Practical class 3

Demography indices

The physician and birth and death registration

Conspectus topics (7–12)

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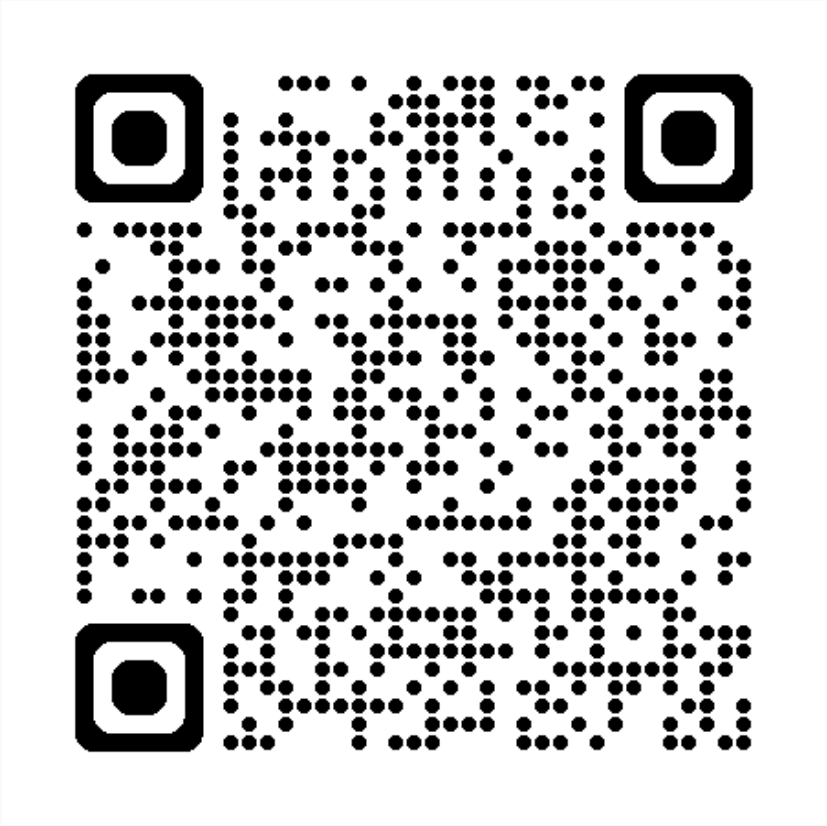
Academic Year 2025/2026

Department of “Social Medicine and Public Health”

download the presentation from https://tinyurl.com/social-med-class-03

15-minutes reading assignment



https://kostadinoff.github.io/learning.html

Group tasks

https://kostadinoff.github.io/tasks.html

Outline

1. Demography — definition and history
2. Demographic transition model
3. Demographic statics
4. Demographic dynamics
5. Natural events — natality
6. Birth registration
7. Natality indicators
8. Mortality — definitions and certification
9. Death registration
10. Mortality indicators
11. Infant mortality indicators
12. Demographic policy

Demography — definition and history

Demography — definition and history (7)

- The word **demography** derives from the Greek δῆμος (*demos*, people) and γράφειν (*graphein*, to write).
- Demography is the science concerned with the analysis of the size, distribution, structure, characteristics, and dynamic processes of human populations.
- It is an **interdisciplinary field** with strong roots in sociology and important connections with economics, statistics, geography, human ecology, biology, medicine, and human genetics.

Demography — three domains (7)

Demography examines three interrelated dimensions:

1. Demographic statics — the size and composition (distribution) of populations at a given moment (31.12.XX). Distributional variables - *age, sex, ethnicity, civil status, education, spatial distribution*.
2. Demographic dynamics — life-course processes that alter this composition: births, deaths, unions (marriage, divorce), migration.
3. Relationships between population composition and change, and the broader social and physical environment in which they occur.

Demography — historical foundations (7)

- The first known census dates to Babylon, ca. 3800 BC. Systematic enumeration in England began in 1086.
- Formal demographic inquiry emerged in early sixteenth-century London through parish-compiled Bills of Mortality — initially a response to plague, later encompassing births, deaths, and marriages.
- **John Graunt** (1620–1674) is recognised as the founder of demography. His 1662 *Natural and Political Observations Made upon the Bills of Mortality* established the analytical foundations of the discipline.

John Graunt

A.

Captain John Graunt

B. *Natural* and *Political*

OBSERVATIONS

Mentioned in a following INDEX,

and made upon the

Bills of Mortality.

BY

Capt. *JOHN GRAUNT*,

Fellow of the *Royal Society*.

With reference to the *Government*, *Religion*, *Trade*, *Growth*, *Air*, *Diseases*, and the several Changes of the said CITY.

——*Non me ut miretur Turba, labores,*
Contentus paucis Lectoribus.——

The Fifth Edition, much Enlarged.

LONDON,

Printed by *John Martyn*, Printer to the *Royal Society*, at the Sign of the Bell in St. *Paul's* Church-yard. MDCLXXVI.

Soc. Reg. Lond.

C

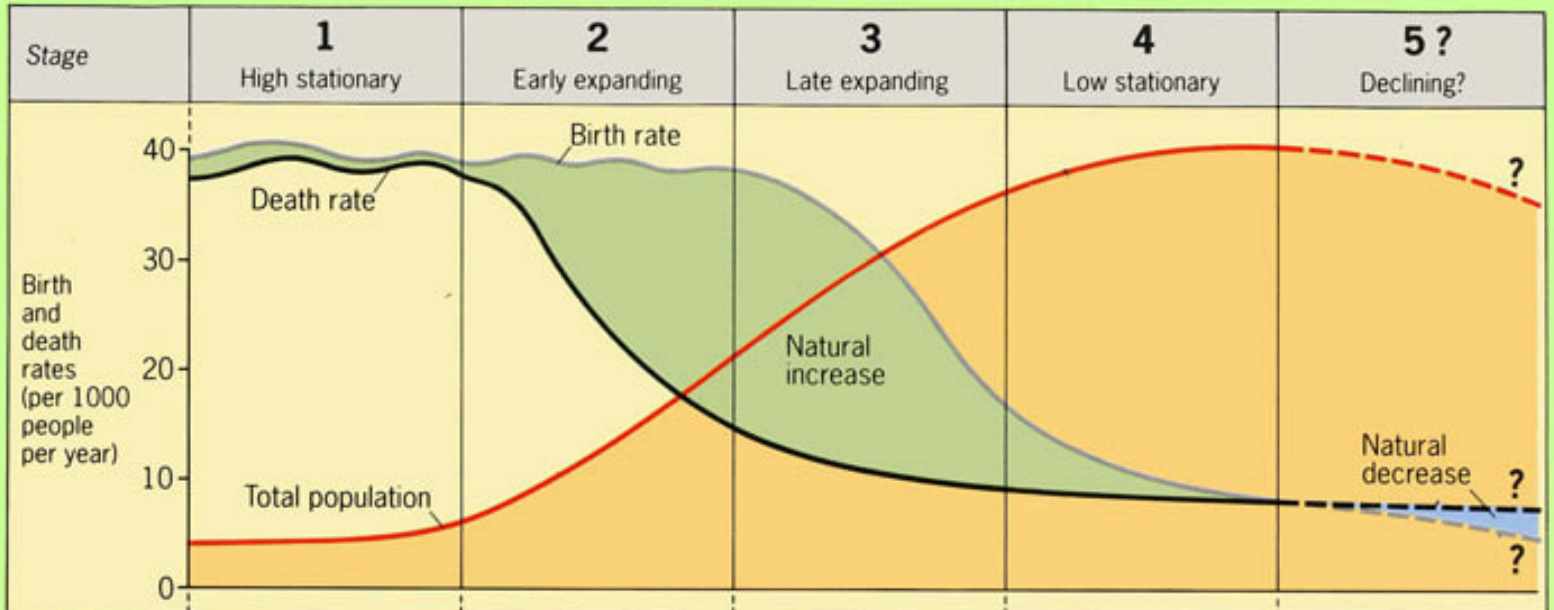
The Table of CASUALTIES.

