جامعة الملك سعود
King Saud University
1957

Global Demography Concepts and Population Pyramid

Dr Rufaidah Al Dabbagh, MBBS, MPH, DrPH
Community Medicine Unit, Family & Community Medicine Department

12, 9, 2021

Objectives

- Define demography
- Describe major sources of population data
- List the important factors that determine population growth and calculate measures of these factor
- Interpret the population pyramid and differentiate between features of developed and developing countries
- Understand the concept and determinants of demographic equilibrium
- Describe and understand the theory of demographic transition
- Define, compute and interpret the population distribution measures

What is demography?

- It is the scientific study of human populations

- It encompasses three domains:

1.Change in population size

2.Composition of a population

3.Distribution of a population in space

Why is demography important?

The health of people in a community depends on the dynamic interaction between size of the population and the space they occupy

Sources of demographic data

- Vital statistics (Birth and death registration)
- General Authority for Statistics (GAS)
- Ministry of health
- World Health Organization statistics
- United Nations
- World Bank Statistics

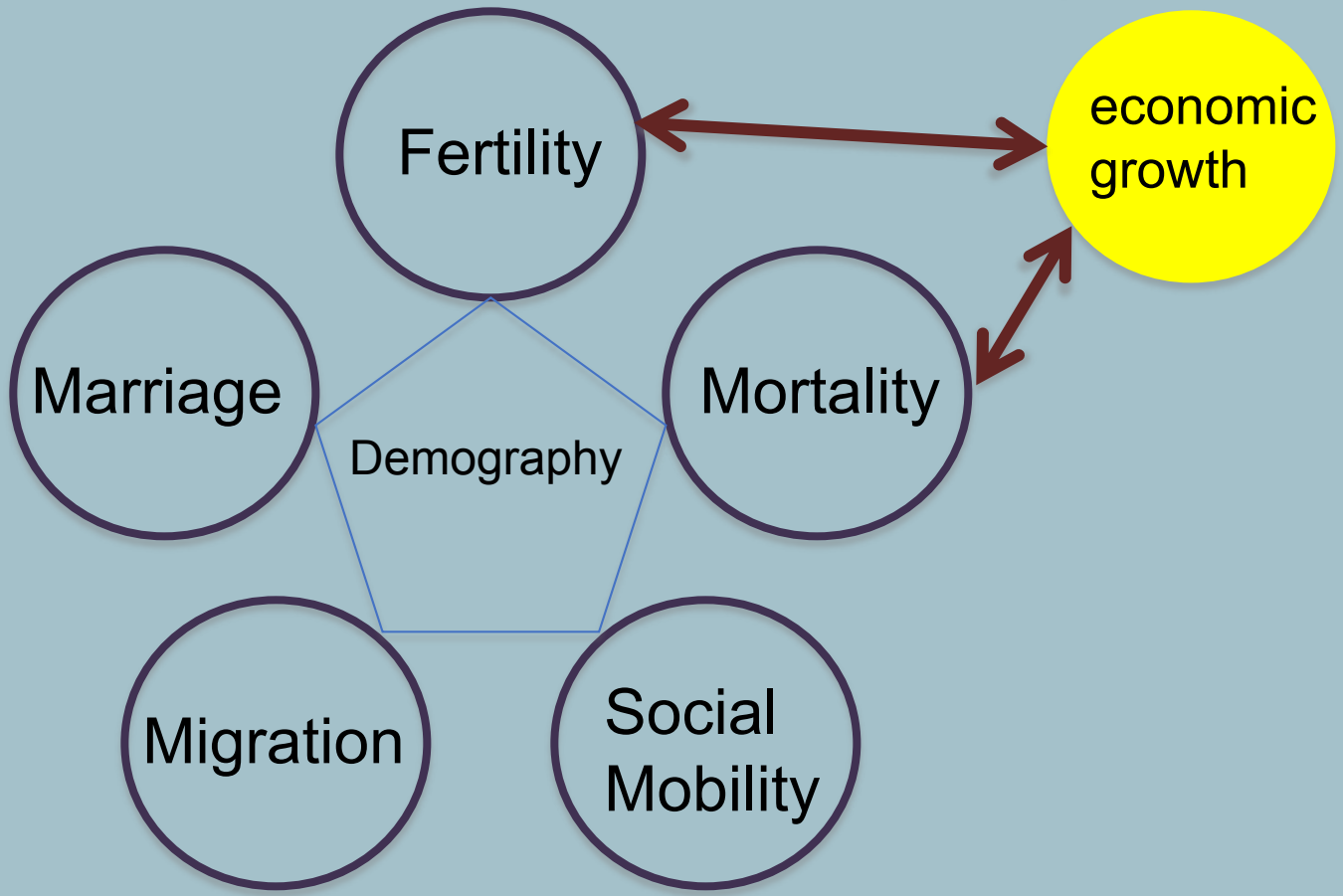
Sources of their Saudi Data are not clear

Available Demographic Indicators from GAS

- Demographic Indicators Reported by
  - Age groups (reported in 5-year bins)
  - Gender
  - Region of residence
  - Nationality (Saudi vs. Non-Saudi)
  - Marital status
  - Education status
  - Number of live births
  - Use of OCP
  - Number of deaths
  - Disability

What determines demographic distribution of a population and population size?

Population size, distribution and composition are determined by:



1-Fertility

- The actual bearing of children, is determined by:

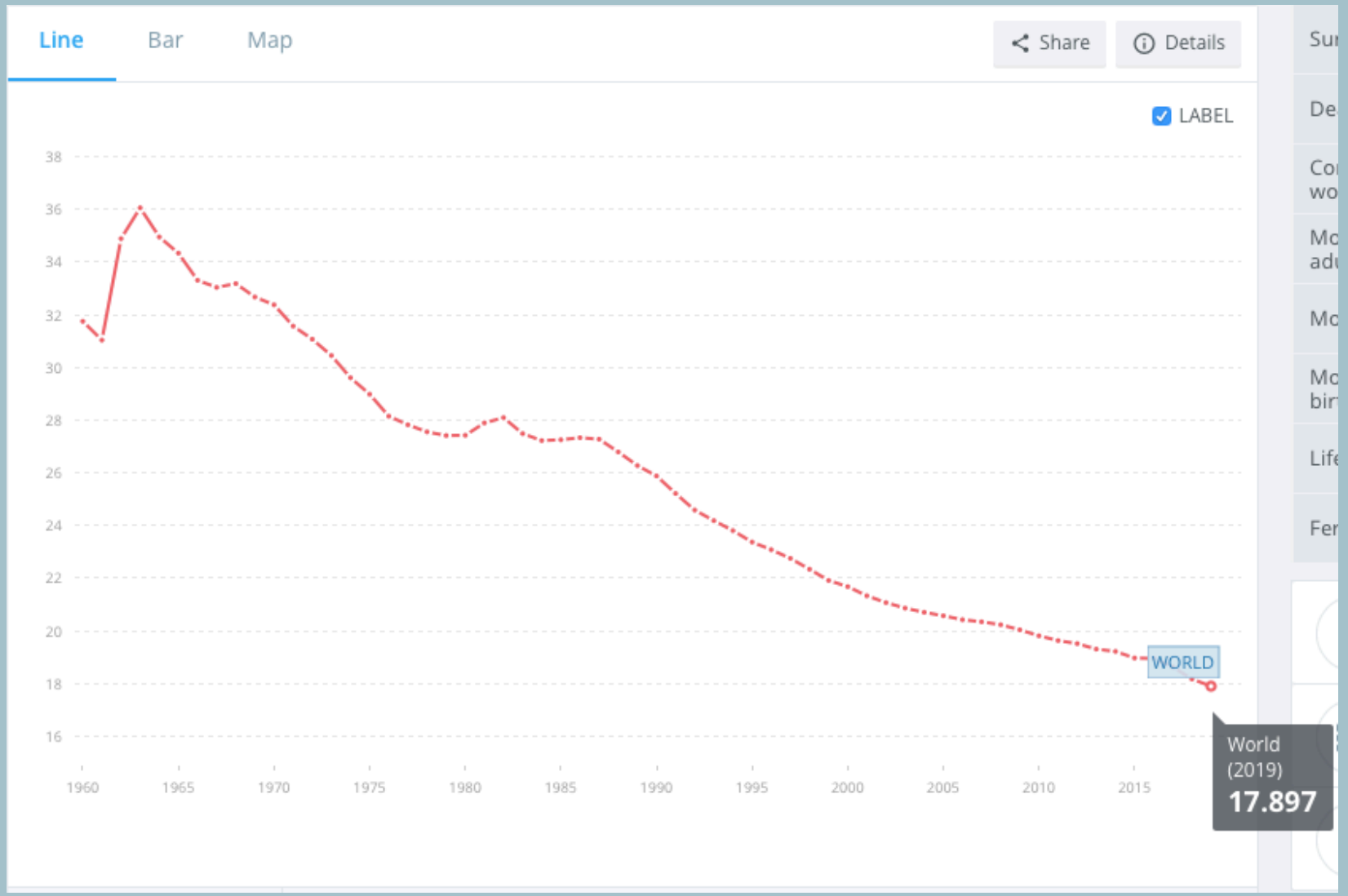
1. *Age at marriage* (inverse relationship)
2. *Duration of married life* (most happen in early y)
3. *Spacing of children*
4. *Education* (inverse relationship)
5. *Economic status* (inverse relationship)
6. *Religion*
7. *Nutrition* (Inverse relationship)
8. *Family planning*
9. *Other factor*….physiological, biological, cultural, social

Measures of Fertility

1. Crude Birth Rate:

$$\frac{\text{Number of live births in a year in a specific locality}}{\text{estimated mid-year population size in that same year and locality}} \times 1000$$

Crude Birth Rate Trend (World Bank)



Source: The World Bank. Available from: https://data.worldbank.org/indicator/SP.DYN.CBRT.IN

Measures of Fertility cont.

2. General Fertility Rate:

number of live births per 1000 women in the reproductive age-group (15-44 or 49 years) in a given year

$$\frac{\text{Number of live births in a year in a specific locality}}{\text{Mid-year female population age 15-49 (reproductive age) in that same year and same locality}} \times 1000$$

Problems? – not all women in denominator at risk for childbirth or married

Measures of Fertility cont.

3. General *Marital* Fertility Rate:

- number of live births per 1000 ***married*** women in the reproductive age group (15-44 or 49) in a given year

$$\frac{\text{Number of live births in a year in a specific locality}}{\text{Mid-year female married population age 15-49 in that same year and same locality}} \times 1000$$

Measures of Fertility cont.

4. Age-specific Fertility Rate:

- number of live births in a year to 1000 women in any specified age-group

$$\frac{\text{Number of live births among a specific age group}}{\text{Mid-year female population in that age group in that same year and same locality}} \times 1000$$

Measures of Fertility cont.

