DP IB Environmental Systems & Societies (ESS): SL

Your notes

Human Population Dynamics

Contents

Demographic Variables

- Demographic tools are essential for understanding and quantifying human population dynamics
  - They provide valuable insights into birth and death rates, fertility patterns, population growth rates, and other demographic indicators
- Below are some key demographic tools and how they are calculated:

Crude Birth Rate (CBR)

- The CBR is the number of live births per 1 000 individuals in a population during a specific time period
- It is calculated by dividing the total number of live births in a year by the total population and then multiplying by 1 000

$$CBR = \frac{\text{total number of live births per year}}{\text{total population}} \times 1\,000$$

Worked Example

A country has 25 000 live births in a year, and the total population is 500 000.

Calculate the crude birth rate.

Answer

CBR = (Number of live births / Total population) x 1 000
CBR = (25 000 / 500 000) x 1 000
CBR = 50 births per 1 000 individuals

Crude Death Rate (CDR)

- The CDR is the number of deaths per 1 000 individuals in a population during a specific time period
- It is calculated by dividing the total number of deaths in a year by the total population and then multiplying by 1 000

$$CDR = \frac{\text{total number of deaths per year}}{\text{total population}} \times 1\,000$$

Worked Example

In a given year, a country recorded 15 000 deaths, and the total population is 750 000.

Calculate the crude death rate.

Answer

CDR = (Number of deaths / Total population) x 1 000
CDR = (15 000 / 750 000) x 1 000
CDR = 20 deaths per 1 000 individuals

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Total Fertility Rate (TFR)

- The TFR is an estimate of the average number of children a woman would have during her reproductive years if she experienced the current age-specific fertility rates throughout her lifetime
- It is calculated by summing the age-specific fertility rates (ASFR) and multiplying the result by five

$$TFR = \Sigma ASFR \times 5$$

Worked Example

The age-specific fertility rates for a country are as follows:

Age 15–19: 20 births per 1 000 women
Age 20–24: 80 births per 1 000 women
Age 25–29: 120 births per 1 000 women
Age 30–34: 100 births per 1 000 women
Age 35–39: 40 births per 1 000 women
Age 40–44: 10 births per 1 000 women

Calculate the total fertility rate.

Answer

TFR = (20 + 80 + 120 + 100 + 40 + 10) x 5
TFR = 1 850 births per 1 000 women

Doubling Time (DT)

- The DT is the time it takes for a population to double in size based on its current growth rate
- It is calculated using the rule of 70, where the number 70 is divided by the population growth rate

$$DT = \frac{70}{\text{growth rate \%}}$$

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Worked Example

A population has a growth rate of 2% per year.

Calculate the doubling time.

Answer

DT = 70 / Growth rate
DT = 70 / 2
DT = 35 years

Natural Increase Rate (NIR)

- The NIR is the rate at which a population grows or declines due to the difference between the crude birth rate and the crude death rate
- It is calculated by subtracting the CDR from the CBR and then dividing the result by 10

$$\text{NIR} = \frac{\text{CBR} - \text{CDR}}{10}$$

Worked Example

A country has a CBR of 25 births per 1 000 individuals and a CDR of 10 deaths per 1 000 individuals.

Calculate the natural increase rate (annual growth rate).

Answer

NIR = (CBR - CDR) / 10
NIR = (25 - 10) / 10
NIR = 1.5%

- These demographic tools provide valuable quantitative measures to analyse and compare population trends across different regions and time periods
- They assist policymakers, researchers, and demographers in understanding population dynamics, projecting future growth, and formulating effective strategies for social and economic development

Human Population Growth Curve

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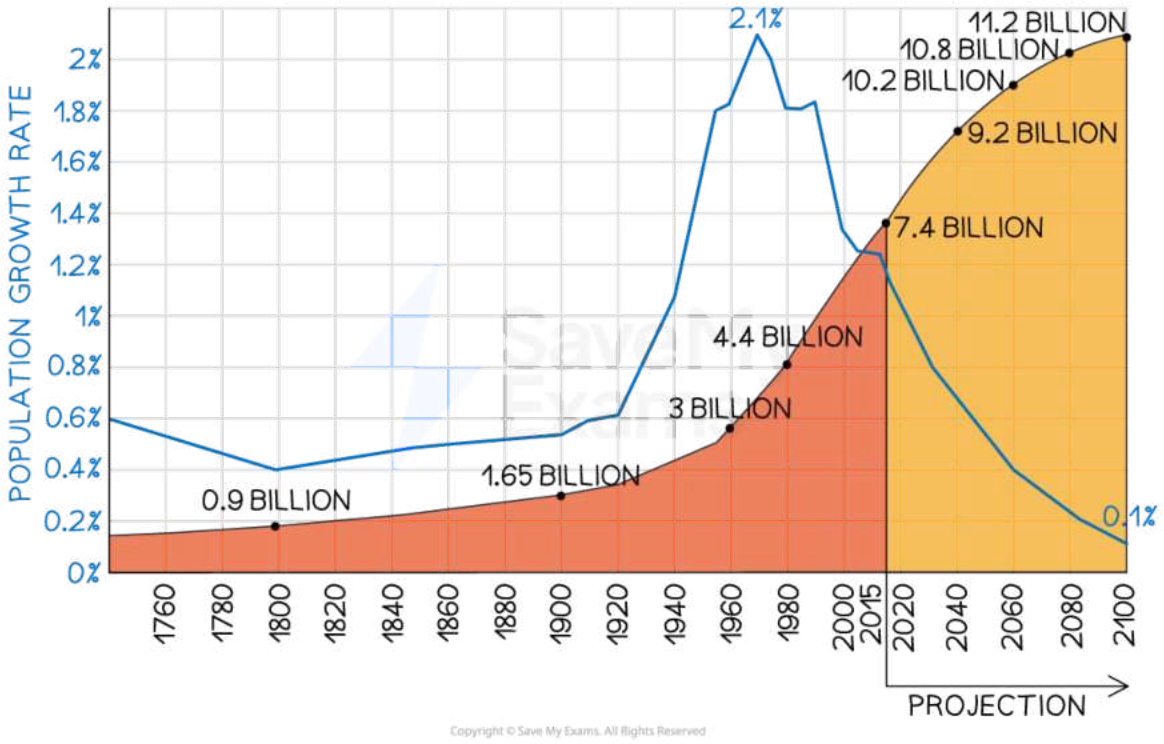
Human Population Growth Curve