Demographic transition model

Demographic transition model (7)

- The **Demographic Transition Model (DTM)** was formulated by American demographer **Warren Thompson** in 1929 and further developed by **Frank Notestein** (1945).
- The DTM describes the historical shift from high birth and death rates to low birth and death rates as societies move from pre-industrial to industrialised economic systems.
- The model comprises **five stages**, each characterised by a distinct combination of fertility, mortality, and population growth.

Demographic transition model



Stage	1 High stationary	2 Early expanding	3 Late expanding	4 Low stationary	5? Declining?
Examples	A few remote groups	Egypt, Kenya, India	Brazil	USA, Japan France, UK	Germany
Birth rate	High	High	Falling	Low	Very low
Death rate	High	Falls rapidly	Falls more slowly	Low	Low
Natural increase	Stable or slow increase	Very rapid increase	Increase slows down	Stable or slow increase	Slow decrease
Reasons for changes in birth rate	Many children needed for farming. Many children die at an early age. Religious/social encouragement. No family planning.		Improved medical care and diet. Fewer children needed.	Family planning. Good health. Improving status of women. Later marriages.	
Reasons for changes in death rate	Disease, famine. Poor medical knowledge so many children die.	Improvements in medical care, water supply and sanitation. Fewer children die.		Good health care. Reliable food supply.	

Demographic transition model — five stages (7)

Stage	Birth rate	Death rate	Growth
1 — Pre-transition	High	High	Stable/low
2 — Mortality decline	High	Falling	Rapid ↑
3 — Fertility decline	Falling	Low	Moderate ↑
4 — Equilibrium	Low	Low	Stable
5 — Below-replacement	Very low	Low	Decline

Demographic statics

Population size (7)

- As of 31 December 2024, the population of Bulgaria is 6 437 360, representing 1.4% of the EU total.
- Population density: 58.1 persons per km².
- Data are collected by the **National Statistical Institute (NSI)** on the basis of the population and housing census, the population register, and the register of civil status acts.

Demographic (balance) equation:

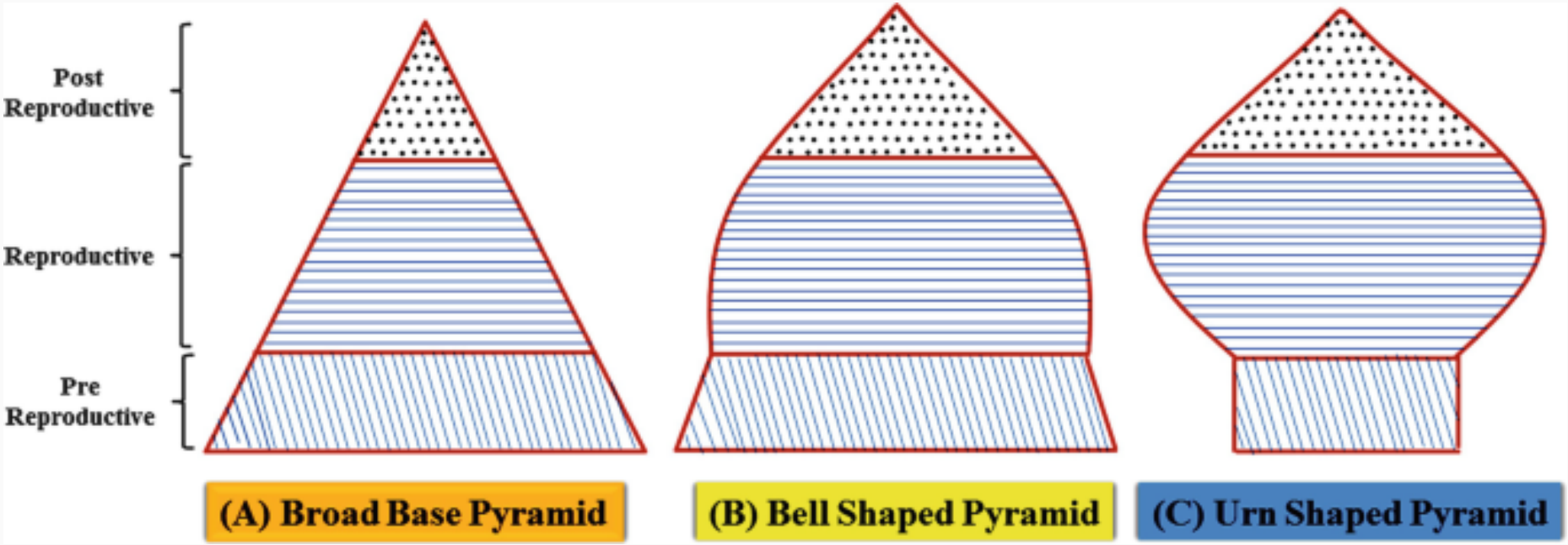
$$P_x = P_{x-1} + B - D + I - E$$

where P_x = end-of-year population; B = births; D = deaths; I = immigrants; E = emigrants.

