JOHNS HOPKINS
BLOOMBERG
SCHOOL of PUBLIC HEALTH

Mortality and Morbidity

Data Sources for Measuring Mortality

Module 6a
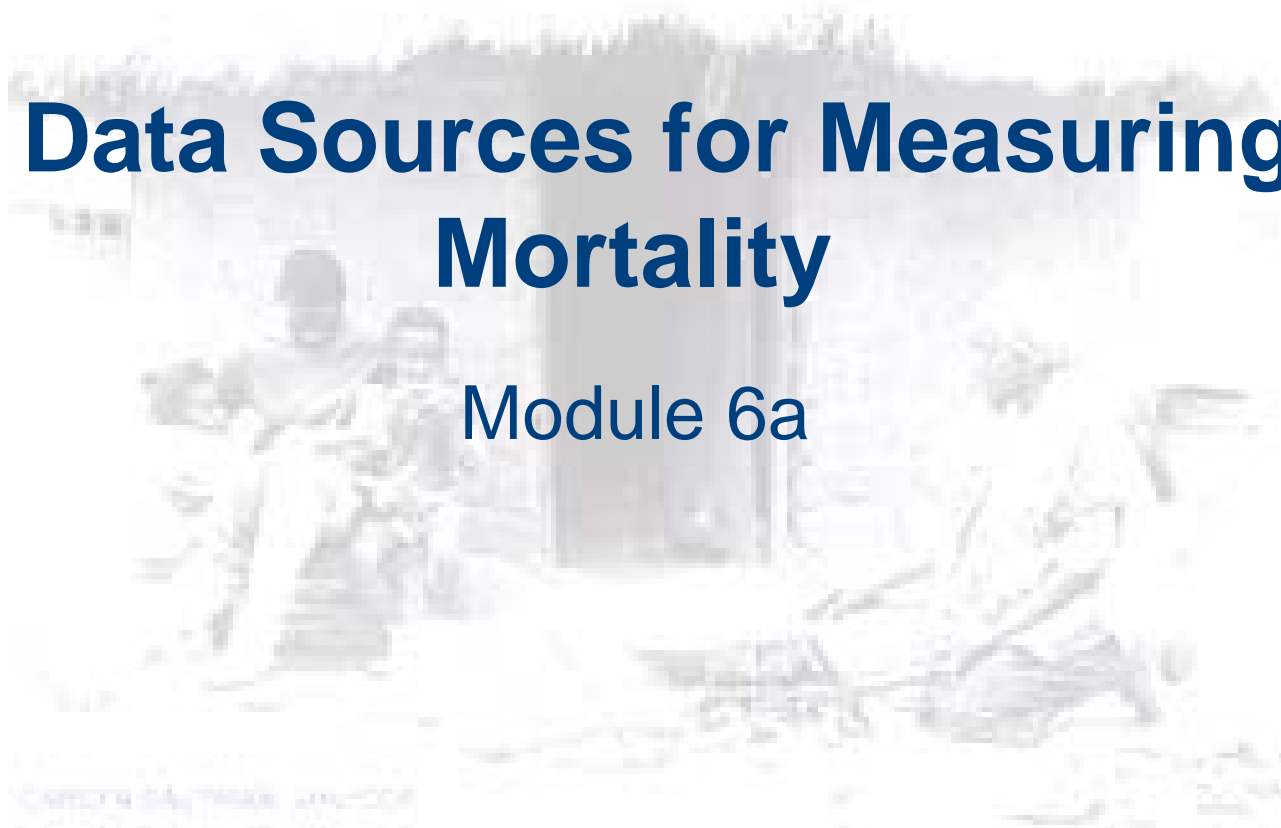
Learning Objectives

Upon completion of this module, the student will be able to :

◆ Identify different sources of data for measuring mortality and morbidity

◆ Explain some of the problems relating to the completeness and quality of the data

Mortality and Morbidity as Indicators of Health Status of a Population

◆ Death is a unique and universal event, and as a final event, clearly defined

◆ Age at death and cause provide an instant depiction of health status

◆ In high mortality settings, information on trends of death (by causes) substantiate the progress of health programs

continued

Mortality and Morbidity as Indicators of Health Status of a Population

- As survival improves with modernization and populations age, mortality measures do not give an adequate picture of a population's health status

- Indicators of morbidity such as the prevalence of chronic diseases and disabilities become more important

Major Sources of Mortality Information

- ◆ National vital registration systems - a major source in developed countries
- ◆ Sample registration systems (e.g., in China and India)
- ◆ Household surveys - to estimate infant and child mortality
- ◆ Special longitudinal investigations (e.g., maternal mortality studies)

Vital Registration or Vital Statistics Systems

Features

◆ Universal coverage of the population

◆ Continuous operation

Death Registration: Counting the Events

- Definition: official notification that a death has occurred

- Usually a legal requirement before burial/cremation

- Counts (rates) by age, sex, location and time provide invaluable health data

- Concurrent registration essential for good cause of death determination

Data Collection for Vital Registration

♦ Events are collected by a local registration office, usually a government agency

♦ Who reports to registration office?

   – Individual citizens, local officials, physicians, hospital employees, etc.

♦ Main advantage is universal coverage

♦ Disadvantages are late or never reporting

Special Problems of Vital Registration in Developing Countries

- Laws vary dramatically across the countries
- Public compliance poor
- Definitions of vital events varies
- Inadequate resources
- Lack of trained personnel to collect data
- Data infrequently analyzed
- Underutilization of data

National Sample Registration Systems - India

♦ Sample Registration System (SRS)
  – Began in 1964-65
  – Over 6000 sampling units (about 10,000,000 population)
  – Dual registration systems for births and deaths
  – Provides fertility and mortality estimates for every state and territory
  – Cause of death based on lay reporting

Data Collection in Developing Countries by Sample Surveys

- ◆ Systematic national household sample surveys to collect data on population and health began during early 1960's to measure the demographic impact of family planning programs

- ◆ Family planning and population surveys are still the largest sources of data for health in developing countries

Data Collection in Developing Countries by Sample Surveys

- ◆ Major International Household Surveys
  - – 1970s to 1985 -World Fertility Surveys (WFS)
  - – 1985 to Present - Demographic and Health Surveys (DHS)
- ◆ Mortality (and morbidity) data limited to infants, children and mothers

Special Longitudinal Population Studies

♦ Specialized longitudinal studies of selected events

  – Maternal mortality, in Egypt, Nigeria, Philippines, Bangladesh, etc.

