U.S. Centers for Disease Control and Prevention
National Center for Health Statistics
International Statistics Program

Analysis of Vital Statistics Data

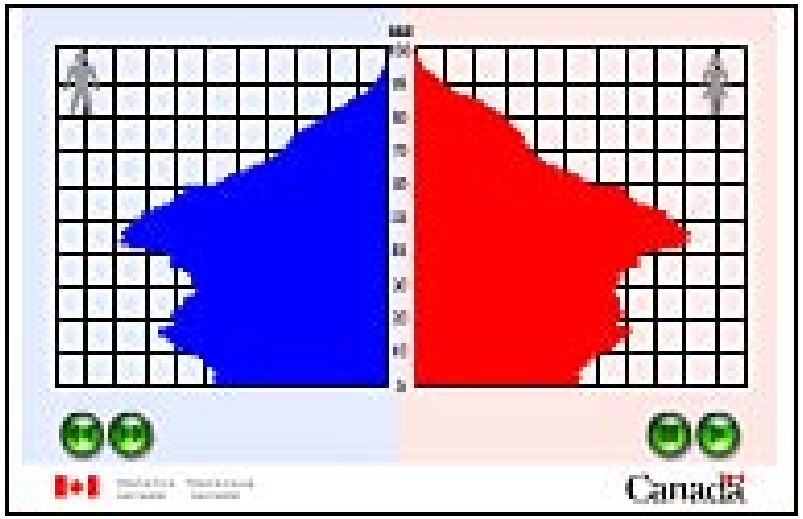
These materials have been developed by the National Center for Health Statistics, International Statistics Program, Hyattsville, Md., as part of the CDC Global Program for Civil Registration and Vital Statistics Improvement.

Outline

- Uses, general principles, & standardization of VS data
- Types of vital statistics measures
- Visualizing data (general)
- Natality
- Mortality
- Linking data

Uses of Vital Statistics

- Planning human development
- Dynamics of reproduction
- Life-tables
- Risks of dying
- Population growth dynamics
- Population projections
- Monitoring & evaluating interventions



Population Pyramid, Statistics Canada

SOURCES: PRVSS2, Chapter I.B.; NCHS, Unit 15.

Uses of Vital Statistics

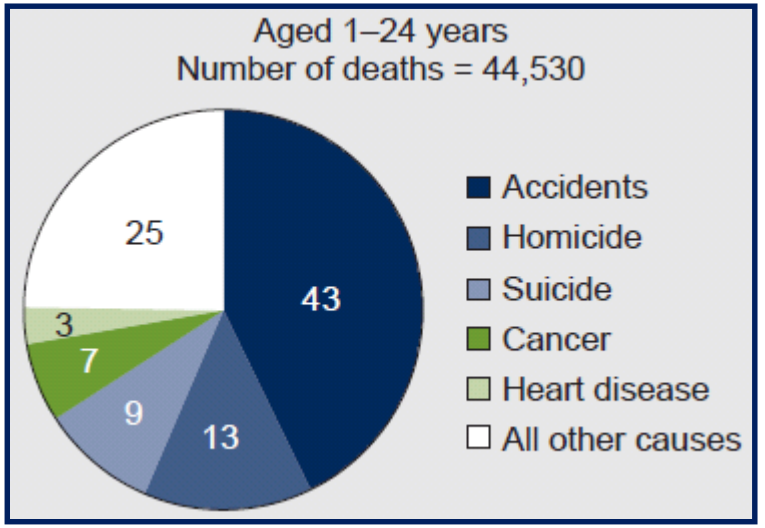
Can facilitate information for:

- **Provision of services for vulnerable populations (i.e. single mothers & children)**
- **Regional & urban/rural comparisons**
- **Allocation of resources (i.e. health care, education, & social security)**

Uses of Vital Statistics

Only nationally representative source for:

- **Mortality by cause of death**
- **Risks of premature death by sex & age**
- **Relative risks of death among subgroups**
- **Cause-specific risk of dying trends**



CDC, NVSS, 2007

SOURCES: PRVSS2, Chapter I.B.

General Principles: Useable Statistics

- **Clear, explicit, & simple definitions**
  - Universal acceptance / international standards
  - Comparability (geographically & over time)
- **Continuity**
  - Setting targets
  - Evaluating social & economic plans
- **Flexibility** to adapt
  - New methods / requirements
  - Computing technology
  - Changes described in reporting (titles, footnotes)

SOURCES: PRVSS2, Chapter I.B.; Chapter II.G.3.; NCHS, Unit 15.

Standardization of VS Data: ICD & International Comparison

- **WHO: International Statistical Classification of Diseases and Related Health Problems**
- **Revisions**
  - **Currently in 10th Revision (1993)**
  - **Recommended every 10 years; getting longer**
  - **Countries are slower to adopt**
- **Ideal source for international comparison**
  - **Universal morbidity & mortality coding**
  - **Only cases seen by physician**

SOURCES: WHO ICD-10, Volume 2, Chapter 5; NAPHSIS.

Standardization of VS Data: ICD & International Comparison

- **ICD in (country):**
  - (current status)
  - (future steps)

SOURCES: WHO ICD-10, Volume 2, Chapter 5; NAPHSIS.

Standard Definitions & Guidelines

WHO, 1998

- **Adopted by World Health Assembly**
  (ICD-10 Volume 1, pp 1233-1238)
- **Necessary for international comparison**
- **List of definitions**
  - **Cause of death**
  - **Live birth**
  - **Fetal death**
  - **Birth weight**
  - **Gestational age**
  - **Pre-term, term, post-term**
  - **Perinatal / neonatal period**
  - **Maternal / late maternal death**
  - **Pregnancy related death**
  - **Direct obstetric deaths**
  - **Indirect obstetric deaths**

SOURCES: WHO ICD-10, Volume 1, p 1233-1238; Volume 2, Chapter 5.

Differences in Reporting Requirements: "Live Birth"

Table 1. Requirements for reporting a live birth, United States and selected European countries, 2004

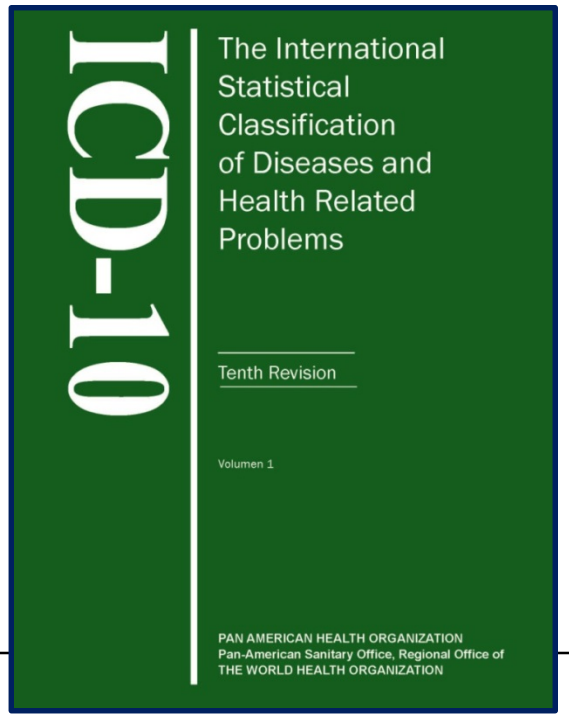
Reporting requirement	Country
All live births	Austria, Denmark, England and Wales, Finland, Germany, Hungary, Italy, Northern Ireland, Portugal, Scotland, Slovak Republic, Spain, Sweden, United States
Live births at 12 weeks of gestation or more	Norway
Live births at 500 grams birthweight or more, and less than 500 grams if the infant survives for 24 hours	Czech Republic
Live births at 22 weeks of gestation or more, or 500 grams birthweight or more	France
All live births for civil registration, births at 500 grams birthweight or more for the national perinatal register	Ireland
Live births at 22 weeks of gestation or more, 500 grams birthweight or more if gestational age is unknown	Netherlands
Live births at 500 or more grams birthweight	Poland

SOURCE: NCHS/National Vital Statistics System for U.S. data and European Perinatal Health Report, p. 40 for European data: http://www.europeristat.com/bm.doc/european-perinatal-health-report.pdf.

SOURCES: MacDorman, MF and Mathews TJ. Behind International Rankings of Infant Mortality: How the United States Compares with Europe. NCHS Data Brief No. 23. Nov. 2009. See also: Healy, B. Behind the Baby Count. US News & World Report. 2 Oct 2006.

Review: Vital Statistics Data

- **Uses**
  - **Variety of indicators**
  - **Generate information for services**
  - **Nationally representative data source**
- **General Principles**
  - **Clear, explicit, & simple definitions**
  - **Continuity**
  - **Flexibility to adapt**
- **Standardization**



PAHO, 2009

Discuss

How are causes of death classified in your country?

How often are the ICD codes revised? What version is currently used in your country?

If ICD10 is in use, what edition of that revision is being used in your country?

Types of Vital Statistics Measures: Absolute versus Relative

Absolute counts

- **Not comparable over time/geography**
- **Can stratify number of events (count) by:**
  - **Demographics (age, sex, marital status, race/ethnicity)**
  - **Time (month, year)**
  - **Location (district, region)**
  - **Place of occurrence (home vs. health institution)**

SOURCES: NAPHSIS; NCHS, Unit 17.

Types of Vital Statistics Measures: Absolute versus Relative

Relative numbers: percentages, ratios, and rates

- **Relating absolute counts to population at risk: must have denominator information**
- **Place- and time- specific**
- **Comparable**
- **Source of information / denominators:**
  - **Census projections**
  - **Hospital reports (limited to events that take place in a health institution)**

SOURCES: NAPHSIS; Kenya; NCHS, Unit 17.

Types of Vital Statistics Measures: Percentages

- **Computing by hundredths**
- **Numerator must be part of denominator**
- **Example: % of premature babies**

  = number of premature births X 100

  total number of births

- **Percentages as summary statistics**
  - **Array of subcategories, using total as denominator**
  - **Can obtain percentage distribution**
  - **All percentages should add up to 100 percent**

Source: NAPHSIS; NCHS, Unit 17.

Types of Vital Statistics Measures: Ratios

- **Used to indicate relative size of one number compared with another number**

- **Numerator does NOT have to be part of denominator**

- **Example: Sex Ratio at Birth**

  = number of male live births X 100 (or 1,000)

  number of female live births

  = number of male live births per 100 (or 1,000) female live births

SOURCES: NAPHSIS; NCHS, Unit 17.

Types of Vital Statistics Measures: Rates

- **Describes rapidity of occurrence during a stated period of time**
- **Example: infant mortality rate**

  $$= \frac{\text{\# deaths under 1 yr during given calendar year}}{\text{\# live births during same year}} \times 1{,}000$$

- **Two types of rates**
  - **Based on vital statistics only**
  - **Based on vital statistics and population statistics**

SOURCES: NAPHSIS; NCHS, Unit 17.

Types of Vital Statistics Measures: Rates

- **Based on vital statistics only**

  Infant mortality rate

  $$= \frac{\text{\# deaths under 1 yr during given calendar year}}{\text{\# live births during same year}} \times 1{,}000$$

- **Based on vital statistics and population statistics**

  Age-specific (infant) death rate

  $$= \frac{\text{\# deaths under 1 yr during given calendar year}}{\text{mid-period total population of children under 1 yr}} \times 1{,}000$$

- **Importance of census data**

SOURCES: NAPHSIS; NCHS, Unit 17.

Discuss

How will percentages help you to summarize statistical data?

Review: Types of Vital Statistics Measures

- **Absolute versus relative**
- **Percentages**
- **Ratios**
- **Rates**

Visualizing Data: Tabulations

- **Degree of detail**
  - Cause
  - Sex, race
  - Age
  - Geographical area
- **Depends on**
  - Purpose of statistics
  - Range/completeness of data
- **Column and row totals should add up correctly**

LIVE BIRTHS ON GUAM AND SAIPAN
1990 to 2000

	GUAM					SAIPAN
YEAR	JAN-MAR	APR-JUN	JUL-SEP	OCT-DEC	TOTAL	BIRTHS
1990	690	730	780	714	2,914	not available
1991	716	724	784	799	3,023	1,423
1992	802	784	908	893	3,387	1,511
1993	821	873	977	866	3,537	not available
1994	889	874	925	908	3,596	1,424
1995	854	835	948	960	3,597	not available
1996	883	818	979	941	3,621	1,477
1997	868	901	978	968	3,715	not available
1998	946	885	950	918	3,699	1,421
1999	831	883	622	1,028	3,364	not available
2000	891	794	825	920	3,430	1,436

GUAM source: *Labor and Delivery Unit, Guam Memorial Hospital*
SAIPAN source: *Office of Health Planning and Statistics, Division of Public Health, Northern Mariana Islands Department of Health.*

SOURCES: WHO ICD-10, Volume 2, Chapter 5; NCHS, Unit 17.

Tabulations: Specify Time Reference

- **By date of registration**
  - For provisional tabulations only
  - Need to evaluate differences expected
  - May be quicker for weekly, monthly, or quarterly summaries

- **By date of occurrence of event**
  - Recommended for final tabulations
  - Must define "cut-off" date for reporting events
    - Legislation
    - Organizational structure

SOURCES: WHO ICD-10, Volume 2, Chapter 5; UN Handbook, Module 18, A1.

Tabulations: Specify Geographic Reference

- **Goal:** ***complete coverage of country's total population***

- **May focus on areas of known coverage**
  - **Incentive for lower-quality areas to improve**
  - **Interim measure**
  - **Data not nationally representative; supplement data:**
    - **Statistical adjustment for under-reporting**
    - **Collecting supplementary data by field surveys**

SOURCES: WHO ICD-10, Volume 2, Chapter 5; UN Handbook, Module 18, A2.

Tabulations: Specify Geographic Reference

- **Normal assumption:** little difference between resident population & population present

- By place of usual residence
  - Use for *final tabulations* for civil divisions & large cities
  - Can present by events of residents versus non-residents
  - Must consider legal definition of "residence"

- By place of occurrence:

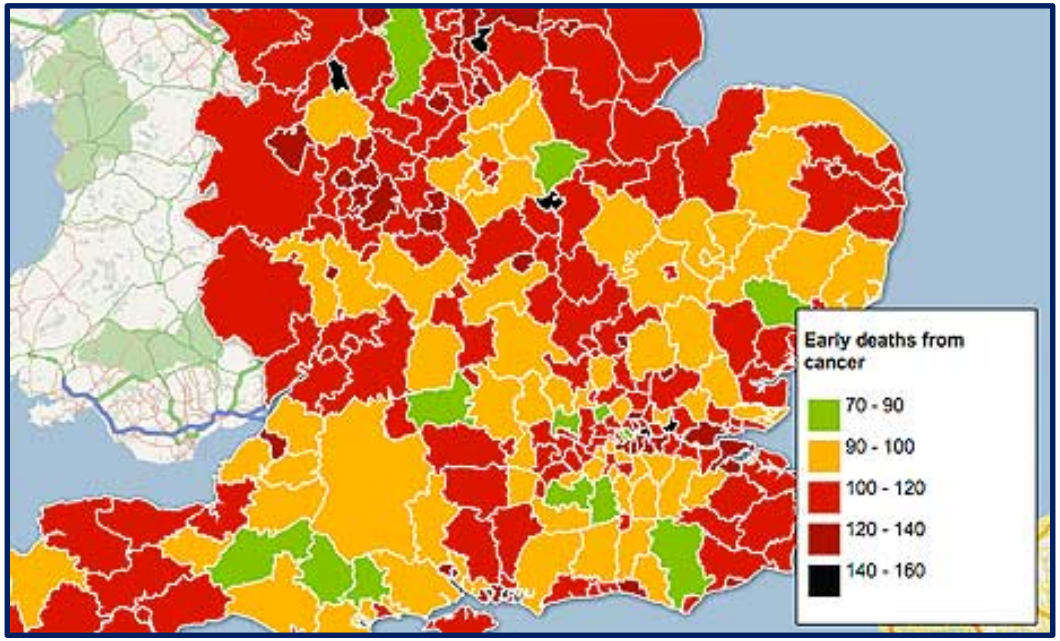
Recommended for subnational areas

SOURCES: WHO ICD-10, Volume 2, Chapter 5; UN Handbook, Module 18, A2.

Visualizing Data: Charts, Graphs & Figures

- **Customize for local needs**

- **Use to expand data interpretation**



The Guardian, UK, 2011

- **Use to explain/justify needs to stakeholders**

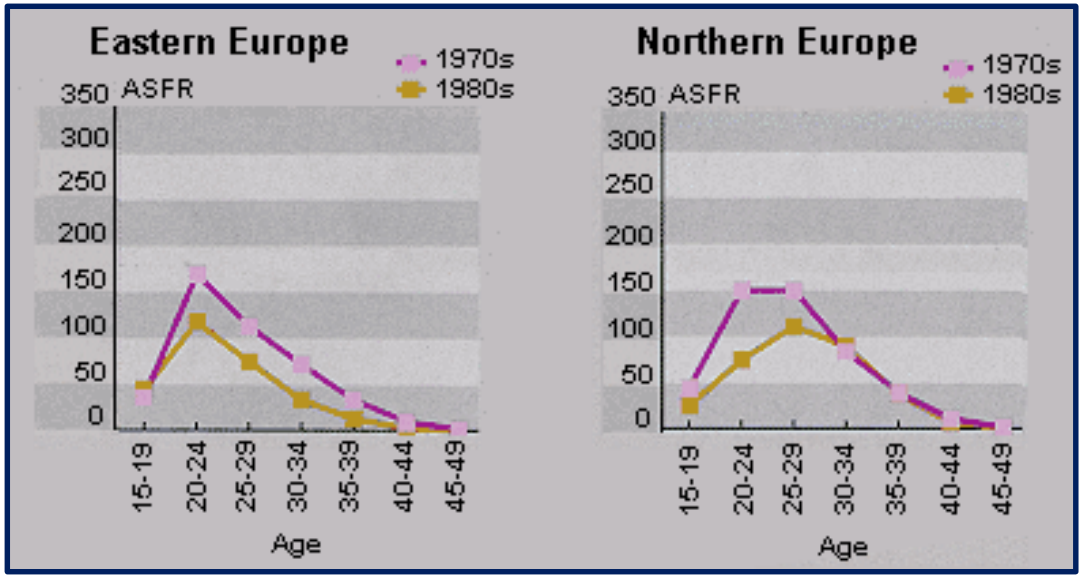
Review: Visualizing Data

- **Tabulations**
  - **Time reference**
  - **Geographic reference**

- **Charts, graphs, & figures**

Natality Statistics

- **Various rates/ratios/percentages**
- **Age specific rates**
- **Fertility rates**
- **Tabulations**
- **Graphs/charts/figures**



UN, World Fertility Patterns, 1997

SOURCES: NAPHSIS

Crude Birth Rate

- # resident live births for a specific area **during a specified period**
- **divided by total population for that area (usually mid-year)**
- **multiplied by 1,000**

$$\frac{\text{Total resident live births}}{\text{Total Population}} \times 1{,}000$$

ON YOUR OWN: What is the birth rate in this area in 2005?

180,000 live births in 2005 among area residents

12,300,000 estimated population in 2005 for area residents

SOURCES: NAPHSIS

Crude Birth Rate: Example

180,000 live births in 2005 among area residents

12,300,000 estimated population in 2005 for area residents

$$\frac{180{,}000}{12{,}300{,}000} \times 1{,}000 = 14.6$$

14.6 live births per 1,000 area residents in 2005

SOURCES: NAPHSIS

Sex Ratio at Birth

- # resident male live births for a specific area during a specified period
- divided by # of resident female live births for that area & period
- multiplied by 100 or 1,000

$$\frac{\text{\# of resident male live births}}{\text{\# of resident female live births}} \times 100 \text{ (or } 1{,}000\text{)}$$

ON YOUR OWN: What is the sex ratio at birth for the area in 2008?

58,000 = male live births in 2008 to area residents

55,000 = female live births in 2008 to area residents

SOURCES: NAPHSIS

Sex Ratio at Birth: Example

58,000 = male live births in 2008 to area residents

55,000 = female live births in 2008 to area residents

$$\frac{58{,}000}{55{,}000} \times 100 = 105.5$$

105.5 male births per 100 female live births among area residents in 2008

SOURCES: NAPHSIS

% Low (Very Low) Birth Weight

- # resident live births for a specific area during a specified period with a birth weight of less than 2,500 (1,500) grams
- divided by # of resident live births for that area & period
- multiplied by 100 to get a %

$$\frac{\text{\# of resident live births < 2,500 (1,500) grams}}{\text{\# of resident live births}} \times 100$$

ON YOUR OWN: What is the % low birth weight for the area in 2005?

10,500 = live births < 2,500 grams in 2005 among area residents

150,000 = live births in 2005 to area residents

SOURCES: NAPHSIS

% Low Birth Weight: Example

10,500 = live births < 2,500 grams in 2005 among area residents

150,000 = live births in 2005 to area residents

$$\frac{10{,}500}{150{,}000} \times 100 = 7.0$$

7.0 % of all live births in 2005 among area residents were low birthweight births

SOURCES: NAPHSIS

% Preterm Live Births

- # resident live births for a specific area during a specified period with a gestational age < 37 completed weeks
- divided by # of resident live births for that area & period
- multiplied by 100 to get a %

$$\frac{\text{\# of resident preterm (< 37 weeks) live births}}{\text{\# of resident live births}} \times 100$$

ON YOUR OWN: What is the % preterm live births in the area in 2008?

15,900 = preterm (< 37 weeks) live births in 2008 among area residents

127,000 = live births in 2008 to area residents

SOURCES: NAPHSIS

% Preterm Live Births: Example

15,900 = preterm (< 37 weeks) live births in 2008 among area residents

127,000 = live births in 2008 to area residents

$$\frac{15{,}900}{127{,}000} \times 100 = 12.5$$

12.5 % of all live births in 2008 among area residents were preterm births.