Age and sex structure (7)

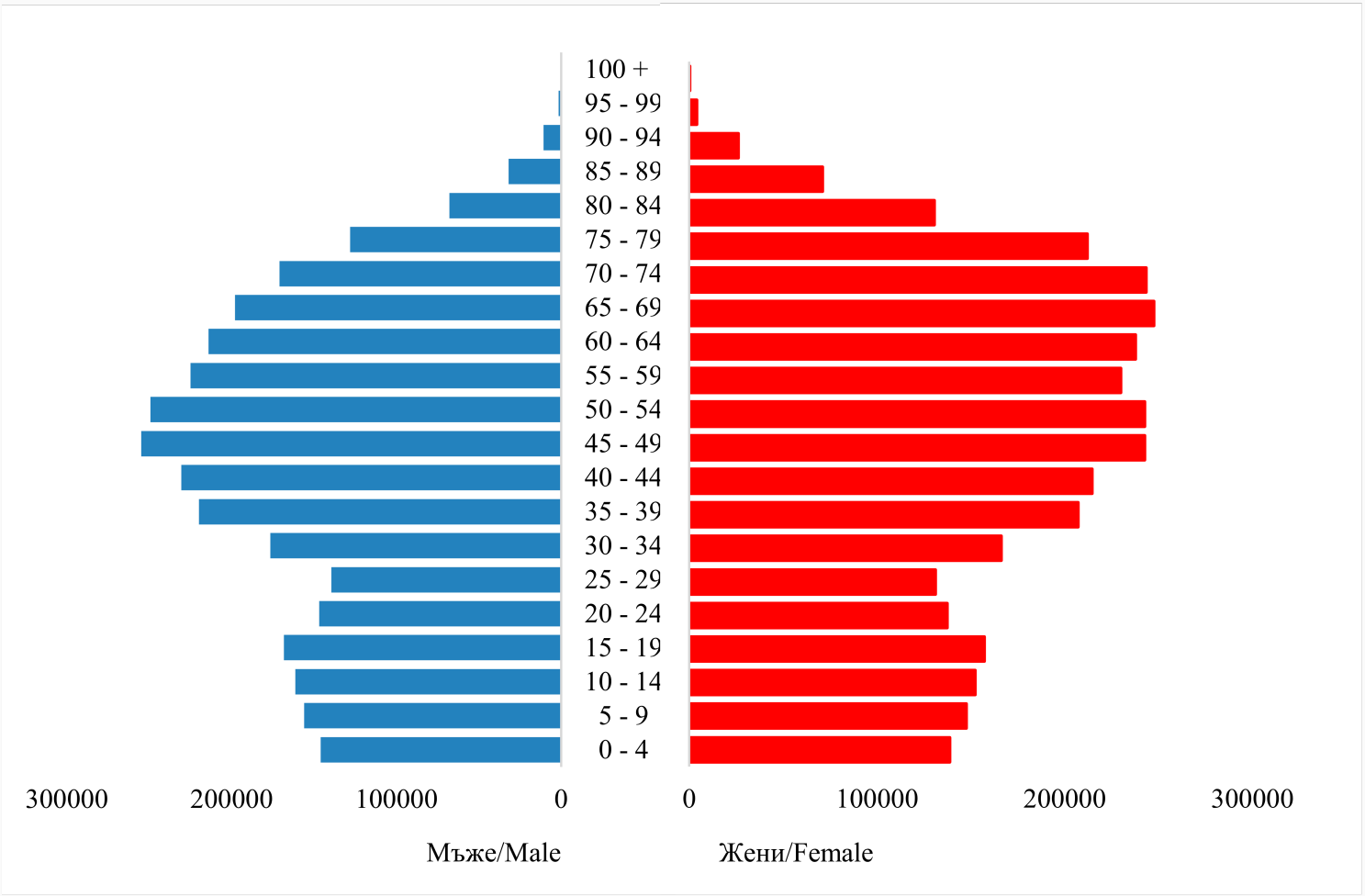
- Age and sex composition are fundamental demographic characteristics of any population.
- Population pyramids display the absolute or relative size of each age–sex cohort and reveal a population's history and future prospects.
- Bars are arranged with youngest cohorts at the base and oldest at the apex; males conventionally on the left, females on the right.
- Three main pyramid forms: expansive (wide base — high fertility); stationary (near-uniform width); constrictive (narrow base — below-replacement fertility).

Age and sex structure



Age and sex structure

Фиг. 1. Възрастова структура на населението към 31.12.2024 година
Figure 1. Age structure of the population as of 31.12.2024



Sex ratio (7)

More boys are born than girls, though higher male mortality across the life course narrows this gap.

The Sex Ratio (SR) measures the sex composition of a population:

$$\mathrm{SR} = \frac{F}{M}$$

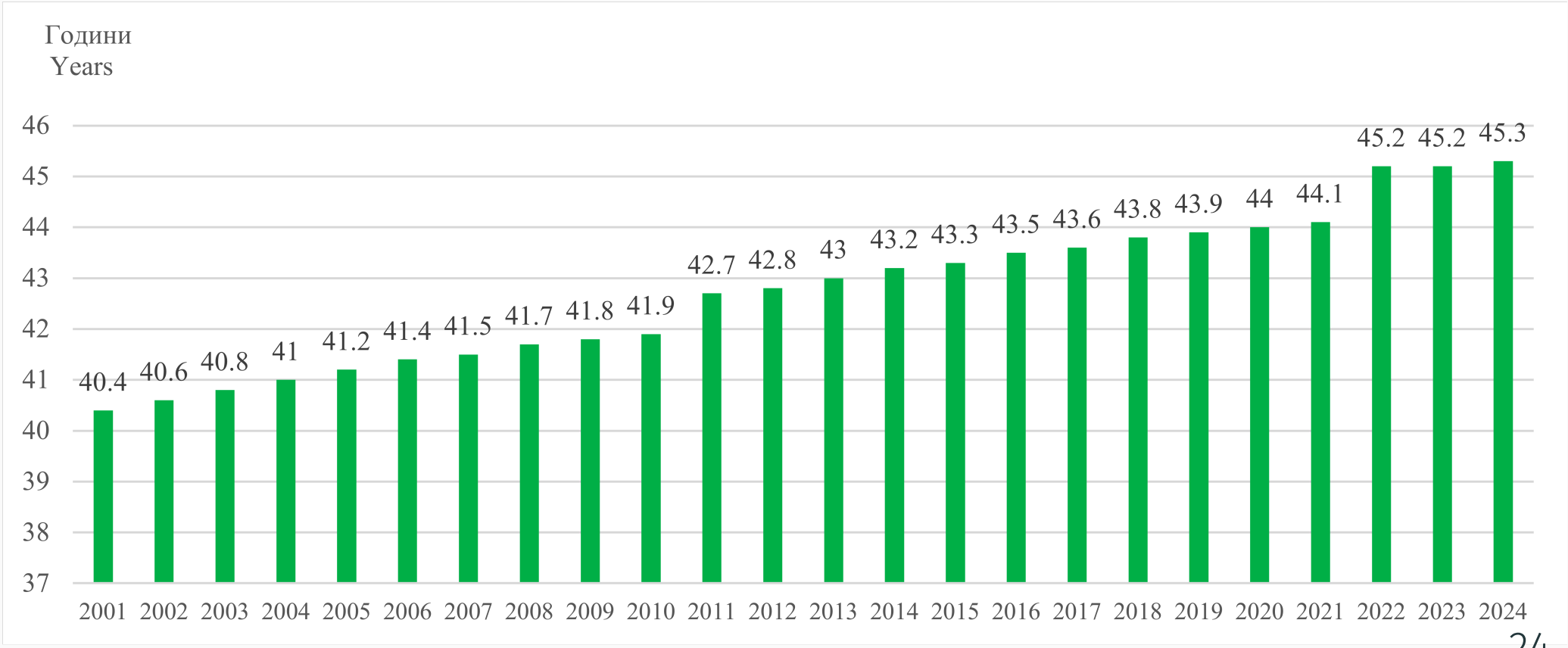
In Bulgaria, SR = **1.08** — on average, 1.08 women per man.