♦ Continuing longitudinal event registration in selected study populations

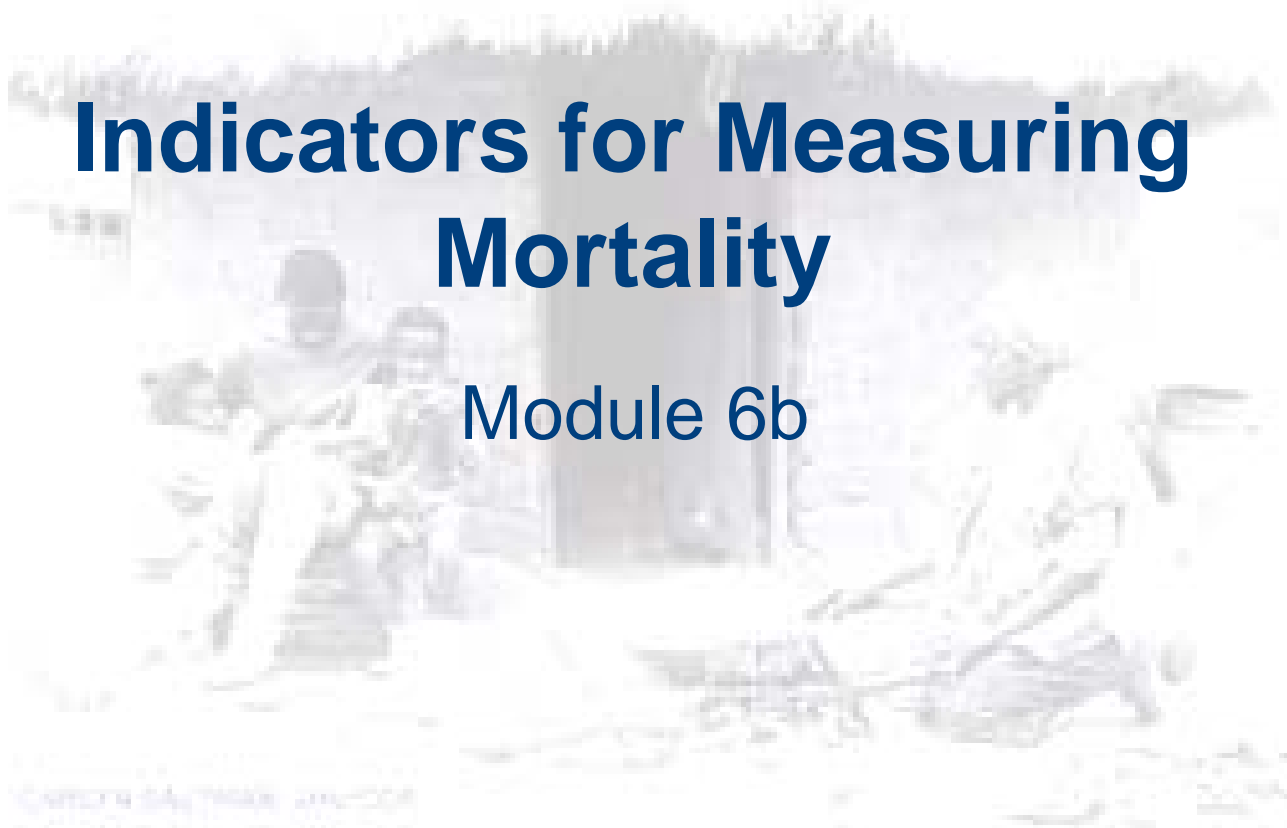 – in Matlab in Bangladesh, Rakai in Uganda, Navrongo in Ghana, etc.

Summary slide

◆ This concludes this lecture. The key concepts introduced in this lecture include

– Importance of mortality and morbidity as indicators of health status of a population

– Major sources of mortality information

Mortality and Morbidity

Indicators for Measuring Mortality

Module 6b

Learning Objectives

Upon completion of this module, the student will be able to :

◆ Describe, calculate and interpret different mortality and morbidity indicators

Measures of Mortality

- Crude Death Rates
- Age-Specific Death Rates
- Life Table Estimates
  - Life expectancy
  - Survivorship (by age)
- Cause-Specific Death Rates
- Special Indicators
  - Infant and maternal mortality rates

Crude Mortality Indicators

Crude Death Rate (CDR)

◆ Number of deaths in a given year per 1000 mid-year population

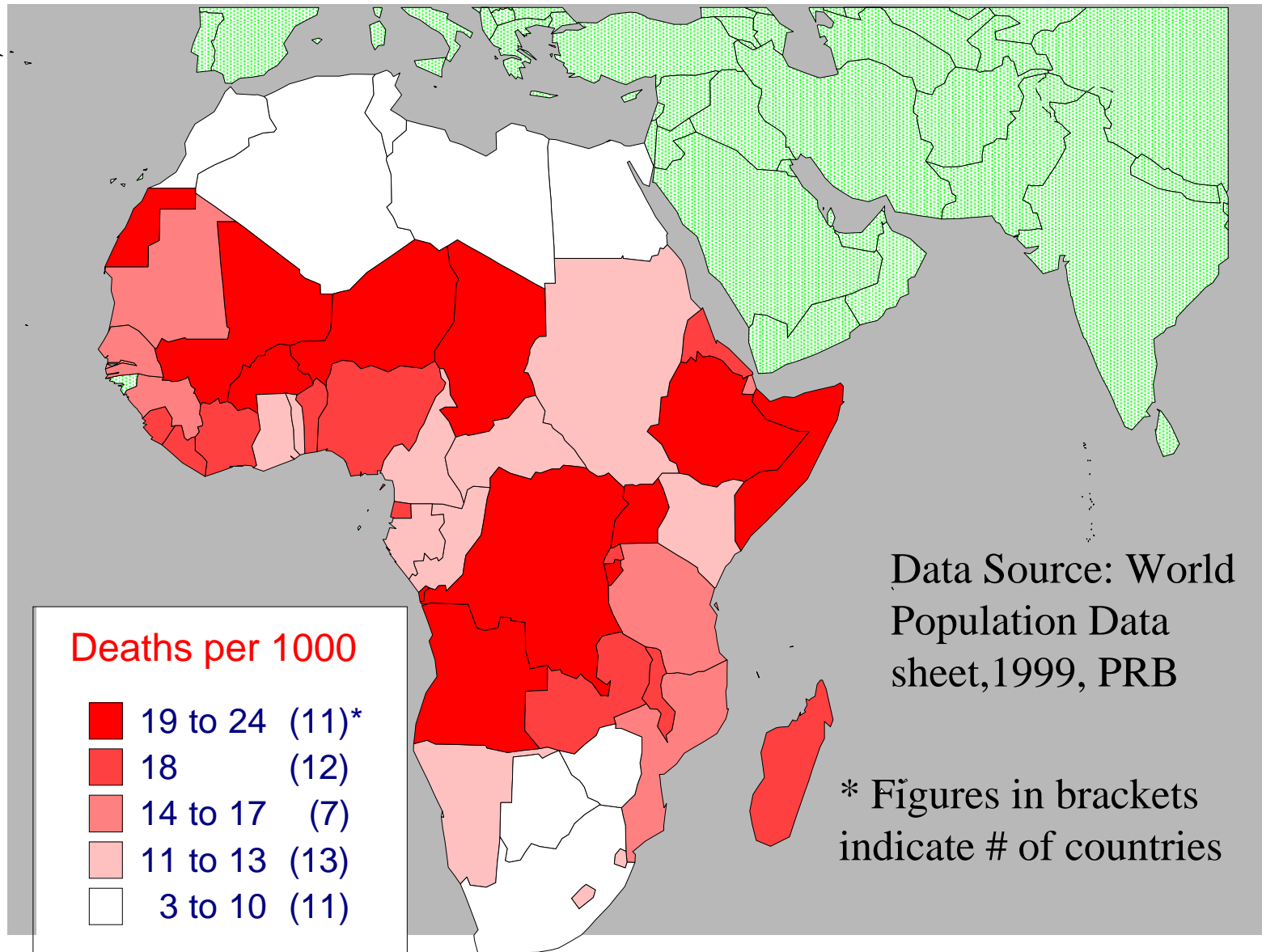$$\frac{\text{Number of deaths/year}}{\text{Mid}-\text{year population}} * 1000$$

Crude Death Rate : Example

♦ Uganda's crude death rate in 1999 is

$$\frac{\text{\# of deaths}}{\text{Total mid - year population}} \times k = \frac{420{,}296}{22{,}804{,}973} \times 1000 = 18.4$$

which indicates that there were about 18 deaths per 1000 inhabitants in the year 1999.