SOURCES: NAPHSIS

Age-Specific Birth Rate

- # resident live births to women in a specific age group for a specific area during a specified period
- divided by the total population of women in the same age group for that area & period
- multiplied by 1,000 to get a rate

$$\frac{\text{\# resident live births to women in a specific age group}}{\text{\# of women in the same age group}} \times 1{,}000$$

ON YOUR OWN: ***What is the 2008 area birth rate for women 20-24 yrs?***

36,000 = live births in 2008 among resident women 20-24 years old

310,000 = area resident women who are 20-24 years old in 2008

Age-Specific Birth Rate: Example

36,000 = live births in 2008 among area resident women who are 20-24 years old

310,000 = area resident women who are 20-24 years old in 2008

$$\frac{36{,}000}{310{,}000} \times 1{,}000 = 116.1$$

116.1 live births per 1,000 area resident women who are 20-24 years old in 2008

SOURCES: NAPHSIS

General Fertility Rate

- # resident live births for a specific area during a specified period
- divided by the female population age 15-49 years (usually estimated for a mid-year) for the same area/period
- multiplied by 1,000

$$\frac{\text{\# of resident live births}}{\text{\# of females aged 15-49}} \times 1{,}000$$

***ON YOUR OWN:** What is the general fertility rate in the area in 2008?*

180,000 = live births in 2008 among area residents

2,700,000 = estimated # of area resident females 15-49 yrs in 2008 (estimated for 1 July, 2008)

General Fertility Rate: Example

180,000 = live births in 2008 among area residents

2,700,000 = estimated # of area resident females who are 15-44 years old in 2008 (estimated for 1 July, 2008)

$$\frac{180{,}000}{2{,}700{,}000} \times 1{,}000 = 66.7$$

66.7 live births per 1,000 area resident women who are 15-44 years old in 2008

Total Fertility Rate

- sum the age-specific birth rates (5-yr age groups between 10 & 49) for female residents of a specific area during a specified period
- multiply by 5

$$(\Sigma ASBR) \times 5$$

where ASBR is each 5-year age-specific birth rate: $\frac{Bx}{Px} \times 1{,}000$

where Bx is the # live births to mothers age *x*

- Bx age groups: <15, 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, & 45+

Px is the # resident women age *x*

- Px age groups: 10-14, 15-19, 20-24, 25-29, 30-34, 35-39, 40-44 & 45-49

SOURCES: NAPHSIS

Total Fertility Rate

1. **Determine Bx and Px**
   a) **List # live births to moms in each age group (Bx)**
   b) **List # resident women in each age group (Px)**
2. **Calculate the age-specific birth rates (ASBR)**
   a) **Divide Bx by Px**
   b) **Multiply by 1,000**
3. **Sum the age-specific birth rates (ASBR)**
4. **Multiply the total ASBR by 5**

Total Fertility Rate for an area for year 2000:

1. Determine Bx and Px (given)

Mother's Age Group	2000 Live Births (Bx)	2000 Mid-year Female Population (Px)	ASBR
10-14	300*	165,000	
15-19	11,000	179,000	
20-24	20,000	192,000	
25-29	22,000	222,000	
30-34	20,000	213,000	
35-39	10,000	212,000	
40-44	2,000	210,000	
45-49	500*	200,000	

*For groups 10-14 & 45-49, births to ages < 15 and 45+ are used.

Total Fertility Rate for an area for year 2000:

2. Calculate the age-specific birth rate (ASBR)

$$ASBR = \frac{Bx}{Px} \times 1{,}000$$

Age Group	2000 Live Births (Bx)	2000 Female Population (Px	ASBR rounded)
10-14	300	165,000	

SOURCES: NAPHSIS

Total Fertility Rate for an area for year 2000:

2. Calculate the age-specific birth rate (ASBR)

$$ASBR = \frac{Bx}{Px} \times 1{,}000$$

Mother's Age Group	2000 Live Births (Bx)	2000 Female Population (Px	ASBR rounded)
10-14	300	165,000	1.8

$$ASBR = \frac{300}{165{,}000} \times 1{,}000 = 1.8 \text{ live births per } 1{,}000$$

SOURCES: NAPHSIS

Total Fertility Rate for an area for year 2000:

Finish the remaining groups …

Mother's Age Group	2000 Live Births (Bx)	2000 Female Population (Px)	ASBR (rounded)
10-14	300*	165,000	1.8=300/165,000*1,000
15-19	11,000	179,000	
20-24	20,000	192,000	
25-29	22,000	222,000	
30-34	20,000	213,000	
35-39	10,000	212,000	
40-44	2,000	210,000	
45-49	500*	200,000	

*For groups 10-14 & 45-49, births to ages < 15 and 45+ are used.

Total Fertility Rate for an area for year 2000:

Finish the remaining groups …

Mother's Age Group	2000 Live Births (Bx)	2000 Female Population (Px)	ASBR (rounded)
10-14	300*	165,000	1.8
15-19	11,000	179,000	61.5
20-24	20,000	192,000	104.2
25-29	22,000	222,000	99.1
30-34	20,000	213,000	93.9
35-39	10,000	212,000	47.2
40-44	2,000	210,000	9.5
45-49	500*	200,000	2.5

*For groups 10-14 & 45-49, births to ages < 15 and 45+ are used.

Total Fertility Rate for an area for year 2000:

3. Sum the age-specific birth rates (ASBR)

Age Group	2000 Live Births (Bx)	2000 Female Population (Px)	ASBR (rounded)
10-14	300*	165,000	1.8
15-19	11,000	179,000	---
20-24	20,000	192,000	---
25-29	22,000	222,000	---
30-34	20,000	213,000	---
35-39	10,000	212,000	---
40-44	2,000	210,000	---
45-49	500*	200,000	---

Total or Σ of ASBRs → _____ **live births per 1,000**

SOURCES: NAPHSIS

Total Fertility Rate for an area for year 2000:

3. Sum the age-specific birth rates (ASBR)

Age Group	2000 Live Births (Bx)	2000 Female Population (Px)	ASBR (rounded)
10-14	300*	165,000	1.8
15-19	11,000	179,000	61.5
20-24	20,000	192,000	104.2
25-29	22,000	222,000	99.1
30-34	20,000	213,000	93.9
35-39	10,000	212,000	47.2
40-44	2,000	210,000	9.5
45-49	500*	200,000	2.5

Total or Σ of ASBRs → **419.7 live births per 1,000**

SOURCES: NAPHSIS

Total Fertility Rate for an area for year 2000:

4. Multiply the total ASBR by 5

Total or Σ of ASBRs → _____ *live births per 1,000*

$$TFR = (\Sigma ASBR) \times 5$$

SOURCES: NAPHSIS

Total Fertility Rate for an area for year 2000:

4. Multiply the total ASBR by 5

Total or Σ of ASBRs → *419.7 live births per 1,000*

$$TFR = (\Sigma ASBR) \times 5$$

419.7 X 5 = 2,098.5 *live births per 1,000 female area residents in 2000 who live through their reproductive yrs*

An alternative interpretation:

2,098.5 / 1,000 = ***2.1 children per woman during reproductive years***

SOURCES: NAPHSIS

Natality Statistics

What types of natality statistics are produced/used in your country?

Review: Natality Statistics

- Crude birth rate
- Sex ratio at birth
- % low (very low) birth weight
- % preterm live births
- Age-specific birth rates
- General fertility rate
- Total fertility rate

Natality Statistics: Tabulations & Figures

- Data based on information recorded on birth certificate/registration
- Where necessary, use census/projections for denominators
- Uses: identify population group with highest # or % of births

Live Births by Age of Mother & Live Birth Order

Live birth order (child)	All ages	< 15 years	15-19 years	20-24 years	25-29 years	30-34 years	35-39 years	40-44 years	45-49 years	50-54 years
1st	194,990	1,245	40,367	49,976	44,294	32,894	16,928	8,289	997	25
2nd	164,574	53	10,944	39,678	42,028	39,288	21,934	9,427	1,183	39
3rd	108,726	5	2,023	17,823	35,098	27,185	17,932	7,926	715	19
4th	55,737	-	589	6,023	12,377	22,047	9,022	5,078	585	16
5th	45,061	-	128	2,133	6,992	19,832	8,043	7,012	898	23
6th	10,339	-	15	849	3,514	3,349	1,970	590	48	4
7th	5,000	-	3	195	1,364	1,802	1,210	393	29	4
8th+	4,783	-	2	76	788	1,645	1,573	640	50	9
Not stated	6,858	33	1,010	2,153	1,763	1,133	588	166	11	1

SOURCES: NVSS Births, p 31.

Live Births and Fertility Rates

Year	Number of Live Births among women aged 15-44 years	Rate per 1,000 women aged 15-44 years
1996	3,928,442	61.4
1997	3,810,292	60.9
1998	3,319,013	57.6
1999	3,421,573	56.4
2000	3,701,352	58.9
2001	3,910,102	60.2
2002	3,892,047	61.5
2003	4,277,382	63.8
2004	4,729,100	64.2
2005	4,779,291	64.5

SOURCES: NVSS, p 4.

Number of Live Births

Year	Number of Live Births among women aged 15-44 years
1996	3,928,442
1997	3,810,292
1998	3,319,013
1999	3,421,573
2000	3,701,352
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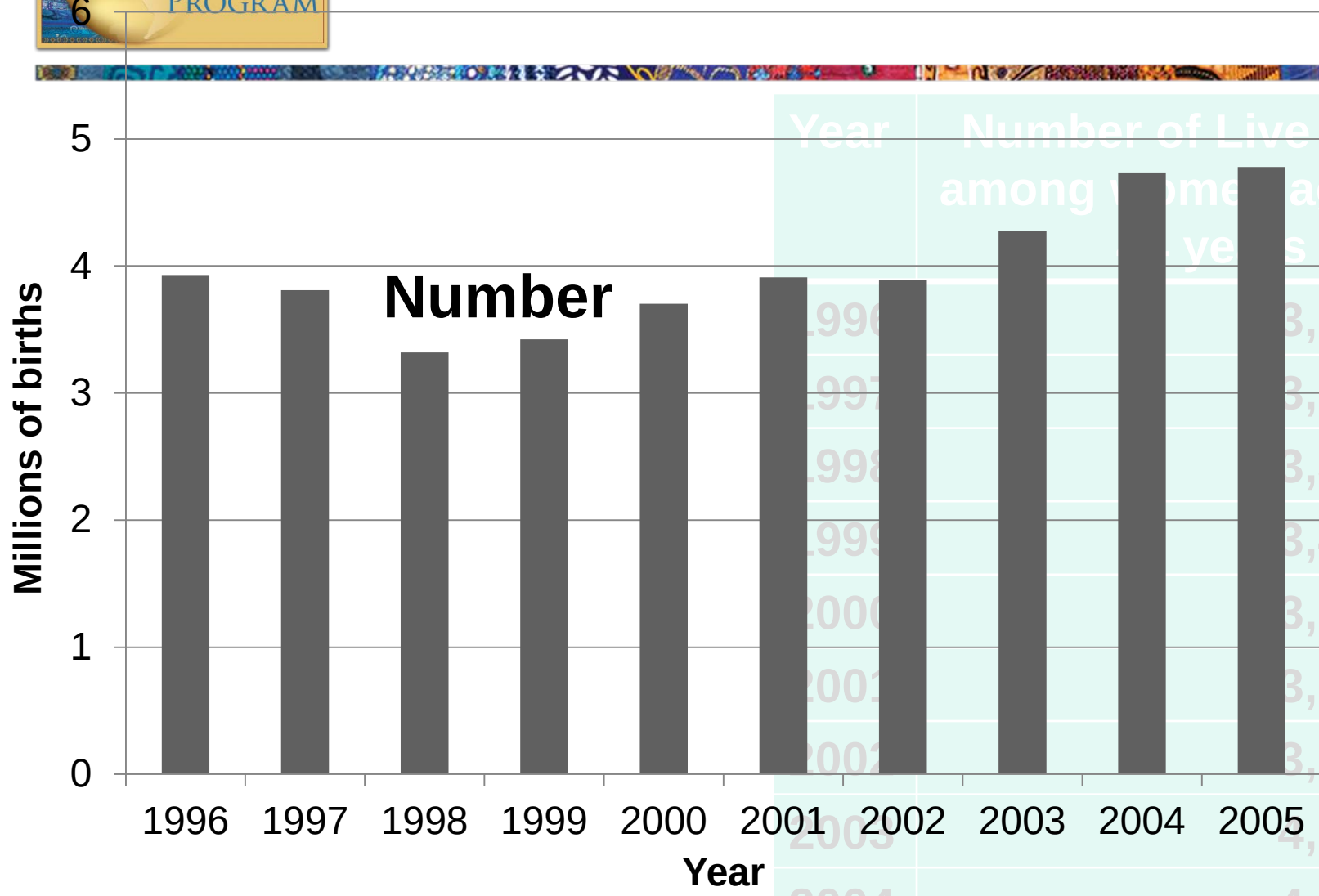
Number of Live Births



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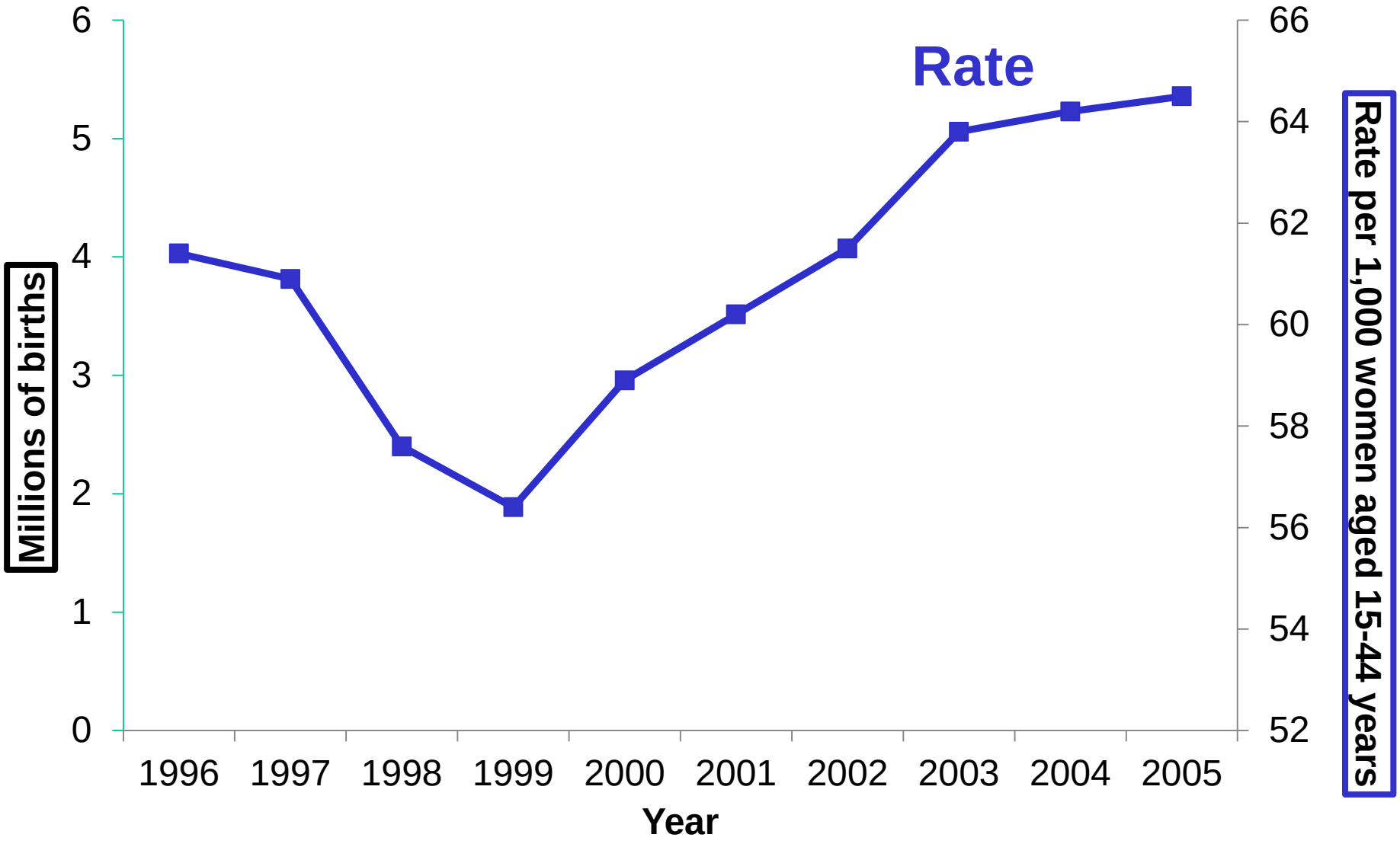
Fertility Rates

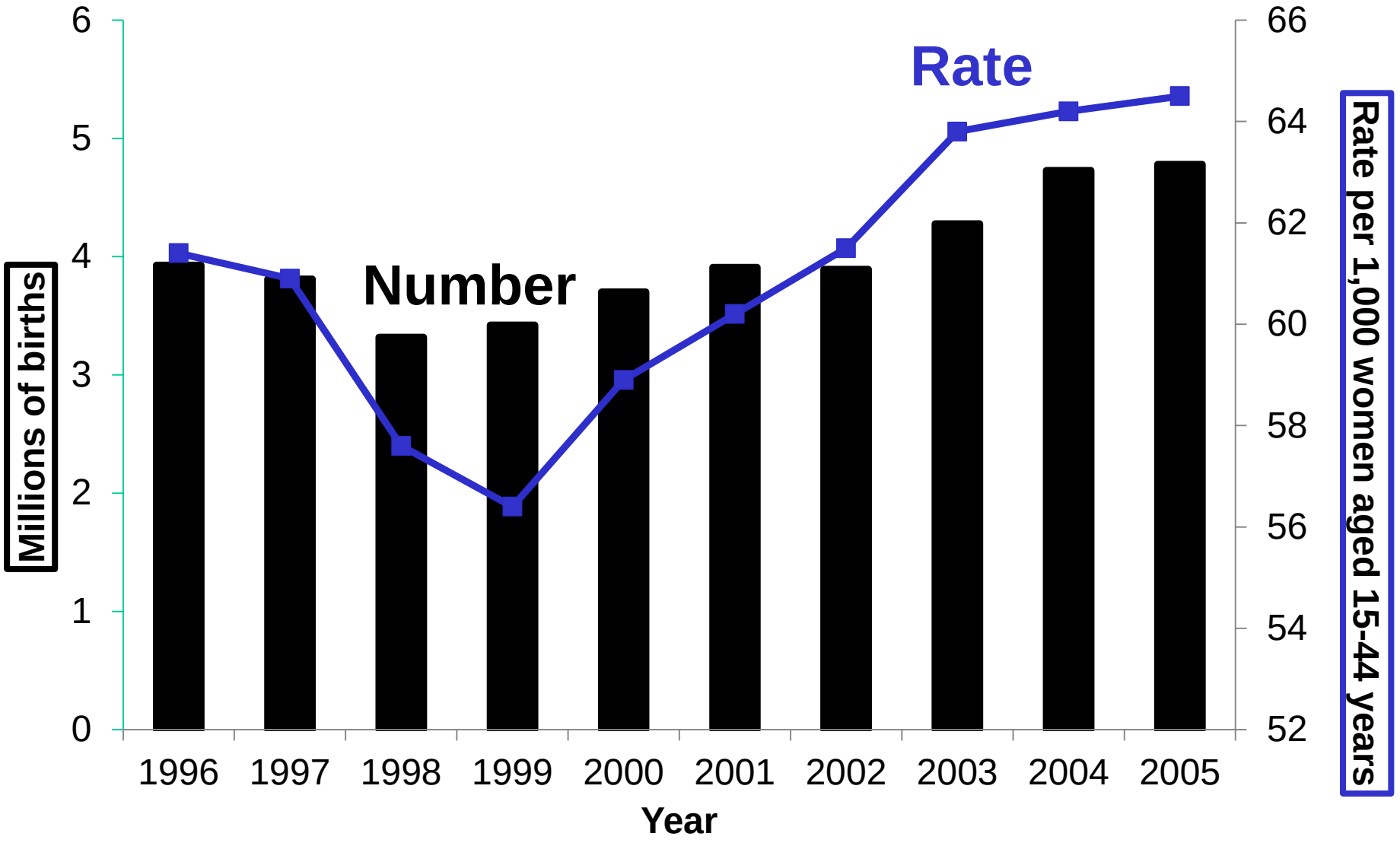
Year	Rate per 1,000 women aged 15-44 years
1996	61.4
1997	60.9
1998	57.6
1999	56.4
2000	58.9
2001	60.2
2002	61.5
2003	63.8
2004	64.2
2005	64.5

SOURCES: NVSS, p 4.