Age structure — key indices (7)

- Mean age — Bulgaria: **45.3 years**
- Child dependency ratio — children (0–14) per 100 persons of working age (15–64)
- Old-age dependency ratio — persons ≥ 65 per 100 persons of working age
- Total dependency ratio — sum of child and old-age dependency ratios
- Ageing index — persons ≥ 65 per 100 children aged 0–14
- Caretaker ratio — persons ≥ 80 per 100 women aged 50–64
- Replacement ratio — persons entering working age *(15–19)* per 100 leaving it *(60–64)*; Bulgaria (31 Dec 2022): **69**

Age structure

Фиг. 2. Средна възраст на населението
Figure 2. Mean age of the population



Demographic dynamics

Demographic dynamics — overview (9)

Population change results from two classes of processes:

- Natural processes: births, deaths, marriages and divorces
- Migration processes: immigration and emigration

Natural growth = births – deaths
Migration growth = immigrants – emigrants

Migration — definition (9)

Migration is the demographic process of change in population membership through a change of residence.

Three defining criteria:

1. A **permanent or semi-permanent** change of residence
2. Crossing an **administrative boundary**
3. Occurring within a **defined period**

Migration — typology (9)

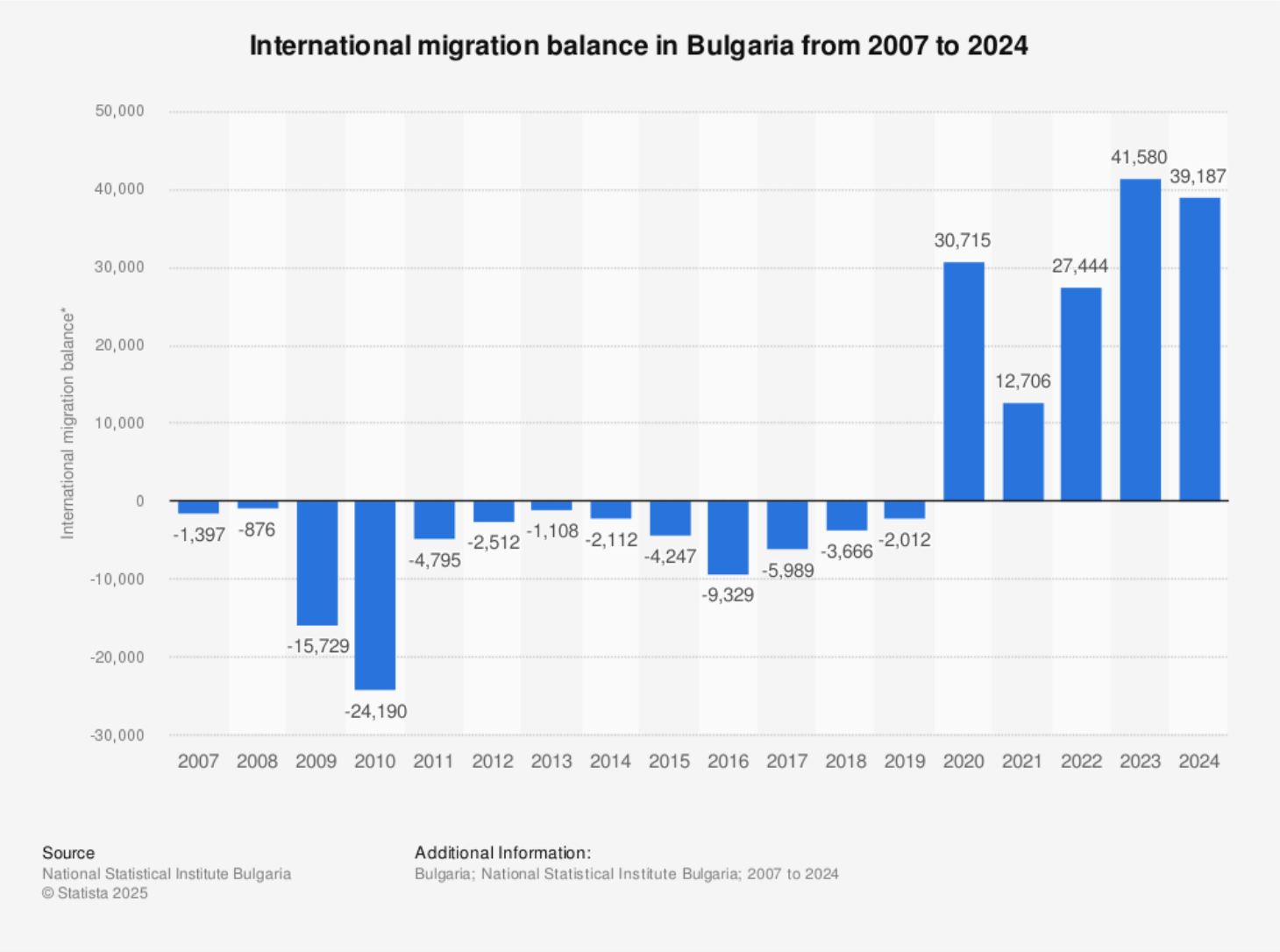
External migration

- Emigration (departure from country of origin)
- Immigration (arrival in country of destination)