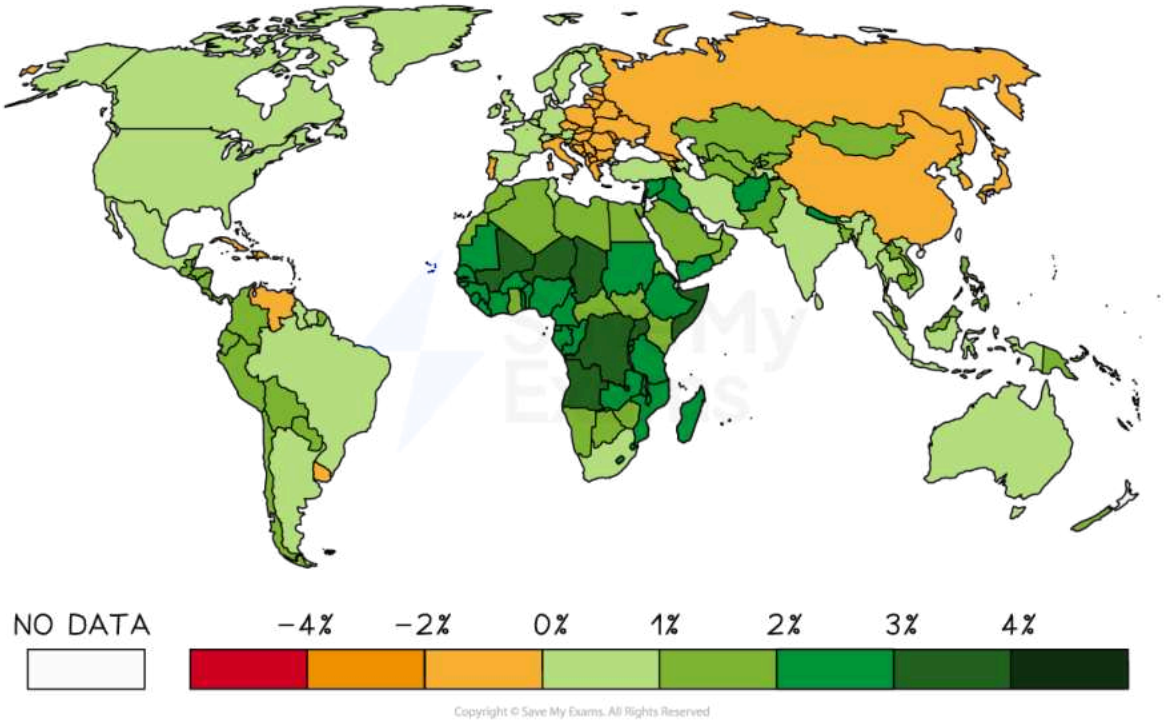
- Population change rates vary with **time**
- The global human population grew very **slowly** until 18th century
  - From 10,000 BCE to 1700 CE the average growth rate was just 0.04% per year
- There has been **exponential** growth in the global human population since the mid 18th century
  - The global human population reached **8 billion** in November 2022
- Despite the **growth rate falling**, the world population is projected to continue to grow until approximately 2100 when it could reach more than 11 billion



World population total and growth rate, 1750–2015 (with projections until 2100)

- Population change rates also vary over **space**

- Countries that went through **Industrial Revolutions** in the 18th and 19th centuries experienced **rapid** population **growth**
  - Today those countries are **developed** and their growth rates have **fallen**
  - In some cases, they have fallen so much that their total populations are in **decline** (e.g. Japan)
- The fastest population **growth** today occurs in **developing** countries that are rapidly **industrialising**



Global pattern of population growth rate (2021)

Increased Stress on Earth Systems

- As the human population grows, there is an **increased demand** for natural resources such as food, water, and energy, putting stress on ecosystems and depleting these resources
- The **expansion** of **urban areas** and **infrastructure** to accommodate the growing population leads to **habitat destruction** and **fragmentation**, affecting biodiversity and ecosystem functioning
- Increased consumption patterns and production of goods result in **higher levels of waste generation** and **pollution**, further straining environmental systems and contributing to climate change

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- Growing population density in certain regions leads to increased pressure on land and can lead to issues such as deforestation, soil degradation, and loss of agricultural productivity
- The demand for freshwater increases with population growth, leading to **overexploitation of water sources**, depletion of aquifers, and potential water scarcity in some regions
- The increase in human activities, such as industrialisation and transportation, contributes to air and water pollution, greenhouse gas emissions, and overall environmental degradation
- The need for more housing, infrastructure, and agricultural land often leads to encroachment on natural habitats, resulting in the displacement and extinction of wildlife species
- The **cumulative impact** of human population growth on Earth's systems has implications for the long-term sustainability of resources, the resilience of ecosystems, and the overall health and well-being of both humans and the planet