Crude Death Rates in Africa, 1999

Deaths per 1000

■ (dark red)	19 to 24 (11)*
■ (red)	18 (12)
■ (medium pink)	14 to 17 (7)
■ (light pink)	11 to 13 (13)
□ (white)	3 to 10 (11)

Data Source: World Population Data sheet,1999, PRB

* Figures in brackets indicate # of countries

21

Crude Death Rates Around the World
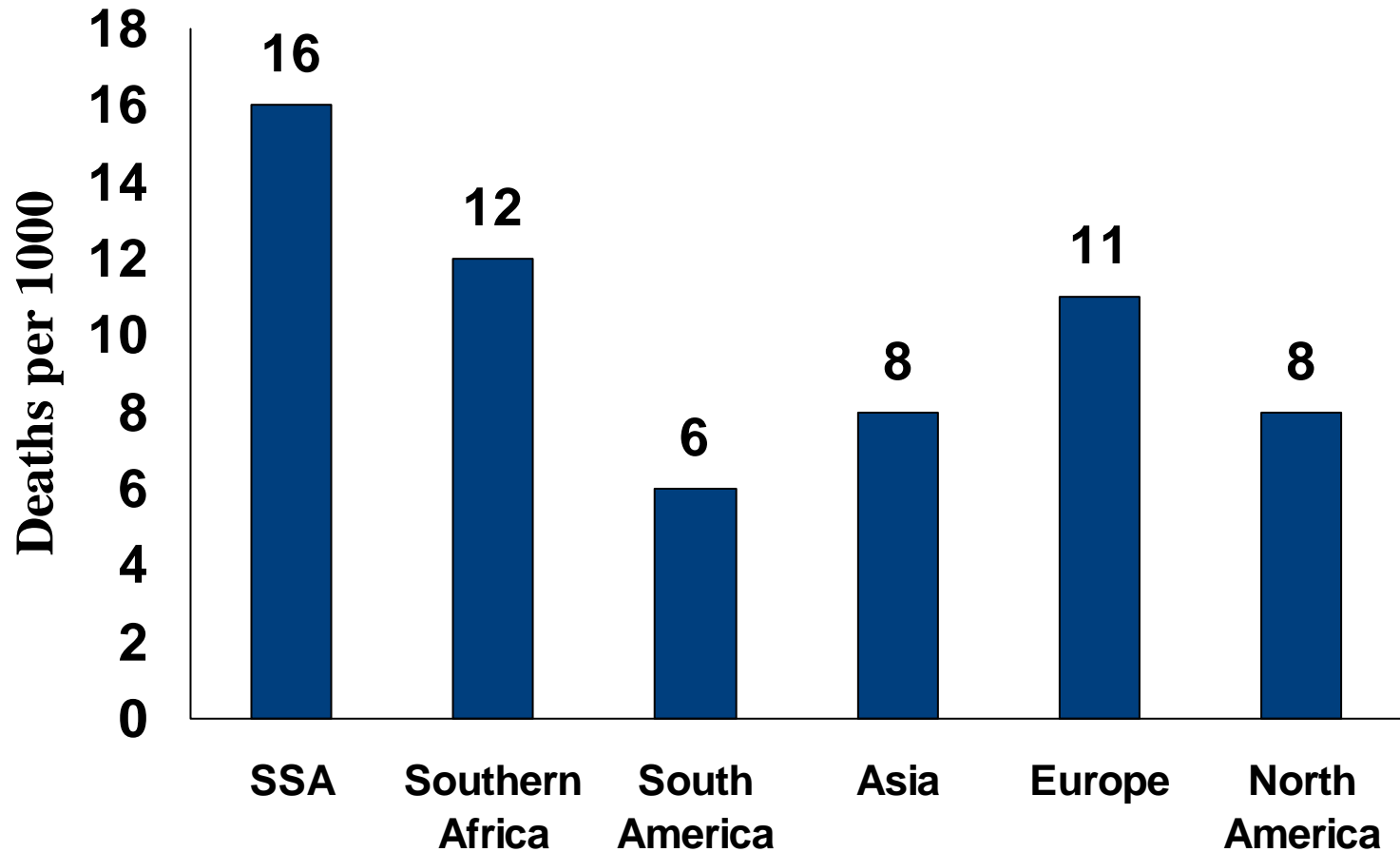
Data Source: World Population data sheet, 1999, PRB

Crude Death Rates
Points to Note

- Risks of death change by age, so CDR is affected by population age structure

- Aging populations can have rising CDRs, even as the health conditions are improving

- LDCs with very young populations will often have lower CDRs than MDCs even though their overall health conditions are poorer

- Therefore mortality comparisons across countries should always use mortality indicators that are adjusted for differences in age composition