Internal migration

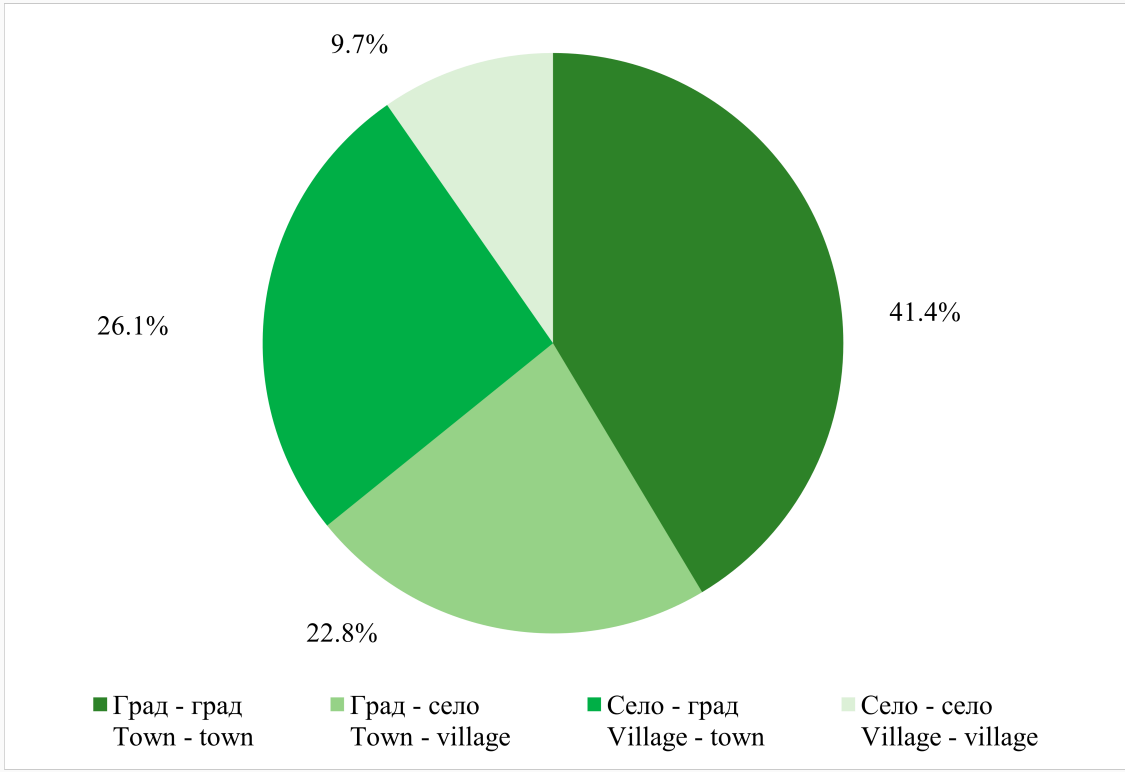
- Temporary: daily (commuting), seasonal, semi-permanent
- Permanent: rural–urban, urban–rural, urban–urban, rural–rural

External migration

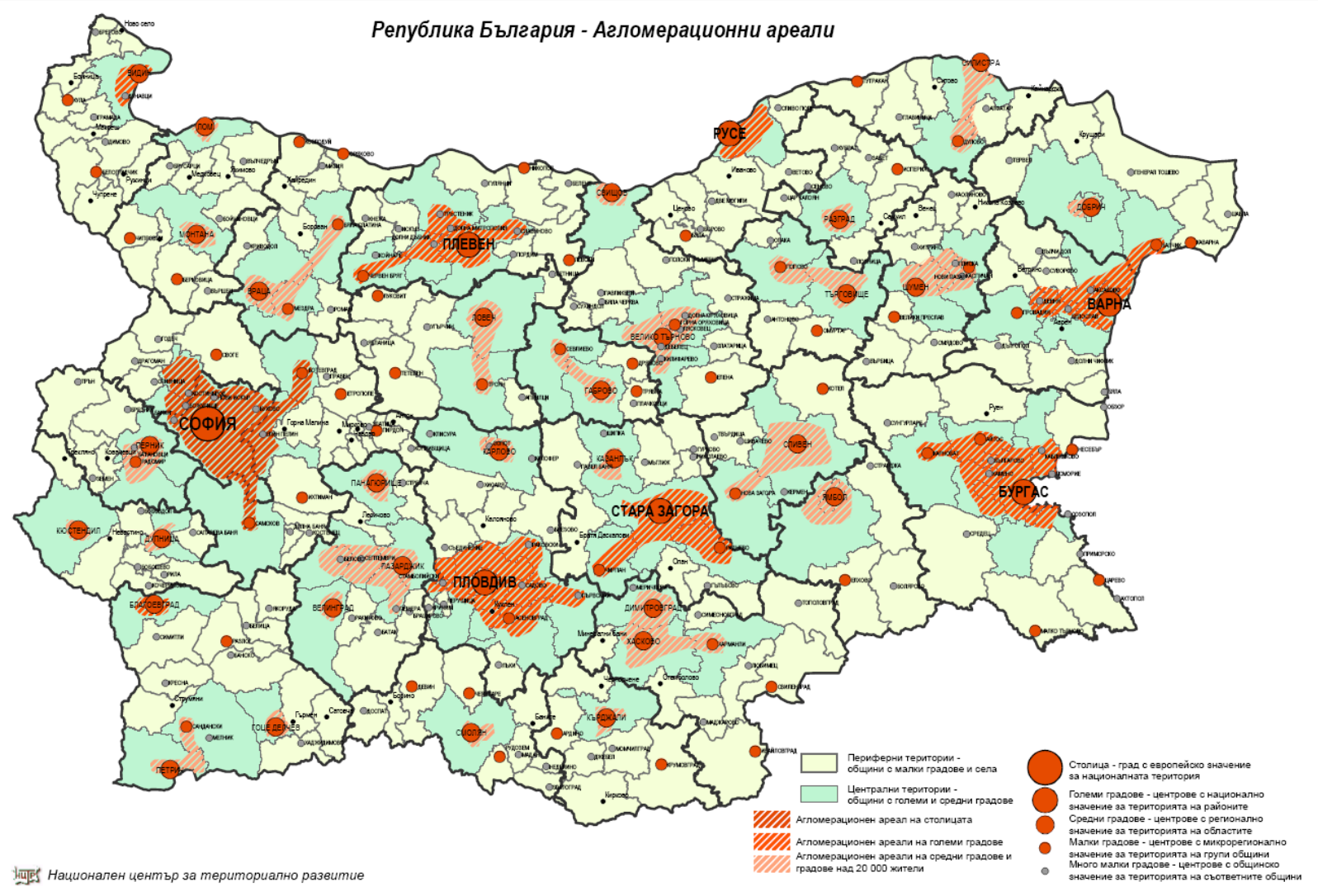


Internal migration

Фиг. 7. Направления на вътрешната миграция през 2024 година
Figure 7. Directions of the internal migration in 2024



Urbanization



Migration — health effects by type (9)

Migration type	Principal health consequences
Voluntary (free)	"Healthy migrant" selection effect; shift of chronic disease risk toward host-country patterns; importation of infectious disease via air travel (SARS 2002–2003, dengue, airport malaria).
Forced (refugees)	Epidemic infectious disease in overcrowded camps (cholera, dysentery — Rwanda 1994); malnutrition-induced immune suppression; high prevalence of psychological trauma.
Rural–urban (internal)	Slum sanitation deficits → waterborne disease (cholera, typhoid); air pollution → chronic respiratory disease and TB in overcrowded housing; altered sexual networks → HIV/STI spread.
Trafficking (involuntary)	Physical and psychological abuse; occupational hazard exposure; high STI/HIV risk from sexual exploitation.
Animal/vector	Zoonotic spillover (migrating birds → Crimean–Congo haemorrhagic fever); vector range expansion (Aedes albopictus → chikungunya, dengue in new regions).