5. Total Fertility Rate: (rate per woman)

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

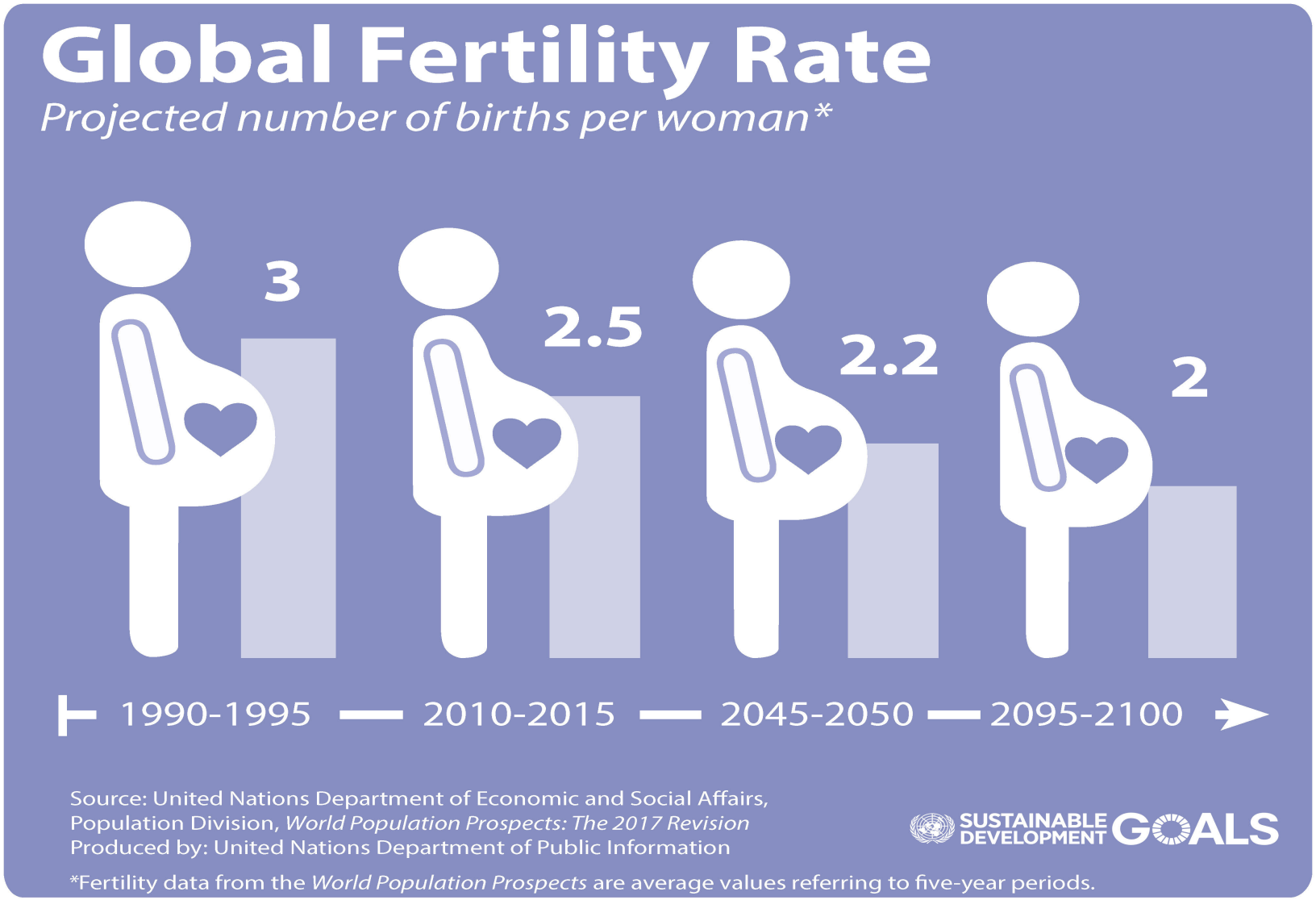
Approximates "completed family size"

$$\frac{\text{Sum of age specific fertility rates}}{1000} \text{ (rate per woman)}$$

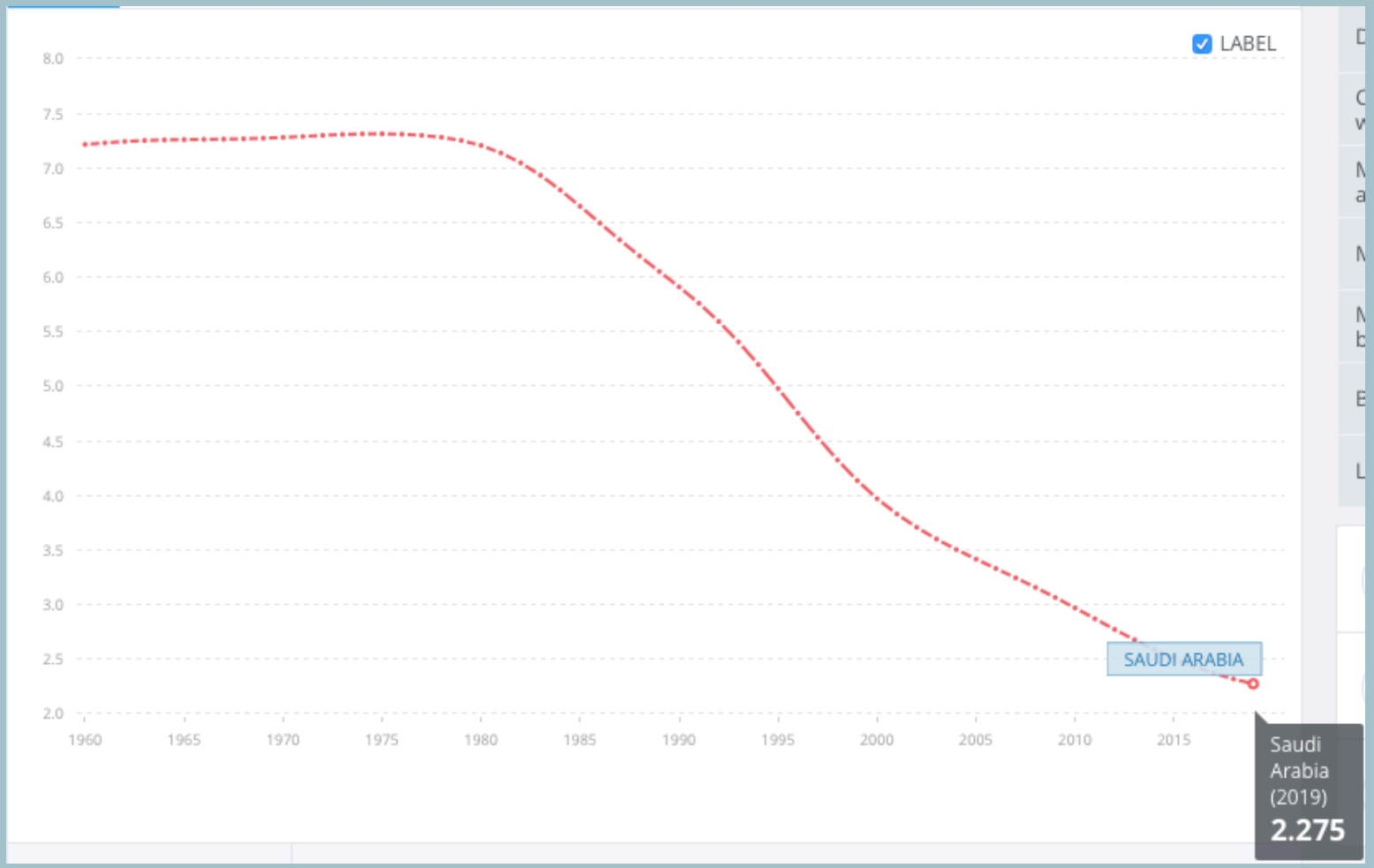
or ***Sum of age specific fertility rate*** (rate per 1000 women)

If using a 5-year period, then: Σage specific fertility rate x 5

Global "Total Fertility Rates" (projection)



Trend of "Total Fertility Rate" in KSA



Source: The World Bank. Available from: https://data.worldbank.org/indicator/SP.DYN.TFRT.IN

Impact of fertility on age distribution

- High fertility =>

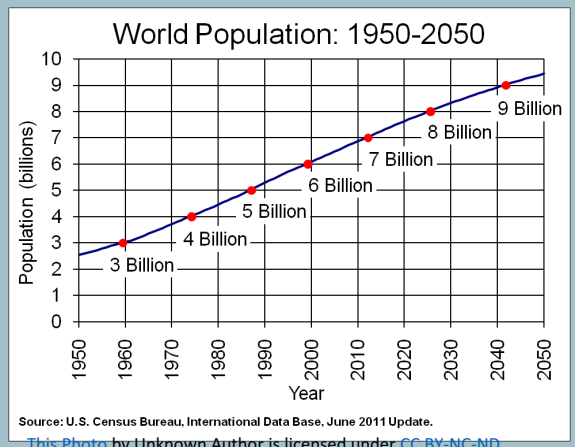
High proportion of young people in the population (e.g. developing countries)

- Low fertility =>

Condensed proportion of retired people in a population (e.g. developed countries)

- How does that impact healthcare needs?

Fertility and population explosion
What's it all about?

