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# Fertility and Reproduction

## Data sources and Crude indicators of Fertility

### Module 4a

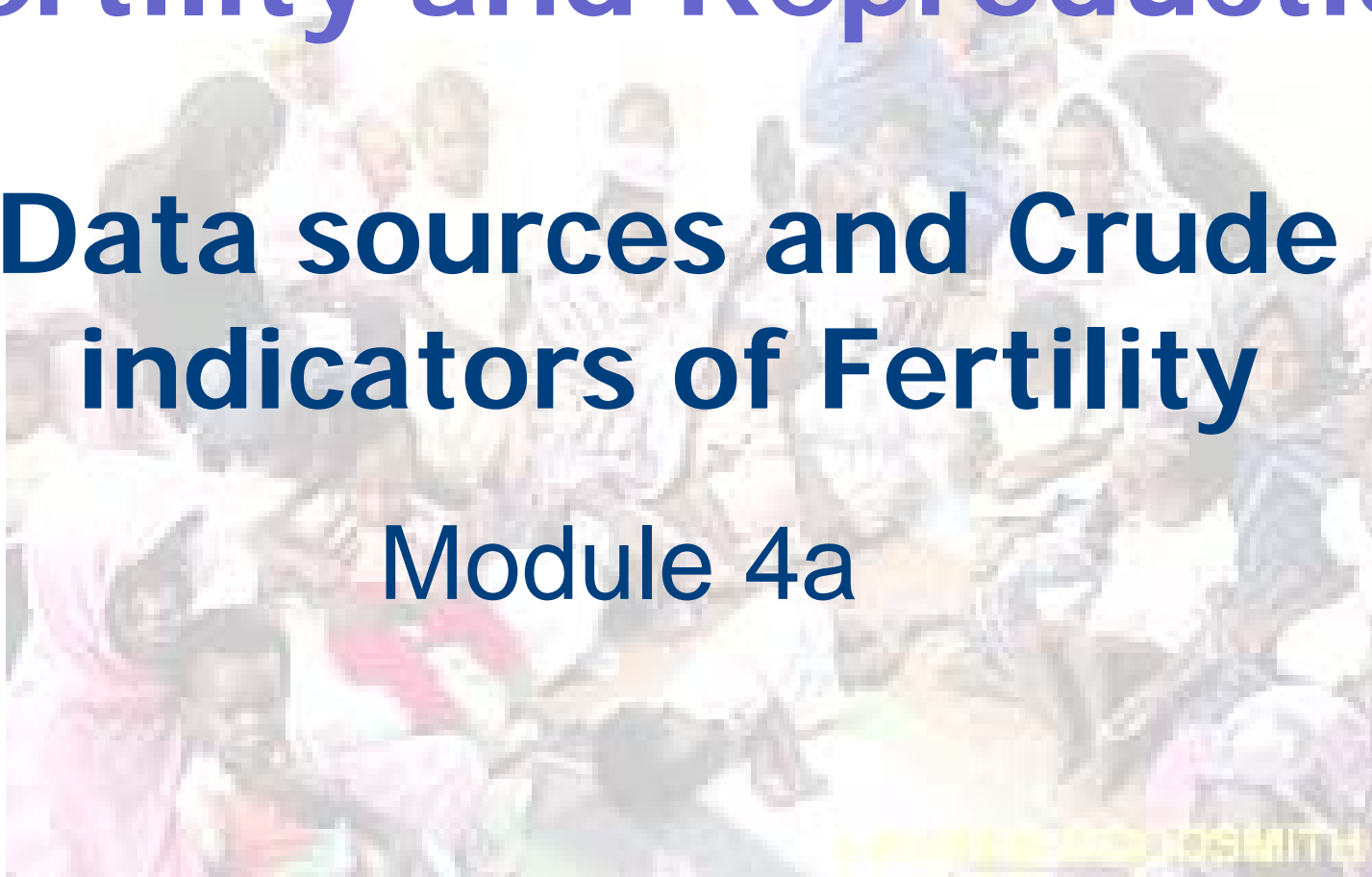


Photo: © 1991 Lauren Goodsmith, Courtesy of Photoshare

# Learning Objectives

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

- ◆ Distinguish among different terms used to describe fertility in the populations
- ◆ Identify different sources of data to calculate different indicators of fertility
- ◆ Calculate and interpret different crude indicators of fertility