External migration — quantitative indicators (9)

1. Inward migration rate = arrivals ÷ mid-year population × 1,000
2. Outward migration rate = departures ÷ mid-year population × 1,000
3. Net migration rate = (arrivals − departures) ÷ mid-year population × 1,000
4. Gross migration rate = (|arrivals| + |departures|) ÷ mid-year population × 1,000
5. Migration effectiveness ratio = net migration rate ÷ gross migration rate

Migration sequence — five phases (9)

1. Predominantly male pioneers arrive; high mobility, erratic movement.
2. Pioneers encourage relatives and friends to follow social assistance networks form.
3. Women and families arrive settlements stabilise, mobility decreases.
4. Second generation matures movement patterns approach those of the host population.
5. Third generation is demographically indistinguishable from the host population.

Migration — push and pull factors (9)

Push factors (origin):

- Economic hardship; political instability, conflict, or persecution
- Environmental hazards: natural disasters, climate change, degradation
- Social factors: discrimination, limited access to education or healthcare
- Demographic pressure: overpopulation, housing shortage

Pull factors (destination):

- Economic opportunity; political stability
- Family reunification; established social networks
- Favourable immigration policies; prospects for legal residency

Natural events — natality

Fertility and natality — overview (10)

- **Fertility** largely determines the age structure of a population.
- Sustained high fertility after mortality decline produced the most explosive population growth episodes of the modern era.
- The biological potential for childbearing (**fecundity**) has come increasingly under voluntary control over the past century through contraception and reproductive health services.

Birth — legal definition (10)

Ordinance No. 9 of 27 April 2021 — Medical Standard “Obstetrics and Gynaecology”

- The complete expulsion or extraction of the product of conception (fetus and fetal appendages) that is potentially viable by the criteria:
  - a fetus from a pregnancy that has reached 25+0 gestational weeks and/or weighs ≥ 700 grams.
  - A fetus below 25 gestational weeks that receives full resuscitative measures is recorded as a birth **after surviving 72 hours**.

Birth — further definitions (10)

- Live fetus: a fetus demonstrating signs of blood circulation. In the absence of such signs, the fetus is designated **dead** (foetus mortuus — stillbirth).
- Abortion: loss or termination of pregnancy before the fetus meets the viability criteria — types: *voluntary, spontaneous, therapeutic termination of pregnancy (TToP), criminal.*
- Premature birth: delivery before **37 completed gestational weeks** (fewer than 259 days).
- Neonatal period: first 27 complete days of life.
- Perinatal period: from 25 completed gestational weeks through the first 6 days after birth.

Birth registration

Birth certificate — legal basis (11)

Ordinance on Civil Status Acts — Section II, Art. 7

The birth certificate (*акт за раждане*) is an official written document in which the civil status official registers the birth event pursuant to the Civil Registration Act.

The certificate is drawn up on the basis of one of the following:

- **Written birth notification**.
- Court decision.
- Copy or extract from a birth certificate issued by a Bulgarian diplomatic/consular representative or a foreign civil status authority.
- Protocol for a found, abandoned, or discarded newborn.

Birth — registration procedure (11)

Ordinance on Civil Status Act

- The written birth notification is submitted to the civil status official within (*Local Civil Registrar*, *Municipal Registry Office*) **5 days** of birth (day of birth not counted).
- For a **stillborn child**, the notification must be provided within **24 hours** of birth.
- The birth certificate is drawn up within **7 days** of birth.
- The birth certificate for a **stillborn child** must be drawn up within **48 hours** of birth.
- If a child is born alive but dies before the birth certificate is drawn up, a **birth certificate and a death certificate are prepared simultaneously**.

Natality indicators

Natality — key indicators (10)

Crude Birth Rate (CBR): *Bulgaria 2024:* ***8.3‰***

$$\text{CBR} = \frac{\text{Live births}}{\text{Average annual population}} \times 1000$$

Assessment scale: Low < 15‰ | Average 15–25‰ | High > 25‰

Total Fertility Rate (TFR)

$$\text{TFR} = \sum_{a=15}^{49} \frac{\text{Births}_a}{\text{Women}_a}$$

- Average number of children per woman across the entire reproductive period (15–49 years).

Net Reproduction Rate (10)

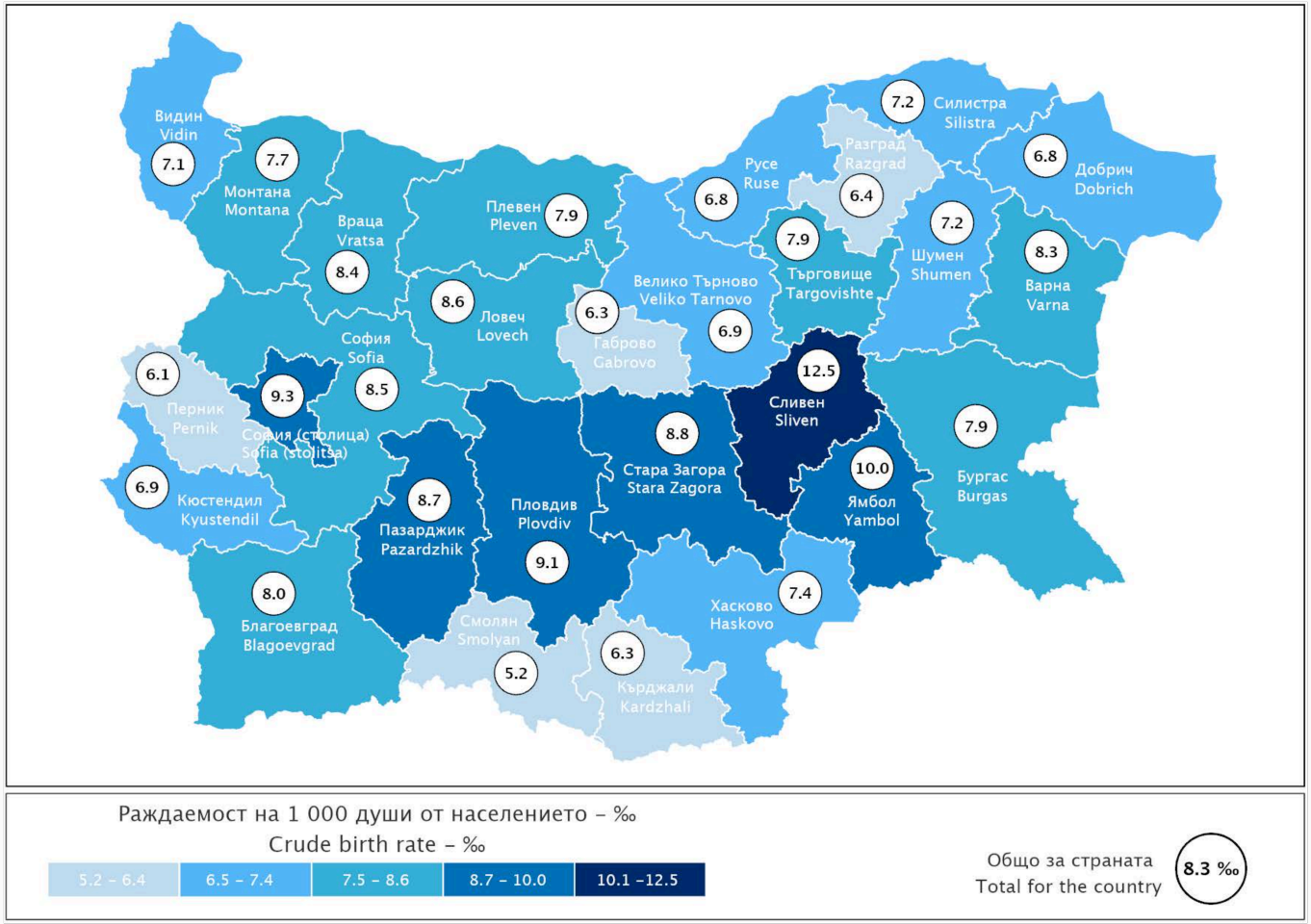
The **Net Reproduction Rate (NRR)** estimates generational replacement through the female lineage — the number of daughters who will survive to replace their mothers.