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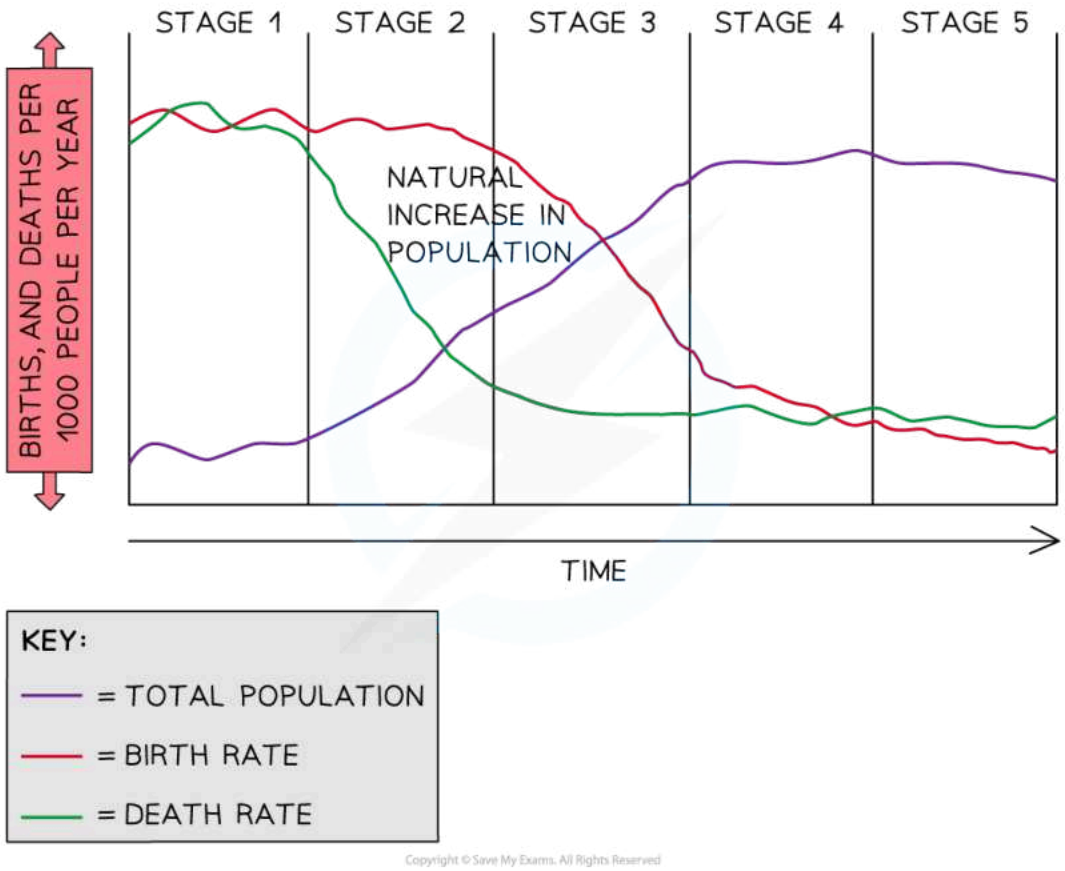
Human Population Models

- Age-gender pyramids and demographic transition models (DTM) can be useful in the prediction of human population growth

Demographic Transition Model

- The DTM is a model that shows how a population transitions from a pre-industrial stage with high crude birth rates and high crude death rates to an economically advanced stage with low or declining crude birth rates and low crude death rates
  - The demographic transition model illustrates five generalised stages that countries pass through as they develop
  - It shows how the birth and death rates change and how this affects the overall population as the country



The Demographic Transition Model

Stage 1

- The total population is low
- High birth rates due to lack of contraception/family planning
- High death rates due to poor healthcare, poor diet and famine
- High infant mortality which leads people to have more children so that some children survive to adulthood

Stage 2

- The total population starts to rise rapidly
- Birth rates remain high as people continue to have large families

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- Death rates decrease as a result of improved diets, better healthcare, lower infant mortality and increased access to clean water

Stage 3

- The total population continues to increase but the rate of growth begins to slow
- Birth rate begins to fall rapidly due to increased birth control, family planning, increased cost of raising children and low infant mortality rate
- Death rate still decreasing but at a slower rate as improvements in medicine, hygiene, diet and water quality continue

Stage 4

- The total population is high and is increasing slowly
- Birth rate is low and fluctuating due to accessible birth control and the choice of having fewer children as well as delaying the age women start to have children
- Death rate is low and fluctuating

Stage 5

- The total population starts to slowly decline as the death rate exceeds the birth rate
- Birth rate is low and slowly decreasing
- Death rate is low and fluctuating

Population Pyramids

- A population pyramid (also known as an age-gender pyramid) is a graphical representation of a population's age and gender structure
  - It displays the percentage or number of individuals in each age group and gender within a given population, typically a country or region
- The population pyramid is usually represented as a horizontal bar graph, with the age groups displayed along the vertical axis, and the percentage or number of individuals in each age group displayed along the horizontal axis
  - The left side of the graph displays the male population, while the right side shows the female population
- The shape of the population pyramid can provide insights into the demographic characteristics of a population
  - For instance, a pyramid with a broad base and a narrow top indicates a young population with high fertility rates and low life expectancy, while a pyramid with a narrow base and a broad top indicates an aging population with low fertility rates and high life expectancy