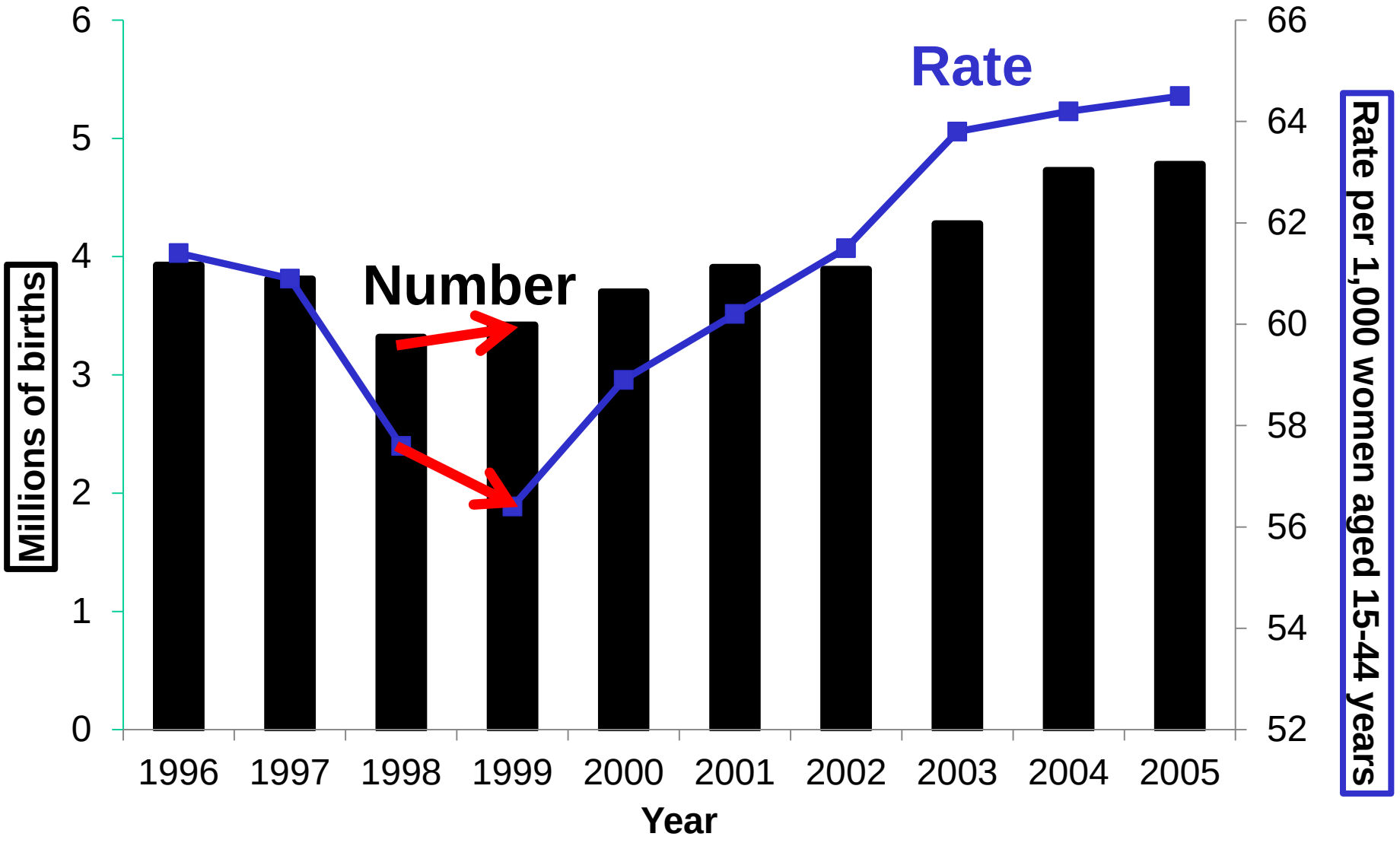
Fertility Rates



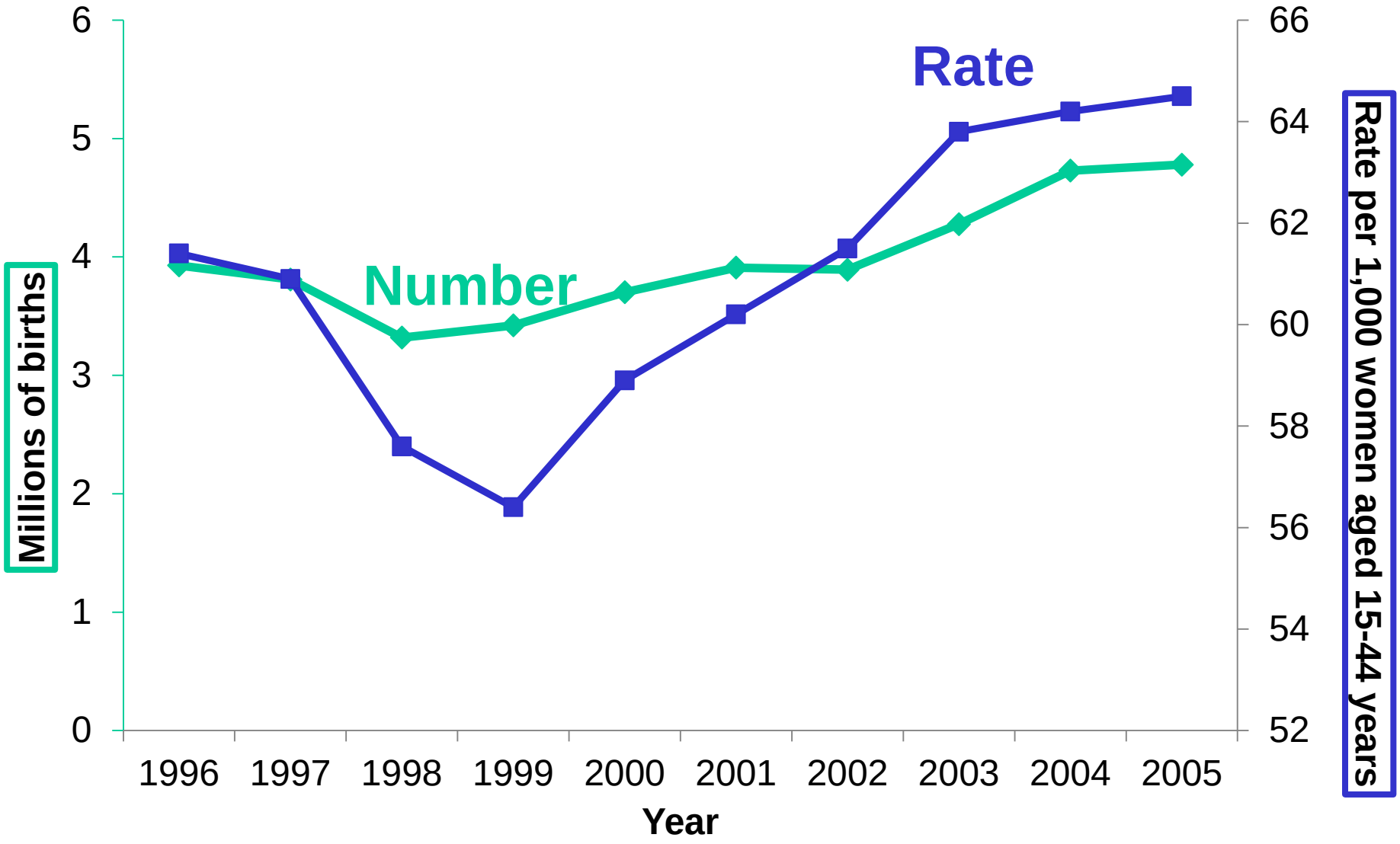
Live Births and Fertility Rates



Live Births and Fertility Rates



Live Births and Fertility Rates

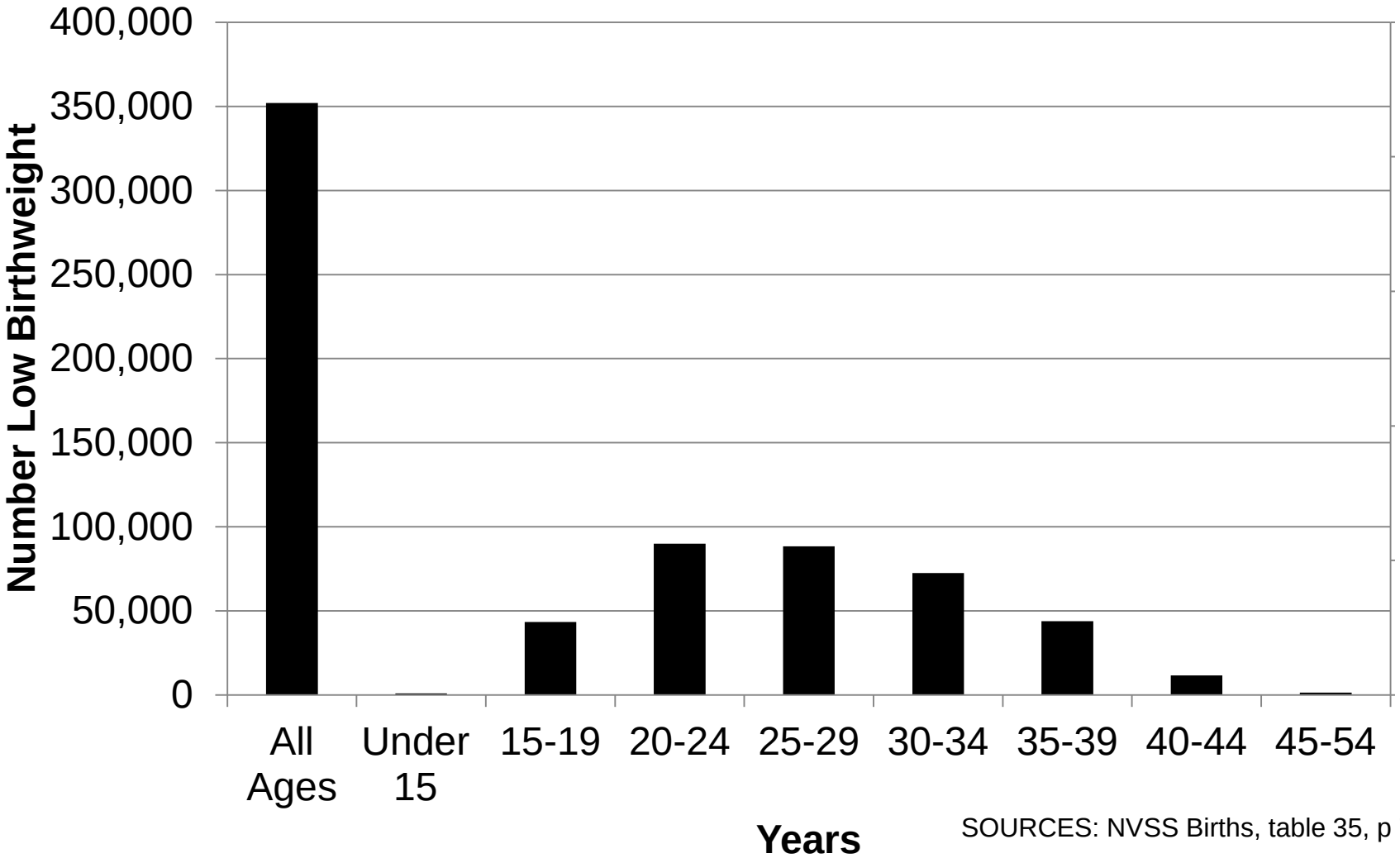


% Low Birthweight by Age of Mother

Age of Mother	Number Low Birthweight	% low Birthweight
All Ages	351,974	8.3
Under 15 years	856	13.4
15-19 years	43,369	10.0
20-24 years	89,982	8.3
25-29 years	88,386	7.5
30-34 years	72,524	7.6
35-39 years	43,855	8.8
40-44 years	11,589	11.0
45-54 years	1,413	20.3

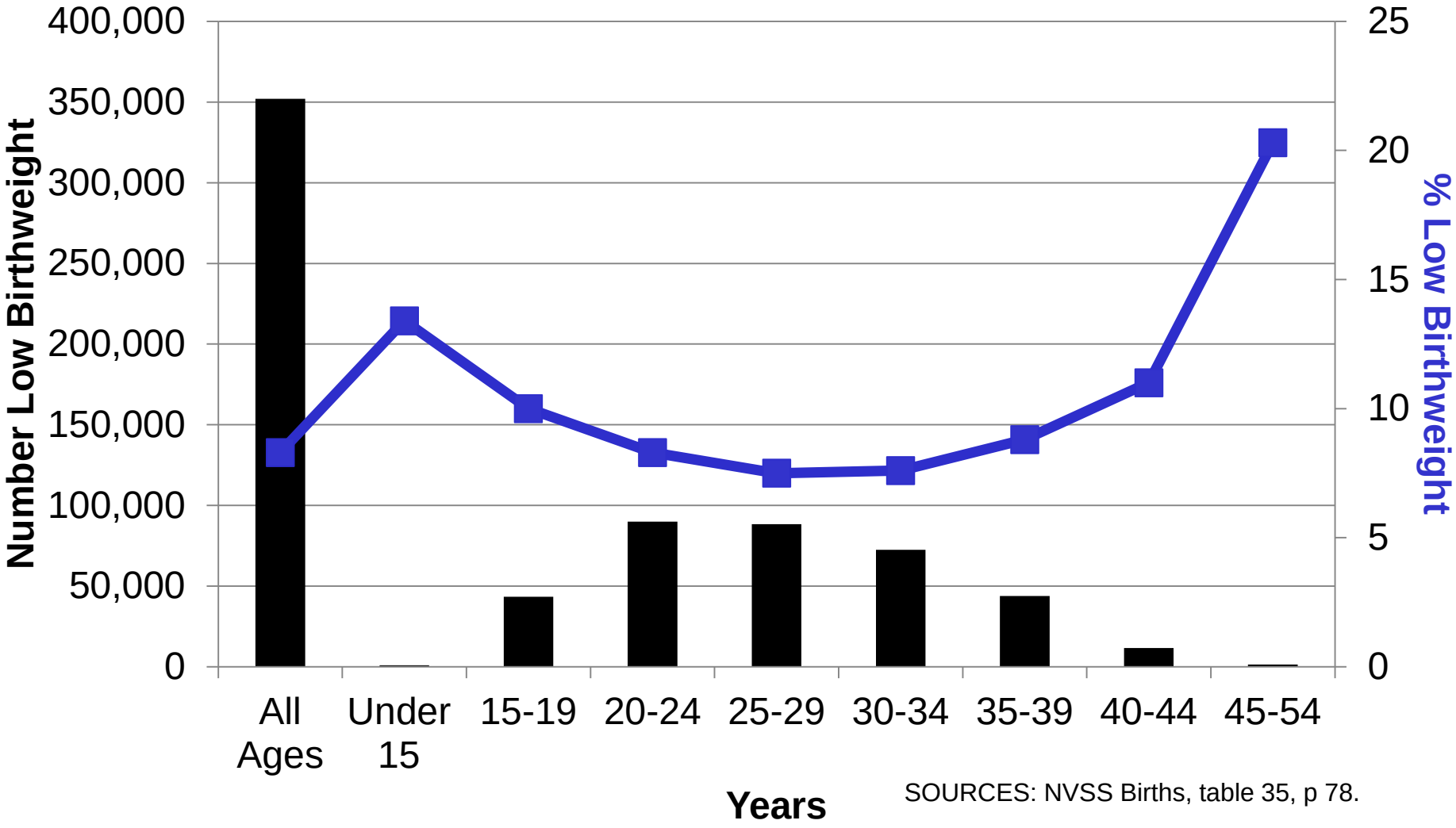
Sources: NVSS Births, table 35, p 78.

Number of Low Weight Births by Age of Mother



SOURCES: NVSS Births, table 35, p 78.

% Low Birthweight by Age of Mother



SOURCES: NVSS Births, table 35, p 78.

Total Fertility Rates & Birth Rates by Age of Mother

Year	Total Fertility Rate	Birth Rates (live births per 1,000 females)							
		10-14 Years	15-19 years	20-24 years	25-29 years	30-34 years	35-39 years	40-44 years	45-49 years
2006	2,100.5	0.6	41.9	105.9	116.7	97.7	47.3	9.4	0.6
2005	2,053.5	0.7	40.5	102.2	115.5	95.8	46.3	9.1	0.6
2004	2,045.5	0.7	41.1	101.7	115.5	95.3	45.4	8.9	0.5
2003	2,042.5	0.6	41.6	102.6	115.6	95.1	43.8	8.7	0.5
2002	2,013.0	0.7	43.0	103.6	113.6	91.5	41.4	8.3	0.5
2001	2,034.0	0.8	45.3	106.2	113.4	91.9	40.6	8.1	0.5
2000	2,056.0	0.9	47.7	109.7	113.5	91.2	39.7	8.0	0.5
1999	2,007.5	0.9	48.8	107.9	111.2	87.1	37.8	7.4	0.4
1998	1,999.0	1.0	50.3	108.4	110.2	85.2	36.9	7.4	0.4
1999	1,971.0	1.1	51.3	107.3	108.3	83.0	35.7	7.1	0.4

SOURCES: NVSS Births, p 33.

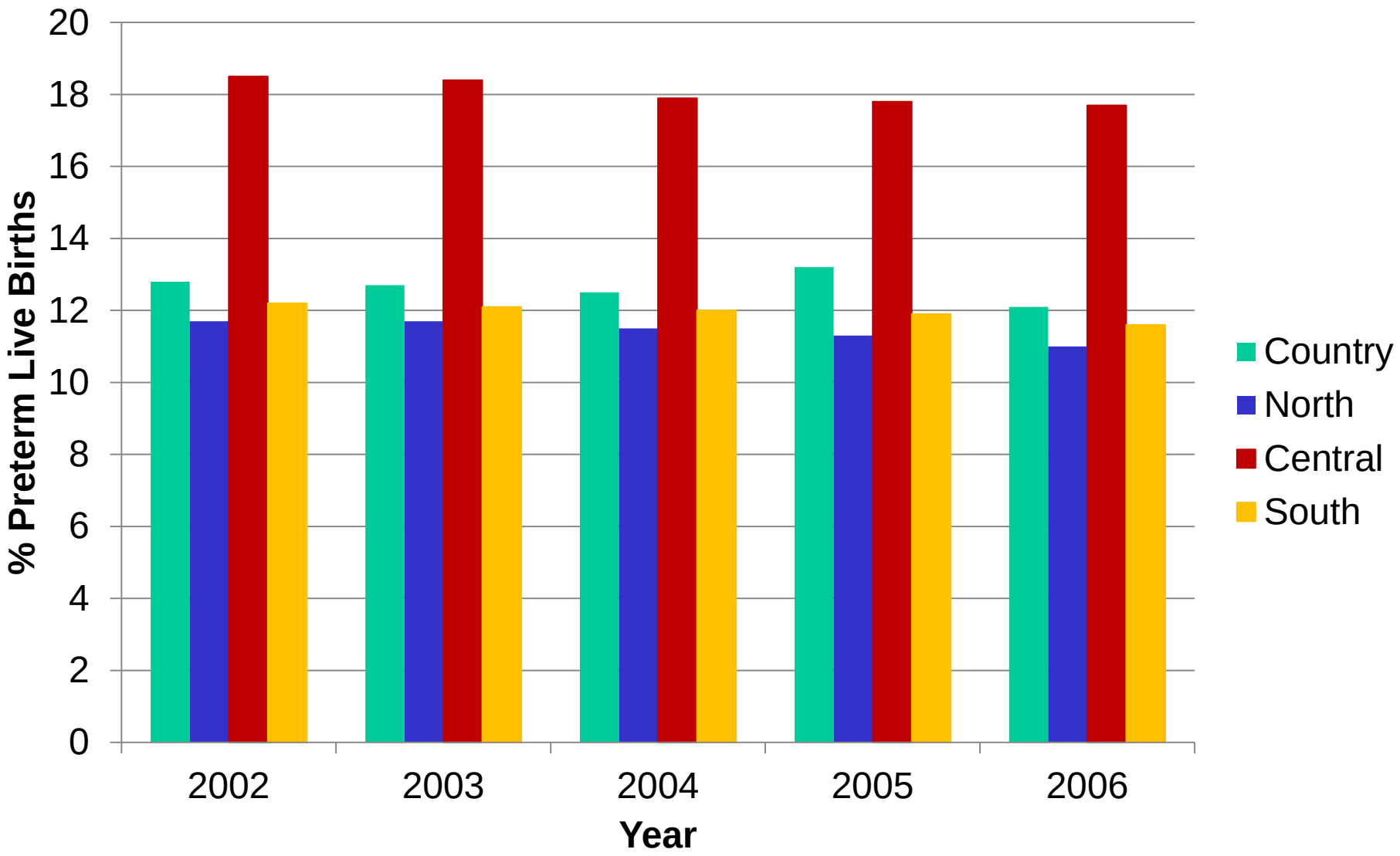
Exercise: Graph the % of Preterm Live Births

Year	Country	North	Central	South
2002	12.8	11.7	18.5	12.2
2003	12.7	11.7	18.4	12.1
2004	12.5	11.5	17.9	12.0
2005	13.2	11.3	17.8	11.9
2006	12.1	11.0	17.7	11.6

- **Bar graph**
- **Over time, by year**
- **Total & by region**

SOURCES: NVSS Births

% Preterm Live Births by Region 2002-2006



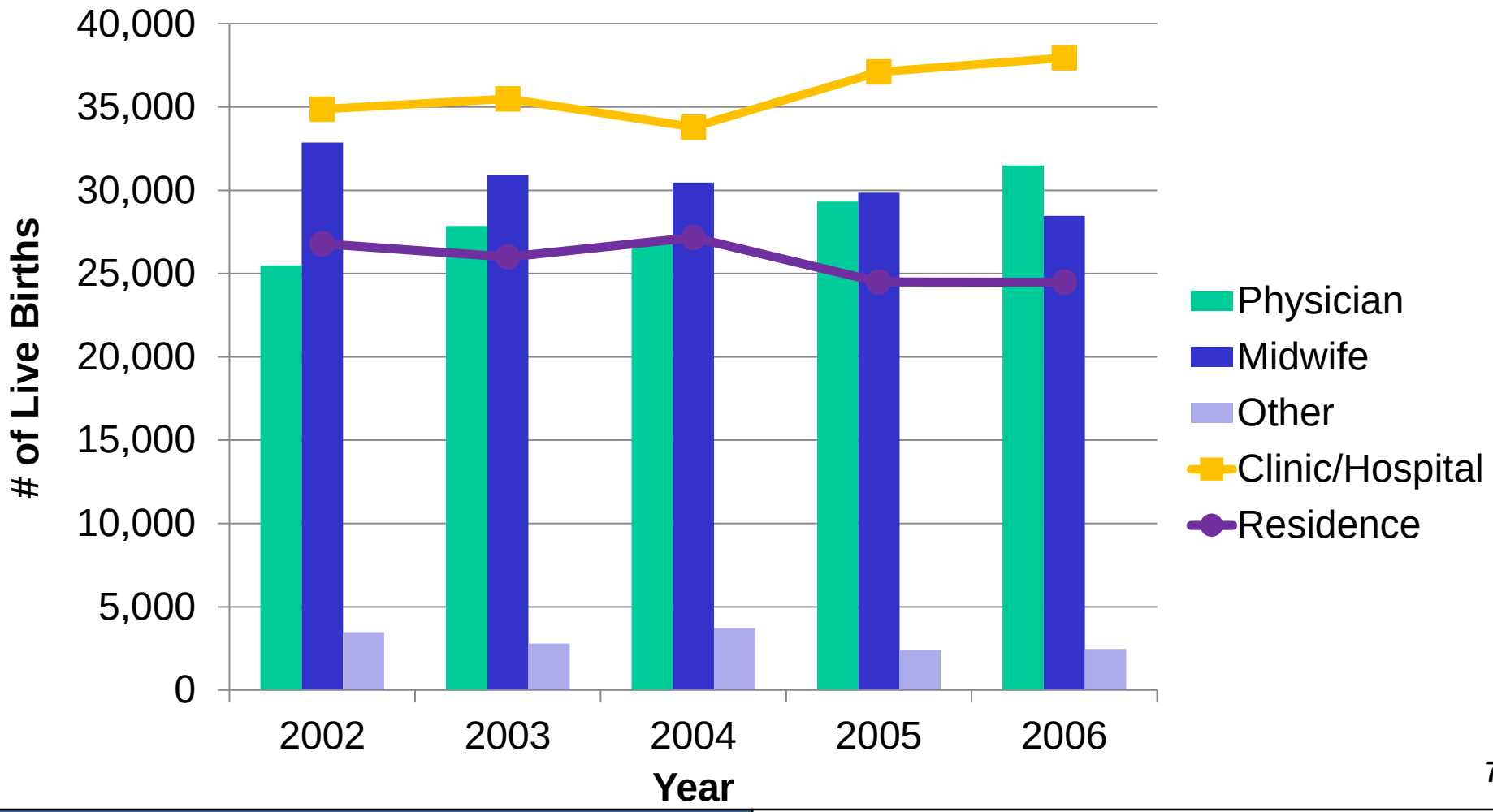
Exercise: Graph the # of Live Births by Attendant and Place of Delivery

	Attendant			Place of Delivery	
Year	Physician	Midwife	Other	Clinic/ Hospital	Residence
2002	25,487	32,864	3,477	34,862	26,786
2003	27,855	30,893	2,796	35,489	26,001
2004	26,783	30,455	3,711	33,786	27,163
2005	29,325	29,861	2,421	37,104	24,503
2006	31,499	28,471	2,468	37,949	24,489