- NRR = 1: exact generational replacement
- NRR < 1: below-replacement fertility — fewer daughters than mothers
- NRR > 1: above-replacement fertility — population grows across generations

Replacement-level fertility conventionally requires a TFR of approximately **2.1** children per woman in low-mortality populations.

Crude Birth Rate (CBR)

Фиг. 4. Коефициент на раждаемост по области през 2024 година
Figure 4. Crude birth rate by district in 2024



Mortality — definitions and certification

Death — medical and legal definition (10)

Ordinance No. 21/2015 on the Medical Criteria and Procedure for Establishing Death — Chapter II, Art. 5

Death is established in the presence of **one** of the following conditions:

1. Permanent and irreversible cessation of **circulatory and respiratory** functions
2. Permanent and irreversible cessation of **all functions of the brain** with maintained cardiac activity (*brain death*)

Confirmation of circulatory–respiratory death (10)

- Palpable absence of pulse in both carotid and both femoral arteries
- Auscultatory absence of cardiac activity
- Absence of respiratory movements of the diaphragm and thorax on visual observation
- Absence of breath sounds on bilateral chest auscultation

An ECG may be used to **confirm** absence of electrical cardiac activity but is **not sufficient alone** to establish death.

Confirmation of brain death (10)

Art. 8–14 — Permanent irreversible cessation of all brain functions

- Established exclusively in medical establishments authorised for organ procurement.
- Determined by a **standing commission of three physicians** (anaesthesiology–intensive care, neurology, neurosurgery, or radiology), appointed by the head of the establishment with consent of the Executive Agency “Medical Supervision”.
- Requires **unanimous agreement** of the commission after two clinical examinations ≥ 12 hours apart and — where mandated — instrumental confirmation of absent cerebral blood flow (obligatory in children < 6 years).
- Time of death = moment of the **apnoea test**.

Death registration

Death certificate — legal basis (11)

Ordinance on Civil Status Acts — Section IV, Art. 24

The death certificate (*акт за смърт*) is an official written document in which the civil status official registers the death event pursuant to the Civil Registration Act.

The certificate is drawn up on the basis of one of the following:

- Written death notification (Cause-of-Death Statement / Medical Certificate of Cause of Death — per Ordinance No. 42/2004, ICD-10)
- Court decision
- Copy or extract from a death certificate issued by a Bulgarian diplomatic/consular representative or a foreign civil status authority

Death notification — procedure (11)

Ordinance on Civil Status Acts — Arts. 24–25

- The written death notification (**Съобщение за смърт**) is provided **immediately** to the civil status official in the municipality, district, mayoralty, or locality where the event occurred (*Local Civil Registrar*, *Municipal Registry Office*).
- The death certificate is drawn up **no later than 48 hours** after the occurrence of death. In other cases (court decision, foreign document) the certificate is drawn up within **7 days** of document receipt.
- A death certificate **cannot** be drawn up for a person of **unestablished identity**.

Death notification — document routing (11)

The physician (or paramedic) who confirms death completes the **Cause-of-Death Statement** in **triplicate**:

1. First copy → civil registry official in the municipality, district, or mayoralty of the place of death
2. Second copy → respective **Regional Health Inspectorate** within two months of issuance (used for ICD-10 coding and transmission to NSI territorial statistical bureaux)
3. Third copy → retained by the physician or stored in the medical establishment's dedicated register

Mortality indicators

Mortality — key indicators (10)

Crude Death Rate (CDR) : *Bulgaria 2024:* ***15.6‰***

$$\text{CDR} = \frac{\text{Deaths}}{\text{Average annual population}} \times 1000$$

Assessment: Low < 10‰ | Average 10–15‰ | High > 15‰

Life expectancy at birth — the average number of years of life remaining for a newborn if age-specific mortality rates observed in a given year were to persist throughout life. Integrates the entire mortality experience from infancy to old age into a single, interpretable metric.

Premature mortality — deaths occurring below age 65 as a proportion of all deaths.

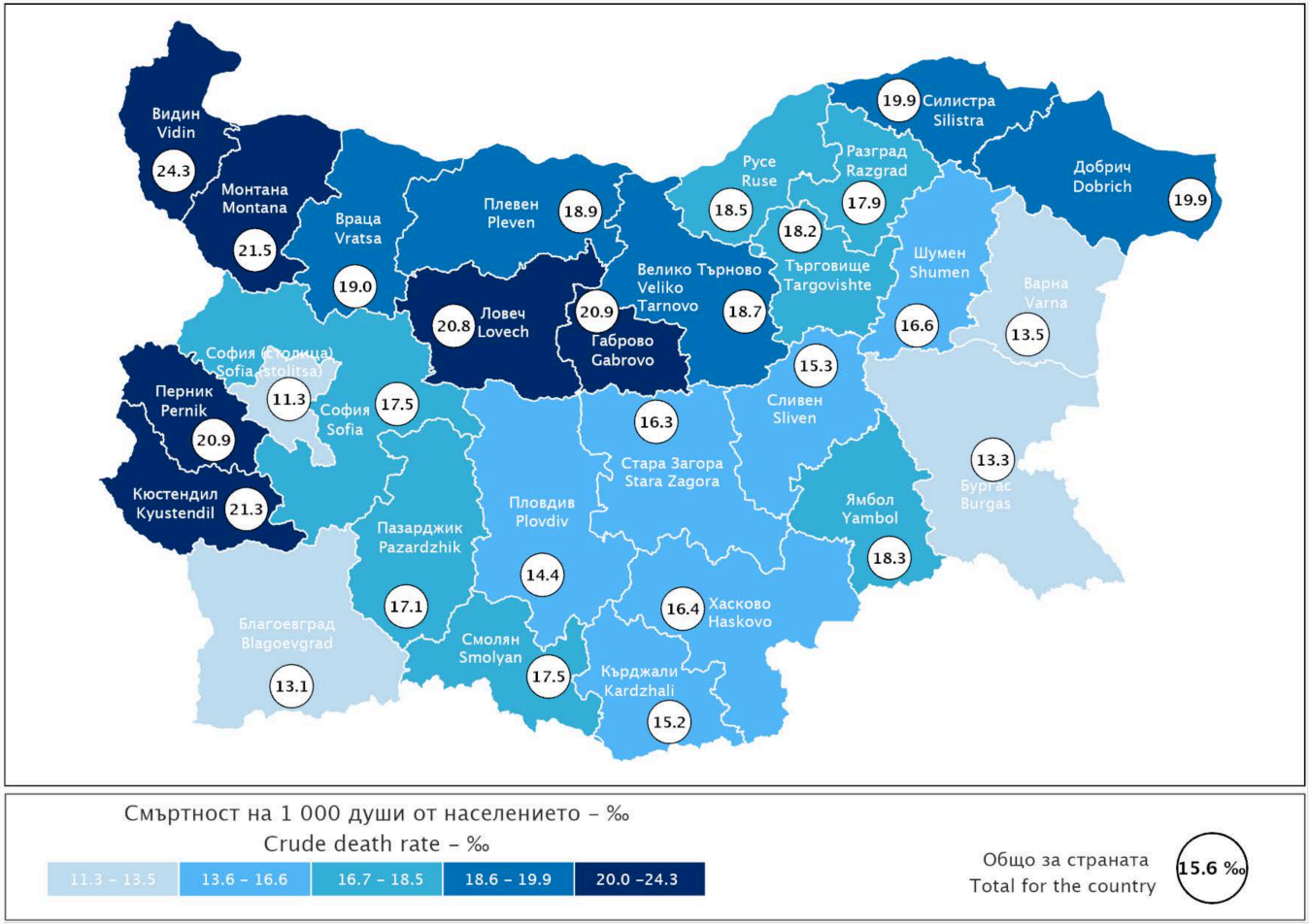
Mortality — cause-specific indicators (10)