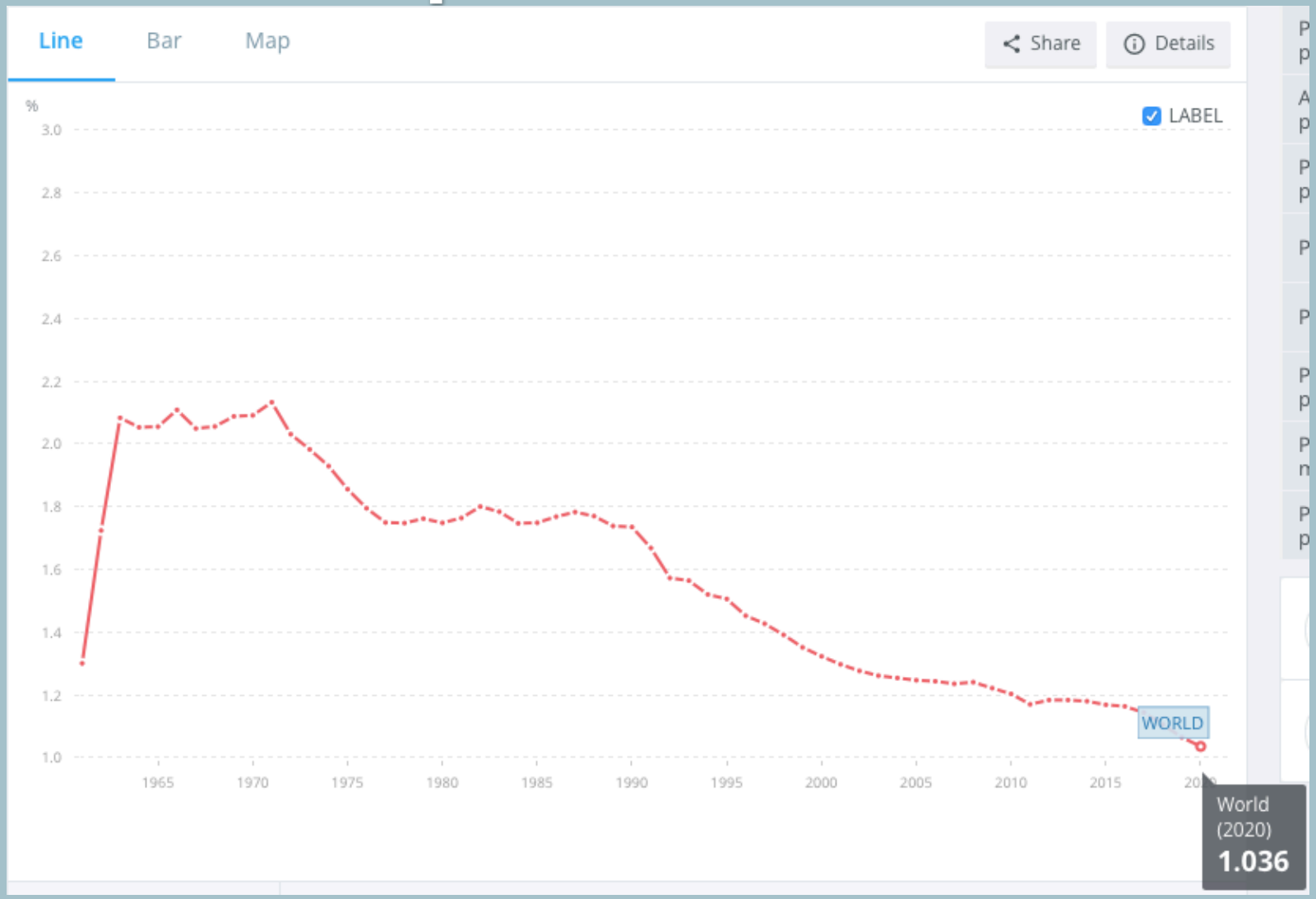


- Controversy starting from the late 1700s
- Thomas Malthus theory: "An essay on the principles of population"

- **Argument:** population growth -> overpopulation -> competition on resources -> famine -> pandemics -> destruction of humanity

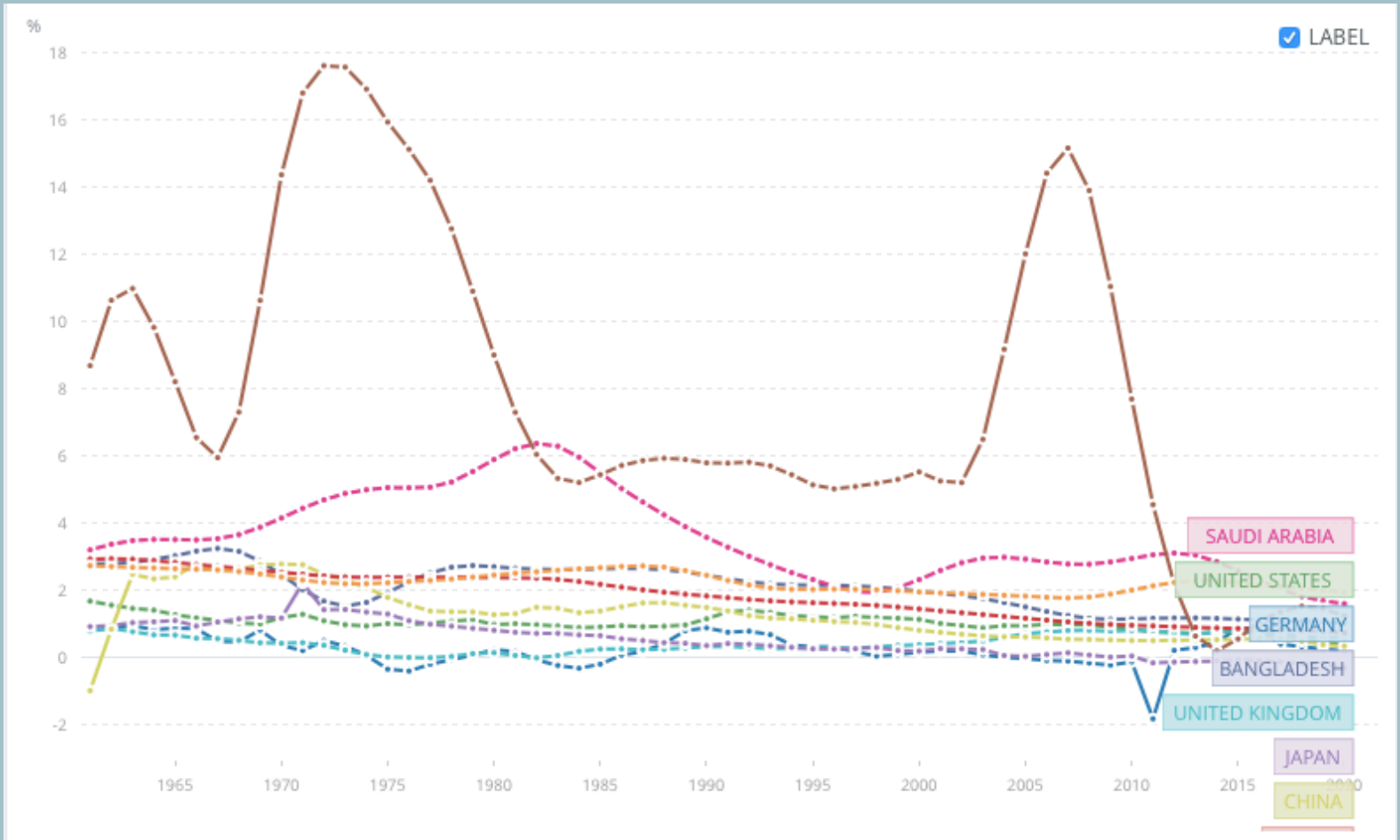
- **Fallacy in their argument:**
  - Only focusing on birth control; not meeting healthcare and development needs of disadvantaged populations
  - Agricultural revolution made resources more available
  - Better hygiene and health -> fertility rates and death rates are stable
  - He did not consider stages of **demographic transition**

Annual Population Growth World



Source: The World Bank. Available from: https://data.worldbank.org/indicator/SP.POP.GROW?locations=SA

Annual Population Growth Select Countries



Source: The World Bank. Available from: https://data.worldbank.org/indicator/SP.POP.GROW?locations=SA

Stages of Demographic Transition

- This explains the changes of birth rates and death rates and describes the population growth cycle in relation to economic development

- These have been based on observations of European nations' transitions. However, they are highly applicable to low income nations, too

5 Stages for Demographic Transition

- **Stage 1:** (High Stationary)
  - High birth rate
  - High death rate

- **Stage 2:** (Early expanding)
  - Birth rates remain the same
  - Death rates begin to decline
  - e.g. many of the countries in developing world

5 Stages for Demographic Transition

- **Stage 3:** (Late Expanding)
  - Death rates further decline
  - Birth rates begin to fall
  - Birth rates > death rates => population growth
- **Stage 4:** (Low stationary)
  - Low birth rate
  - Low death rate
  - Population becomes stationary; Zero population growth:

    i.e. birth rates = death rates -> *Population equilibrium*
  - Many developed countries

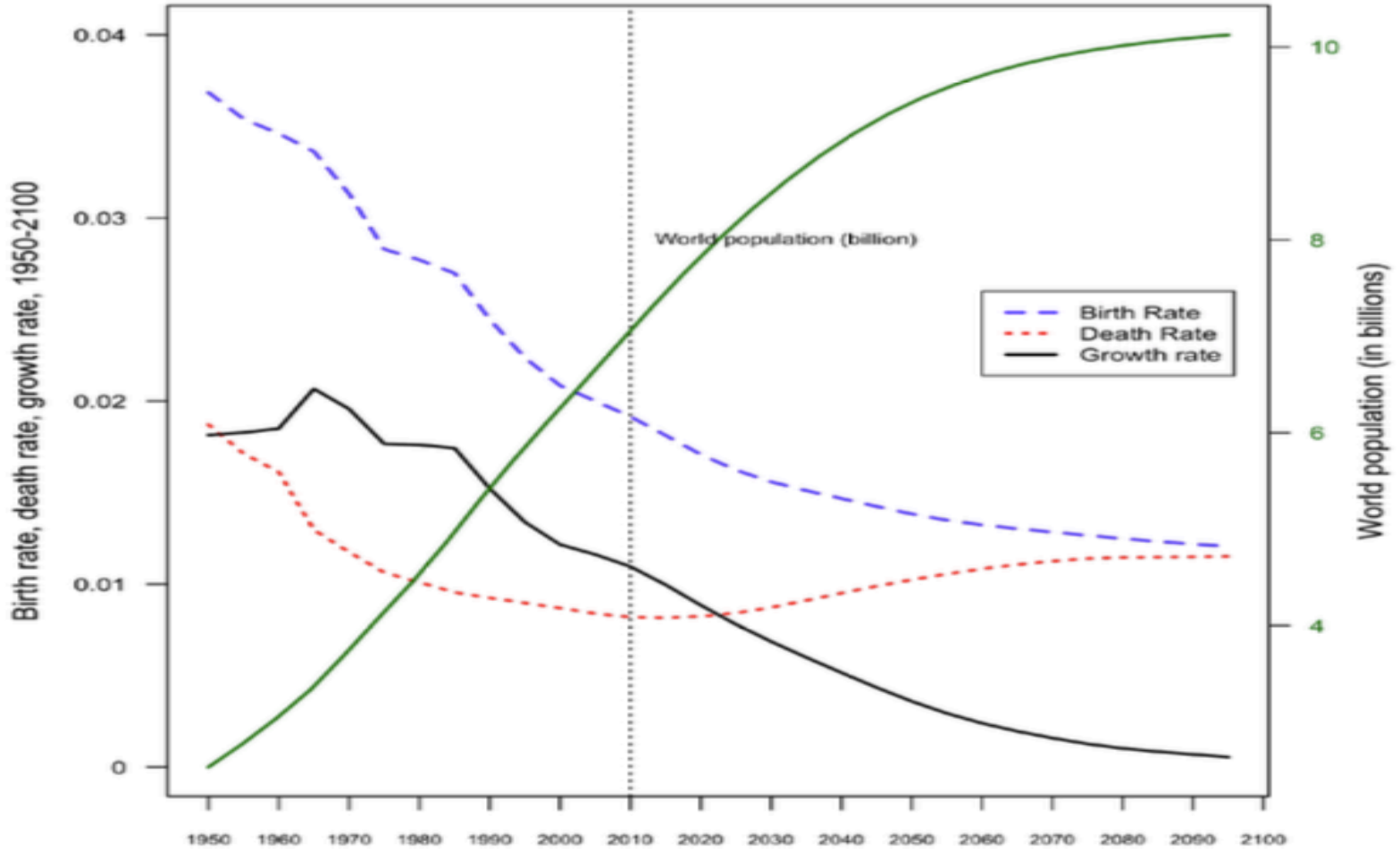
5 Stages for Demographic Transition

- **Stage 5:** (Declining)
  - Birth rates very low
  - Death rates very low
  - Birth rates < death rates
  - Population decline
  - e.g. Germany and Hungary

Limitations of Demographic Transition Model

- Migration is not considered in the model

Expected population size from 1950-2100



Source: United Nations (2011)

2- Migration

- According to UN reports, 281 million people live outside the country where they were born in 2020*
- Of these, 34 million (12%) are refugees or asylum seekers

- Migration (for economic opportunities) is towards high-income countries, except for refugees mostly migrate to low-income countries
- Median age of migrants is 39 years
- Mostly women -> for refuge
- Mostly men -> for work

*Source: United Nations. International Migration 2020 Highlights. Available from: https://www.un.org/en/desa/international-migration-2020-highlights.