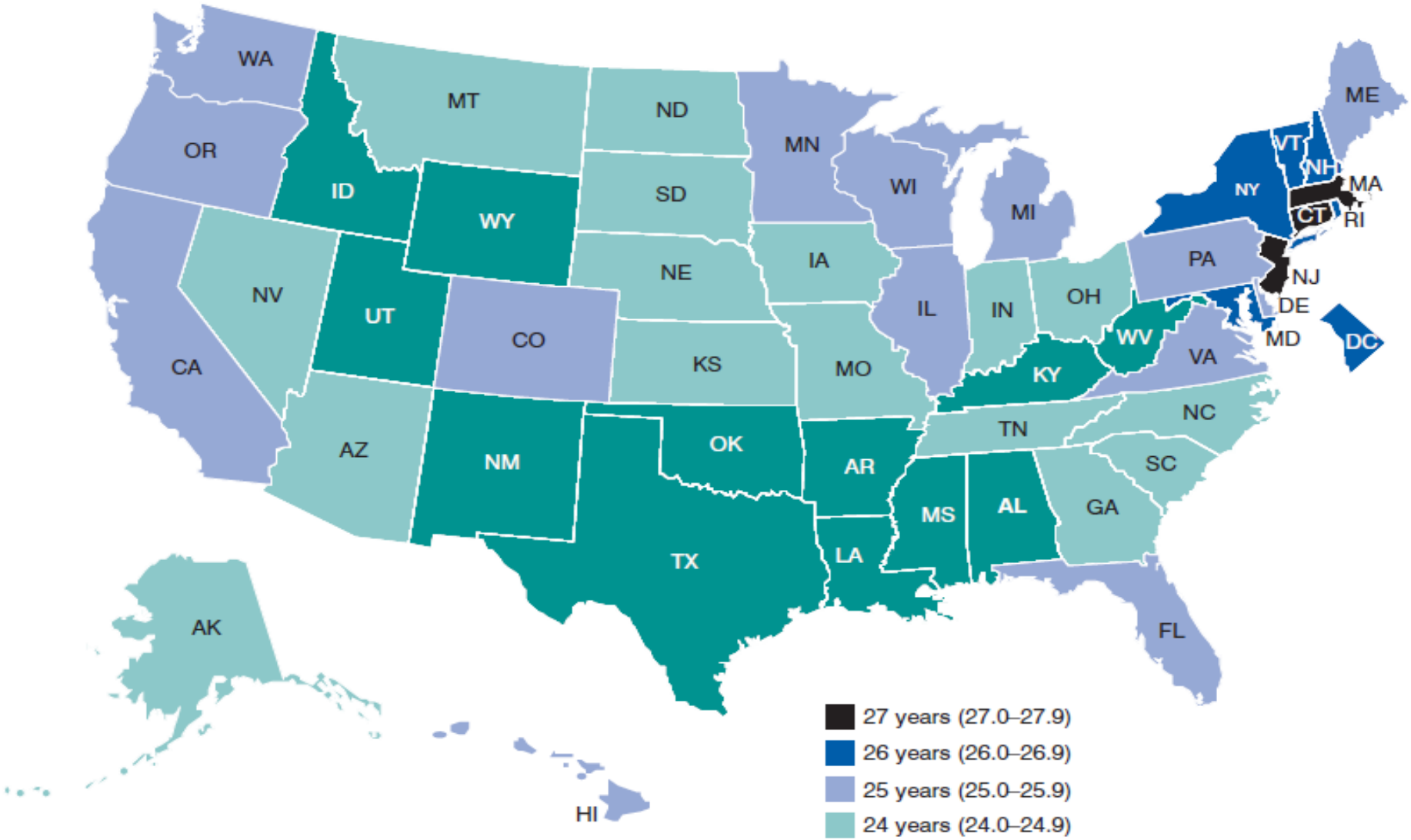
- Bar & Line graph
- Over time, by year
- By attendant (bar) & place of delivery (line)

SOURCES: NVSS Births

Number of Live Births by Attendant & Place of Delivery



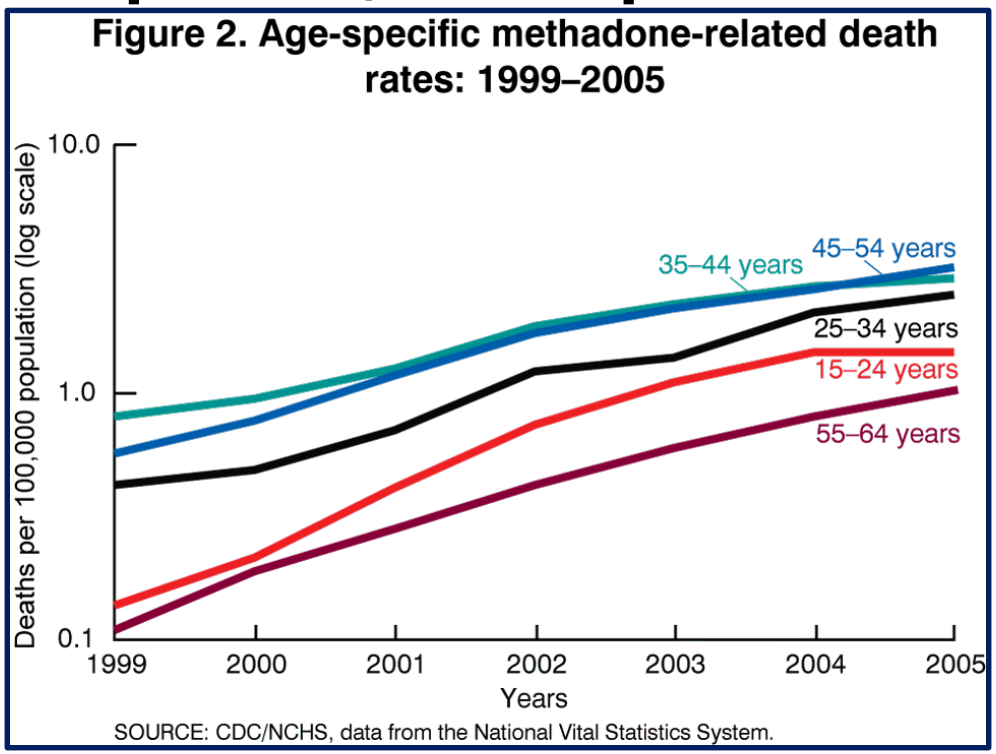
Mean Age of Mother at First Birth By State



NOTE: Mean age of mother at first birth for United States, 25.0.
SOURCE: CDC/NCHS, National Vital Statistics System.

Mortality Statistics

- Crude rates
- Age specific, cause specific, race specific rates
- Age adjusting
- Tabulations
- Graphs/charts/ figures



SOURCES: NAPHSIS

Crude Death Rate

- # resident deaths for a specific area during a specified period
- divided by the total population (mid-year estimate) for the same area/period
- multiplied by 100,000

$$\frac{\text{\# of resident deaths}}{\text{Total Population}} \times 100{,}000$$

ON YOUR OWN: What is the crude death rate in the area in 2006?

15,231 = total deaths in area during 2006

2,010,787 = estimated 2006 mid-year population for area residents

SOURCES: NAPHSIS

Crude Death Rate

15,231 = total deaths in area during 2006

2,010,787 = estimated 2006 mid-year population for area residents

$$\frac{15{,}231}{2{,}010{,}787} \times 100{,}000 = 757.5$$

757.5 resident deaths per 100,000 area population in 2006

SOURCES: NAPHSIS

Age Specific Death Rate

- # resident deaths for a specific age or age group in a specific area during a specified period
- divided by the population (mid-year estimate) of the same age or age group in the same area/period
- multiplied by 100,000

$$\frac{\text{\# of resident deaths in specified age/group}}{\text{Total population in same specified age/group}} \times 100{,}000$$

ON YOUR OWN: What is the area death rate for children ages 1-14 in 2006?

37 = deaths among area children ages 1 -14 during 2006

381,910 = estimated 2006 mid-year population for area population aged 1-14

SOURCES: NAPHSIS

Age Specific Death Rate

37 = deaths among area children ages 1-14 during 2006

381,910 = estimated 2006 mid-year population for area population aged 1-14

$$\frac{37}{381{,}910} \times 100{,}000 = 9.7$$

9.7 deaths per 100,000 area population aged 381,910 1-14 in 2006

SOURCES: NAPHSIS

Cause Specific Death Rate

- # resident deaths from a specified cause in a specific area during a specified period
- divided by the total population at risk (mid-year estimate) in the same area/period
- multiplied by 100,000

$$\frac{\text{\# of resident deaths from specific cause}}{\text{Total population at risk}} \times 100{,}000$$

ON YOUR OWN: What is the 2006 area death rate for homicide deaths?

137 = homicide deaths among area residents in 2006

2,010,787 = estimated 2006 mid-year population for area

Cause Specific Death Rate

137 = homicide deaths among area residents in 2006

2,010,787 = estimated 2006 mid-year population for area

$$\frac{137}{2{,}010{,}787} \times 100{,}000 = 6.8$$

6.8 deaths from homicide per 100,000 area population in 2006

SOURCES: NAPHSIS

Infant Mortality Rate

- # resident newborns dying under 1 year of age for a specific area during a specified period
- divided by the number of resident live births for the same area/period
- multiplied by 1,000

$$\frac{\text{\# of resident infant deaths}}{\text{\# of resident live births}} \times 1{,}000$$

ON YOUR OWN: What is the area infant mortality rate in 2008?

1,300 = infant deaths in area during 2008

150,000 = live births in 2008 to area residents

SOURCES: NAPHSIS

Infant Mortality Rate

1,300 = infant deaths in area during 2008

150,000 = live births in 2008 to area residents

$$\frac{1{,}300}{150{,}000} \times 1{,}000 = 8.7$$

8.7 infant deaths per 1,000 live births among area residents in 2008

SOURCES: NAPHSIS

Maternal Mortality Rate

- # resident maternal deaths within 42 days of pregnancy termination due to complications of pregnancy, childbirth, and the puerperium in a specific area during a specified period
- divided by total resident live births for the same area/period
- multiplied by 100,000

$$\frac{\text{\# of resident maternal deaths}}{\text{\# of resident live births}} \times 100{,}000$$

ON YOUR OWN: What is the 2008 area maternal mortality rate?

84 = maternal deaths in area during 2008

130,000 = live births in 2008 to area residents

Maternal Mortality Rate

84 = maternal deaths in area during 2008

130,000 = live births in 2008 to area residents

$$\frac{84}{130{,}000} \times 100{,}000 = 64.6$$

64.6 maternal deaths per 100,000 live births among area residents in 2008

SOURCES: NAPHSIS

Pregnancy-Related Mortality Rate

- # resident deaths of individuals within 42 days of pregnancy termination due to any cause in a specific area during a specified period
- divided by total resident live births for the same area/period
- multiplied by 100,000

$$\frac{\text{\# of resident pregnancy-related deaths}}{\text{\# of resident live births}} \times 100{,}000$$

ON YOUR OWN: What is the 2008 area pregnancy-related mortality rate?

91 = pregnancy-related deaths among area during 2008

130,000 = live births in 2008 to area residents

Pregnancy-Related Mortality Rate

91 = pregnancy-related deaths among area during 2008

130,000 = live births in 2008 to area residents

$$\frac{91}{130{,}000} \times 100{,}000 = 70.0$$

70.0 pregnancy-related deaths per 100,000 live births among area residents in 2008

SOURCES: NAPHSIS

Life Expectancy at Birth

- **Derived through life table calculations**
- **Standardized summary measure**
- **Used as an overall gauge of health, based on population's age-specific mortality experience**
- **Index of the level of mortality within a population**
- **Represent *hypothetical* # years a newborn would live under prevailing mortality levels**

SOURCES: NAPHSIS

LIFE TABLE FOR STATE RESIDENTS, 1999-2001

SOURCES: NAPHSIS		Of 100,000 Born Alive			Stationary Population		
Age at Start of Interval (years)	Probability of Dying During Interval	# Living at Start of Interval	# Dying During Interval		# of Person-Years Lived In the Interval	# of Person-Years Lived in Interval & All Years After	Average Years of Remaining Lifetime
x	$_nq_x$	lx	$_nd_x$		$_nL_x$	T_x	e_x
0	0.00842	100,000	842		99,229	7,682,595	76.8
1	0.00132	99,158	131		396,306	7,583,366	76.5
5	0.00072	99,027	71		494,956	7,187,060	72.6
10	0.00093	98,956	92		494,632	6,692,103	67.6
15	0.00347	98,864	343		493,535	6,197,472	62.7
20	0.00499	98,521	491		491,374	5,703,937	57.9
25	0.00443	98,030	434		489,090	5,212,563	53.2
30	0.00555	97,595	542		486,695	4,723,473	48.4
35	0.00760	97,054	737		483,565	4,236,779	43.7
40	0.01161	96,316	1,118		479,004	3,753,214	39.0
45	0.01766	95,199	1,681		472,041	3,274,211	34.4
50	0.02458	93,517	2,299		462,316	2,802,169	30.0
55	0.03950	91,219	3,603		447,796	2,339,853	25.7
60	0.06192	87,615	5,425		425,422	1,892,057	21.6
65	0.09363	82,190	7,965		392,871	1,466,635	17.8
70	0.14175	74,495	10,560		347,266	1,073,764	14.4
75	0.20809	63,935	13,304		287,616	726,498	11.4
80	0.31556	50,631	15,977		216,239	438,882	8.7
85	1.00000	34,654	34,654		222,643	222,643	6.4

LIFE TABLE FOR STATE RESIDENTS, 1999-2001

SOURCES: NAPHSIS	Of 100,000 Born Alive			Stationary Population		
Age at Start of Interval (years)	Probability of Dying During Interval	# Living at Start of Interval	# Dying During Interval	# of Person-Years Lived In the Interval	# of Person-Years Lived in Interval & All Years After	Average Years of Remaining Lifetime
x	$_nq_x$	lx	$_nd_x$	$_nL_x$	T_x	e_x
0	0.00842	100,000	842	99,229	7,682,595	**76.8**
1	0.00132	99,158	131	396,306	7,583,366	**76.5**
5	0.00072	99,027	71	494,956	7,187,060	72.6
10	0.00093	98,956	92	494,632	6,692,103	67.6
15	0.00347	98,864	343	493,535	6,197,472	62.7
20	0.00499	98,521	491	491,374	5,703,937	57.9
25	0.00443	98,030	434	489,090	5,212,563	53.2
30	0.00555	97,595	542	486,695	4,723,473	48.4
35	0.00760	97,054	737	483,565	4,236,779	43.7
40	0.01161	96,316	1,118	479,004	3,753,214	39.0
45	0.01766	95,199	1,681	472,041	3,274,211	34.4
50	0.02458	93,517	2,299	462,316	2,802,169	30.0
55	0.03950	91,219	3,603	447,796	2,339,853	25.7
60	0.06192	87,615	5,425	425,422	1,892,057	21.6
65	0.09363	82,190	7,965	392,871	1,466,635	**17.8**
70	0.14175	74,495	10,560	347,266	1,073,764	14.4
75	0.20809	63,935	13,304	287,616	726,498	11.4
80	0.31556	50,631	15,977	216,239	438,882	8.7
85	1.00000	34,654	34,654	222,643	222,643	6.4

Years of Potential Life Lost (YPLL)

- **Difference between a predetermined end point age (usually 75 years) and the age at death for a death or deaths that occurred prior to that end point age**

YPLL = (predetermined end point age – age of decedent who died prior to end point age)

ON YOUR OWN: What is the YPLL for a given area resident in 2008?

75 = predetermined end point age

54 = age at death for an area resident in 2008 (who died prior to end point age)

SOURCES: NAPHSIS

Years of Potential Life Lost (YPLL)

75 = predetermined end point age

54 = age at death for an area resident in 2008 (who died prior to end point age)

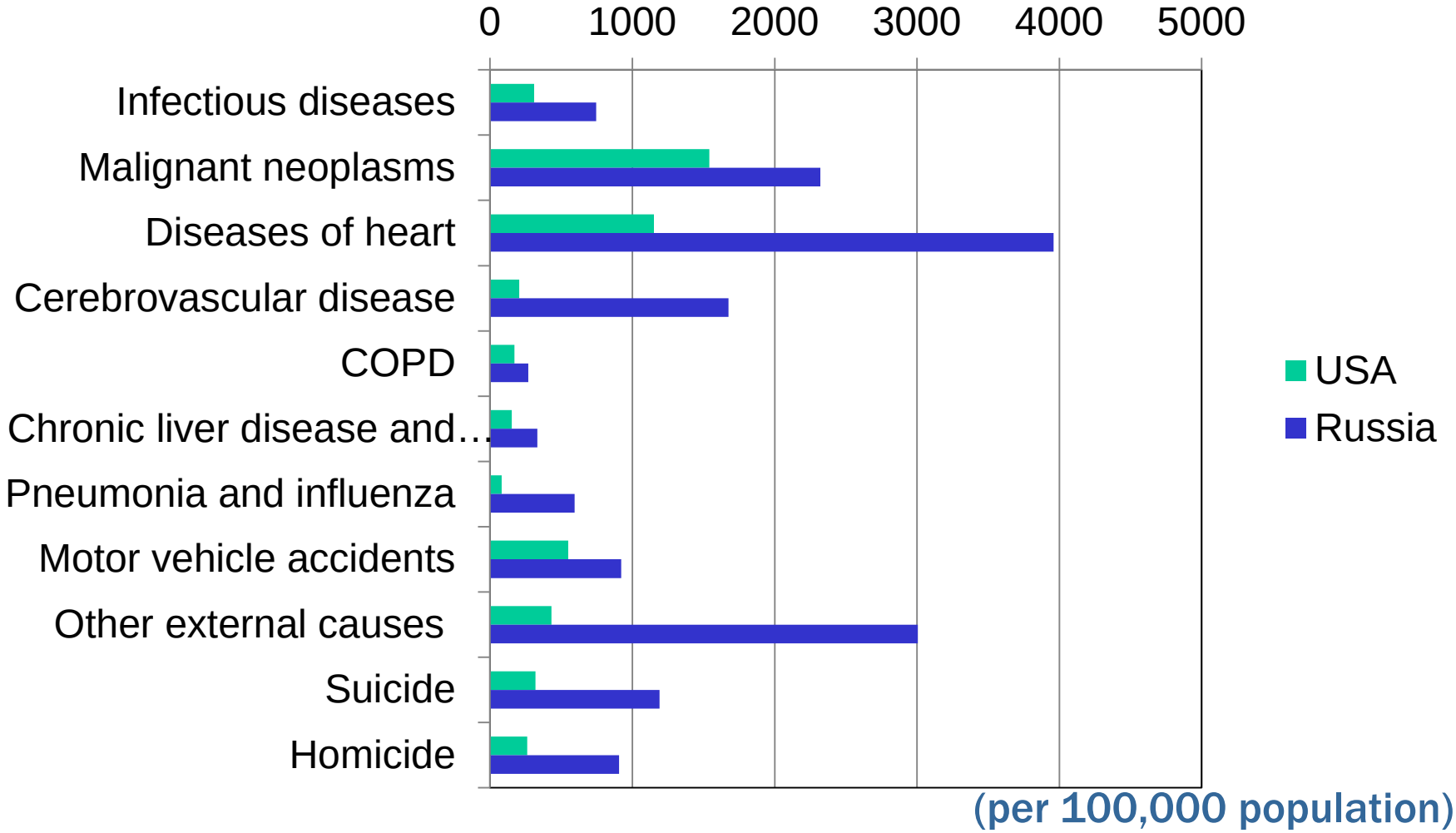
75 – 54 = 21

21 years of potential life lost to that resident who died at age 54 in 2008

SOURCES: NAPHSIS

Using Years of Potential Life Lost:

YPLL by Cause of Death, USA and Russia, 2000



Review: Mortality Statistics

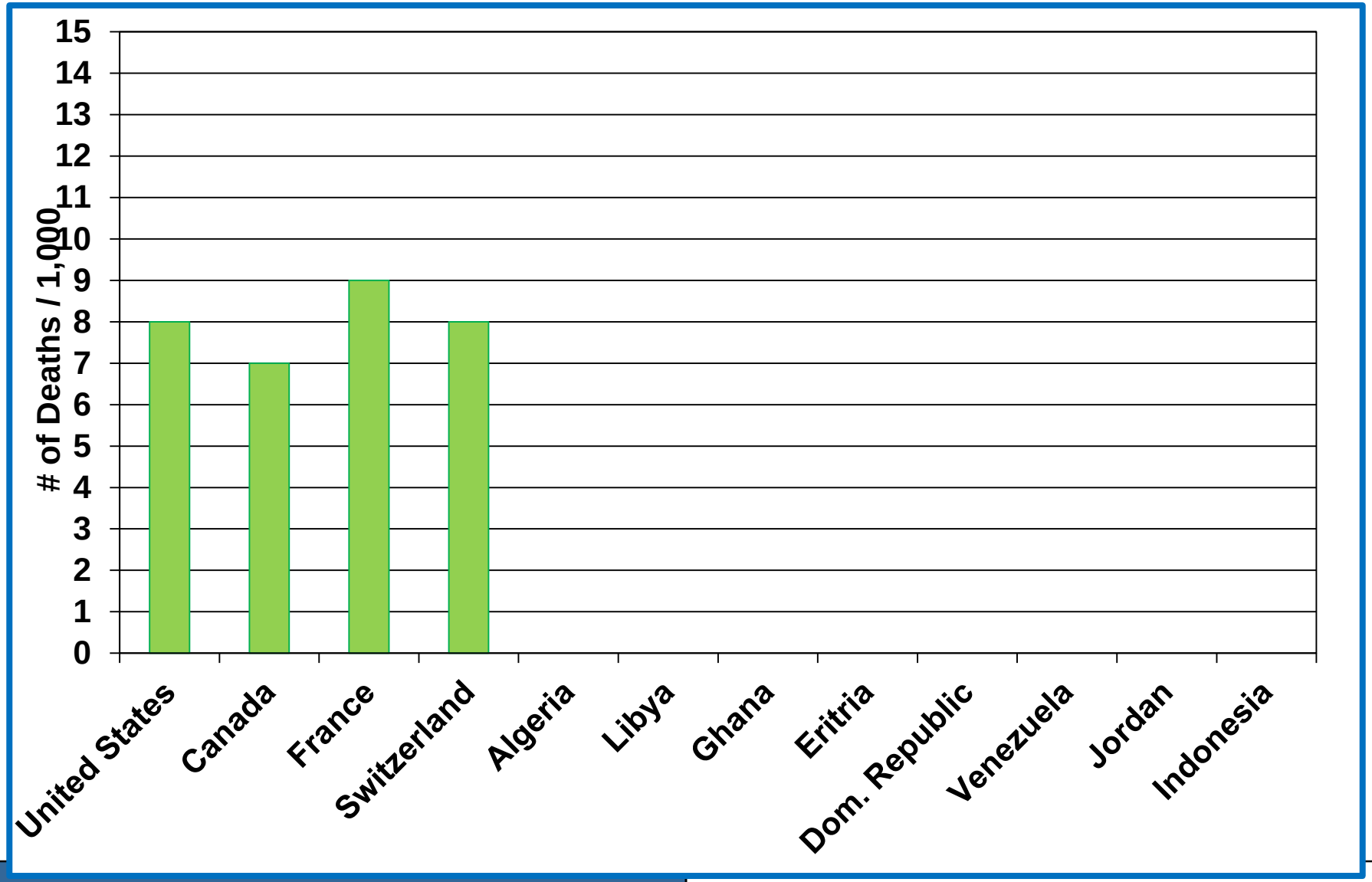
- Crude death rate
- Age specific death rate
- Cause specific death rate
- Infant mortality rate
- Maternal mortality rate
- Pregnancy-related mortality rate
- Life expectancy at birth
- Years of potential life lost

Mortality Statistics: Age Adjusting

- **Controls for effects of differences in population age distributions**
- **Used to compare relative mortality risks among:**
  - **groups (i.e. geographic areas)**
  - **over time**
- **View as relative indices rather than actual measures of mortality risk**

SOURCES: NAPHSIS; NVSS Deaths.