- Cause-specific mortality rate = deaths from a specific disease ÷ average annual population × 1,000
- Case fatality rate (CFR) = deaths from a disease ÷ cases of that disease in a defined period × 100
- Proportionate (disease-specific) mortality = deaths from a specific disease ÷ total deaths × 100

These indicators serve distinct epidemiological purposes: the cause-specific rate quantifies population risk; the CFR measures disease lethality; proportionate mortality describes the burden of one cause within overall mortality.

Crude Death Rate (CDR)

Фиг. 5. Коефициент на смъртност по области през 2024 година
Figure 5. Crude death rate by district in 2024



Infant mortality indicators

Infant mortality — overview (12)

Infant mortality is a fundamental measure of population health, reflecting the quality of maternal and child care, socioeconomic conditions, and the effectiveness of preventive interventions.

The **infant mortality rate (IMR)** measures deaths among children under one year of age per 1,000 live births.

$$\text{IMR} = \frac{\text{Deaths under 1 year}}{\text{Average No of Live births}} \times 1000$$

Infant mortality — classification (12)

Level	Rate (per 1,000 live births)
Very low	< 10
Low	10–14.99
Average	15–24.99
High	25–49.99
Very high	≥ 50

Infant mortality — period-specific indicators (12)

- Perinatal mortality rate = (stillbirths + early neonatal deaths 0–6 days) ÷ total births × 1,000
- Neonatal mortality rate = deaths in days 1–27 ÷ live births × 1,000
  - **Early neonatal**: days 0–6 (overlaps with perinatal period)
  - **Late neonatal**: days 7–27
- Post-neonatal mortality rate = deaths day 28 to < 1 year ÷ live births × 1,000 (excluding first 28 days)
- Maternal mortality rate = pregnancy-related deaths ÷ live births × 1,000
- Stillbirth rate = stillbirths ÷ total births × 1,000

Demographic policy

Demographic policy — definition and types (8)

Demographic policy is the purposeful management of demographic processes within a country or region through legal, economic, and social mechanisms designed to influence fertility, mortality, migration, or population distribution.

Three main types:

- Pronatalist policy — aims to increase birth rates; characteristic of countries with below-replacement fertility and population ageing
- Antinatalist policy — aims to reduce birth rates; historically associated with concerns over rapid population growth and resource scarcity
- Liberal policy — does not set numerical fertility targets; combines elements of both approaches while prioritising reproductive autonomy

Demographic policy — governing framework (8)

In Bulgaria:

- The **Council of Ministers** leads demographic policy.
- The **Ministry of Labour and Social Policy (MLSP)** coordinates and oversees implementation, and is responsible for analysing, evaluating, and forecasting demographic processes.
- Policy is structured through the **National Strategy for Demographic Development**.

Demographic policy — key instruments (8)

- Financial compensation and child benefits
- Childcare facility networks for raising and educating children
- Maternal and child health programmes
- Legal protection of women’s reproductive capacity
- Harmonisation of women’s employment and motherhood
- Preferential access to public services for families with children
- Free, quality, universally accessible education and healthcare
- Promotion of family planning; support for assisted reproductive technologies
- Migration policy measures targeting women of reproductive age

Demographic policy — implementation levels (8)

- **National level**: measures applicable to all Bulgarian citizens
- **Regional level**: targeted interventions in areas with deteriorating indicators (e.g. the Northwest region)
- **Local level**: municipality-specific measures (e.g. financial support for infertility treatment for residents of Plovdiv Municipality)
- **Business sector**: additional childcare leave; financial incentives; flexible work schedules; on-site childcare centres and kindergartens

Factors for birth — proximate determinants (11)

Domain	Key determinants
Intercourse	Age at union formation; proportion permanently single; time lost between unions; frequency of intercourse; voluntary/involuntary abstinence
Conception	Contraception and sterilisation; involuntary infecundity (age, malnutrition, STIs); breastfeeding-induced postpartum amenorrhea
Gestation	Involuntary fetal mortality (miscarriage, stillbirth — risk ↑ with maternal age); voluntary fetal mortality (induced abortion)
Background	Reproductive cohort size (women aged 15–49); education, urbanisation, wealth, and economic structure — shaping desired family size and contraceptive adoption

Factors for mortality (11)

Factor group	Principal determinants
Biological–demographic	Age (J-shaped risk curve); sex (women biologically advantaged); genetic disposition, acquired immunity, baseline health
Environmental–social	Malnutrition → immune suppression; population density, poor sanitation, unsafe water, air pollution; poverty and low socioeconomic status
Behavioural–lifestyle	Tobacco, physical inactivity, poor diet, alcohol — primary drivers in developed-country mortality
Proximate causes (less-developed)	Communicable diseases: lower respiratory infections, diarrhoeal disease, HIV/AIDS, TB, malaria, maternal/perinatal conditions
Proximate causes (more-developed)	Non-communicable diseases: cardiovascular disease, cancers, chronic respiratory disease, diabetes; accidents and injuries

Thank you for your attention!