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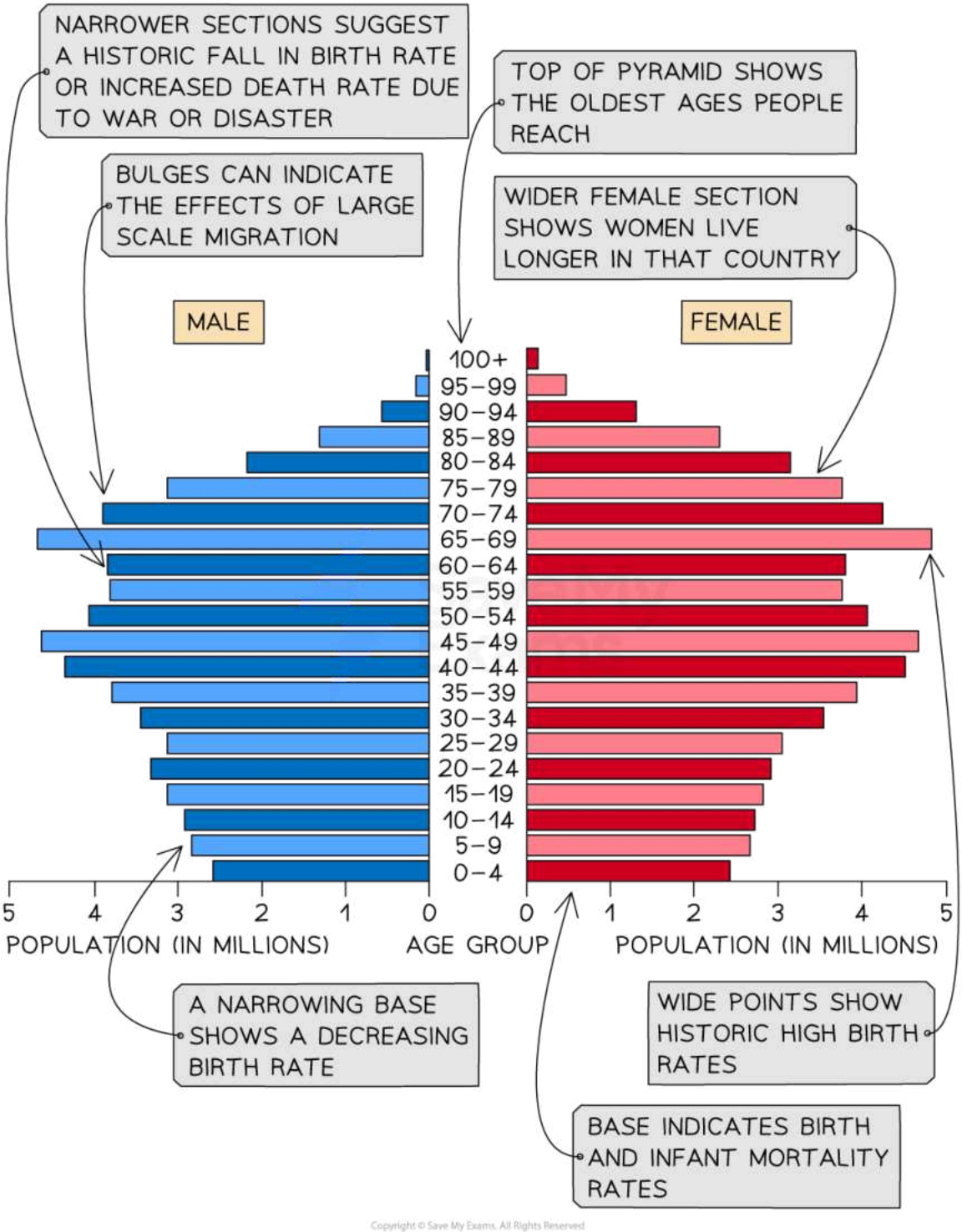

An example of a population pyramid

- Population pyramids are widely used by demographers, economists, and policymakers to understand population trends, forecast future population growth, and plan for social and economic policies
- They are also used in fields such as public health, education, and social welfare to plan for the needs of specific age groups within a population
  - This means that governments can estimate and plan for spending
- As countries develop and pass through the stages of demographic transition the shape of the population pyramid changes
- The population pyramid can be used to identify the following groups:
  - Young dependents
  - Old dependents
  - Economically active (working population)
  - Dependency ratio

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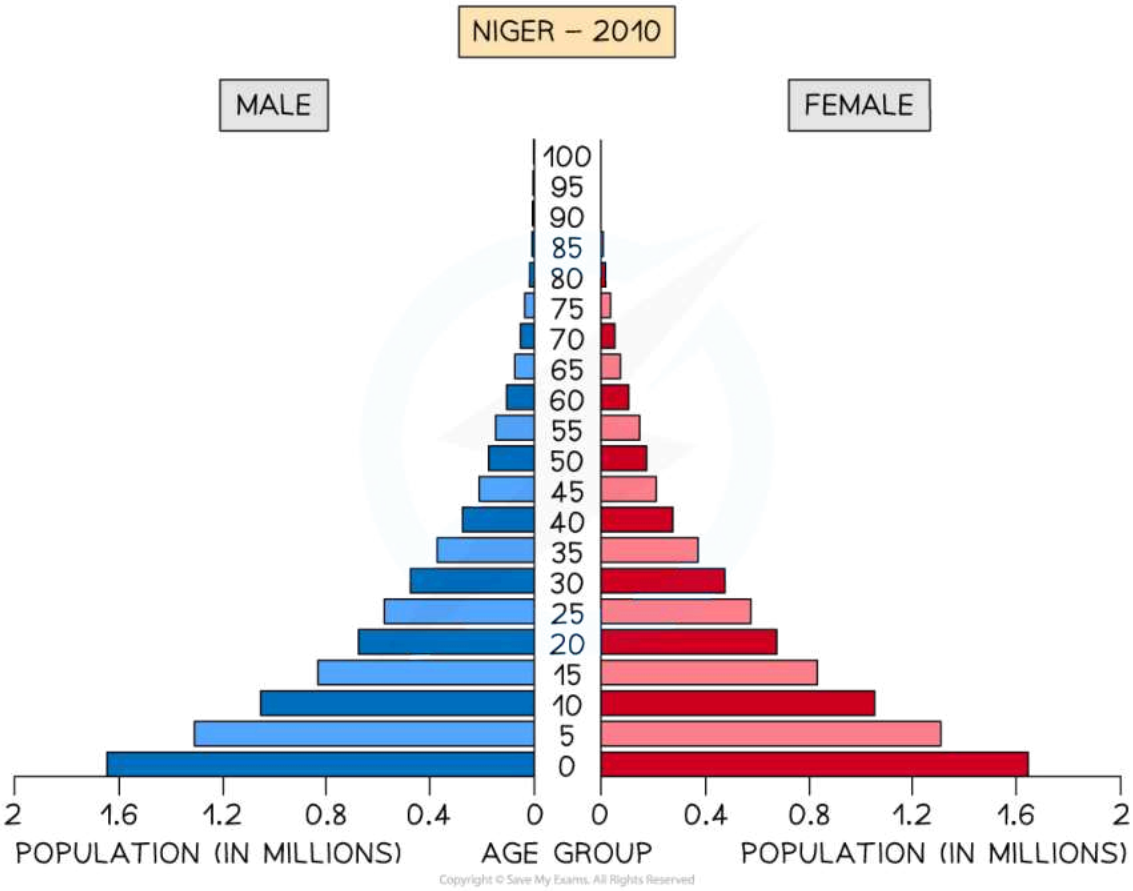