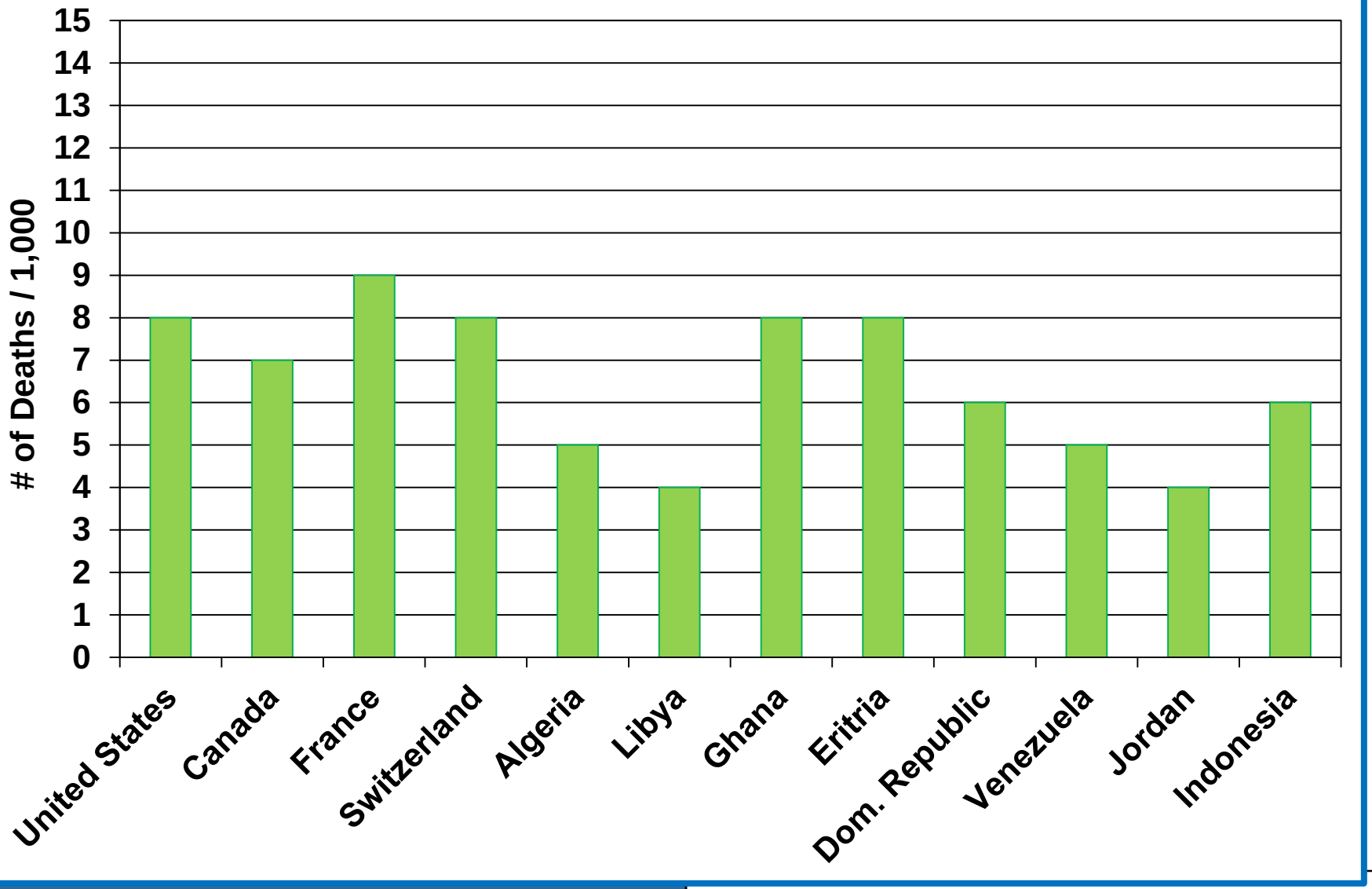
2011 Deaths per 1,000 Population



Analysis of Vital Statistics Data

Population Reference Bureau, 2011

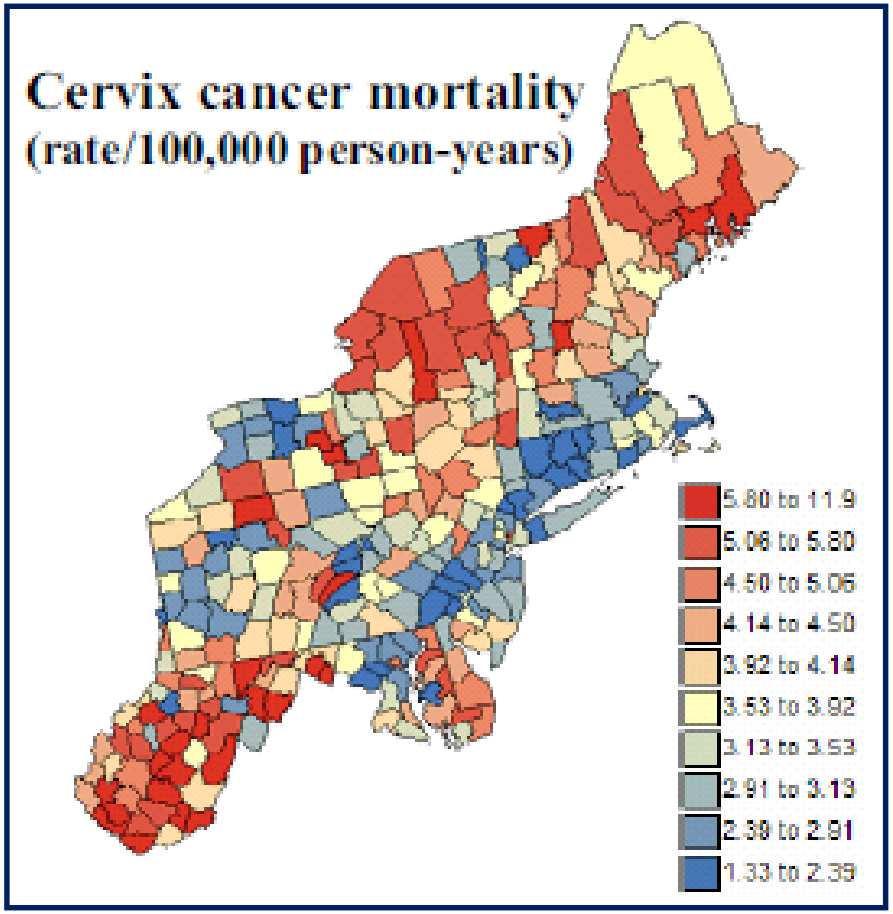
2011 Deaths per 1,000 Population



Population Reference Bureau, 2011

Mortality Statistics: Age Adjusted Death Rate

- A death rate that controls for the effects of differences in population age distributions
- Necessary for comparing across geographic areas



Goovaerts, 2005

SOURCES: NAPHSIS; NVSS Deaths.

Age-adjusted Death Rate: Direct Age-Adjustment

- Same as calculating weighted average
- Applying age-specific death rates in observed pop. to standard pop. age distribution (weights)
- Calculation:

1. Need standard population weights

$$\text{Weight} = \frac{\text{\# of persons in a given age group}}{\text{total \# of persons in standard population (all ages combined)}}$$

2. Calculate age-specific rate for each age group
3. Multiply age-specific rate for each age group by weight
4. Sum the products

SOURCES: NAPHSIS; NVSS Deaths; WHOSIS.

Exercise - Calculate:

Age-adjusted death rates

from diabetes mellitus

for State A and State B

using data from 2003-2005

1. Standard Population Weight

WHO World Standard Population Distribution

- **World Average: 2000-2025**

Age Group	Weight	World Average (Proportion, %)
0	0.018	1.8
1-4	0.07	7.0
5-14	0.173	17.3
15-24	0.167	16.7
25-34	0.155	15.5
35-44	0.138	13.8
45-54	0.114	11.4
55-64	0.083	8.3
65-74	0.052	5.2
75-84	0.024	2.4
85+	0.006	0.6
All Ages	1.00	100.0

SOURCES: NAPHSIS; NVSS Deaths; WHOSIS.

2. Calculate age-specific rate for each age group

Rate for Diabetes Mellitus, 2003-2005

	STATE A			STATE B		
Age Group (years)	# of Deaths	Population Counts	Age-Specific Rate	# of Deaths	Population Counts	Age-Specific Rate
Under 1	0	84,952		0	350	
1-4	0	325,508		0	1,266	
5-14	2	828,663		0	4,384	
15-24	2	893,809		0	4,526	
25-34	19	718,484		0	2,977	
35-44	61	810,632		1	4,269	
45-54	160	833,948		0	5,581	
55-64	297	602,768		1	5,985	
65-74	443	381,451		11	5,946	
75-84	546	235,030		6	4,086	
85 +	369	82,660		3	1,584	
All Ages	1,899	5,797,906		22	40,952	

Death Rate for Diabetes Mellitus, 2003-2005

	STATE A						STATE B					
Age Group (years)	# of Deaths		Population Counts		Age-Specific Rate		# of Deaths		Population Counts		Age-Specific Rate	
Under 1	0	/	84,952	=	0		0		350			
1-4	0		325,508				0		1,266			
5-14	2		828,663				0		4,384			
15-24	2		893,809				0		4,526			
25-34	19		718,484				0		2,977			
35-44	61		810,632				1		4,269			
45-54	160		833,948				0		5,581			
55-64	297		602,768				1		5,985			
65-74	443		381,451				11		5,946			
75-84	546		235,030				6		4,086			
85 +	369		82,660				3		1,584			
All Ages	1,899		5,797,906				22		40,952			

Death Rate for Diabetes Mellitus, 2003-2005

	STATE A						STATE B					
Age Group (years)	# of Deaths		Population Counts		Age-Specific Rate		# of Deaths		Population Counts		Age-Specific Rate	
Under 1	0	/	84,952	=	0		0	/	350	=	0	
1-4	0	/	325,508	=	0		0	/	1,266	=	0	
5-14	2	/	828,663	=	0.24		0	/	4,384	=	0	
15-24	2	/	893,809	=	0.22		0	/	4,526	=	0	
25-34	19	/	718,484	=	2.64		0	/	2,977	=	0	
35-44	61	/	810,632	=	7.52		1	/	4,269	=	23.43	
45-54	160	/	833,948	=	19.19		0	/	5,581	=	0	
55-64	297	/	602,768	=	49.27		1	/	5,985	=	16.71	
65-74	443	/	381,451	=	116.14		11	/	5,946	=	185.01	
75-84	546	/	235,030	=	232.31		6	/	4,086	=	146.85	
85 +	369	/	82,660	=	446.41		3	/	1,584	=	189.45	
All Ages	1,899	/	5,797,906	=	32.75		22	/	40,952	=	53.72	

3. Multiply age-specific rate for each age group by weight

Death Rate for Diabetes Mellitus, 2003-2005

	STATE A						STATE B				
Age Group (years)	Age-Specific Rate		WHO Standard Pop Weight		Age Adjusted Rate		Age-Specific Rate		WHO Standard Pop Weight		Age Adjusted Rate
Under 1	0	X	0.018	=	0		0		0.018		
1-4	0		0.07				0		0.07		
5-14	0.24		0.173				0		0.173		
15-24	0.22		0.167				0		0.167		
25-34	2.64		0.155				0		0.155		
35-44	7.52		0.138				23.43		0.138		
45-54	19.19		0.114				0		0.114		
55-64	49.27		0.083				16.71		0.083		
65-74	116.14		0.052				185.01		0.052		
75-84	232.31		0.024				146.85		0.024		
85 +	446.41		0.006				189.45		0.006		

Death Rate for Diabetes Mellitus, 2003-2005

	STATE A						STATE B					
Age Group (years)	Age-Specific Rate		WHO Standard Pop Weight		Age Adjusted Rate		Age-Specific Rate		WHO Standard Pop Weight		Age Adjusted Rate	
Under 1	0	X	0.018	=	0		0	X	0.018	=	0	
1-4	0	X	0.07	=	0		0	X	0.07	=	0	
5-14	0.24	X	0.173	=	0.042		0	X	0.173	=	0	
15-24	0.22	X	0.167	=	0.037		0	X	0.167	=	0	
25-34	2.64	X	0.155	=	0.409		0	X	0.155	=	0	
35-44	7.52	X	0.138	=	1.038		23.43	X	0.138	=	3.233	
45-54	19.19	X	0.114	=	2.188		0	X	0.114	=	0	
55-64	49.27	X	0.083	=	4.089		16.71	X	0.083	=	1.387	
65-74	116.14	X	0.052	=	6.039		185.01	X	0.052	=	9.621	
75-84	232.31	X	0.024	=	5.575		146.85	X	0.024	=	3.524	
85 +	446.41	X	0.006	=	2.678		189.45	X	0.006	=	1.137	

4. Sum the products

Death Rate for Diabetes Mellitus, 2003-2005

	STATE A						STATE B					
Age Group (years)	Age-Specific Rate		WHO Standard Pop Weight		Age Adjusted Rate		Age-Specific Rate		WHO Standard Pop Weight		Age Adjusted Rate	
Under 1	0	X	0.018	=	0		0	X	0.018	=	0	
1-4	0	X	0.07	=	0		0	X	0.07	=	0	
5-14	0.24	X	0.173	=	0.042		0	X	0.173	=	0	
15-24	0.22	X	0.167	=	0.037		0	X	0.167	=	0	
25-34	2.64	X	0.155	=	0.409		0	X	0.155	=	0	
35-44	7.52	X	0.138	=	1.038		23.43	X	0.138	=	3.233	
45-54	19.19	X	0.114	=	2.188		0	X	0.114	=	0	
55-64	49.27	X	0.083	=	4.089		16.71	X	0.083	=	1.387	
65-74	116.14	X	0.052	=	6.039		185.01	X	0.052	=	9.621	
75-84	232.31	X	0.024	=	5.575		146.85	X	0.024	=	3.524	
85 +	446.41	X	0.006	=	2.678		189.45	X	0.006	=	1.137	
All Ages					**22.095**						**18.902**	

Death Rate for Diabetes Mellitus, 2003-2005

	STATE A						STATE B					
Age Group (years)	Age-Specific Rate		WHO Standard Pop Weight		Age Adjusted Rate		Age-Specific Rate		WHO Standard Pop Weight		Age Adjusted Rate	
Under 1	0	X	0.018	=	0		0	X	0.018	=	0	
1-4	0	X	0.07	=	0		0	X	0.07	=	0	
5-14	0.24	X	0.173	=	0.042		0	X	0.173	=	0	
15-24	0.22	X	0.167	=	0.037		0	X	0.167	=	0	
25-34	2.64	X	0.155	=	0.409		0	X	0.155	=	0	
35-44	7.52	X	0.138	=	1.038		23.43	X	0.138	=	3.233	
45-54	19.19	X	0.114	=	2.188		0	X	0.114	=	0	
55-64	49.27	X	0.083	=	4.089		16.71	X	0.083	=	1.387	
65-74	116.14	X	0.052	=	6.039		185.01	X	0.052	=	9.621	
75-84	232.31	X	0.024	=	5.575		146.85	X	0.024	=	3.524	
85 +	446.41	X	0.006	=	2.678		189.45	X	0.006	=	1.137	
All Ages					**22.095**						**18.902**	
Crude Rates					**32.75**						**53.72**	

Review: Direct Age-Adjustment

1. Need standard population weights
2. Calculate age-specific rate for each age group
3. Multiply age-specific rate for each age group by weight
4. Sum the products

Standardized Mortality Ratio (Indirect Age-adjusted Death Rate)

- To compare the death rates of a study population with those of a standard population
- Averages specific rates in a standard population, weighted by the age distribution of the study population
  - Need:
    - Age-specific death rates for a standard population
    - Age distribution of study population
- Useful when age-specific # of deaths in the study population are unavailable or small (< 25)

SOURCES: NAPHSIS; NVSS Deaths.

Calculating a Standardized Mortality Ratio

1. **Calculate # of <u>expected deaths</u> in population:**

   Σ (Standard age-specific death rate) X (Study age-specific pop weight)

2. **Calculate the standardized mortality ratio**

$$\frac{\text{\# observed deaths in population}}{\text{\# expected deaths (step 1)}} \times 100$$

Exercise - Calculate:

Standardized Mortality Ratio (SMR)

for District A

using 2004 National death rates

as the standard for comparison

59,153 deaths were observed in District A in 2004

1. Calculate # of expected deaths in population

Σ (Standard age-specific death rate) X (Study age-specific pop weight)

Example of Calculating Expected Deaths in a Population

Age Group	National (Standard) Population Death Rate per 100,000		District A Population (#)			Expected Deaths (rounded)
0	5.3		154,585			
1-4	25.6		607,984			
5-14	14.1		1,585,503			
15-24	69.2		1,440,136			
25-34	83.6		1,528,427			
35-44	156.5		1,616,982			
45-54	373.2		1,337,298			
55-64	770.5		872,216			
65-74	1,822.1		527,629			
75-84	4,626.5		365,602			
85+	11,873.4		138,471			
All Ages						

Example of Calculating Expected Deaths in a Population

Age Group	National (Standard) Population Death Rate per 100,000		District A Population (#)			Expected Deaths (rounded)
0	5.3	X	154,585	/ 100,000	=	8
1-4	25.6		607,984			
5-14	14.1		1,585,503			
15-24	69.2		1,440,136			
25-34	83.6		1,528,427			
35-44	156.5		1,616,982			
45-54	373.2		1,337,298			
55-64	770.5		872,216			
65-74	1,822.1		527,629			
75-84	4,626.5		365,602			
85+	11,873.4		138,471			
All Ages						

Example of Calculating Expected Deaths in a Population

Age Group	National (Standard) Population Death Rate per 100,000		District A Population (#)			Expected Deaths (rounded)
0	5.3	X	154,585	/ 100,000	=	8
1-4	25.6	X	607,984	/ 100,000	=	156
5-14	14.1	X	1,585,503	/ 100,000	=	224
15-24	69.2	X	1,440,136	/ 100,000	=	997
25-34	83.6	X	1,528,427	/ 100,000	=	1,278
35-44	156.5	X	1,616,982	/ 100,000	=	2,531
45-54	373.2	X	1,337,298	/ 100,000	=	4,991
55-64	770.5	X	872,216	/ 100,000	=	6,720
65-74	1,822.1	X	527,629	/ 100,000	=	9,614
75-84	4,626.5	X	365,602	/ 100,000	=	16,915
85+	11,873.4	X	138,471	/ 100,000	=	16,441
All Ages						

Example of Calculating Expected Deaths in a Population

Age Group	National (Standard) Population Death Rate per 100,000		District A Population (#)			Expected Deaths (rounded)
0	5.3	X	154,585	/ 100,000	=	8
1-4	25.6	X	607,984	/ 100,000	=	156
5-14	14.1	X	1,585,503	/ 100,000	=	224
15-24	69.2	X	1,440,136	/ 100,000	=	997
25-34	83.6	X	1,528,427	/ 100,000	=	1,278
35-44	156.5	X	1,616,982	/ 100,000	=	2,531
45-54	373.2	X	1,337,298	/ 100,000	=	4,991
55-64	770.5	X	872,216	/ 100,000	=	6,720
65-74	1,822.1	X	527,629	/ 100,000	=	9,614
75-84	4,626.5	X	365,602	/ 100,000	=	16,915
85+	11,873.4	X	138,471	/ 100,000	=	16,441
All Ages						**59,875**

2. Calculate the standardized mortality ratio

$$\frac{\text{\# observed deaths in population}}{\text{\# expected deaths (step 1)}} \times 100$$

$$\frac{\text{------ observed deaths (given)}}{\text{------ expected deaths (step 1)}} \times 100 = \_\_\_\_$$

SMR = _____ deaths per 100,000

2. Calculate the standardized mortality ratio

$$\frac{\text{\# observed deaths in population}}{\text{\# expected deaths (step 1)}} \times 100$$

$$\frac{\text{59,153 observed deaths (given)}}{\text{59,875 expected deaths (step 1)}} \times 100 = 98.8$$

SMR = 98.8 deaths per 100,000

How to interpret an SMR

Comparing deaths in study population (District A) to what would be expected *if the study population had the same probability of dying as the standard population* (National)

- **SMR > 100.0**

  # of observed deaths is greater than what would be expected

- **SMR < 100.0**

  # of observed deaths is less than what would be expected

Review: Age Adjusting

- **Why we adjust**
- **Direct age adjustment**
  - **Uses standard population age distributions**
- **Indirect age adjustment**
  - **Uses standard population age-specific death rate**

Mortality Statistics

What types of mortality statistics are produced/used in your country?

Cause of Death Tabulations

- **Cause of death lists are basis for:**
  - **Leading causes of death**
  - **National cause of death tabulations**

- **WHO death tables by country as a resource:**

  http://www.who.int/healthinfo/statistics/mortality/en/index.html

- **Each country should develop national cause of death tabulation list to meet specific needs**

SOURCES: WHO Health Statistics and Health Information Systems, Mortality Data: http://www.who.int/healthinfo/statistics/mortality/en/index.html

Cause-Specific Mortality Tabulations

ICD Recommendations

- **Coding – various levels of detail available (diagnosis, location of event, contributing conditions, etc.)**
- **Age classifications (vary by indicator)**

< 1 yr	< 1 yr	< 1 yr
1 yr	1-4 yrs	1-14 yrs
2 yrs	5-14 yrs	15-44 yrs
3 yrs	15-24 yrs	45-64 yrs
4 yrs	25-34 yrs	≥ 65 yrs
5-yr groups from 5-84 yrs	35-44 yrs	
≥ 85 yrs	45-54 yrs	
	55-64 yrs	
	65-74 yrs	
	≥ 75 yrs	

SOURCES: WHO ICD-10, Volume 2, Chapter 5; NCHS, Unit 17.

Recommended Age Classifications

Table 9. Death rates by age and age-adjusted death rates for the 15 leading causes of death in 2008: United States, 1999-2008

Cause of death (based on ICD-10, 2004) and year	Age											
	All ages[1]	Under 1 year[2]	1-4 years	5-14 years	15-24 years	25-34 years	35-44 years	45-54 years	55-64 years	65-74 years	75-84 years	85 years and over
All causes												
2008	813.0	650.5	28.3	14.1	75.6	103.3	179.7	420.4	879.2	1,995.6	5,017.7	13,015.1
2007	803.6	684.5	28.6	15.3	79.9	104.9	184.4	420.9	877.7	2,011.3	5,011.6	12,946.5
2006	810.4	690.7	28.4	15.2	82.2	106.3	190.2	427.5	890.9	2,062.1	5,115.0	13,253.1
2005	825.9	692.5	29.4	16.3	81.4	104.4	193.3	432.0	906.9	2,137.1	5,260.0	13,798.6

SOURCES: NVSS Deaths, p 77.

Cause-Specific Mortality Tabulations

ICD Recommendations (continued):

- Area classifications
  - Major civil division (state, province, region, country, etc.)
  - Town or conurbation of ≥ 1 million, otherwise largest town with population ≥ 100,000
  - National aggregate of urban areas (≥ 100,000 population)
  - National aggregate of urban areas (< 100,000 population)
  - National aggregate of rural areas

* Include definitions of urban and rural
* Where medical certification of COD is limited to certain areas, separate figures for deaths not medically certified

SOURCES: WHO ICD-10, Volume 2, Chapter 5.

Cause-Specific Mortality Tabulations

ICD Tabulation Lists:

- Lists of causes of mortality
- Adopted by World Health Assembly in 1990
- 4 lists:
  - General mortality, condensed list (103 causes)
  - General mortality, selected list (80 causes)
  - Infant & child mortality, condensed list (67 causes)
  - Infant & child mortality, selected list (51 causes)

SOURCES: WHO ICD-10, Volume 1, p 1205-20, Volume 2, Chapter 5.