Migration continued.

- Ranking of countries that host migrants in 2020 alone:

	Country	No. of migrants hosted
1	USA	51 million
2	Germany	18 million
3	Saudi Arabia	13 million
4	Russia	12 million
5	UK	9 million

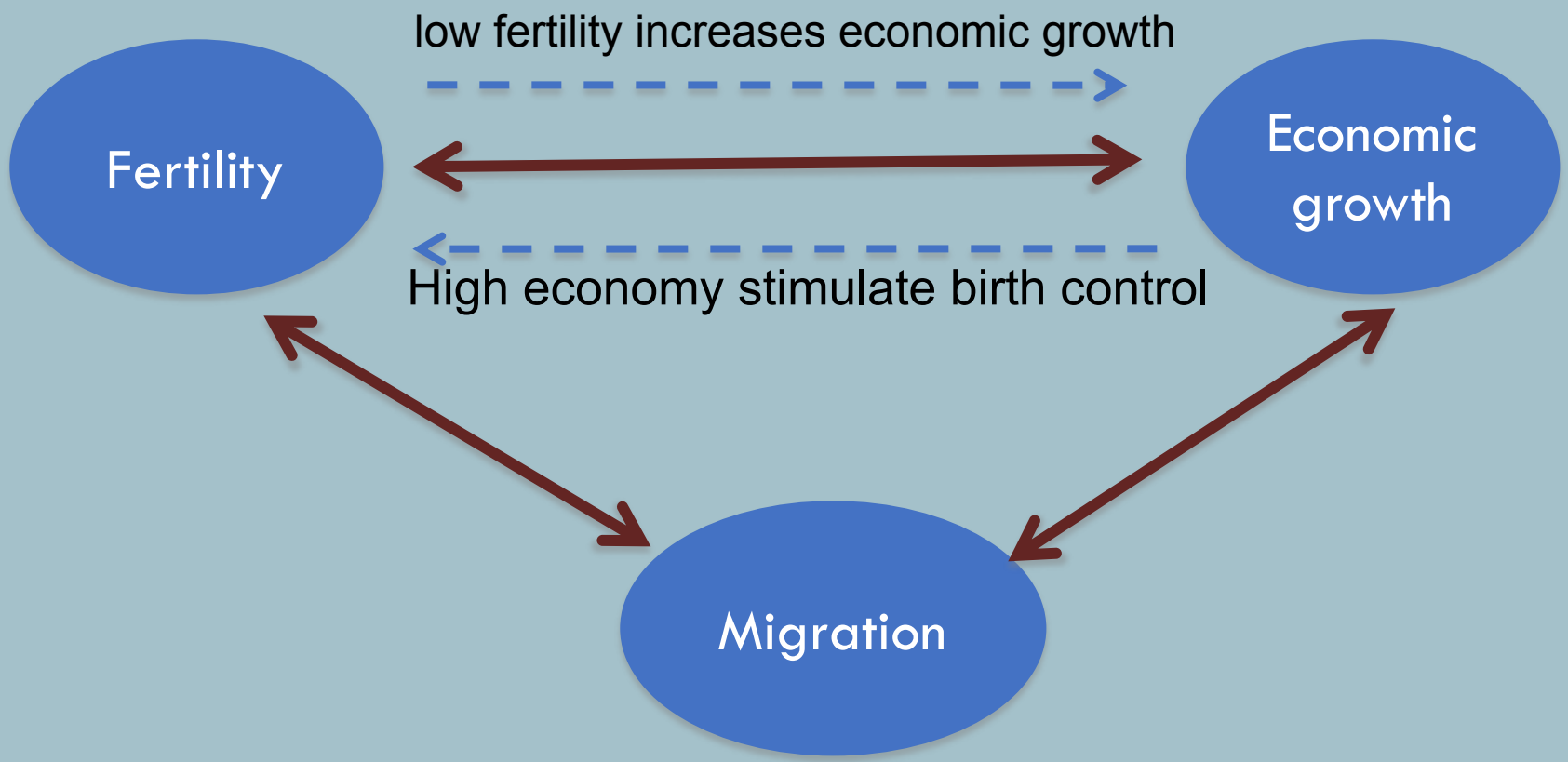
- In 2020, Saudi Arabia ranked the ***third*** worldwide in hosting migrants

*Source: United Nations. International Migration 2020 Highlights. Available from: https://www.un.org/en/desa/international-migration-2020-highlights.

Why is migration important to follow?

- It helps predict how the population will be shaped
- Migration usually goes from low income to more industrialized countries (more economic opportunity)
- Younger and healthier people migrate to more industrialized areas to work
- Migration affects economic growth and is affected by economic growth

Relationship between fertility, migration and economic growth



3-Mortality

- Mortality rate:
  - Number of deaths in a given population in a specific period of time
  - Expressed as per 100 population or per 1000 population

$$MR = \frac{\text{\# of deaths in a given period of time x 100 (or 1000)}}{\text{Total population in the same given period of time in that same population}}$$

Crude death rate

- Crude death rate:
  - Number of deaths in a given population in a specific period of time over the mid-year population of that same time period

$$\text{CDR} = \frac{\text{\# of deaths in a given period of time} \times 1000}{\text{mid-year population in the same given period of time in that same population}}$$

Other measures of mortality

- Age-specific mortality rate
- All cause mortality rate
- Cause-specific mortality rate
- Infant mortality rate
- peri-natal mortality rate
- neonatal mortality rate
- Post-neonatal mortality rate
- Maternal mortality rate
- Maternal mortality ratio

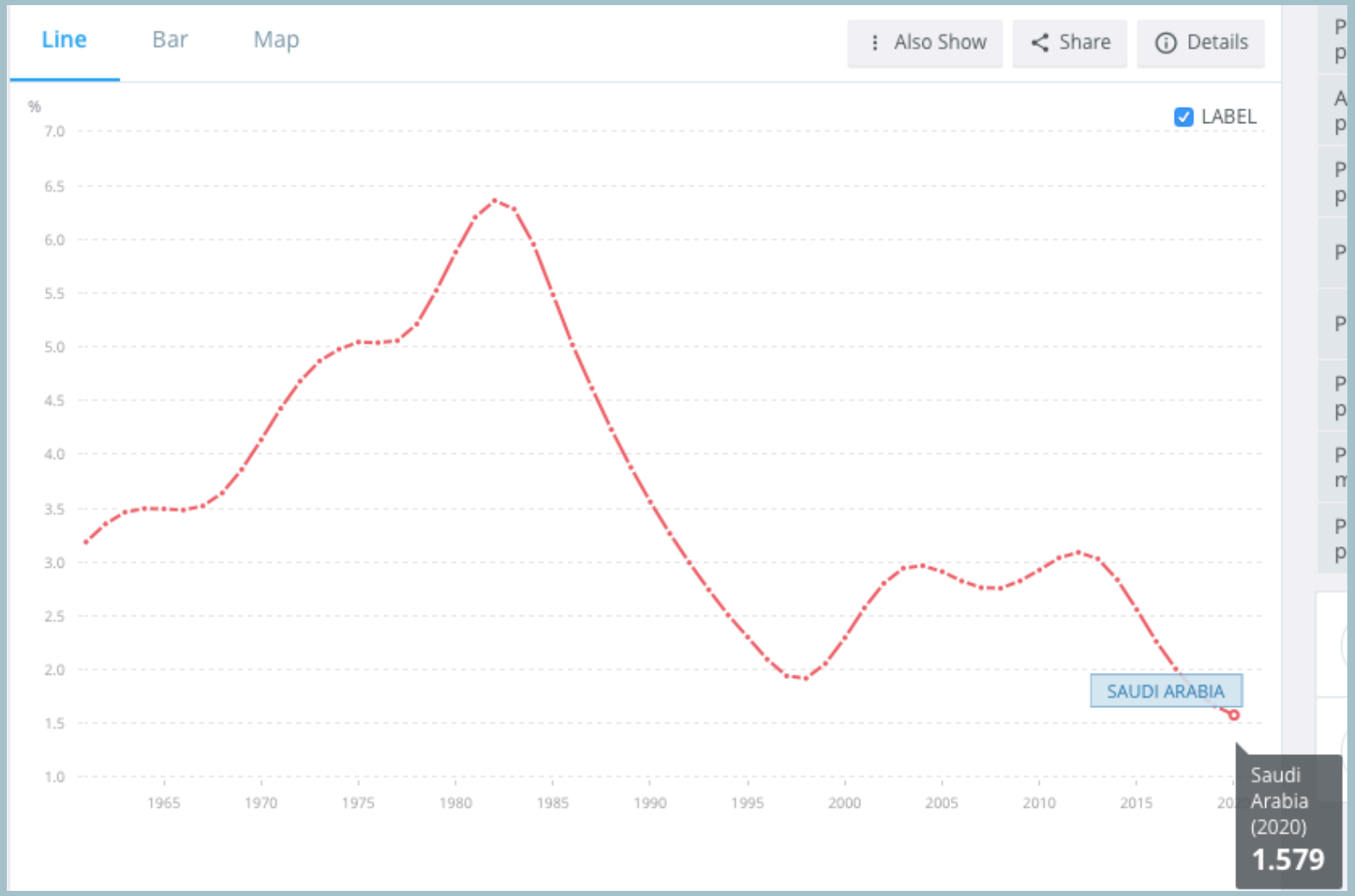
How do we measure population growth

- Population growth rate

Annual population growth rate: (expressed in percentage)