Matlab, Bangladesh

Percent distribution of population and deaths, 1987

Age

Population

Deaths

Median age at death
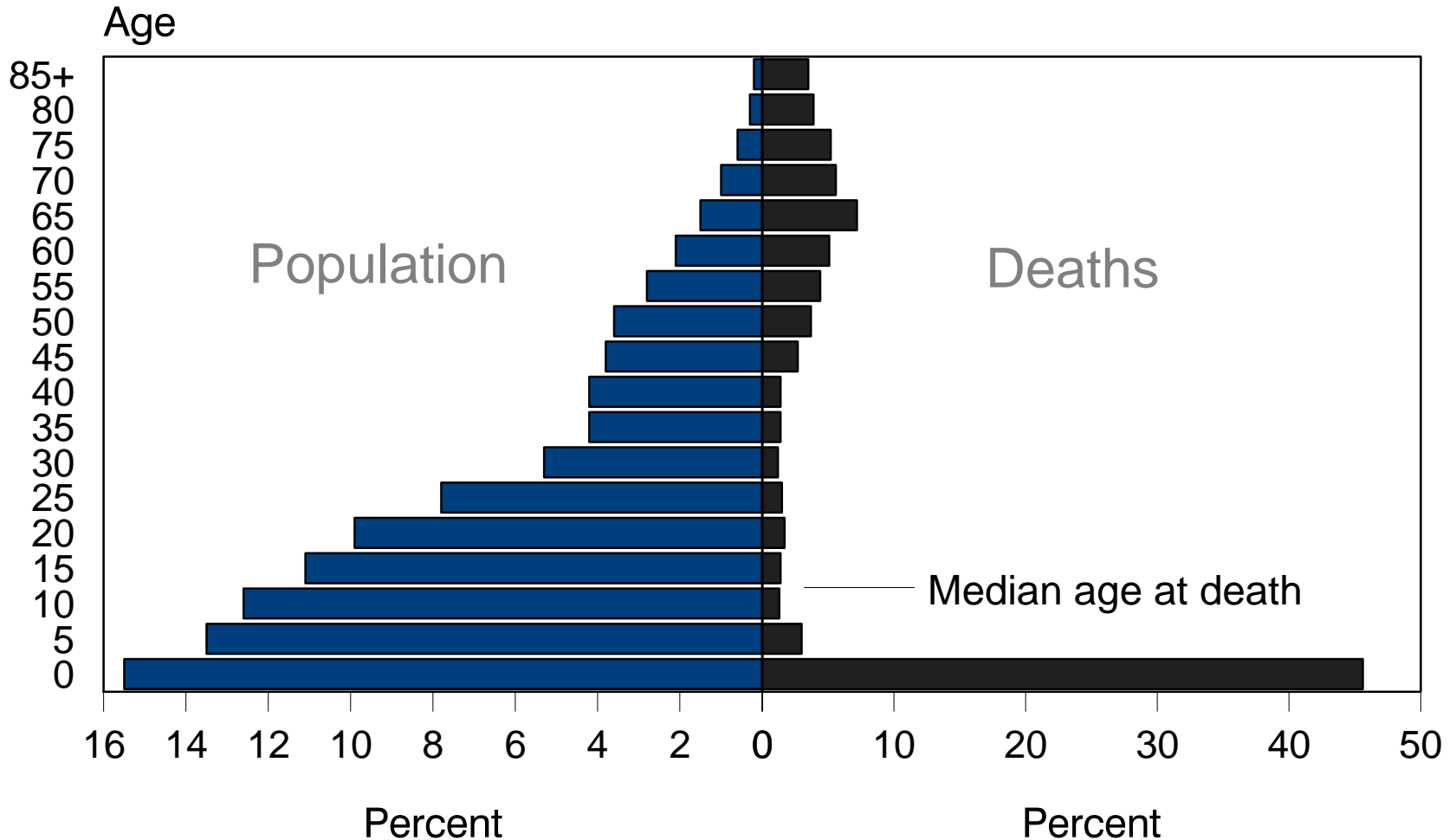
Percent

Percent

Sweden

Percent distribution of population and deaths, 1985
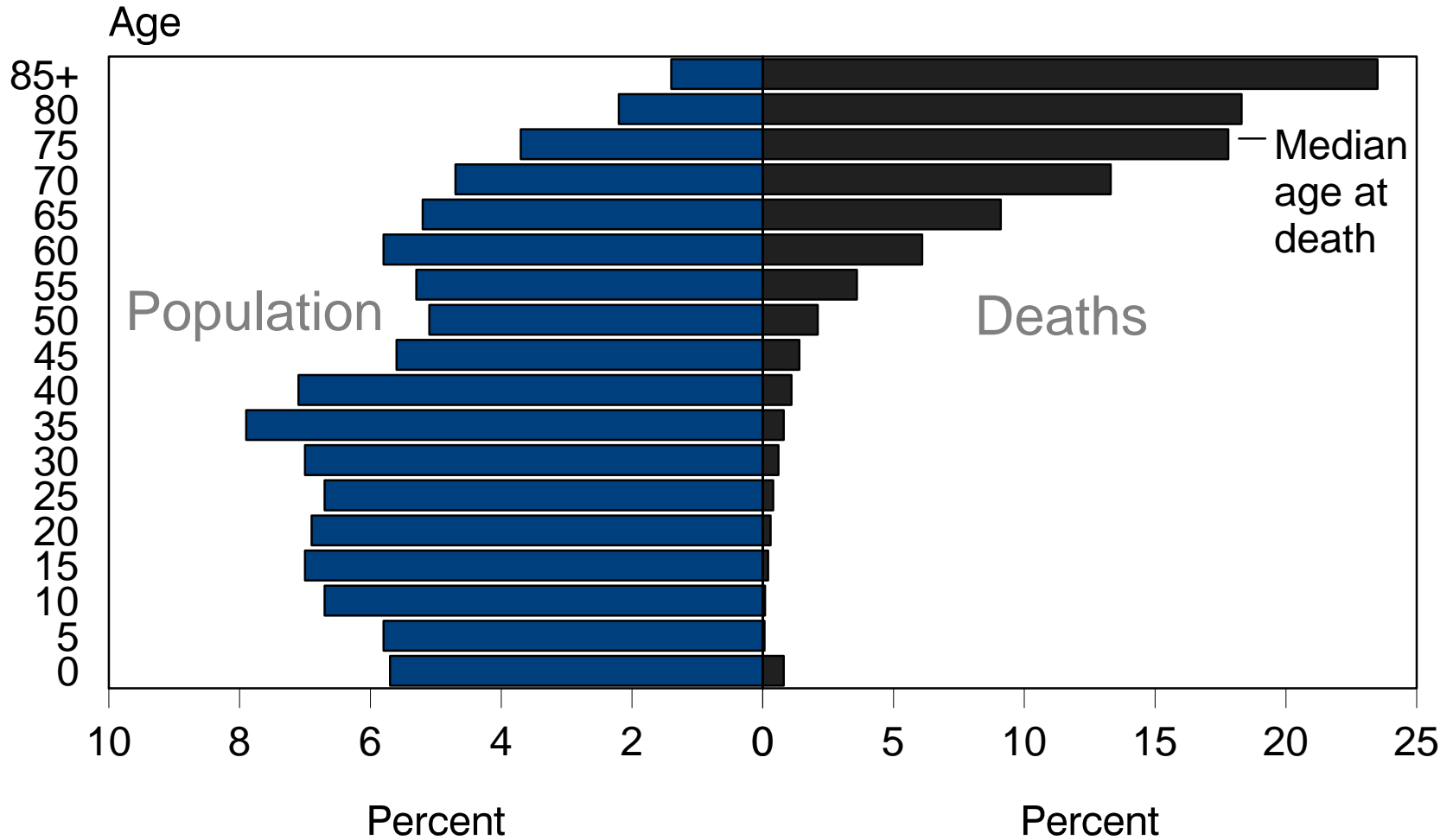
Age Specific Death Rates (ASDR)

Number of deaths per year in a specific age (group) per 1000 persons in the age group

$$= \frac{D_a}{P_a} * 1000$$

Where D_a = Number of deaths in age group a

P_a = Midyear population in age group a

Death Rates by Age, Sweden, 1945 and 1996
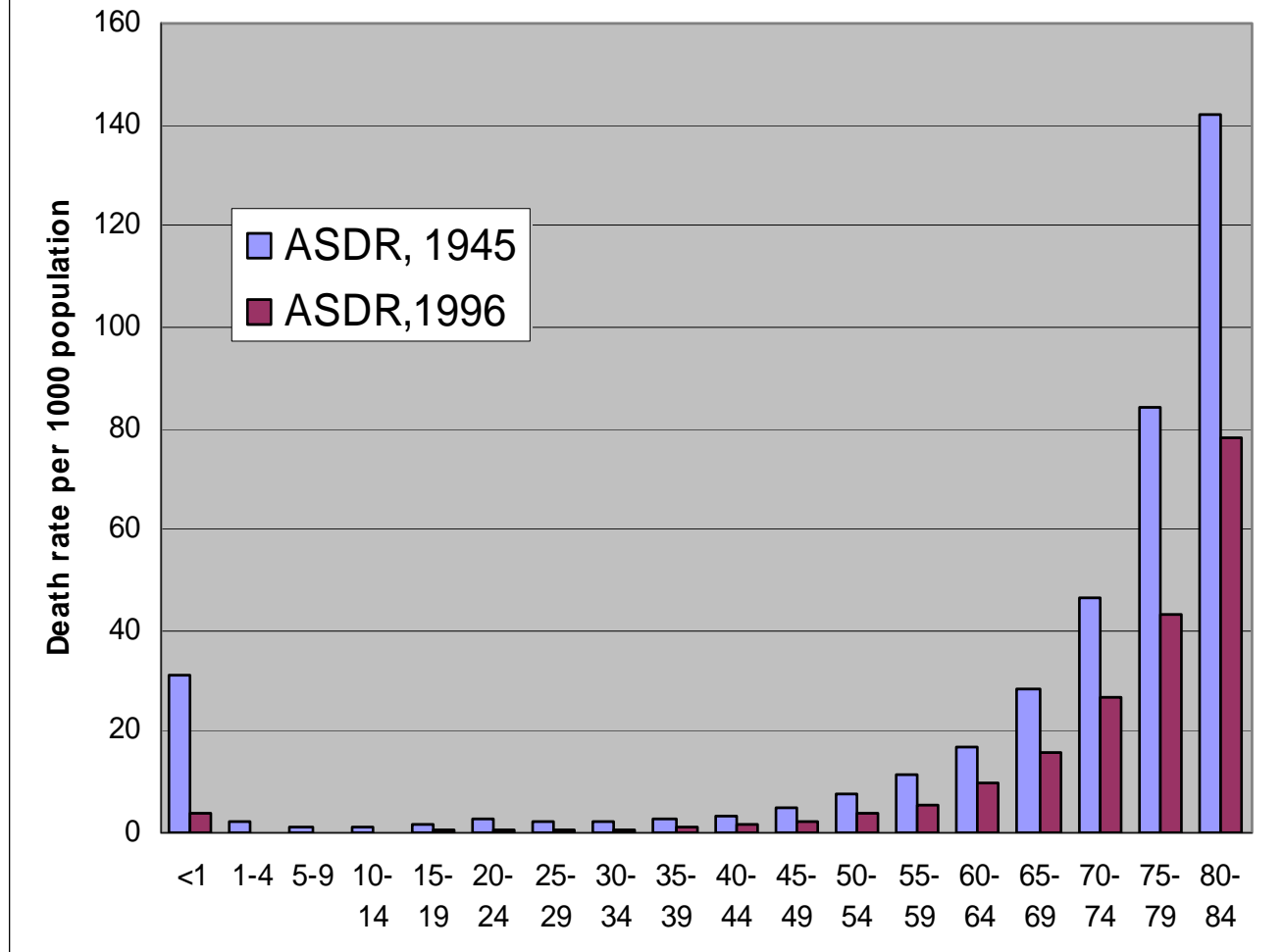
Data Source: UN Demographic Yearbooks, 1948, and 1997

Why Age Specific Death Rates?

