectancy in 1950
in the borders of 2015
No data
68 years
Northern America: 68 years
68 years
Europe: 62 years
55 years
54
43
43 years
35
Caribbean: 51 years
Asia: 41 years
Africa: 36 years
50
South America: 51 years
61
69
Oceania: 61 years
Global average: 46 years
Life expectancy in 2015
No data
82 years
Northern America: 80 years
79 years
Europe: 78 years
71 years
70
69
76 years
68
Caribbean: 73 years
Asia: 72 years
Africa: 61 years
75
South America: 75 years
76
83
Oceania: 78 years
Global average: 71 years
Data: Our World in Data based on Riley (2005) for regional and global averages in 1800; Gapminder for country estimates in 1800; United Nations Population Division for country estimates in 1950 and 2015
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OTHER INDICATORS OF LIFE EXPECTANCY

- **HALE - Health-adjusted life expectancy**
- **DFLE - Disability-free life expectancy**
- **QALY - Quality-adjusted life years**
- **DALY - Disability-adjusted life years**