Population pyramid for Niger

- LEDCs like Niger typically have a concave pyramid shape
- At the start of stage 2 of the demographic transition model
- This indicates:
  - High birth rate
  - Low life expectancy
  - High death rate but starting to decrease
  - High infant mortality rate
  - Young dependent population dominates

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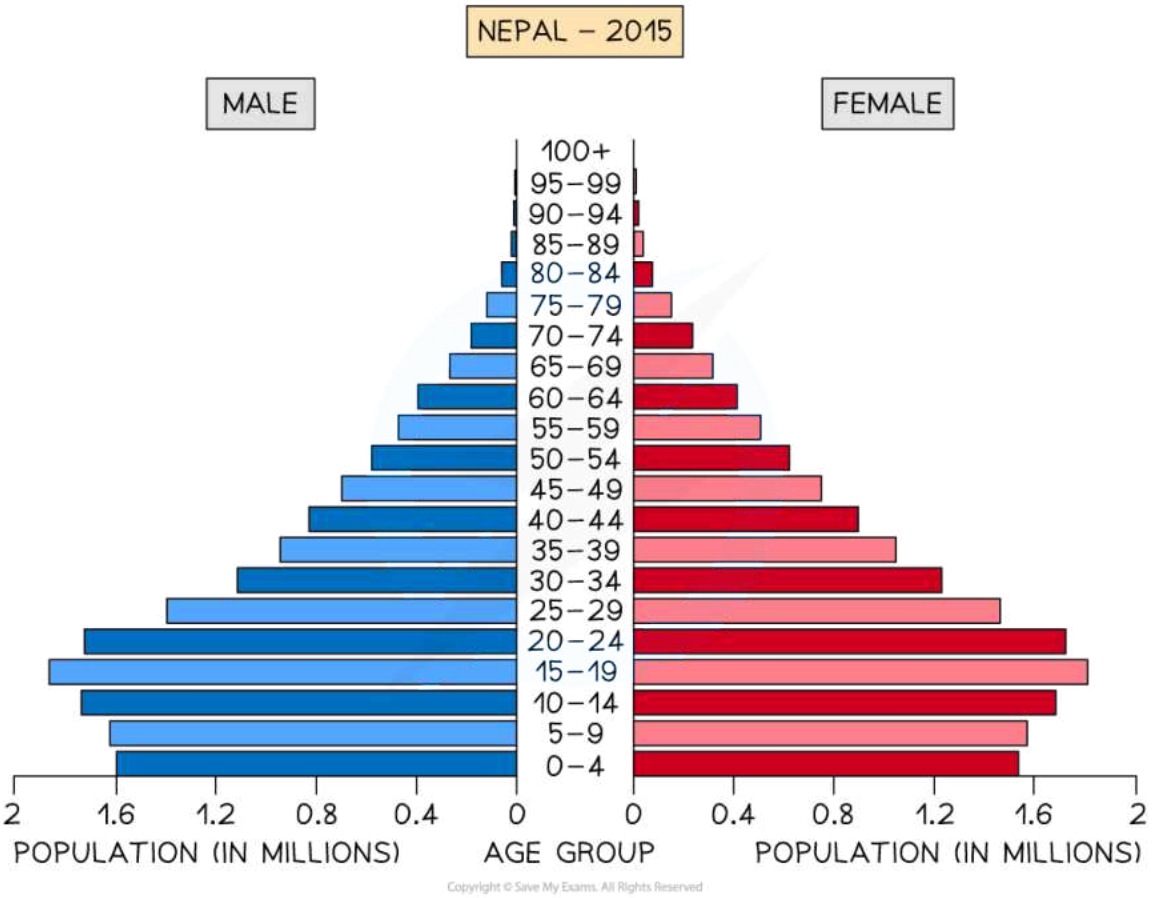

Population pyramid for Nepal

- LEDCs/NICs (newly industrialised countries) that are a little further along the demographic transition, such as Nepal, typically have a pyramid shape
- Stage 3 of the demographic transition model
- This indicates:
  - Decreasing birth rate
  - Increasing life expectancy
  - Decreasing death rate
  - Decreasing infant mortality
  - Larger working age population