- Can compare mortality at different ages

- Can compare mortality in the same age groups over time and/or between countries and areas

- Can be used to calculate life tables to create an age-independent measure of mortality (life-expectancy)

The Life Table

A powerful demographic tool used to simulate the lifetime mortality experience of a population, by taking that population's age-specific death rates and applying them to a hypothetical population of 100,000 people born at the same time

Measurement of Life Expectancy

Life Expectancy at Birth

◆ Average number of years lived among a cohort of births experiencing deaths at each year of age throughout their remaining life-time according to a specific schedule of age specific mortality rates

◆ Note: This measure of mortality is *independent* of the age structure of the population

Life Expectancy

♦ Estimate of the average number of additional years a person could expect to live if the age-specific death rates for a given year prevailed for rest of his or her life

Life Expectancy at Birth: Example

◆ If ASDRs for 1999 remain unchanged, males born in Uganda can expect to live 41 years on average; females can expect to live 42 years

◆ The comparative figures for USA are 74 years and 79 years for males and females respectively

Life Expectancy at Birth for Major World Regions

Region	Value
North America	77
Europe	73
East Asia	72
SE Asia	65
West Asia	68
South America	69
South Africa	56
Middle Africa	49
West Africa	52
SSA	49
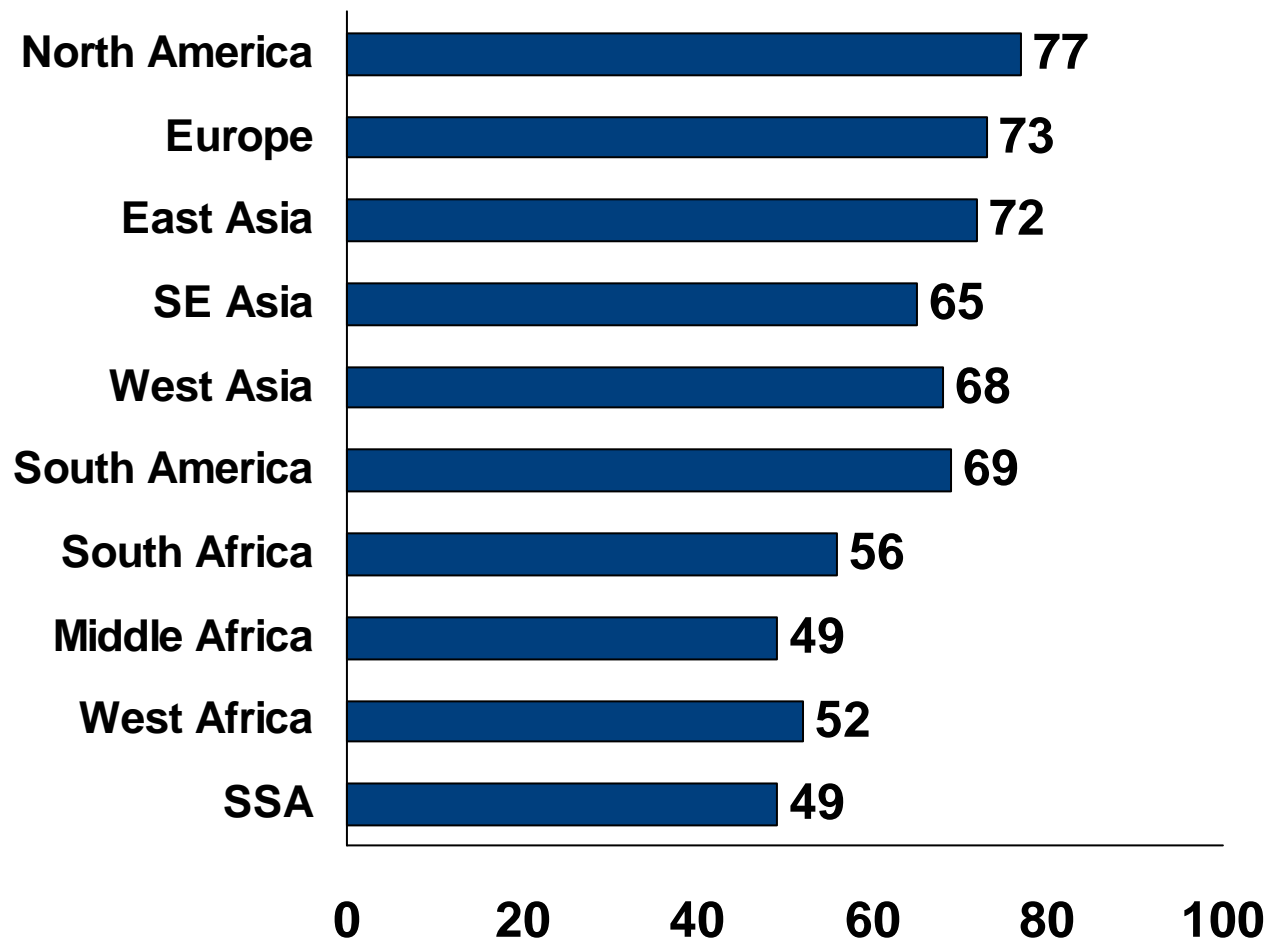
Data Source: World Population Data Sheet,1999, PRB

Mortality Indicator Comparisons in Countries With Death Registration

Country (1985)	CDR	Life Expectancy Male	Female
USA	8.74	71.3	78.4
Sweden	11.26	73.8	79.8
Japan	6.98	75.4	81.1
Korea	6.17	66.2	72.5

Source: Keyfitz and Flieger, 1990

Life Expectancy at Birth: Notes

- ◆ Most commonly cited life-expectancy measure

- ◆ Age independent, can be used to compare health conditions in different populations

- ◆ Good indicator of current health conditions

Cause Specific Death Rates

◆ Number of deaths attributable to a particular cause *c* divided by population at risk , usually expressed in deaths per 100,000

$$= \frac{D_c}{P} \times 100000$$
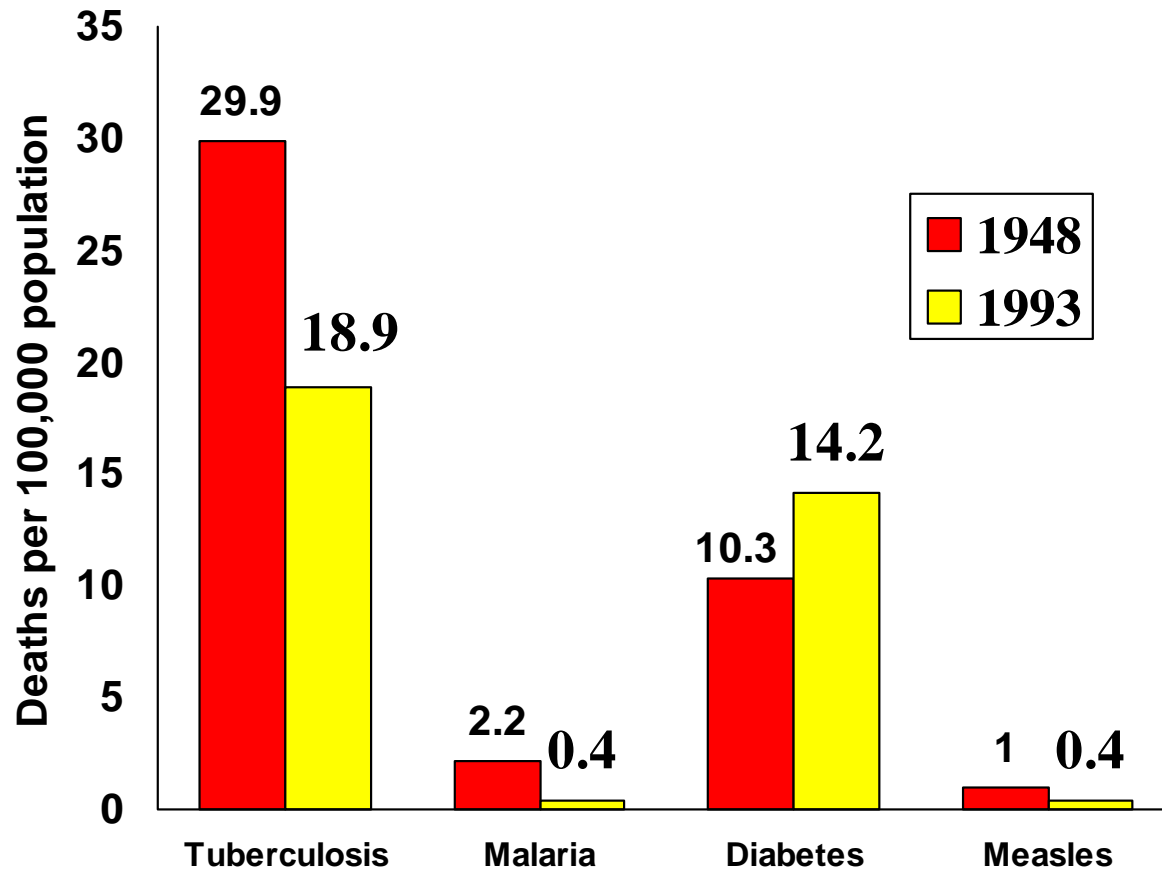
Cause Specific Death Rate: Examples