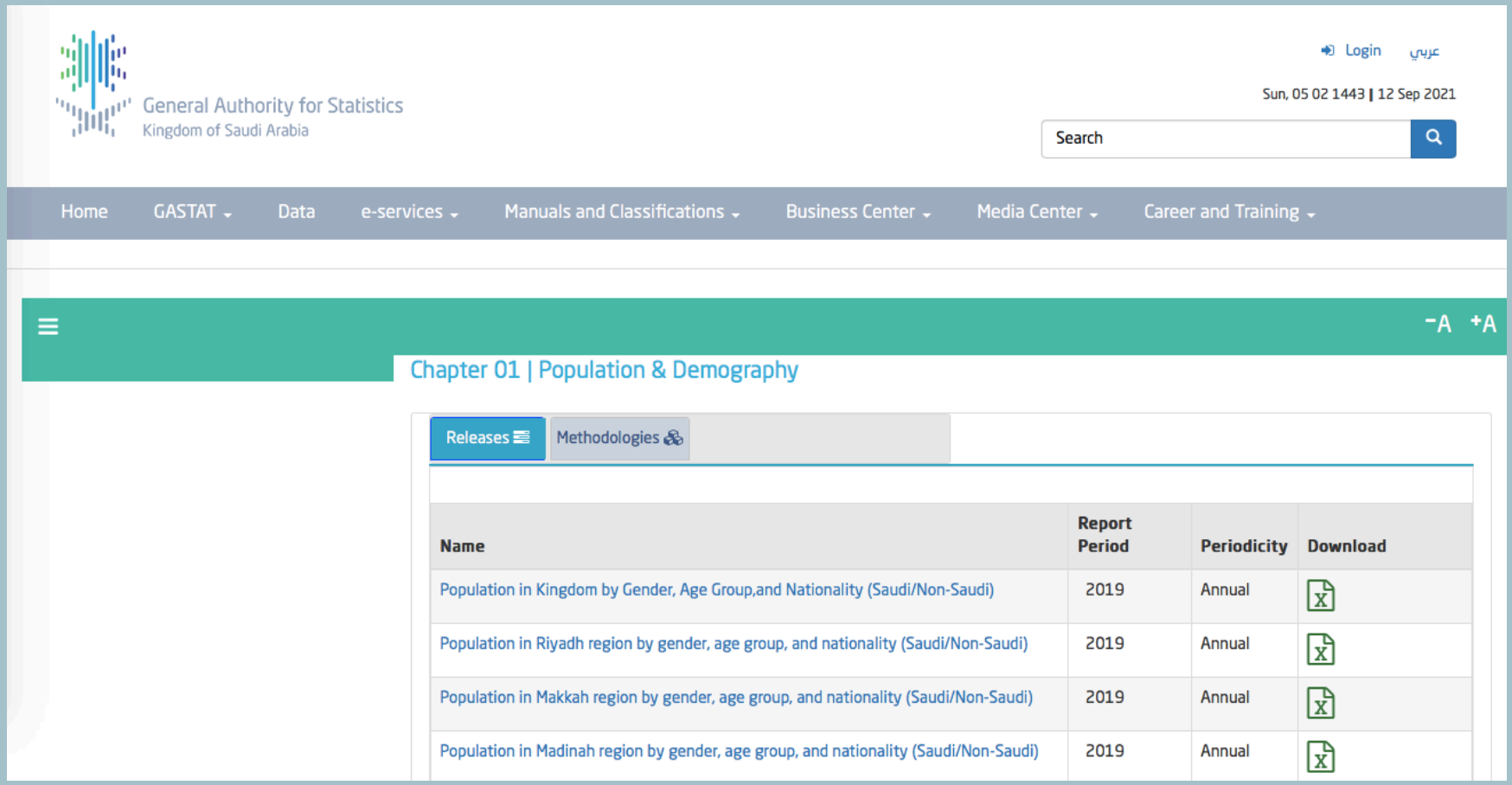
$$\frac{Crude\ Birth\ Rate - Crude\ Death\ Rate}{Population\ Size\ at\ the\ Beginning\ of\ the\ Period} \times 100$$

Annual Population Growth KSA



Source: The World Bank. Available from: https://data.worldbank.org/indicator/SP.POP.GROW?locations=SA

Other Important Population Estimates for KSA



Source: GSTAT. Available from: https://www.stats.gov.sa/en/1007-0

Exponential growth and doubling time concept

- In the 1970s a theory was developed that population size grows exponentially
- Actual data historical data until now rebuke this theory
- Based on exponential growth, the time needed to double population size (population doubling time) was calculated: (70/growth rate)
- Doubling time should NOT be used, as population growth is determined by many factors, and DOES NOT show exponential growth

Source: Bermingham JR. Exponential population growth and doubling times: are they dead or merely quiescent? Population and Environment 2003; 24(4): 313-327.

Example how “doubling time” is flawed

- https://data.worldbank.org/indicator/SP.POP.TOTL?locations=SA&view=chart

Using World Bank data:

- In 1988:
  - Annual growth rate=4.2%, size=15,070,082
  - *Exponential growth theory suggests 16.6 years for population to double*
- In 2013: 30,052,518
- In 2014: 30,916,994
- Took 26 years for KSA population to double in size

Population Distribution KSA

Total Population in 2020: 35,013,414

Population by Age Groups ,and Gender

mid year 2020 — منتصف العام ٢٠٢٠

فئات العمر Age group	Total Population جملة السكان		
	MALE ذكور	FEMALE اناث	Total جملة
4 - 0	1,477,523	1,421,656	2,899,179
9 - 5	1,536,843	1,479,509	3,016,352
14 - 10	1,343,659	1,297,303	2,640,962
19 - 15	1,228,939	1,177,551	2,406,490
24 - 20	1,429,072	1,248,976	2,678,048
29 - 25	1,850,713	1,492,533	3,343,246
34 - 30	2,002,357	1,393,121	3,395,478
39 - 35	2,394,363	1,414,266	3,808,629
44 - 40	2,181,209	1,227,215	3,408,424
49 - 45	1,676,347	850,177	2,526,524
54 - 50	1,208,823	549,702	1,758,525
59 - 55	807,534	404,701	1,212,235
64 - 60	500,209	296,964	797,173
69 - 65	241,585	201,494	443,079
74 - 70	153,697	140,182	293,879
79 - 75	94,134	82,602	176,736
+ 80	104,418	104,037	208,455
Total جملة	20231425	14781989	35013414

* Preliminary estimates are in the middle of the year

* تقديرات أولية في منتصف العام

Source: https://www.stats.gov.sa/sites/default/files/Population%20by%20Age%20Groups%20%2Cand%20Gender_0.pdf