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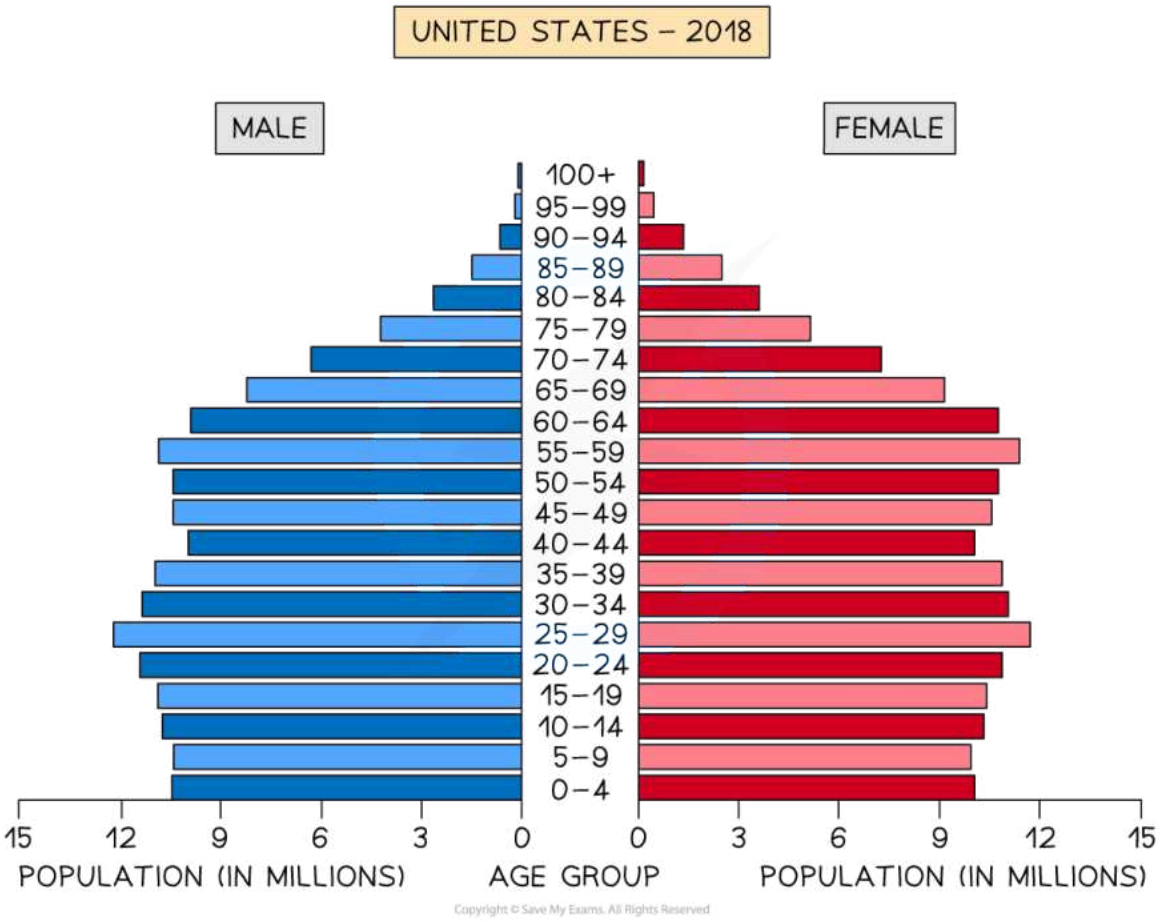

Population pyramid for USA

- HICs (high income countries) such as the USA typically have a column shape
- Stage 4 of the demographic transition model
- This indicates:
  - Decreasing birth rate
  - Increasing life expectancy
  - Decreasing death rate
  - Low infant mortality
  - Larger working age population

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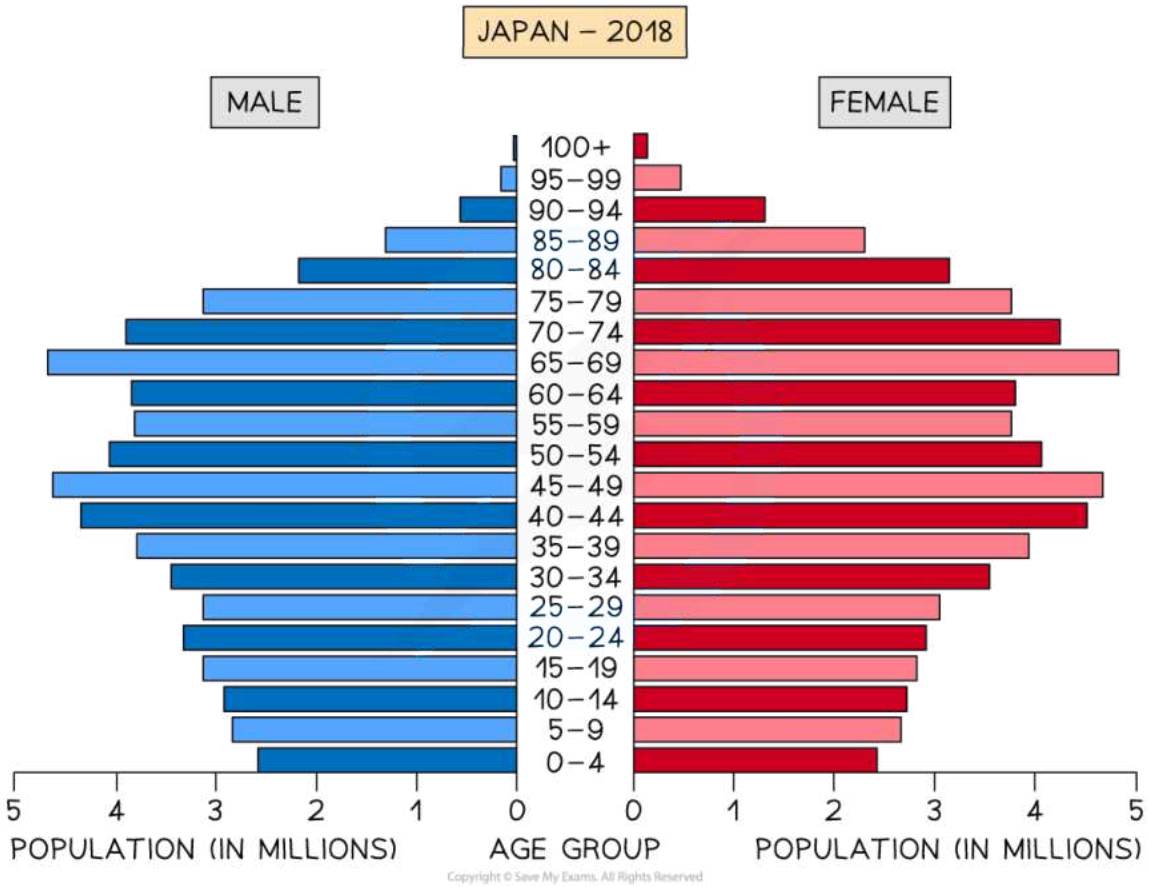

Population pyramid for Japan

- HICs such as Japan then start to develop a pentagon shape with a narrowing base
- Stage 5 of the demographic transition model
- This indicates:
  - Decreasing birth rate
  - Increasing life expectancy
  - Death rate is higher than the birth rate due to the ageing population
  - Low infant mortality
  - Ageing population - older dependent population