Cause-Specific Mortality Tabulations

ICD Tabulation Lists (continued):

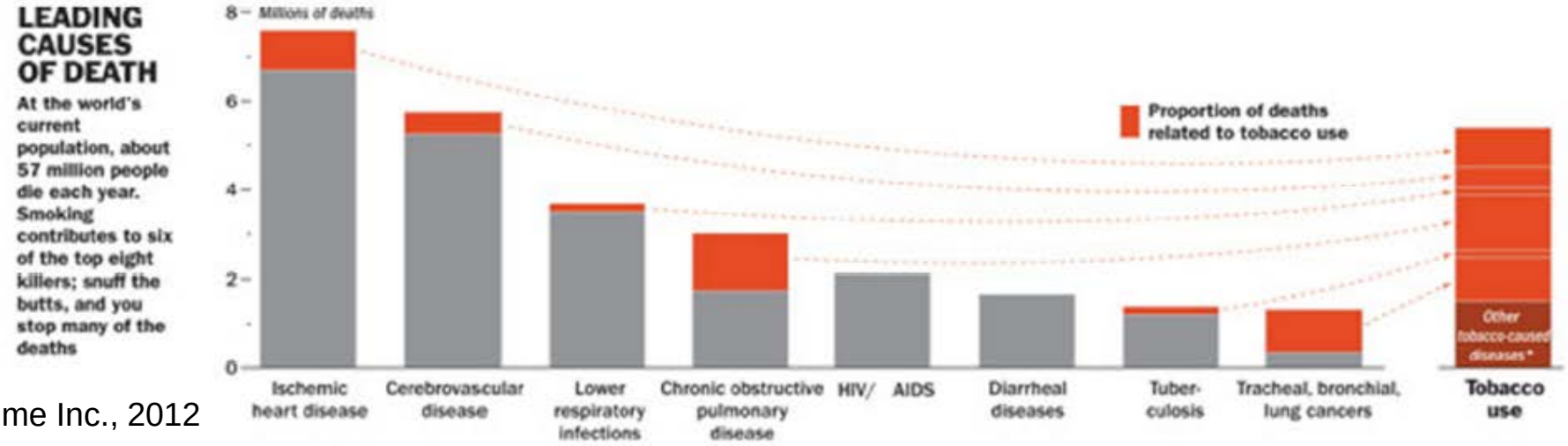
- **Which list to use?**
  - **Condensed**: Condense full range of ICD (3 character) categories
  - **Selected**: Items significant for monitoring population health status at sub-national, national, and international levels
  - **Customize** for local use (if no international comparison)

SOURCES: WHO ICD-10, Volume 1, p 1205-20, Volume 2, Chapter 5.

Mortality Statistics: Tabulations & Figures

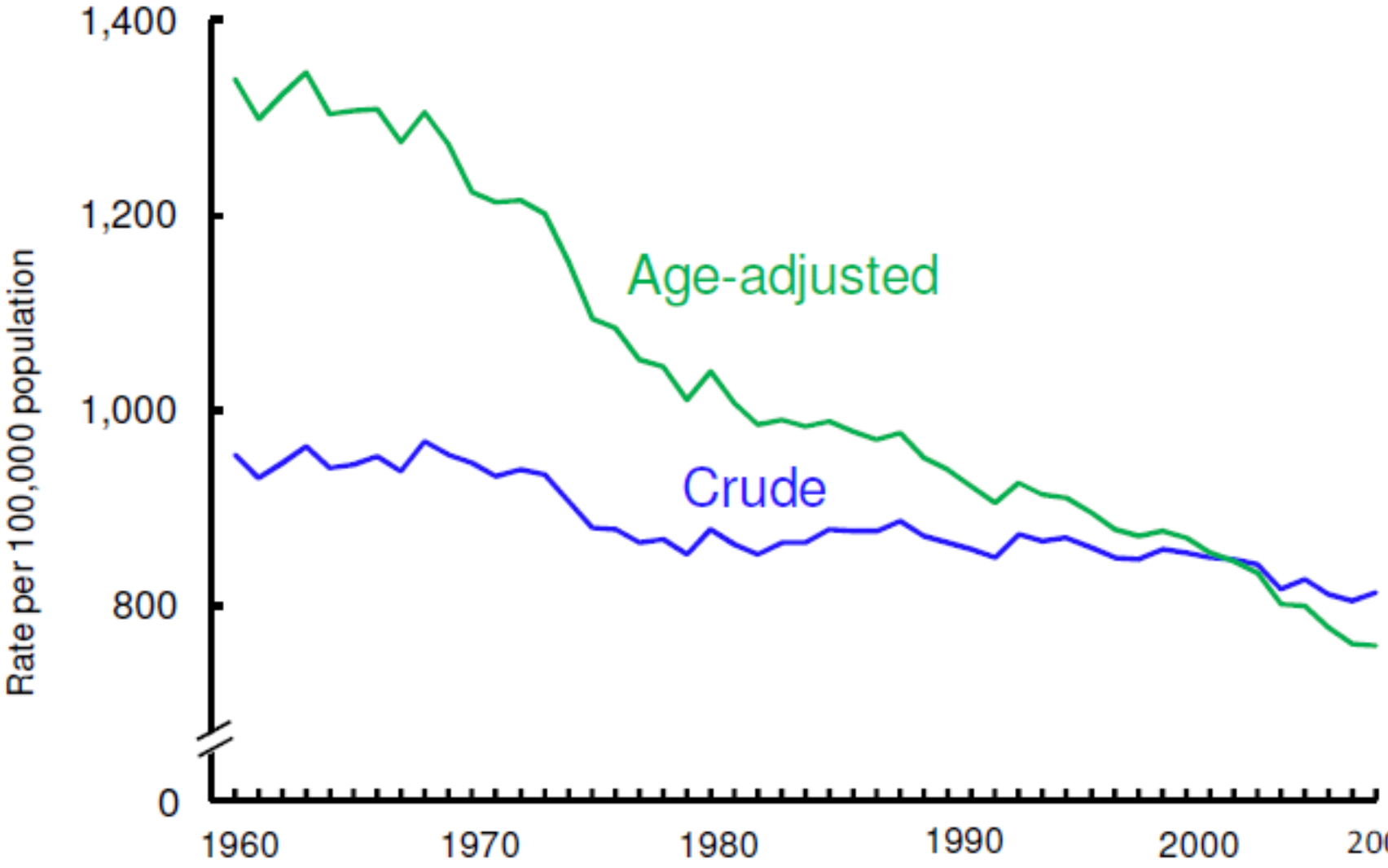
Uses:

- **To identify population group with highest number/percentage of deaths**
- **To rank causes of death, by main groups & underlying cause**



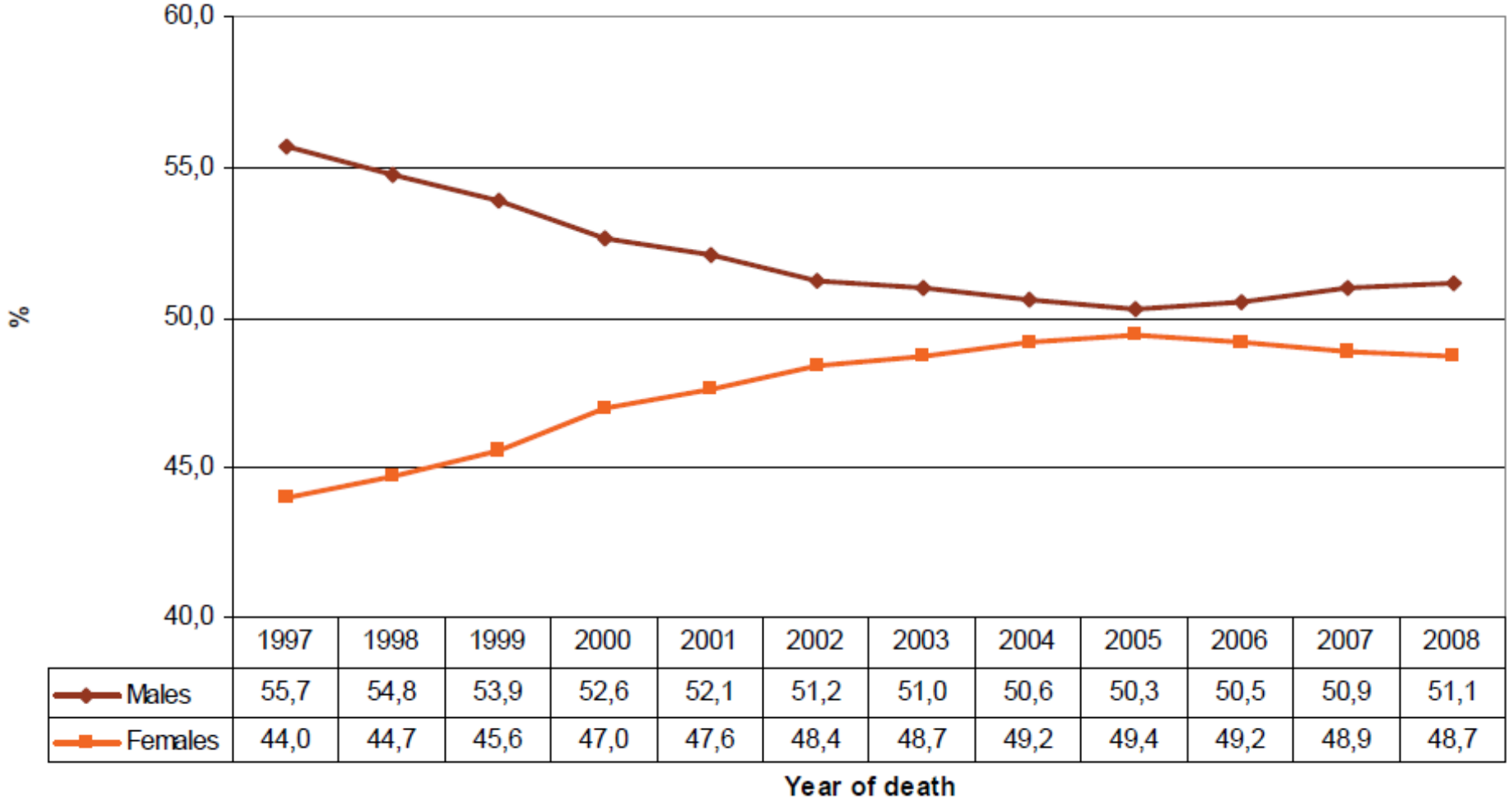
Time Inc., 2012

Crude and Age-adjusted Death Rates



SOURCES: NVSS Deaths, p 9.

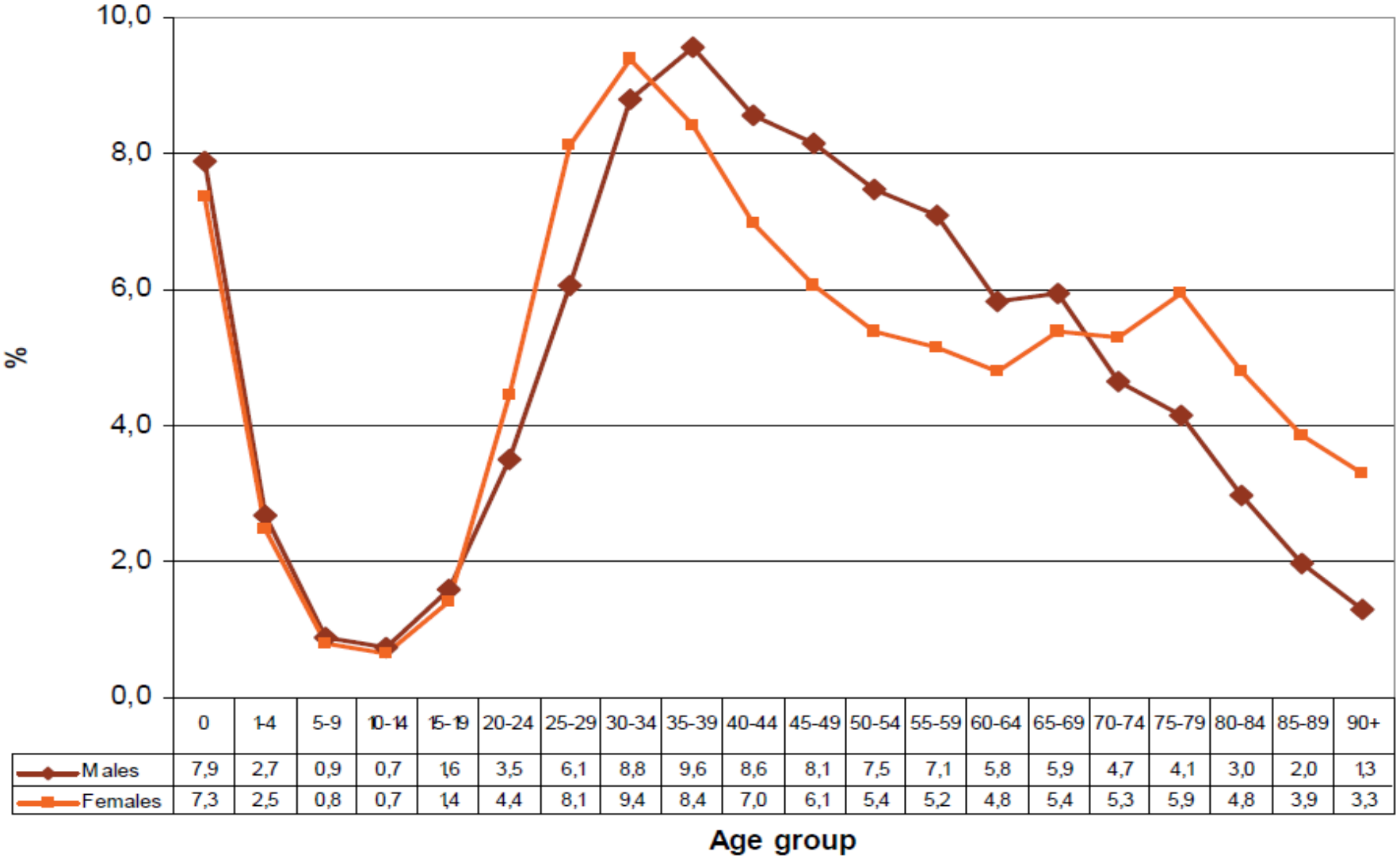
% Distribution of Deaths by Sex and Year of Death



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Males	55,7	54,8	53,9	52,6	52,1	51,2	51,0	50,6	50,3	50,5	50,9	51,1
Females	44,0	44,7	45,6	47,0	47,6	48,4	48,7	49,2	49,4	49,2	48,9	48,7

SOURCES: Statistics SA, p 14.

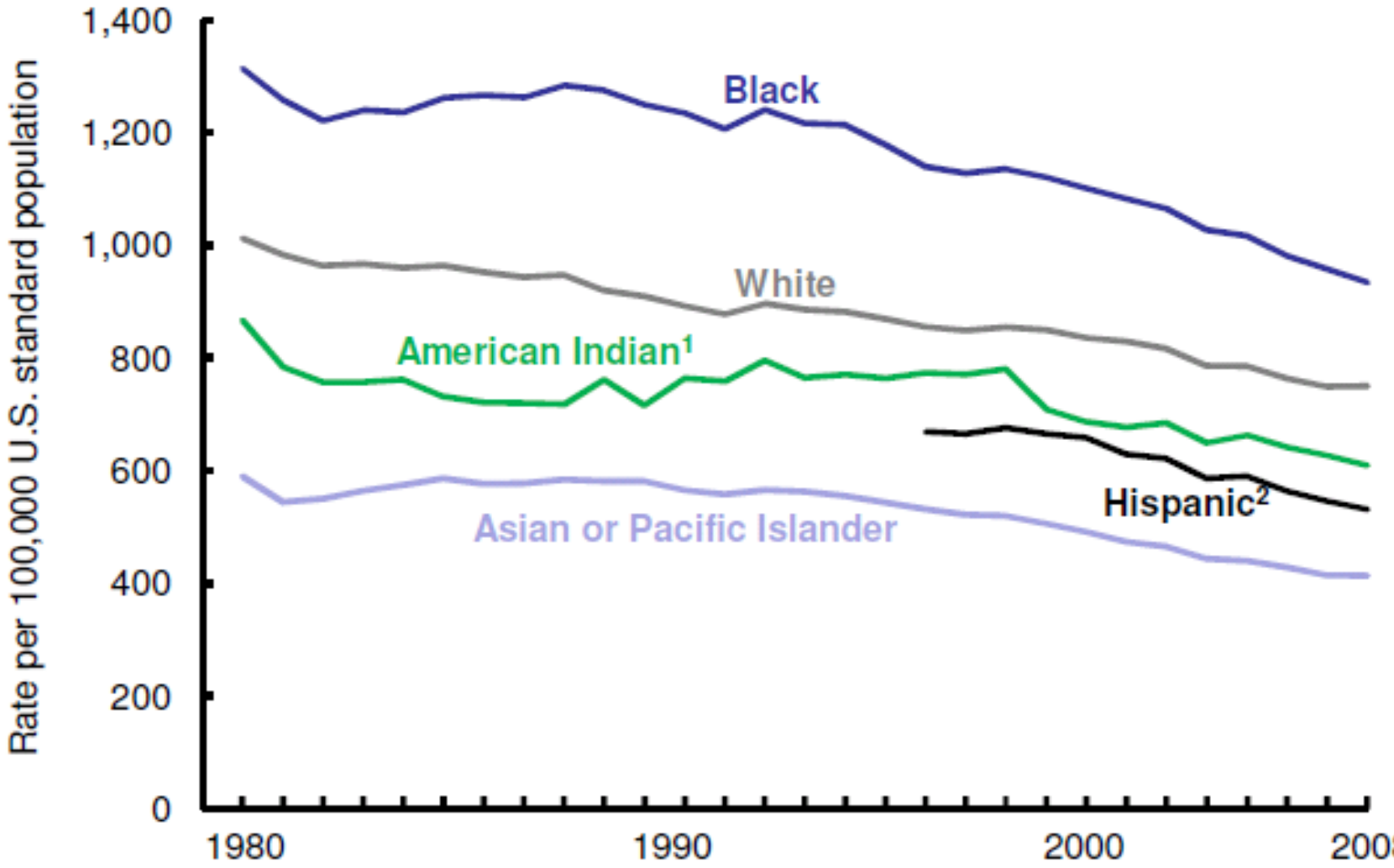
% Distribution of Deaths by Age and Sex, 2008



	0	1-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90+
Males	7,9	2,7	0,9	0,7	1,6	3,5	6,1	8,8	9,6	8,6	8,1	7,5	7,1	5,8	5,9	4,7	4,1	3,0	2,0	1,3
Females	7,3	2,5	0,8	0,7	1,4	4,4	8,1	9,4	8,4	7,0	6,1	5,4	5,2	4,8	5,4	5,3	5,9	4,8	3,9	3,3

SOURCES: Statistics SA, p 16.

Age-adjusted Death Rates by Sub-population



SOURCES: NVSS Deaths, p 10.

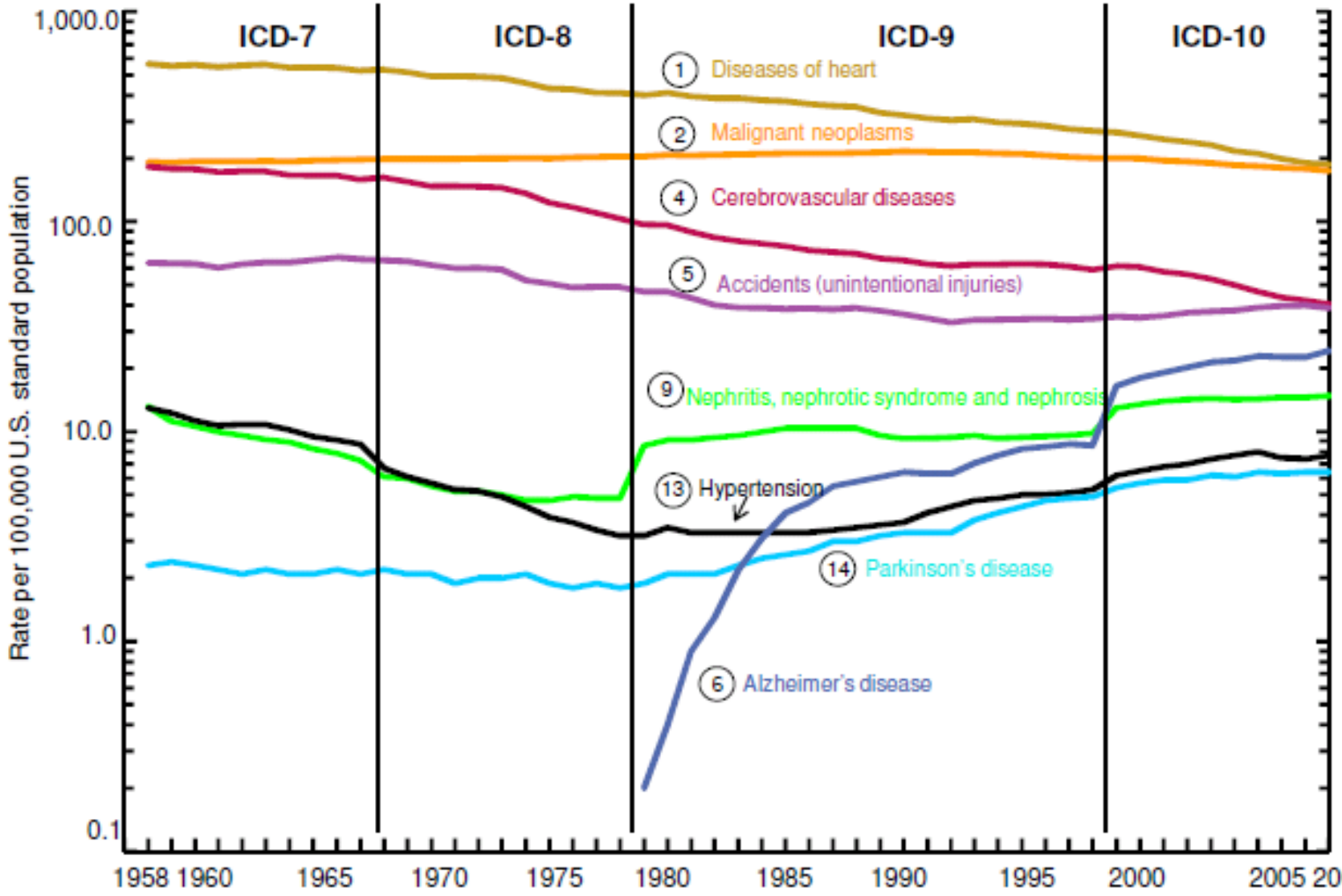
10 Leading Natural Causes of Death

Causes of death (based on the Tenth Revision, International Classification of Diseases, 1992)	2007			2008		
	Rank	Number	%	Rank	Number	%
Tuberculosis (A15-A19)**	1	76 968	12,8	1	74 863	12,6
Influenza and pneumonia (J10-J18)	2	49 941	8,3	2	45 602	7,7
Intestinal infectious diseases (A00-A09)	3	37 491	6,2	3	39 351	6,6
Other forms of heart disease (I30-I52)	4	26 114	4,3	4	26 190	4,4
Cerebrovascular diseases (I60-I69)	5	25 406	4,2	5	24 363	4,1
Diabetes mellitus (E10-E14)	6	20 198	3,3	6	19 558	3,3
Chronic lower respiratory diseases (J40-J47)	7	15 364	2,5	9	14 226	2,4
Certain disorders involving the immune mechanism (D80-D89)	8	15 292	2,5	8	14 639	2,5
Human immunodeficiency virus [HIV] disease (B20-B24)	9	13 561	2,2	7	15 097	2,5
Hypertensive diseases (I10-I15)	10	13 415	2,2	10	14 177	2,4
Other natural causes		254 971	42,3		251 057	42,4
Non-natural cause		54 373	9,0		52 950	8,9
All causes		**603 094**	**100,0**		**592 073**	**100,0**