♦ The cause specific death rate per 100,000 for tuberculosis in South Africa in 1993 was:

$$\frac{\text{Deaths from TB}}{\text{Total Population}} \times k = \frac{7474}{39,544,974} \times 100,000 = 18.9$$

♦ Cause specific death rates for TB in Philippines, Mexico and Sweden were 36.7, 5.1, and 0.4 respectively

(UN Demographic year book, 1997)

Death Rates Due to Specific Causes, South Africa, 1948 and 1993

Data Source: UN Demographic Year Books, 1952, and 1997

Summary Slide

◆ This concludes this module, the key concepts introduced in the module include

– Crude death rate

– Age specific death rate

– Life table and life expectancy

– Cause specific death rate
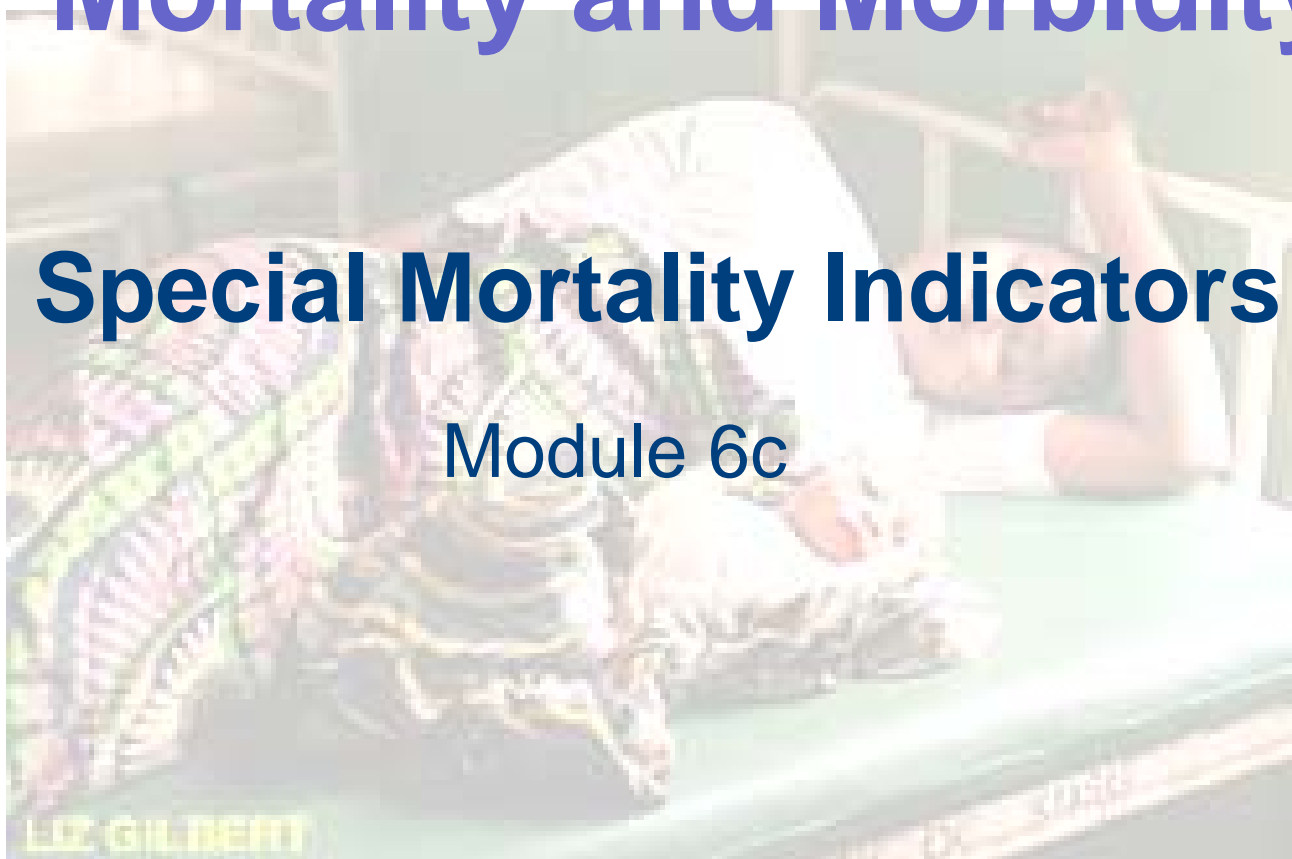
Learning Objectives

Upon completion of this module, the student will be able to :

◆ Describe, calculate and interpret infant mortality rate and different indicators for measuring maternal mortality rate

◆ Describe the differentials in infant mortality rate and maternal mortality rate across different regions of the world

Special Mortality Indicators

Infant Mortality Rate (IMR):

♦ Number of deaths of infants under age 1 per year per 1000 live births in the same year

$$IMR = \frac{\text{\# of deaths of infants in a given year}}{\text{Total live births in that year}} \times 1000$$

Special Mortality Indicators

Infant Mortality Rate (IMR): Examples

- In 1999, the infant mortality rate of Uganda was 81/1000 while Sweden reported one of the lowest infant mortality rates of 3.6/1000