Implications of population structure

- Population pyramids mean that population issues can be identified
- There are range of issues including:
  - Ageing populations
  - Falling birth rates
  - Impacts of migration


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Ageing Populations

- Many HICs are experiencing ageing populations and an increase in the older dependent population
- The implications of this include:
  - Increased number of pension payments
  - Increased need for care homes
  - Increased pressure on the healthcare service and social care
- It also results in fewer workers which means:
  - Governments are not able to collect as much tax
  - Some areas suffer worker shortages

Falling birth rates

- Countries experiencing falling birth rates include many HICs and MICs (middle income countries)
- The implications of this include:
  - School closures due to fewer children
  - Future workforce shortages

Migration

- In some countries migration can lead to an imbalance in the population structure
- The UAE has significantly more males than females
- 29% of the population are males between the ages of 25 and 39 whereas only 10.5% of the population are women 25–39
- This is the result of the migration of males to the UAE to work in the oil, gas and construction industries
- Rapid population growth in some areas as a result of migration can lead to:
  - Increased pressure on services such as healthcare and schools

- A shortage of housing
- Increased traffic congestion
- Increased water and air pollution
- Shortage of food
- Lack of clean water

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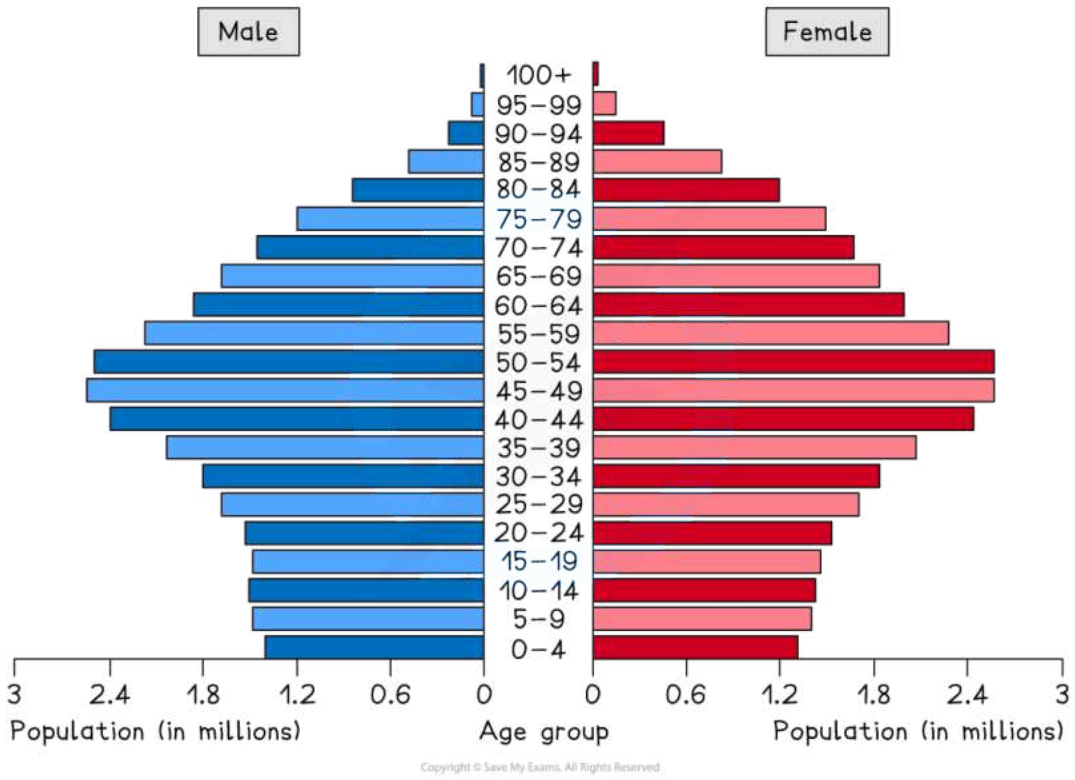
Worked Example

A population pyramid is shown below.

What does the shape of the pyramid tell you about the population structure of the country?



Answer

- The narrow base means a low birth rate
- A low birth rate means a low number of young dependents

- A reasonably broad top means high life expectancy
- The majority of the population is between 40 and 60
- This means there will be a large number of elderly dependents in the future

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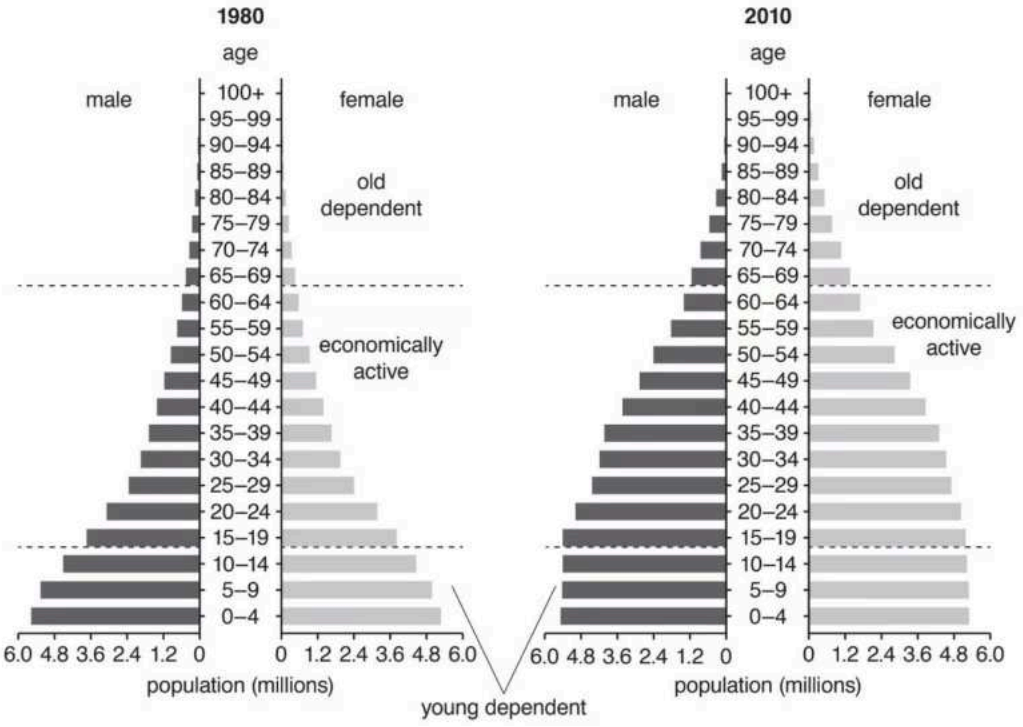
Worked Example

The figure below shows population pyramids for Mexico in 1980 and 2010.