Analysis of Vital Statistics Data

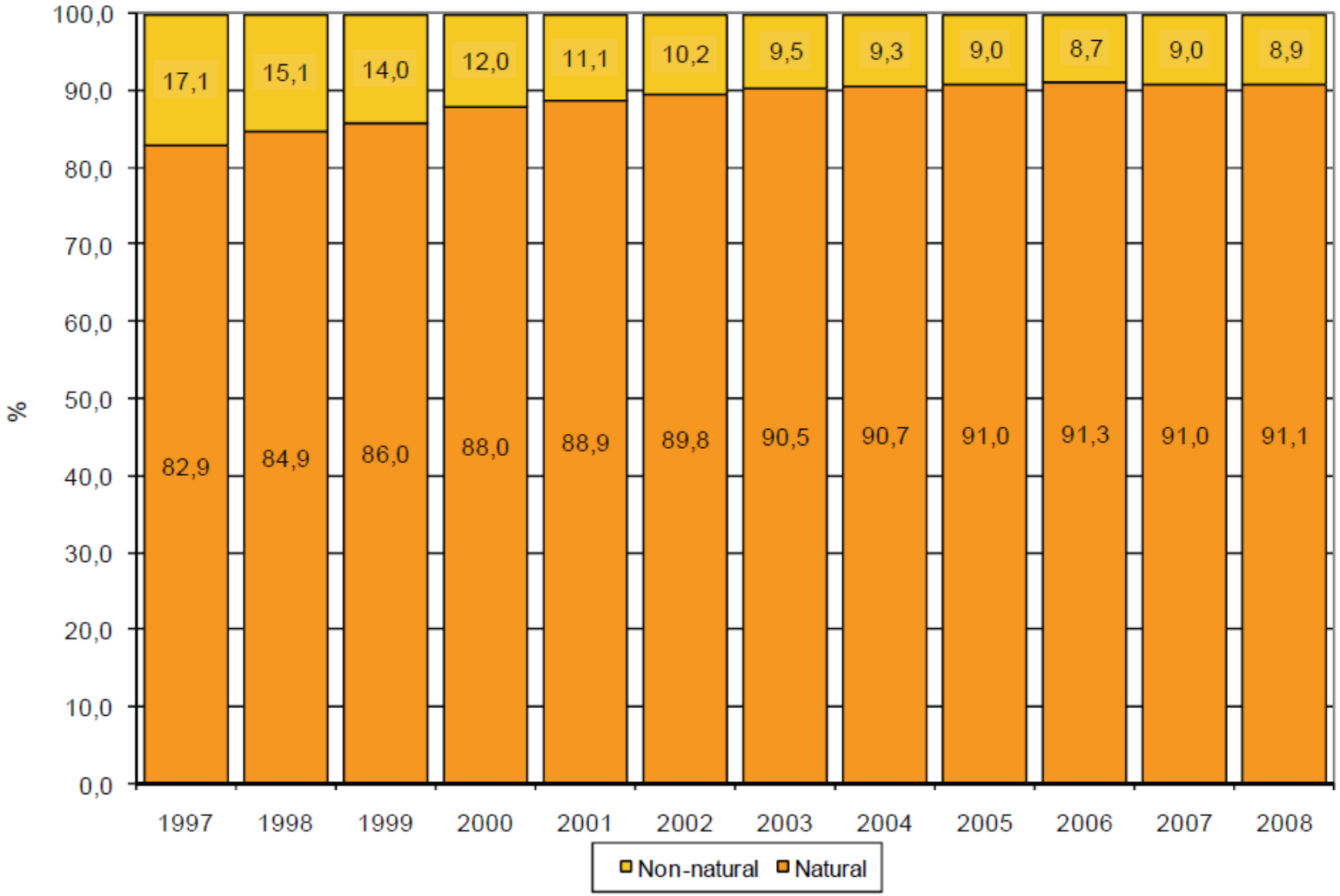
SOURCES: Statistics SA, p 28.

Age-adjusted Death Rates for Leading Causes of Death



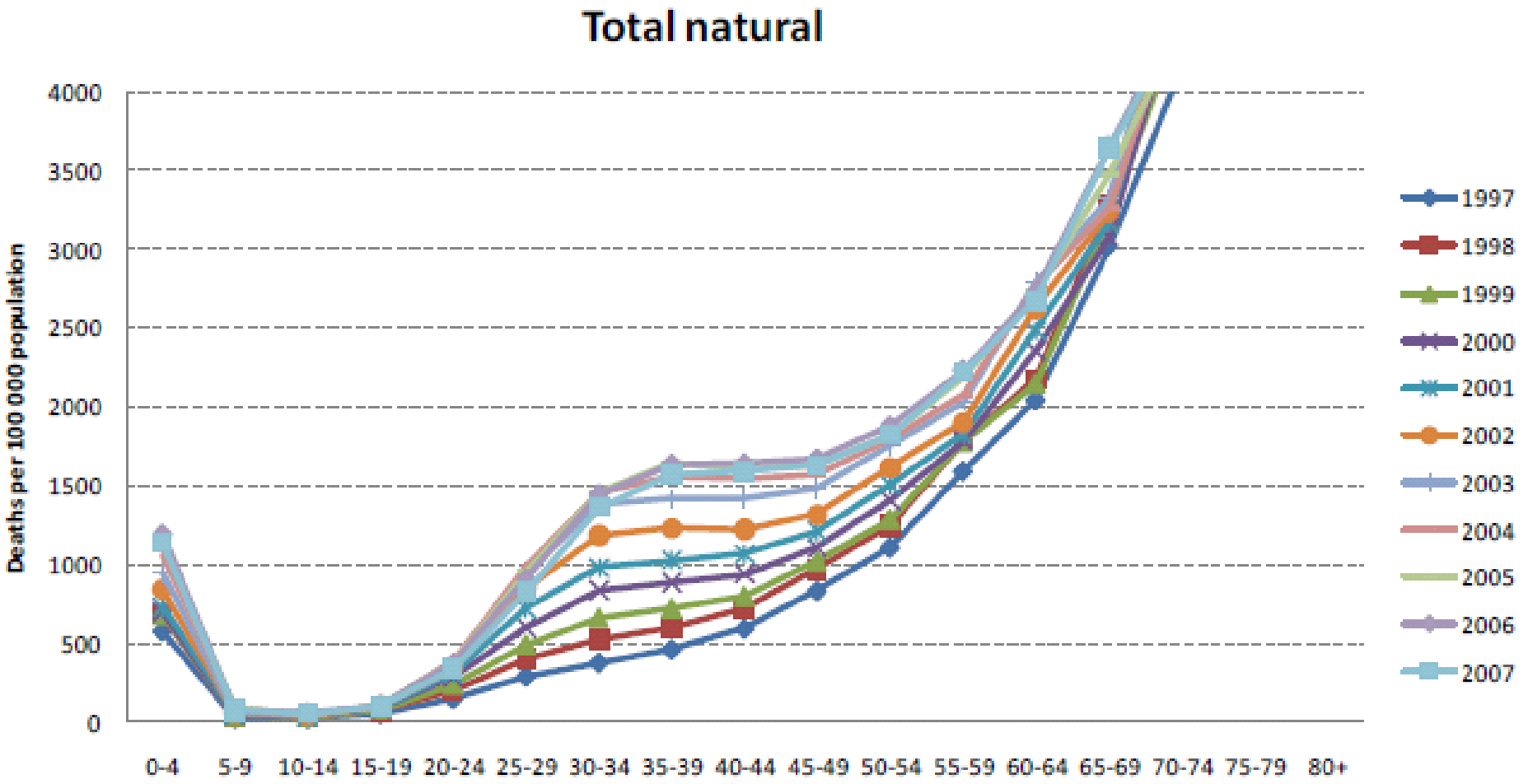
SOURCES: NVSS Death, p 22.

% Distribution of Natural & Non-natural Causes of Death by Year of Death



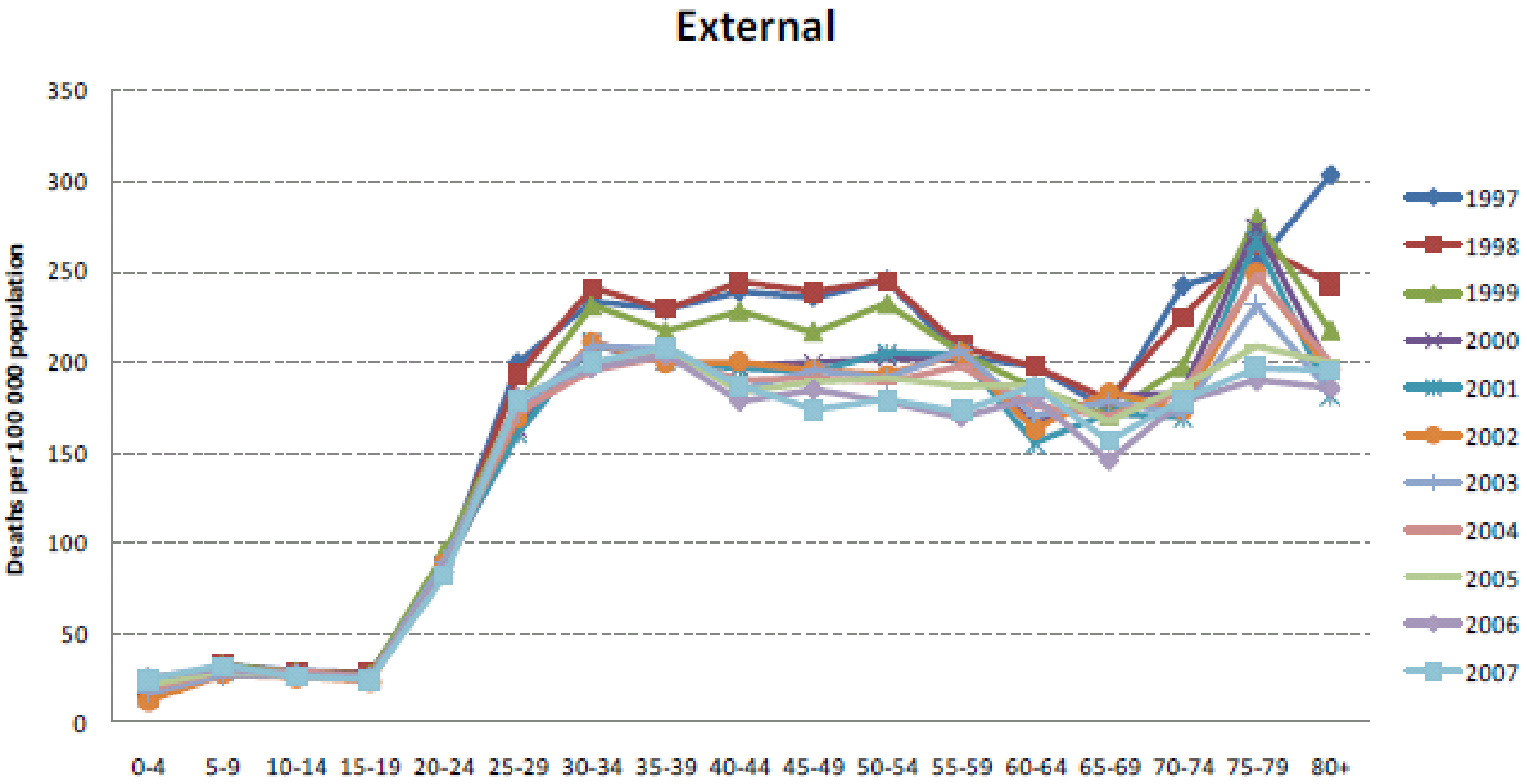
SOURCES: Statistics SA, p 26.

Exercise: Natural versus External Causes of Death



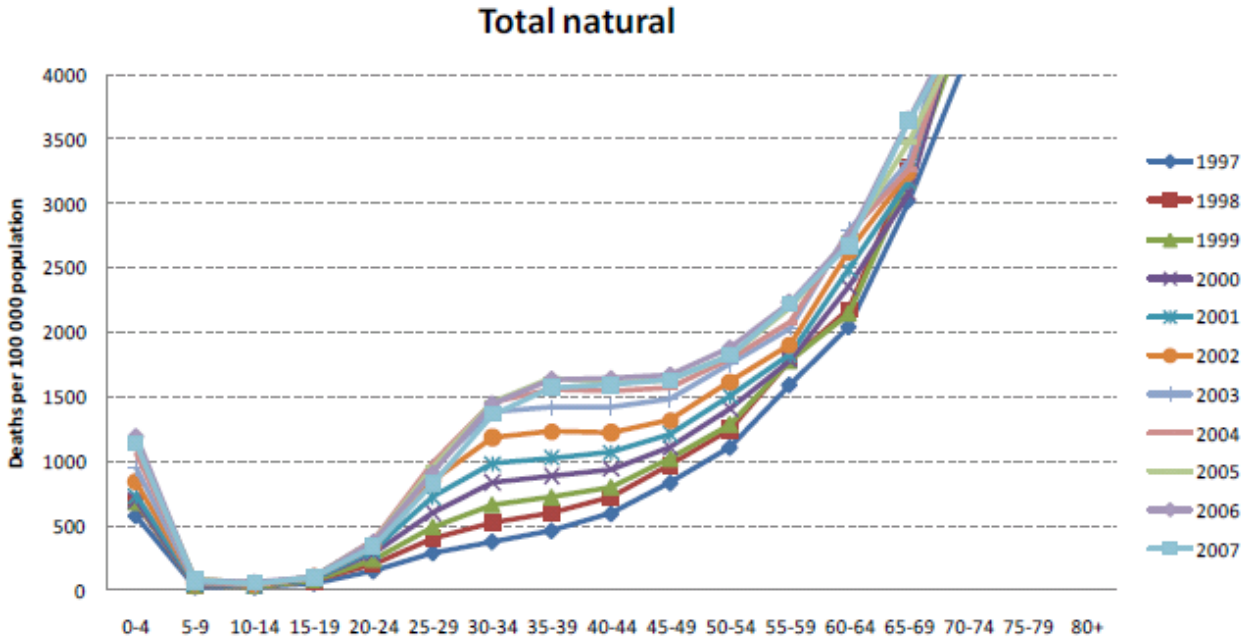
SOURCES: MRC, p 9.

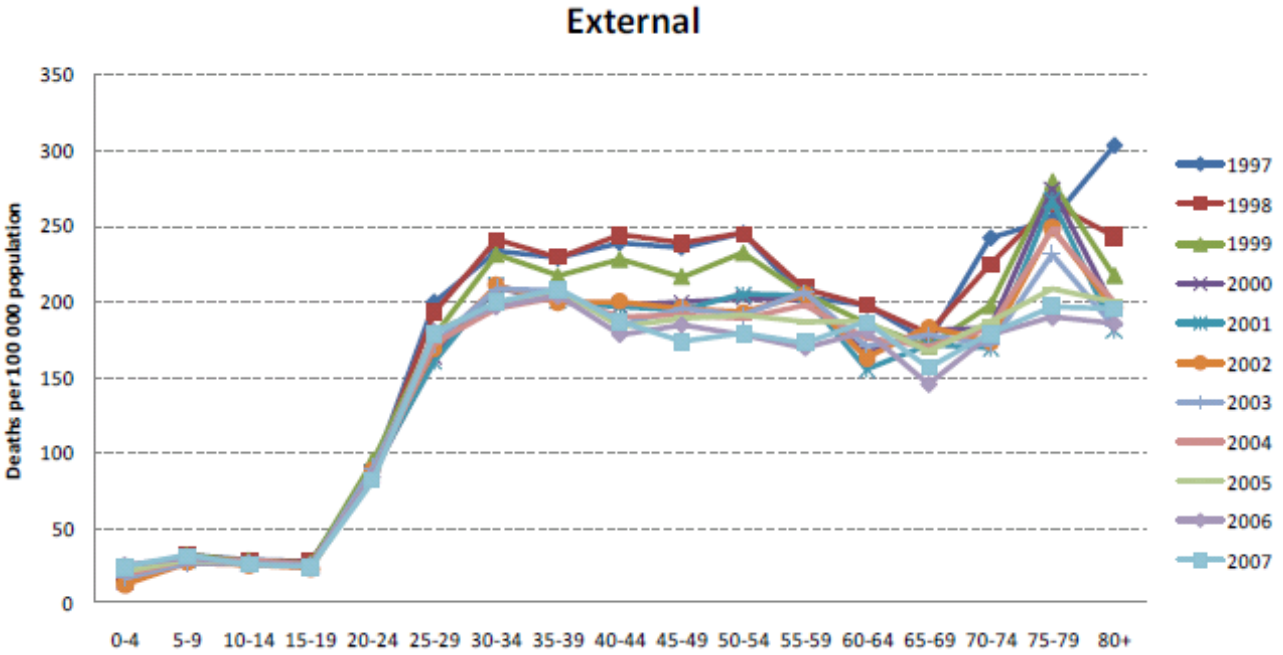
Exercise: Natural versus External Causes of Death



SOURCES: MRC, p 9.

Exercise: Natural versus External Causes of Death





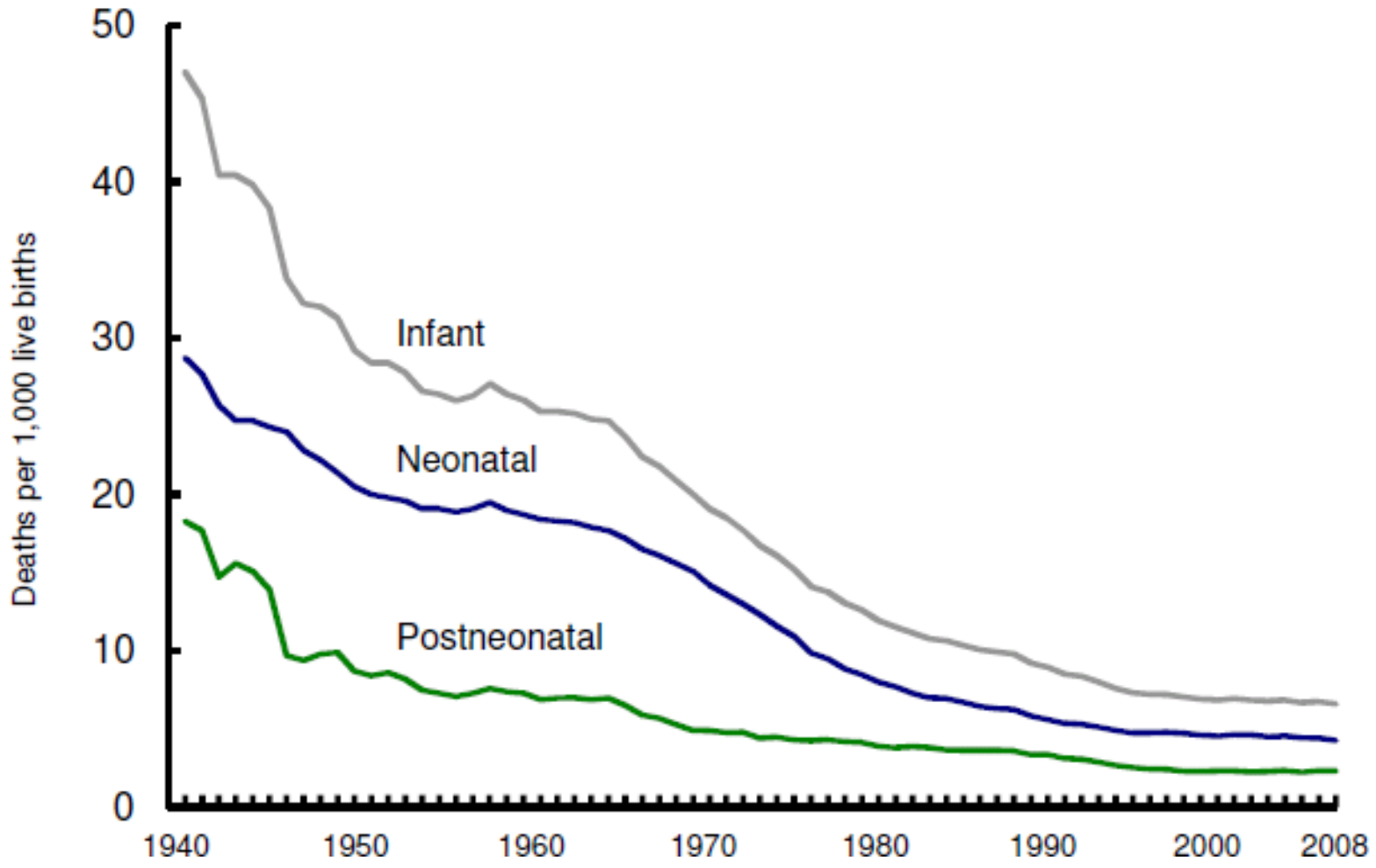
SOURCES: MRC, p 9.