- Malawi reported a IMR of 137/1000, which is very high

Infant Mortality Rates Around the World

Region	Infant Mortality Rate/1000
South America	35
North America	7
Europe	9
East Asia	29
SE Asia	46
West Asia	54
South Africa	55
Middle Africa	104
West Africa	86
SSA	94
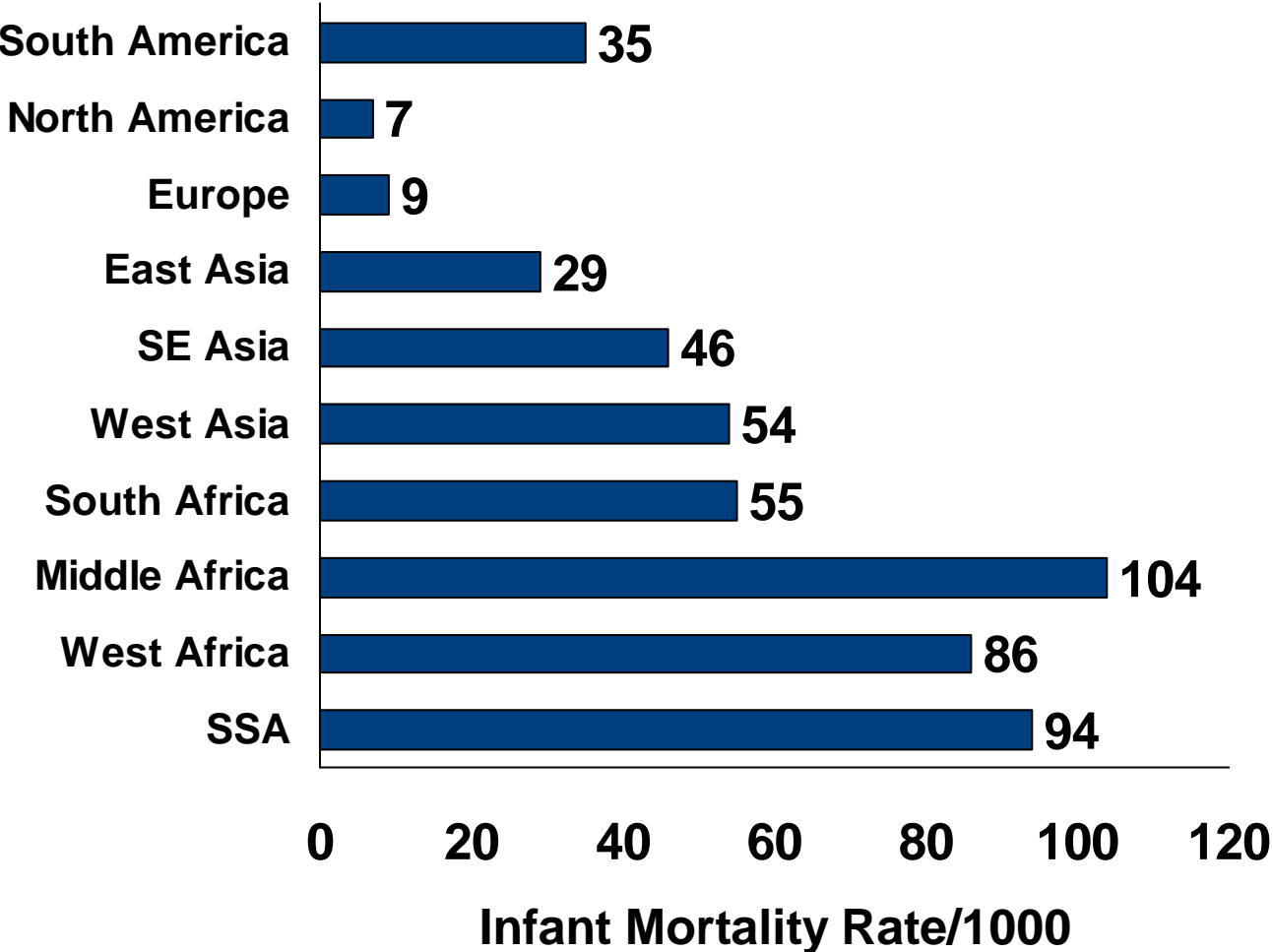
Data Source: World Population Data Sheet,1999, PRB

Why Infant Mortality Rates ?

◆ The IMR is a good indicator of the overall health status of a population

◆ It is a major determinant of life expectancy at birth

◆ The IMR is sensitive to levels and changes in socio-economic conditions of a population

Maternal Mortality

Definition:

‘Maternal death’ is death of a woman

- ✓ while pregnant ,or
- ✓ within 42 days of termination of pregnancy
- ➢ Irrespective of the duration or site of the pregnancy
- ➢ From any cause related to, or aggravated by the pregnancy or its management
- ➢ Not from accidental causes

Maternal Mortality Indicators

- Maternal mortality *ratio* (per 100,000 live births - or per 1000 live births)

- Maternal mortality *rate* (per 100,000 women of childbearing age)

- Life-time risk of maternal mortality

Maternal Mortality Ratio

◆ Number of women who die as a result of complications of pregnancy or childbearing in a given year per 100,000 *live births* in that year

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

◆ Represents the risk associated with each pregnancy, i.e., the obstetric risk

Maternal Mortality Rate

◆ Number of women who die as a result of complications of pregnancy or childbearing in a given year per 100,000 *women of childbearing age* in the population

$$= \frac{\# \text{ of maternal deaths}}{\# \text{ of women ages } 15 \text{-} 49} \times 100,000$$

◆ Represents both the obstetric risk and the frequency with which women are exposed to this risk

Lifetime Risk of Maternal Death

- The risk of an individual woman dying from pregnancy or childbirth during her reproductive lifetime.

- Takes into account both the probability of becoming pregnant and the probability of dying as a result of pregnancy cumulated across a woman's reproductive years

- *Approximated* by product of TFR and maternal mortality ratio

Women's Lifetime Risk of Death from Pregnancy, 1990

Region	Risk of Death
Africa	1 in 16
Asia	1 in 65
Latin America and Caribbean	1 in 130
Europe	1 in 1400
North America	1 in 3700
All developing countries	1 in 48
All developed countries	1 in 1800

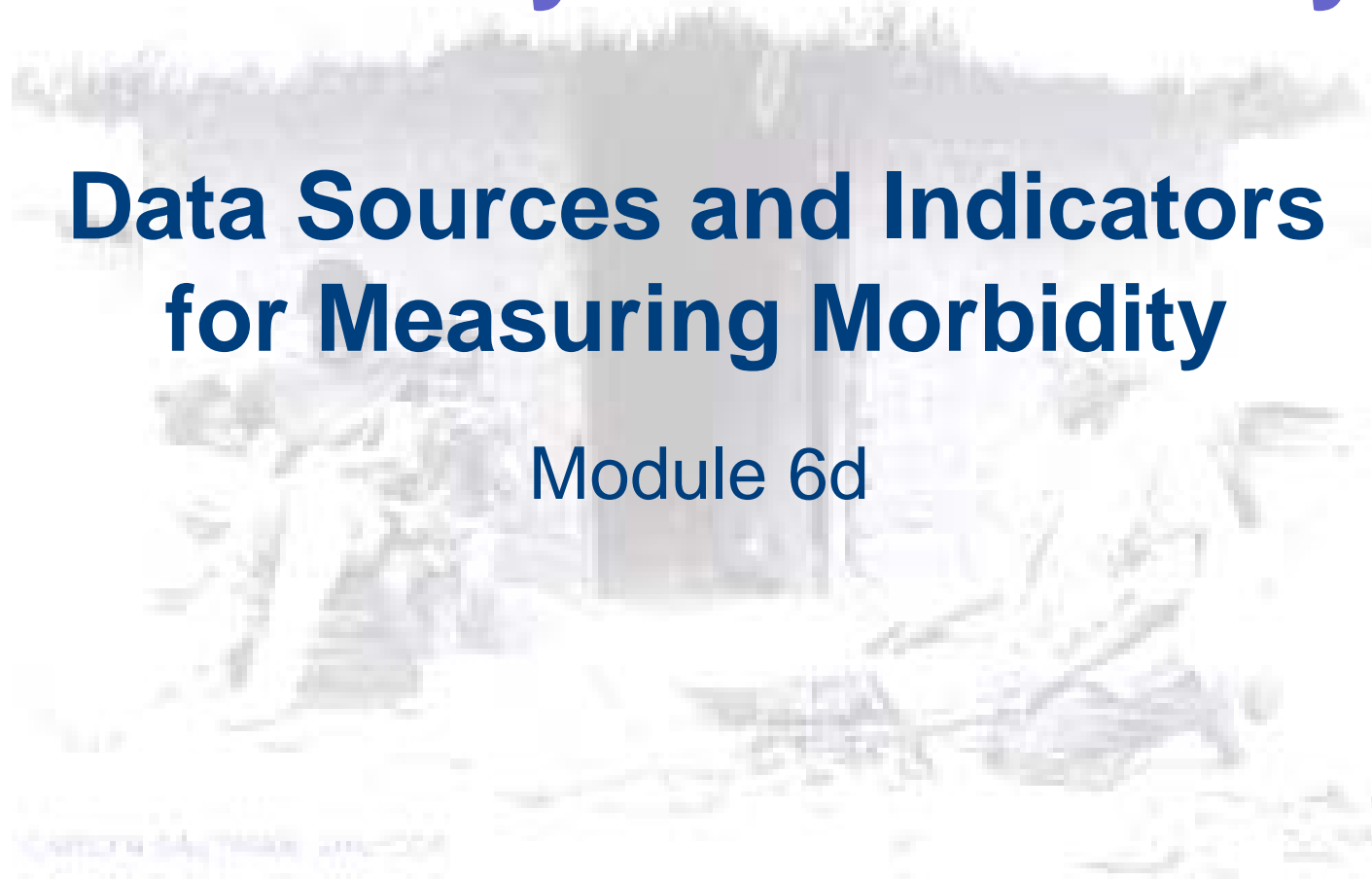*Source: Adapted from Family Care International,1998*

Summary Slide

♦ This concludes this session, the key concepts introduced in this module include

  – Indicators for maternal mortality

  – Infant mortality rate

Mortality and Morbidity

Data Sources and Indicators for Measuring Morbidity

Module 6d

Learning Objectives

Upon completion of this module, the student will be able to :

◆ Identify different sources of data for measuring morbidity

◆ Explain some of the problems relating to the completeness and quality of the data

◆ Describe, calculate and interpret different morbidity indicators

Morbidity

- Morbidity refers to the diseases and illness, injuries, and disabilities in a population

- Data on frequency and distribution of a illness can aid in controlling its spread and, in some cases, may lead to the identification of its causes

Morbidity

- The major methods for gathering morbidity data are through surveillance systems and sample surveys.