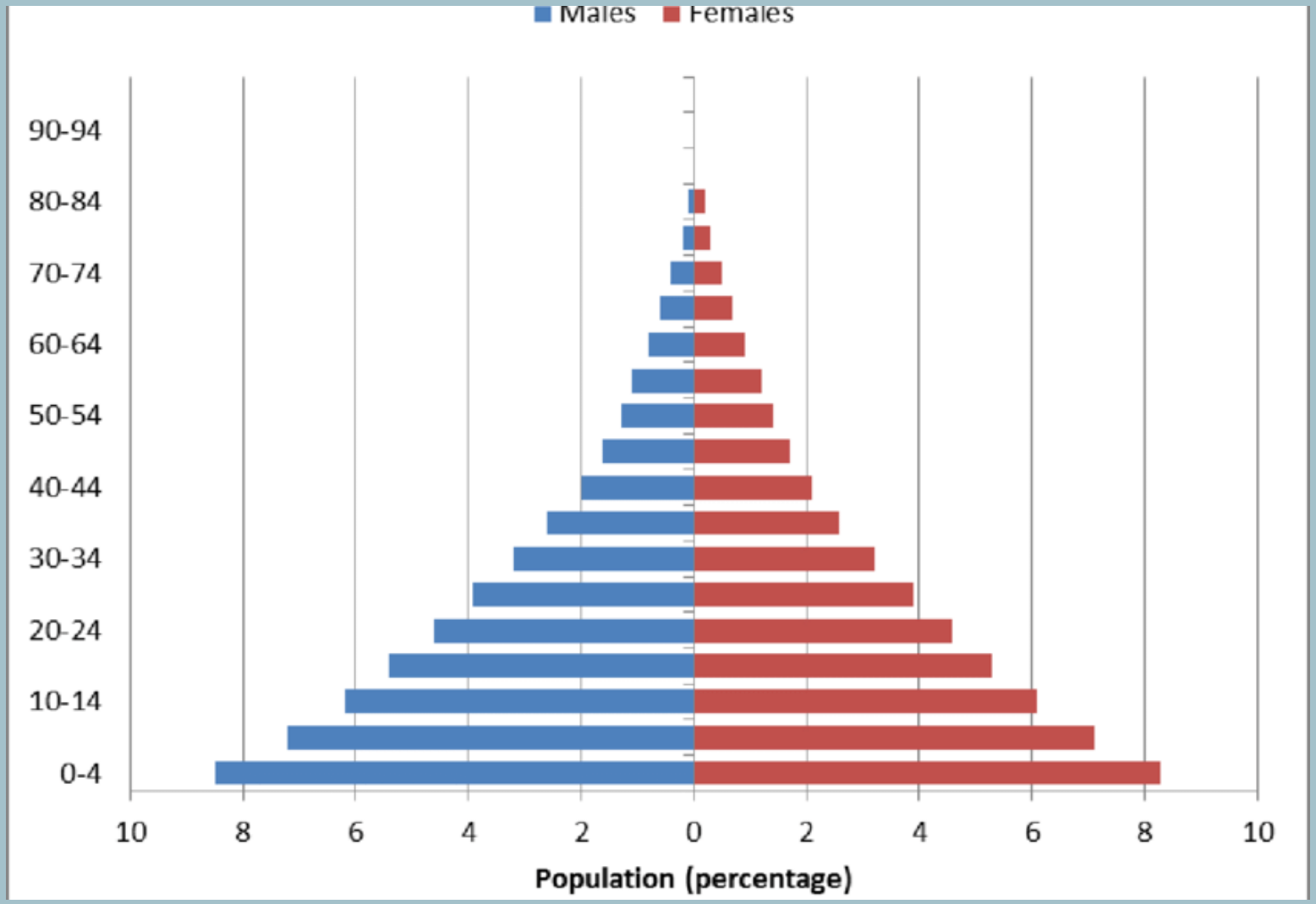
Population Pyramid

Population Pyramid

- This shows the age structure in a certain population

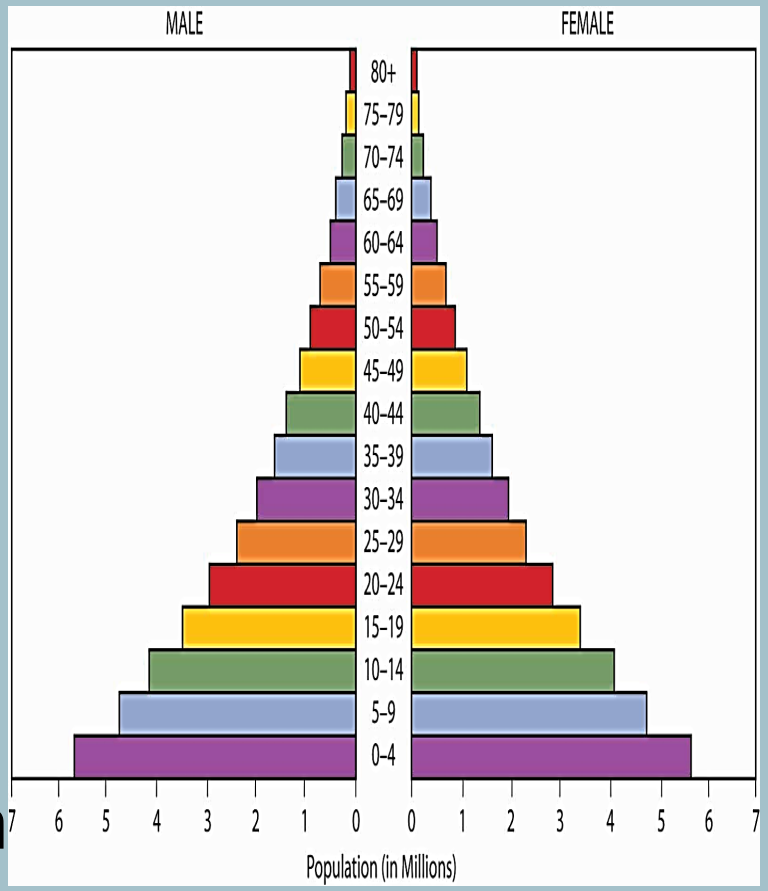
- By looking at the shape, you will be able to get an idea about:
  - Proportion age groups in a population
  - Male to female ratio

Example of population pyramid



Components of population pyramids

- **Base:** wide => high birth rate
  narrow => low birth rate
- **Apex:** old population (retired population) ….wide? narrow?
- **Height:** life span
- **Side:** change in population size due to death or migration

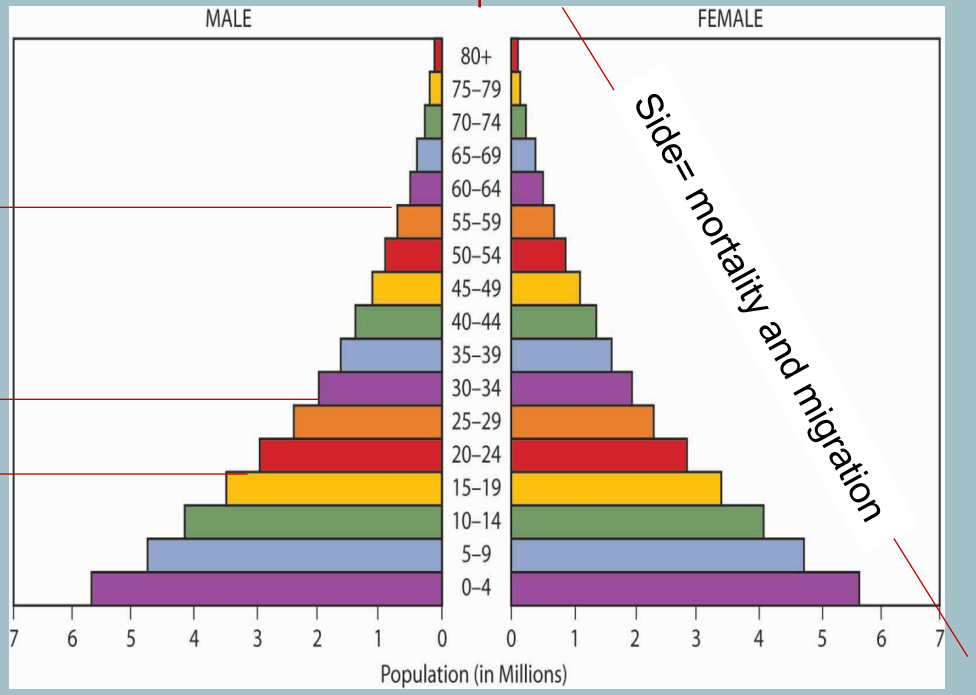


Important demarcating points

- ***Less than 15*** -Size of dependent youth < 15
  - -Large size in rapidly growing population
  - -Small size in slowly growing population
- ***60 + years*** -Represents the size of dependent old ≥ 60
  - -Large size in population with longer life span
  - -Small size in population with short life span
- ***Median age*** -Age that divide the population into two halves
  - -Small in population with high births
  - -Large in population with low births

Apex= People living to old age

People ≥ 60 years=
Old dependency



Side= mortality and migration

Height= life span

Median age

People < 15 years=
Young dependency

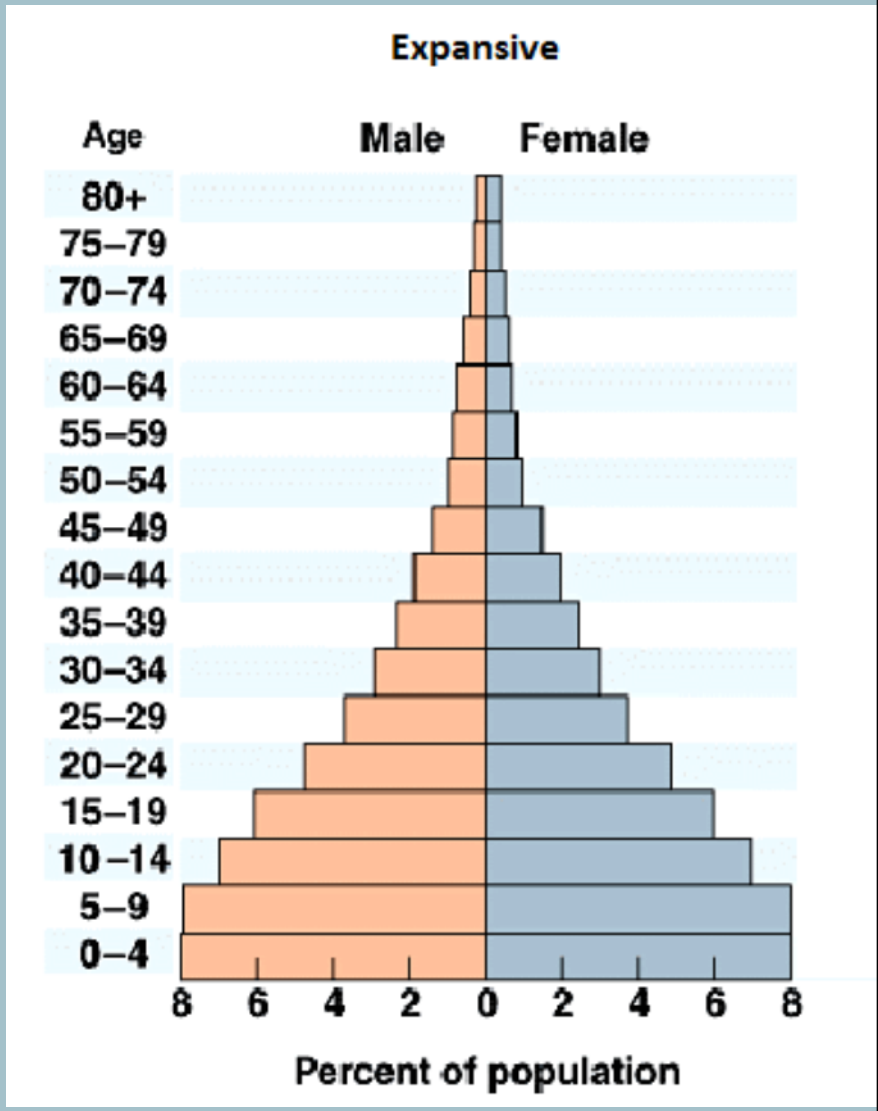
Base= births

Types of population pyramids

1. Expansive
2. Stationary
3. Constrictive

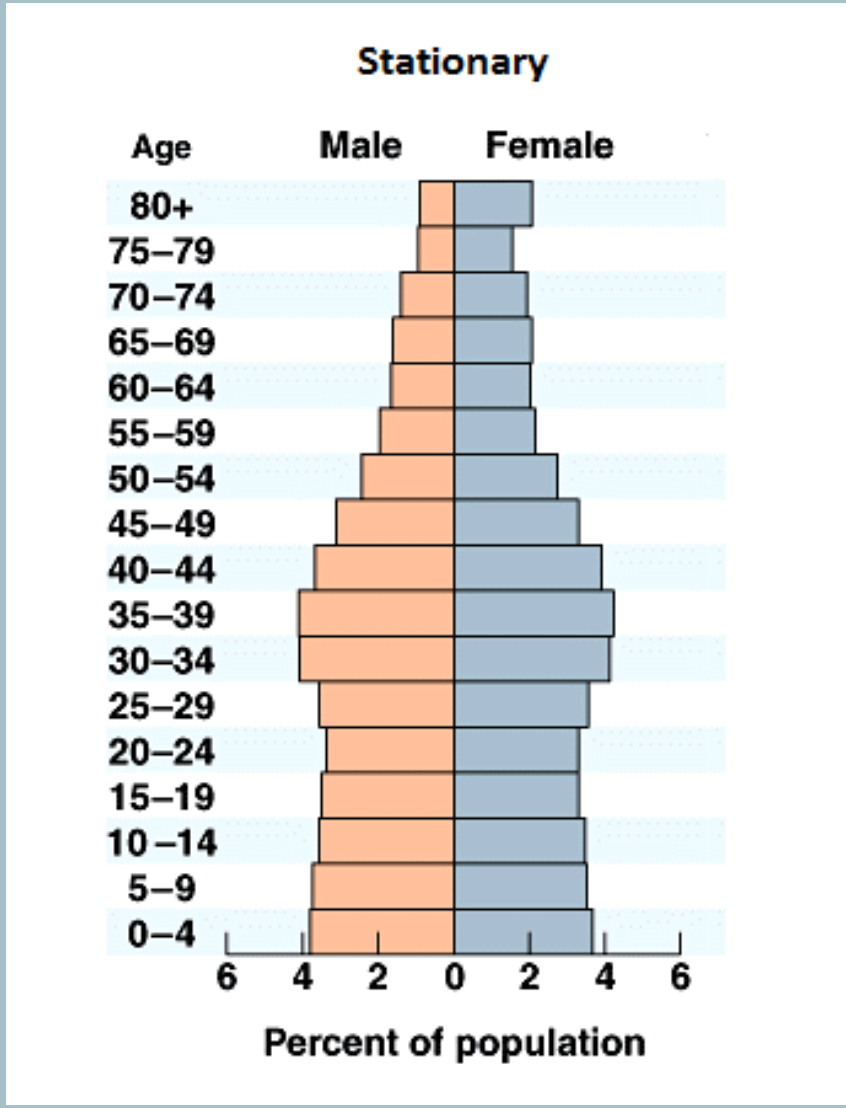
1- Expansive population pyramid

- Expansive or expanding pyramid usually presents itself in the form of triangular shape with concaved edges
- High population growth due to:
  - High birth rate
  - Shorter life expectancy
  - (high death rate)
- Usually associated with lower standard of living