Describe the changes in Mexico's population structure between 1980 and 2010.



Answer

- In 2010 there are:
  - More economically active / working / 15–64 year-olds
  - More elderly / old dependents / 65+ year-olds
  - More young dependents in total / bands up to 19 become more even

Examiner Tips and Tricks

Remember - when interpreting a population pyramid you need to look at four key areas:

- Younger population - is the birth rate high or low?
- Working population - are there enough people of working age to support the young and old dependents?
- Elderly population - is it large or small? (if it is large, then life expectancy is high)
- Male/female split - are there any noticeable differences between the numbers of males and females?

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Factors Affecting Population Dynamics

- Human population dynamics are influenced by a multitude of **interconnected** factors, ranging from cultural and historical aspects, to religious, social, political, and economic forces
- These factors shape population growth, fertility rates, migration patterns, and demographic transitions
- Understanding these influences is crucial for comprehending the complexities of population dynamics

Factors Affecting Population Dynamics

Factor	Description	Examples
Cultural	Cultural beliefs, values, traditions, and practices that shape individuals' perceptions of family size, gender roles, and reproduction	▪ **Pronatalist** cultural norms in certain societies, where having more children is seen as desirable for societal, religious, or economic reasons ▪ Cultural practices promoting large families in some regions, such as in some **rural areas** where children are considered an asset for **labour**
Historical	Past events, historical trends, and experiences that influence population dynamics, including wars, epidemics, and demographic transitions	▪ Population growth after the Industrial Revolution due to improved living conditions and advances in healthcare and technology ▪ Population decline due to the Black Death in the Middle Ages, leading to a significant decrease in population size in Europe
Religious	Beliefs, teachings, and doctrines of religions that shape attitudes towards fertility, contraception, and family planning	▪ Catholicism's opposition to contraceptive methods and promotion of natural family planning methods ▪ Some Islamic teachings promoting large families as a means of fulfilling religious and societal responsibilities

Social	Social norms, gender equality, women's empowerment, and social institutions that influence reproductive decisions	▪ Women's access to education and employment opportunities, enabling them to make informed choices about family planning ▪ **Social pressure** for early marriage and childbearing in certain communities, which can lead to higher fertility rates
Political	Government policies, laws, and regulations that impact population dynamics, such as family planning programs and immigration policies	▪ **One-child policy** in China, which limited families to having only one child to control population growth ▪ Government **subsidies** for large families in some countries, providing **financial incentives** to encourage higher fertility rates
Economic	Socioeconomic conditions, poverty, income inequality, and economic opportunities that influence reproductive decisions and a country's ability to take care of the elderly population	▪ High levels of poverty leading to higher fertility rates due to a lack of access to contraceptives and limited education ▪ Economic development and urbanisation leading to lower fertility rates as women **prioritise education** and **careers** over childbearing

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National and International Development Policies

- National and international development policies play a crucial role in shaping human population dynamics
  - These policies can have direct and indirect impacts on fertility rates, mortality rates, migration patterns, and overall population growth
- Development policies encompass a wide range of areas, including education, healthcare, infrastructure, economic growth, and social welfare
  - Understanding the relationship between development policies and population dynamics is essential for implementing effective strategies for sustainable population management

Education Policies

- Access to **quality education**, particularly for girls and women, is associated with lower fertility rates and improved reproductive health practices
- Education empowers individuals with knowledge about **family planning**, reproductive health, and the benefits of smaller family sizes
- Education also enhances opportunities for **employment**, leading to delayed marriages and childbearing


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Healthcare Policies

- Effective healthcare policies, including access to reproductive healthcare services, family planning, and maternal healthcare, contribute to better health outcomes for **vulnerable age groups** (very young and very old) and **reduced fertility rates**
- Adequate healthcare infrastructure and services, including access to contraceptives and prenatal care, can help individuals make informed decisions regarding family size

Economic Policies

- Economic development policies aimed at poverty reduction and promoting sustainable livelihoods can have indirect impacts on population dynamics
- Reductions in poverty levels are often associated with lower fertility rates, as individuals have better access to education, healthcare, and family planning services
- Economic policies that encourage **job creation** and **income equality** can influence population growth by improving living standards and reducing the need for large family sizes

Social Welfare Policies

- Social welfare programs, such as childcare support, parental leave, and elderly care, can have indirect effects on population dynamics
- These policies can alleviate the burden of child-rearing and support individuals in **making choices** regarding family size and timing

Migration Policies

- National and international migration policies influence population dynamics by determining the flow of individuals across regions and countries
- Migration policies can impact population size and structure, cultural diversity, and the distribution of resources and services
- For example, as a response to the Syrian civil war and other conflicts, Germany implemented an open-door policy, welcoming a large number of **refugees** - this resulted in a significant **increase in the**

population size, with the arrival of individuals and families from various countries seeking asylum and a new life in Germany


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Environmental Policies

- Environmental policies aimed at sustainable resource management, conservation, and mitigating climate change can **indirectly influence** population dynamics
- For example, policies that promote green industries, renewable energy, and sustainable agriculture can contribute to job creation and improved living conditions, which may influence decisions regarding family size and migration patterns
- By ensuring the availability of resources, protecting ecosystems, and mitigating environmental degradation, these policies contribute to a sustainable living environment for present and future generations