- These are both costly procedures and therefore are used only selectively in developing country setting to gather data on health problems of major importance

Disease Surveillance: Key Elements

◆ The systematic collection of pertinent information about events of interest

◆ The orderly consolidation, analysis, and interpretation of these data

◆ The prompt dissemination of the results in a useful form

◆ Timely and appropriate public health action taken based on the findings

Disease Surveillance

- Initially concerned with infectious diseases
- Currently includes a wider range of health data including
  - chronic diseases
  - environmental risk factors
  - health care practices
  - health behaviors

Sources of Data for Surveillance

- Notifiable diseases
  - Clinic/hospital admissions
  - Laboratory specimens
- Sentinel surveillance
- Administrative data systems – e.g., insurance records
- Other data sources – e.g., accident and injury reports

Sample Surveys for Morbidity: Rationale

Economy: of cost, of time -- only limited units are examined and analyzed

Accuracy: quality of enumeration and supervision can be high

Adaptability: many topics can be covered

Elaborateness: in-depth information can be collected

Sample Surveys: Principle Elements

♦ Subjects of study: individual persons, records, etc.

♦ Sample size: determined by the investigators considering precision required for estimates and resources available for the study

♦ Universe to be sample: dependent on study objectives

continued

Sample Surveys: Principle Elements

♦ Data collection procedures: unlimited, e.g., in depth interviews, physical, biological or cognitive measurements, direct observations, etc.

♦ Frequency of enumeration: variable, i.e., single visit, or multiple rounds to the same individual or to different individuals

Morbidity - Indicators

Incidence Rate

♦ Number of persons contracting a disease during a given time period per 1000 population at risk

♦ Refers only to new cases during a defined period

Incidence Rate - Example

Incidence for malaria will be given by:

$$\frac{\text{\# of persons developing malaria during a given time period}}{\text{Population at risk}} \times k$$

Morbidity - Indicators

Prevalence Rate

◆ Number of persons who have a particular disease/condition at a given point in time per 1,000 population

◆ A snapshot of an existing health situation

◆ Includes all known cases of a disease that have not resulted in death,cure or remission

Prevalence Rate - Example

Prevalence of HIV/AIDS among *adults* at a given *point* in time will be

$$\frac{\text{\# of persons ages 15 - 49 with HIV/AIDS}}{\text{Total population ages 15 - 49}} \times k$$

Adult HIV/AIDS Prevalence by Region, 1998

Percent of adults ages 15-49 with HIV/AIDS
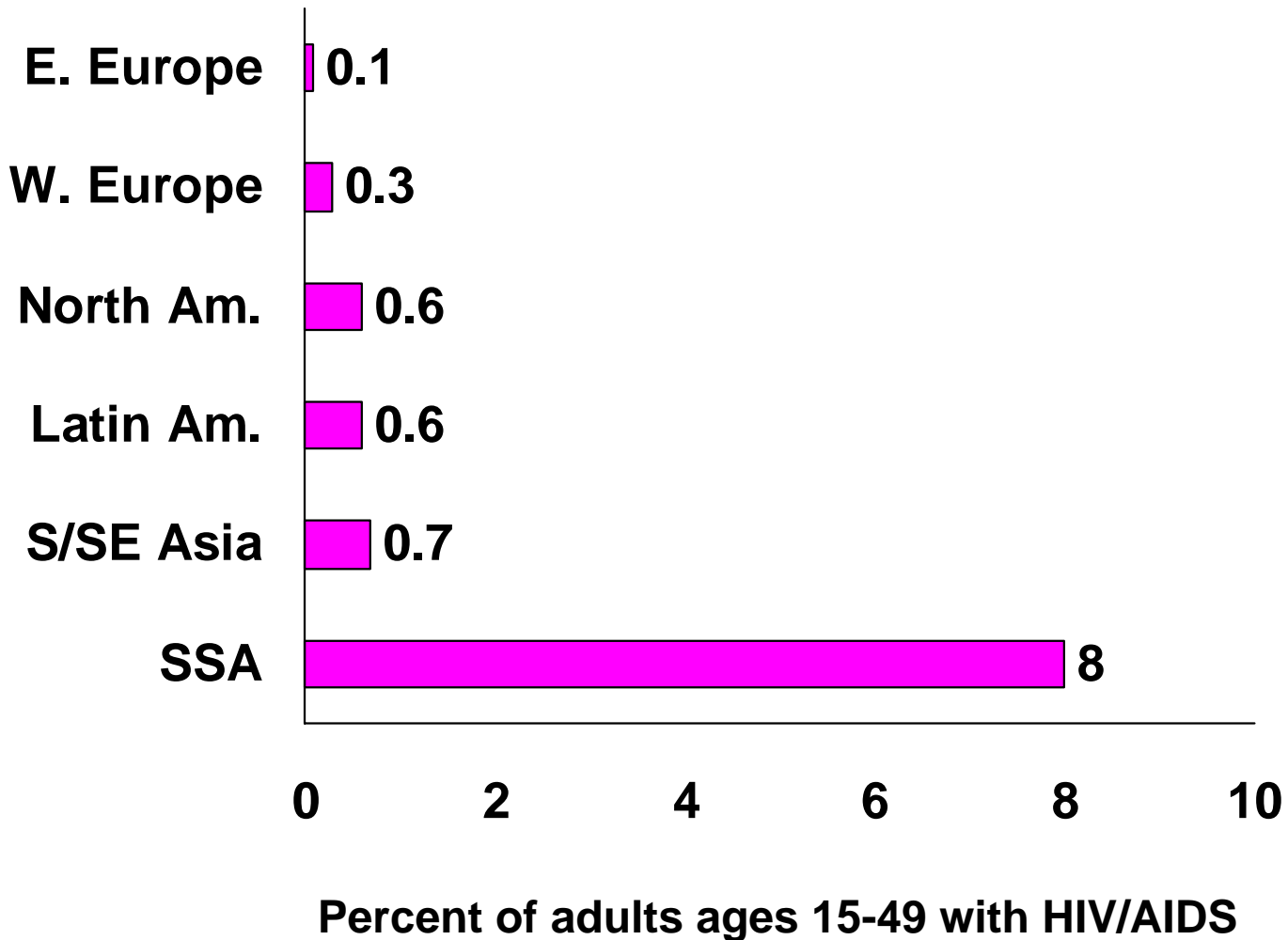
(*Source: UNAIDS, AIDS Epidemic Update – December 1998*)

68

Estimated Worldwide Incidence, Prevalence and Deaths For Selected Infectious Diseases, 1990

	Incidence		Prevalence		Mortality	
Disease	**New cases (1000s)**	**Rate per 100,000**	**Cases (1000s)**	**Rate per 100,000**	**Deaths (1000s)**	**Rate per 100,000**
Malaria	213,743	4,058	2,777	53	856	16
Measles	44,334	842	1,739	33	1,058	20
Tuberculosis	6,346	121	12,739	242	2,040	39
HIV and AIDS	2,153	41	8,823	167	312	6
Poliomyelitis	215	4	10,648	203	27	1

Source: C.Murray and A. Lopez, Global Health Statistics: Epidemiologic Tables (1996)

Summary Slide

- This concludes this session. The key concepts introduced in this module include:
  - Data sources for studying morbidity
  - Key indicators of morbidity