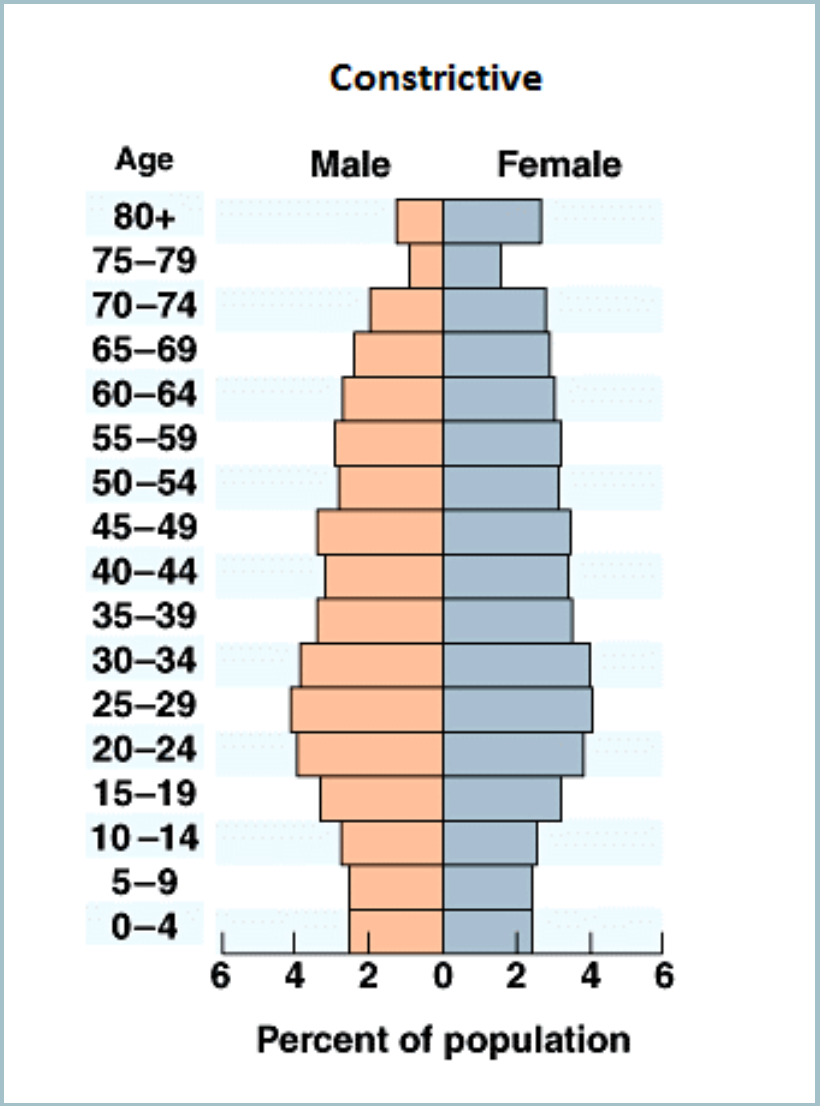
2-Stationary population pyramid

- It is showing unchanging pattern of fertility and mortality
- Age groups almost equal, but it is expected to see smaller figures at the oldest age groups



3-Constrictive population pyramid

- Narrow base
- Apex wider
- It is more common when immigrants are factored out
- Indicated:
  - High level of education
  - Use of birth control
  - Good health care system



Population pyramid in Saudi Arabia over the years

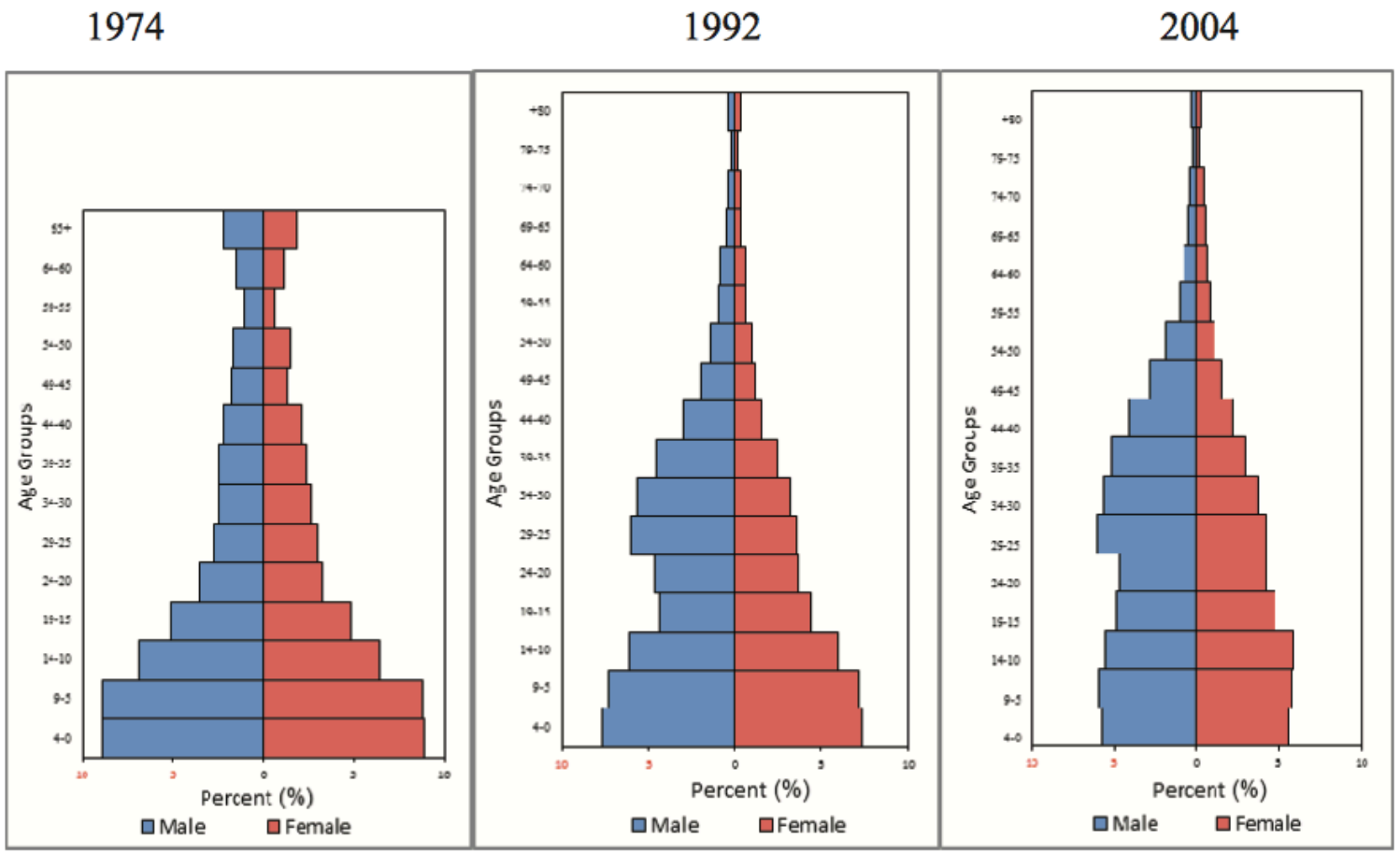


Figure 1. Age pyramid of total population.

Source: Abu Ashwan M, Abdul Salam A, Mouselhy MA. Population growth, structure and distribution in Saudi Arabia. Humanities and Social Sciences Review 2012; 1(4):33–46