Distribution of Deaths by Place of Death

Place of death	Number	Percentage
Hospital	264 609	44,7
ER or Outpatient	9 298	1,6
Dead on arrival	13 661	2,3
Nursing home	12 657	2,1
Home	180 816	30,5
Other	23 707	4,0
Unknown or unspecified	87 325	14,7
Total	**592 073**	**100,0**

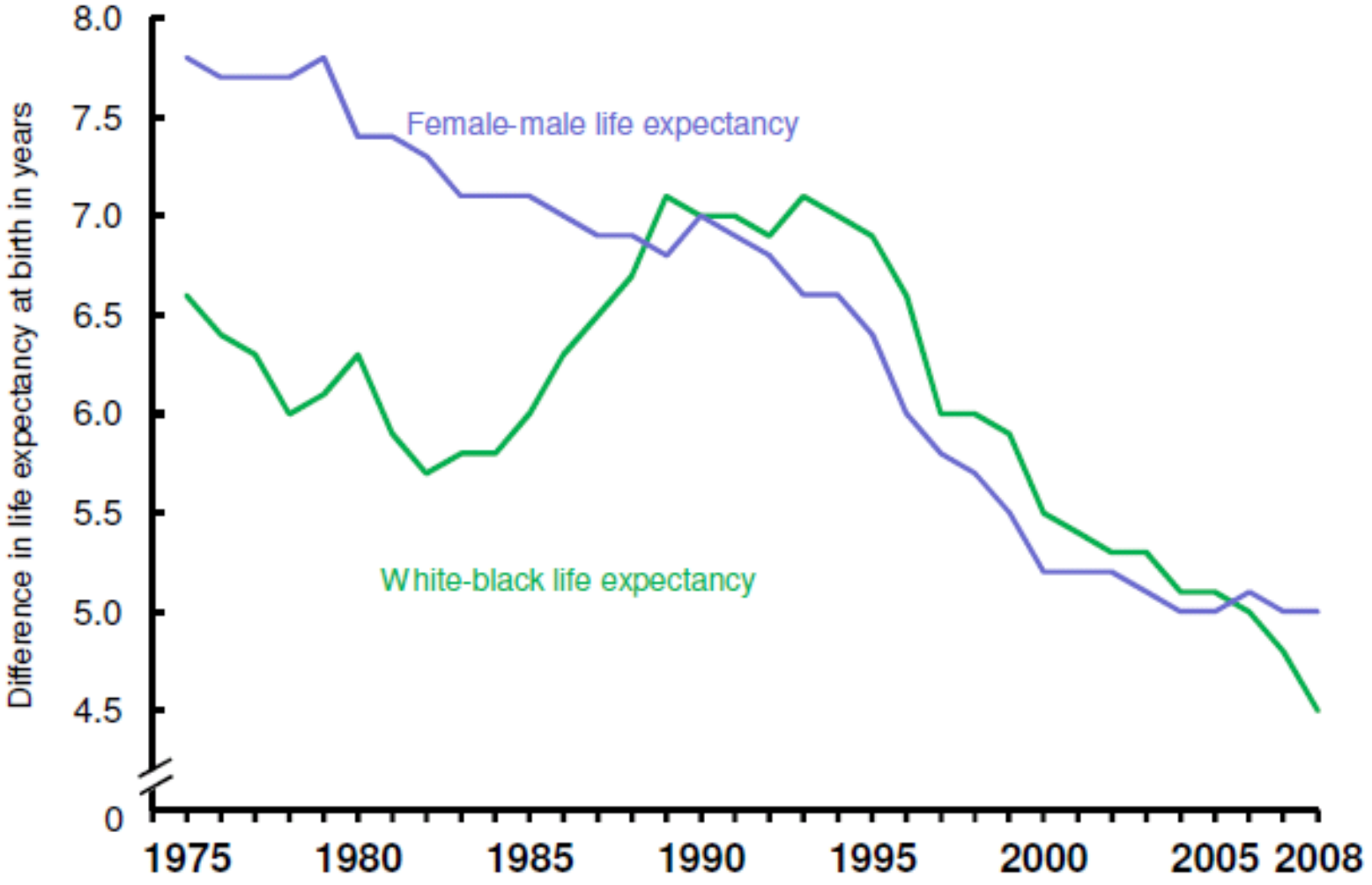
SOURCES: Statistics SA, p 20.

Infant, Neonatal, & Postneonatal Mortality Rates



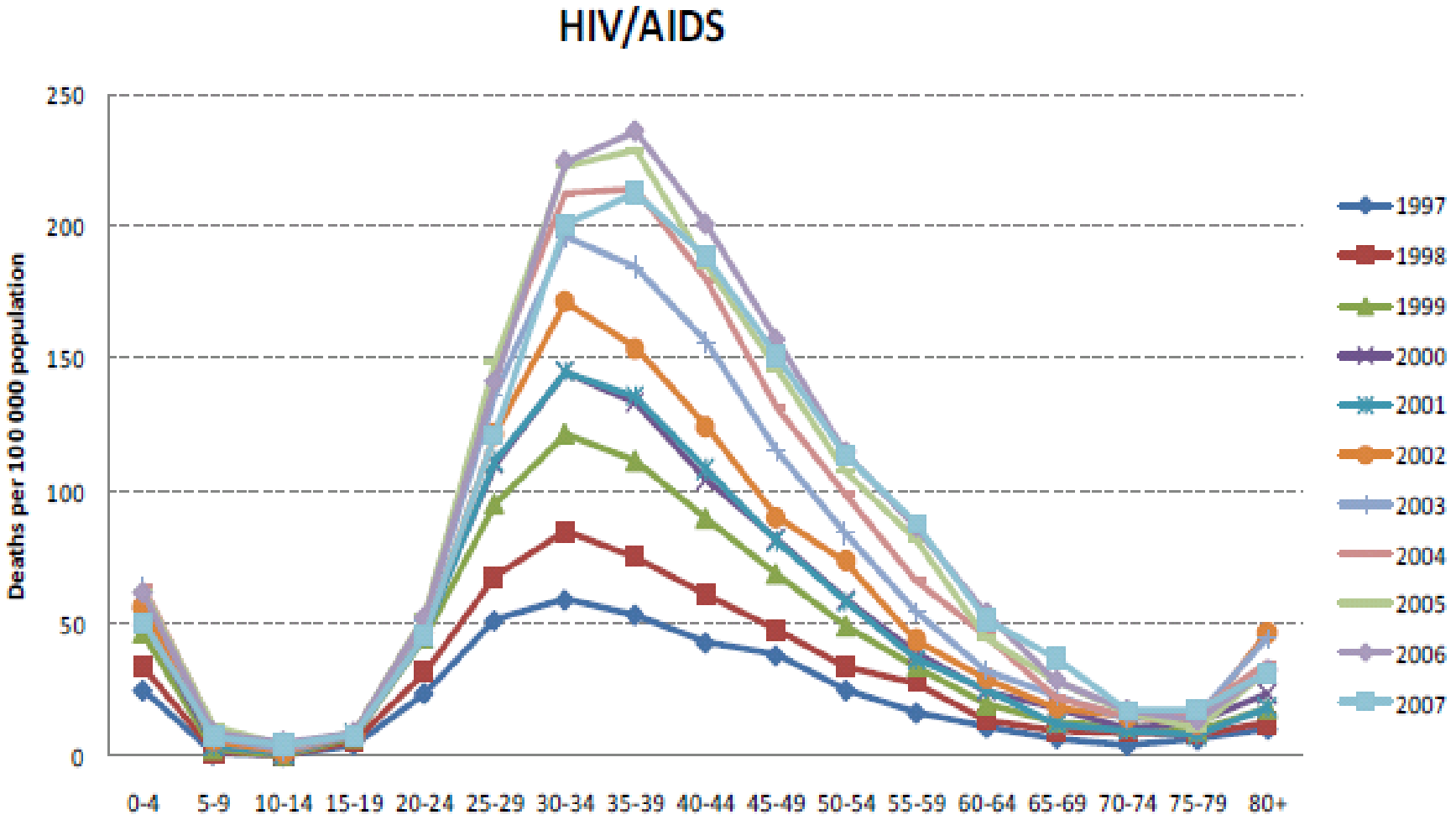
SOURCES: NVSS Deaths, p 26.

Life Expectancy Differential by Sex and Race



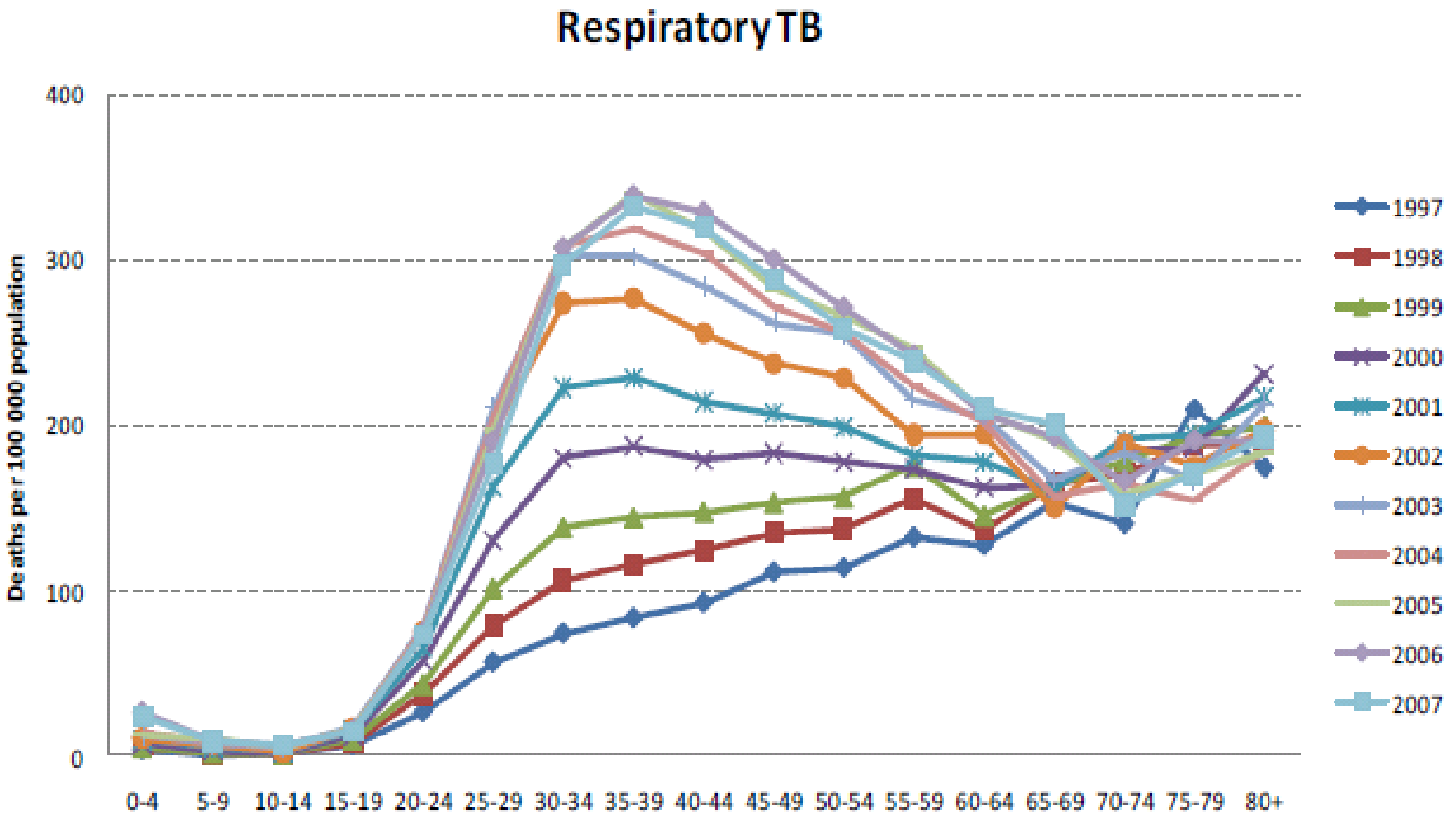
SOURCES: NVSS Deaths, p 14.

HIV Deaths by Age



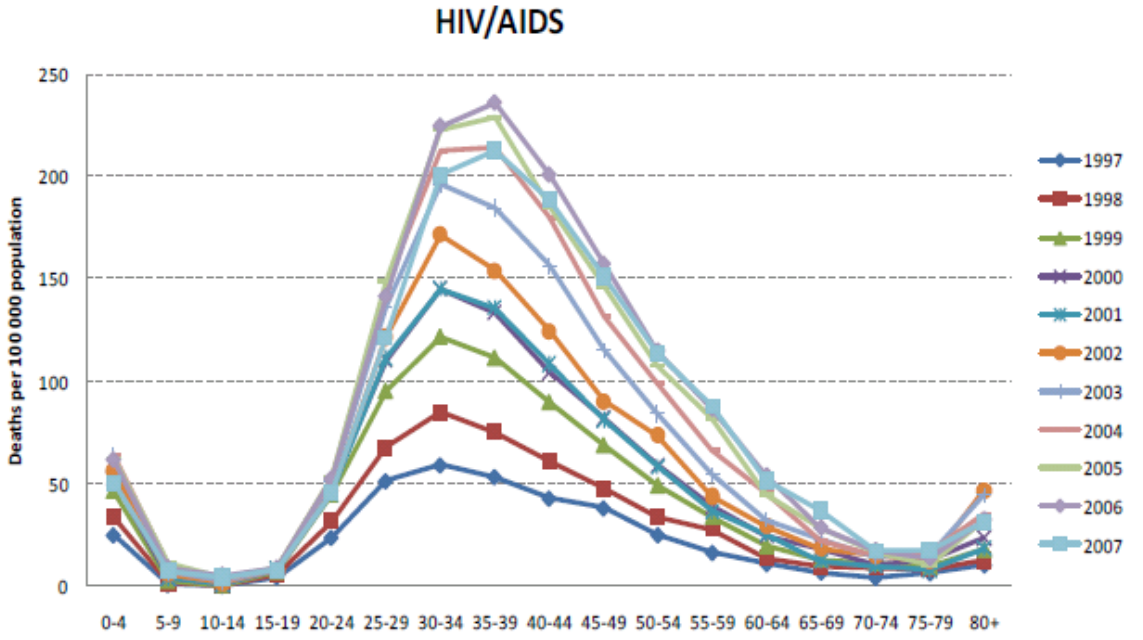
SOURCES: MRC, p 11.

TB Deaths by Age

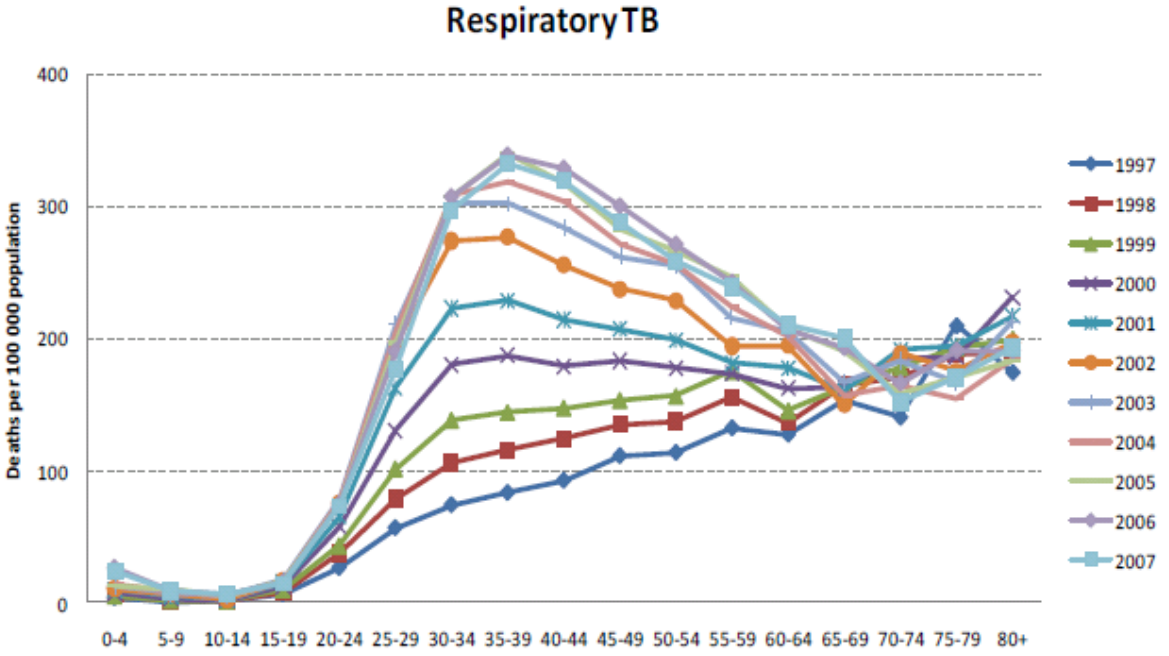


SOURCES: MRC, p 11.

HIV & TB Deaths by Age



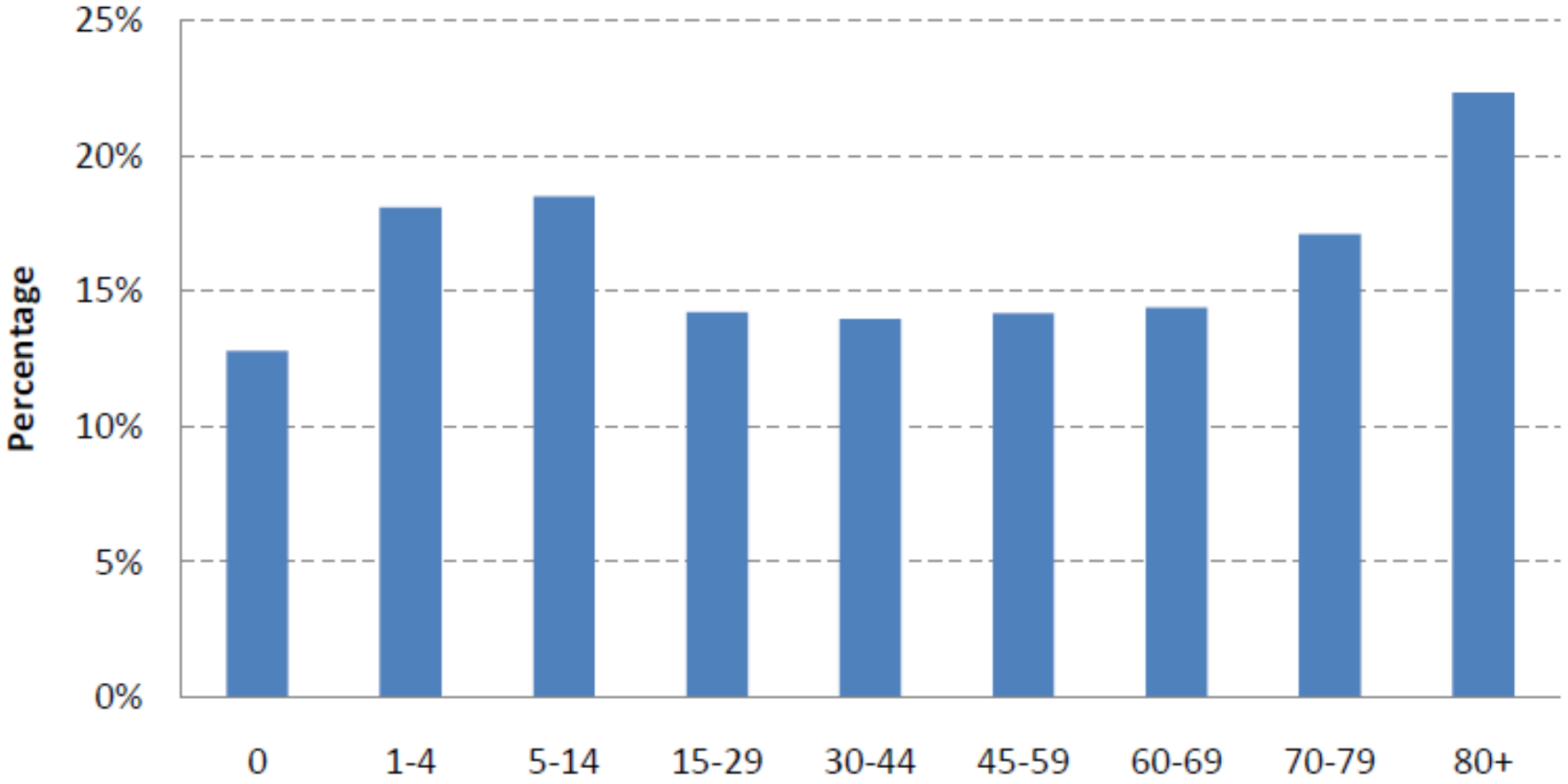
- In more recent years, TB death patterns look more like HIV/AIDS death patterns



- "TB deaths" are more likely deaths due to HIV/AIDS, complicated by TB

SOURCES: MRC, p 11.

Natural Deaths Due to Ill-defined Causes



SOURCES: MRC, p 7.

Analysis Points to Remember

- **Always specify rate/ratio denominator (e.g. live births)**
- **Analysis of population subgroups must consider size of subgroup**
  - **Use broader groups**
    - **Disease classification**
    - **Age categories**
  - **Aggregate data over a longer period of time**

SOURCES: WHO ICD-10, Volume 2, Chapter 5.

Analysis Points to Remember

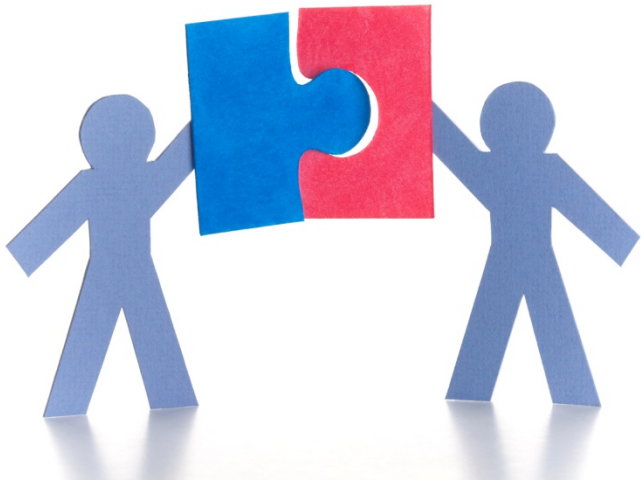
- **Small area analysis**
  - **Produce and use statistics in areas with good coverage**
  - **Data more accurate than survey data**
  - **Data used to show usefulness to government**

Discuss

What would be reasonable goals for collection and compilation of vital statistics?

Matching/Linking Vital Records

- **Example: Matching a birth record with a corresponding death record**
- **Purpose**
  - **Statistical / Reporting**
    - **Richer data set**
    - **Outside users**
  - **Administrative**
    - **Improve quality of information**
    - **Prevent fraud**



SOURCES: PRVSS2, Chapter III.E.10-11; Freedman, p 5-6.

Discuss

What are some non-statistical & statistical uses of record linkage?

Evaluating the Quality of Information

- **Coverage**
  - Representativeness
  - Delays in reporting
- **Accuracy & completeness**
- **Sufficient detail** to reveal relationships
- **Timeliness**
  - Availability of information
  - Date of event versus date event was registered
- **Geographic reference**
  - Place of event versus place of usual residence

Discuss

What leads to late registration?

What can be done to eliminate late registration?

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- (WHO ICD-10) WHO. ICD-10, Tenth Revision, Volumes 1 and 2. 1993.
- (WHOSIS) WHO Statistical Information Systems. Indicator definitions and metadata, 2008. Age-standardized mortality rates by cause.

Activity

- **In small groups, based on the data sheet handout, compute and interpret the following summary statistics and rates for (if using South Africa example, use data for 2009):**
  - ✓ Crude birth rate
  - ✓ Sex ratio at birth
  - ✓ Percent of premature births
  - ✓ Crude death rate
  - ✓ Infant mortality rate
  - ✓ Neonatal mortality rate
  - ✓ Post-neonatal mort. rate
  - ✓ Age-specific death rate
  - ✓ Age-adjusted death rate (using either direct or indirect method — see worksheet)
- **Discuss how the various defects in basic data would affect the computed statistics.**

Activity

- In small groups, draft statistical "dummy" tables that you would publish in an annual CRVS report for your country.
  - Consider the number/type of categories or groups to be used in the tables
  - Consider the types of measures you would present
- Share with the class.

Activity

Select subgroups & label categories

Label headings

				TOTAL
TOTAL				

Make sure all column and row totals are summed correctly

Overall Review

1. Vital statistics (*can / cannot*) be used for planning human development.
2. Vital statistics are *(one of many / the only)* nationally representative source(s) of mortality by cause of death.
3. Useable statistics have *(complex / simple)* definitions.
4. Useable statistics are *(able / not able)* to be adapted.
5. Absolute counts *(are / are not)* comparable over time/geography.

Overall Review

6. ***(Absolute / Relative)*** **numbers must have denominator information.**

7. **In a ratio, the numerator *(does / does not)* have to be part of denominator.**

8. **Final tabulations should be calculated by date of *(occurrence / registration)* of the event.**

9. **Final tabulations should be calculated by place of *(usual residence / occurrence of event)*.**

10. **Small area analysis data are *(less / more)* accurate than survey data.**