Population pyramid in Saudi Arabia over the years

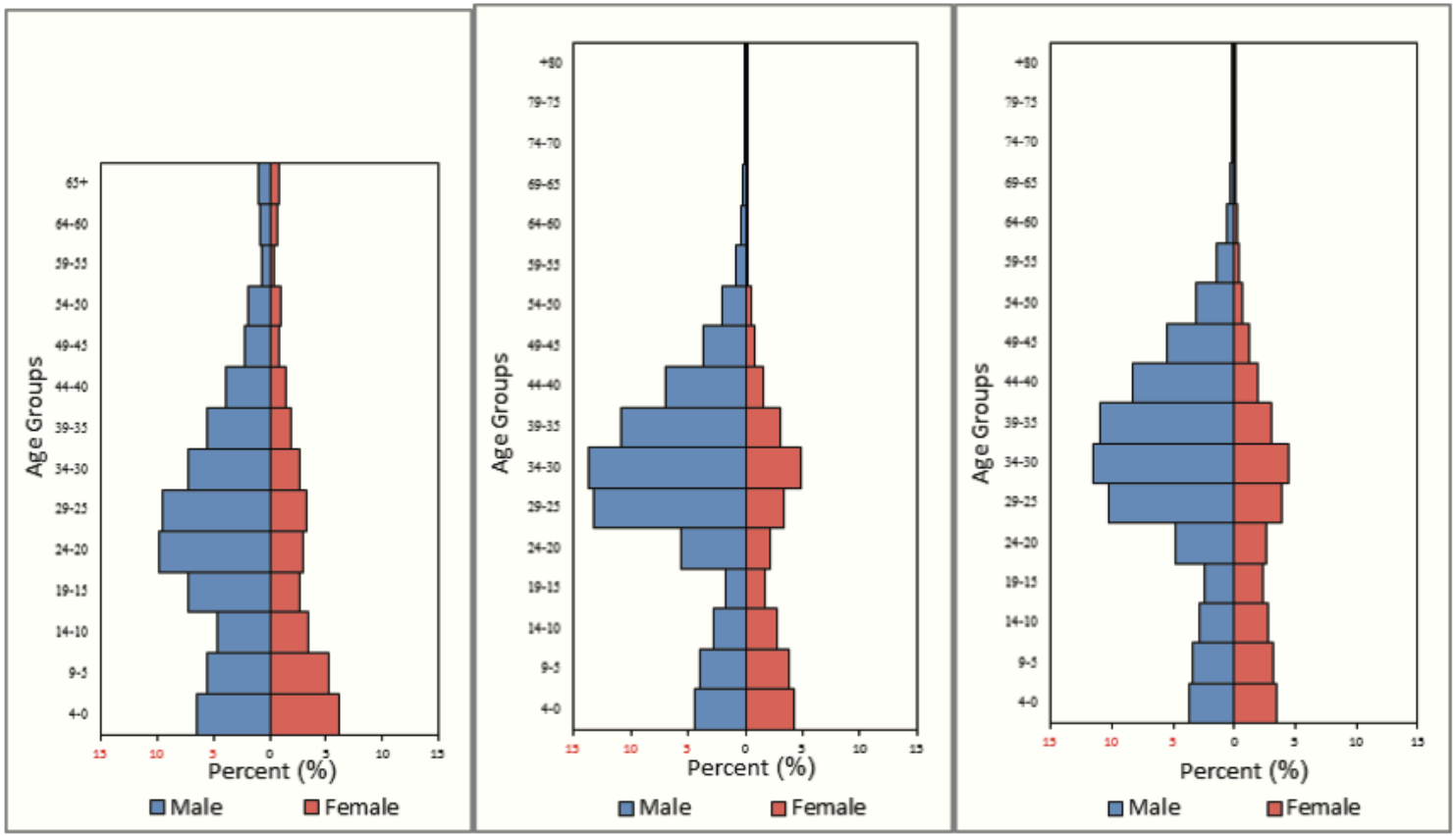
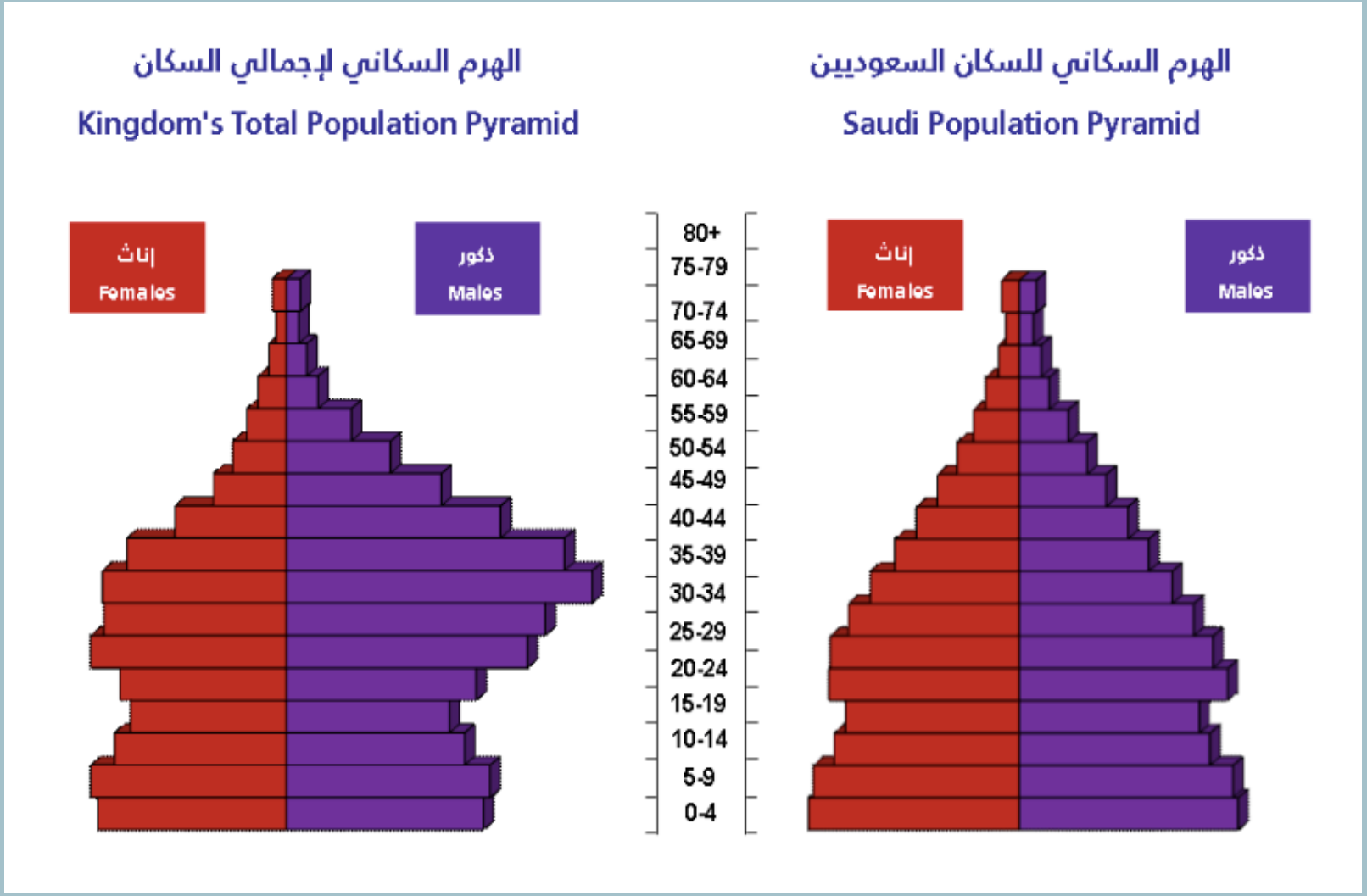


Figure 3. Age pyramid of expatriate population .

Source: Abu Ashwan M, Abdul Salam A, Mouselhy MA. Population growth, structure and distribution in Saudi Arabia. Humanities and Social Sciences Review 2012; 1(4):33–46

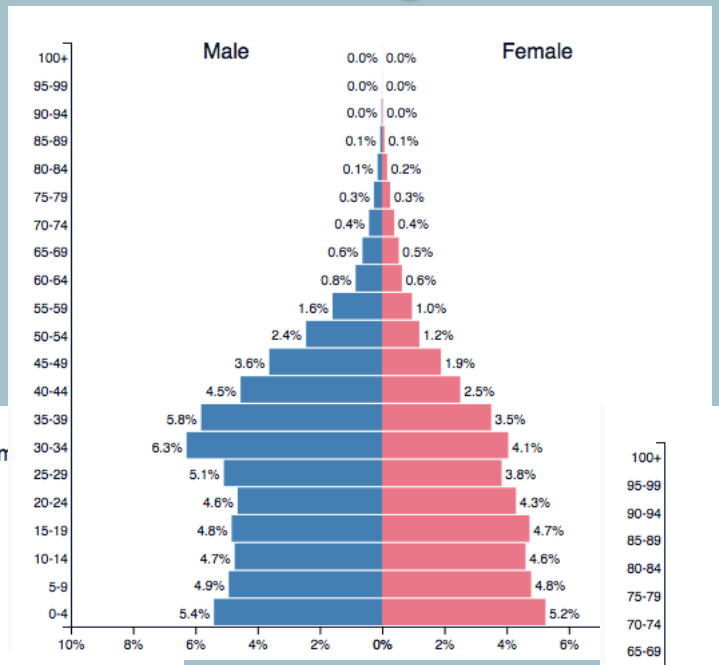
KSA population pyramid (2016)



Source: General Authority for Statistics, 2016 ***(based on 2010 data)***

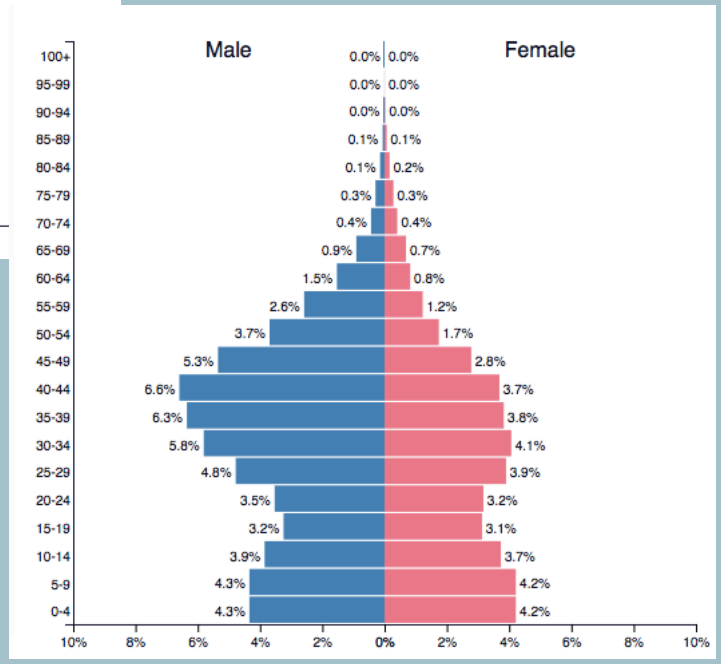
KSA Population Pyramid 20 years

2000



2010

2020



Source: https://www.populationpyramid.net/saudi-arabia/2020/

Other important population distribution measures

- Sex Ratio

What was the M:F ratio in KSA 2020?

Population Distribution KSA

Total Population in 2020: 35,013,414

Population by Age Groups ,and Gender

mid year 2020 — منتصف العام ٢٠٢٠

فئات العمر Age group	Total Population جملة السكان		
	MALE ذكور	FEMALE اناث	Total جملة
4 - 0	1,477,523	1,421,656	2,899,179
9 - 5	1,536,843	1,479,509	3,016,352
14 - 10	1,343,659	1,297,303	2,640,962
19 - 15	1,228,939	1,177,551	2,406,490
24 - 20	1,429,072	1,248,976	2,678,048
29 - 25	1,850,713	1,492,533	3,343,246
34 - 30	2,002,357	1,393,121	3,395,478
39 - 35	2,394,363	1,414,266	3,808,629
44 - 40	2,181,209	1,227,215	3,408,424
49 - 45	1,676,347	850,177	2,526,524
54 - 50	1,208,823	549,702	1,758,525
59 - 55	807,534	404,701	1,212,235
64 - 60	500,209	296,964	797,173
69 - 65	241,585	201,494	443,079
74 - 70	153,697	140,182	293,879
79 - 75	94,134	82,602	176,736
+ 80	104,418	104,037	208,455
Total جملة	20231425	14781989	35013414

* Preliminary estimates are in the middle of the year

* تقديرات أولية في منتصف العام

Source: https://www.stats.gov.sa/sites/default/files/Population%20by%20Age%20Groups%20%2Cand%20Gender_0.pdf

Other important population distribution measures

- Dependency ratio (x 100)

The proportion of persons above 65 years of age and children below 15 years of age are considered to be dependant on the economically productive age group (15-64 years)

- Total dependency ratio (x 100)

The ratio of the combined age groups 0-14 years plus 65 years and above to the 15-65 years age group is referred to as the total dependency ratio.

Population density

- Total population in a certain region divided by the surface area of that same region

Total population / surface area

جامعة الملك سعود
King Saud University
1957

References:

- Bongaarts J. Human population growth and the demographic transition. *Philos Trans R Soc Lond B Biol Sci*. 2009;364(1532):2985-2990. doi:10.1098/rstb.2009.0137
- Lee R. The outlook for population growth. *Science*. 2011;333(6042):569-573. doi:10.1126/science.1208859