# I. Definitions

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- ◆ **Fertility** = Production of a live birth (natality)
- ◆ **Infertility** = Inability to produce a live birth
- ◆ **Parity** = Number of children born alive to a woman
- ◆ **Gravidity** = Number of pregnancies a woman has had whether or not they produce a live birth
- ◆ **Fecundity** = Physiological capacity to conceive (reproductive potential)

*continued*

# I. Definitions

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- ◆ **Infecundity** (sterility) = Inability of a woman to conceive a pregnancy
  - Primary sterility = Never able to conceive a pregnancy
  - Secondary sterility = Inability to conceive after one or more children have been born
- ◆ **Fecundability** = Probability that a woman will conceive during a menstrual cycle

# Fertility Measurement: Sources of Data

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- ◆ Censuses
- ◆ Vital registration systems
- ◆ Nationally representative sample surveys  
World Fertility Surveys (WFS),  
Demographic and Health Surveys (DHS),  
etc.

# A Fertility Measure from Census Data

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## Child-Woman Ratio

Number of children under age 5 per  
1000 women of childbearing age in a  
given year

$$\frac{\text{Number of children  
under age 5}}{\text{Number of women  
ages 15 - 49}} \times 1000$$

# A Fertility Measure from Census Data

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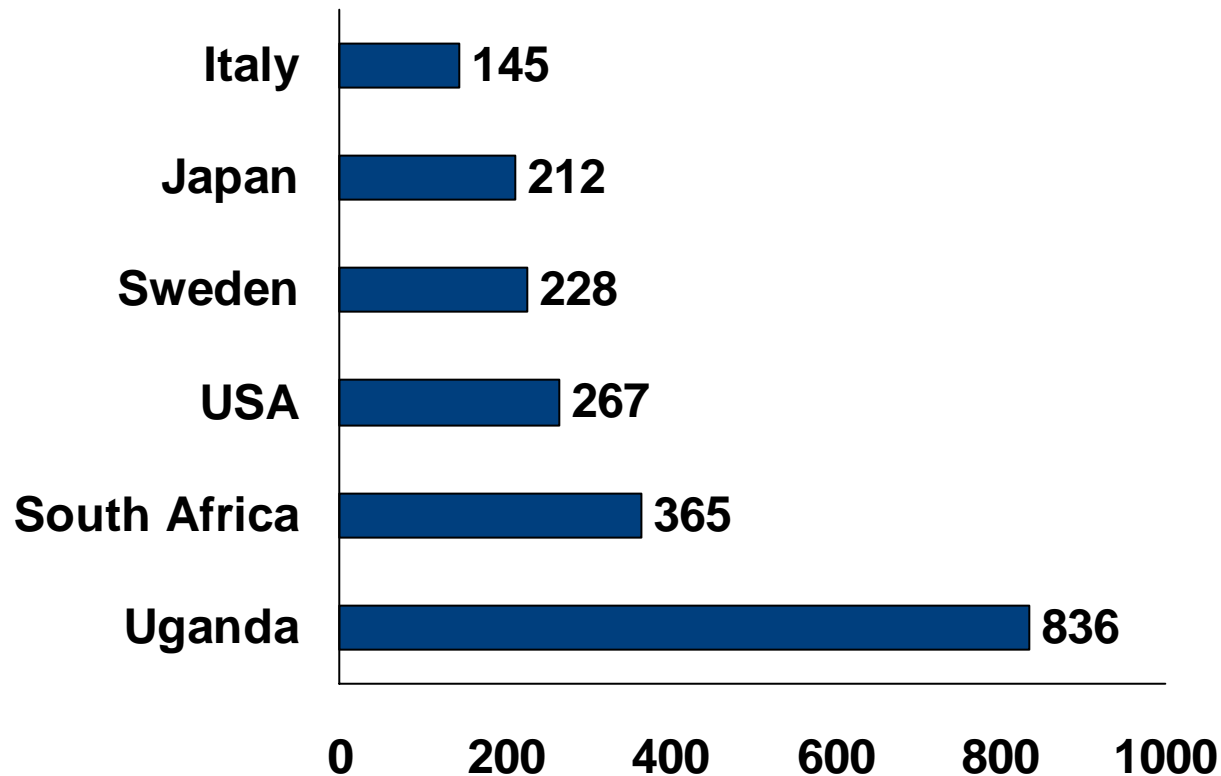
Child-women ratio in Uganda in the  
year 1991 is:

$$\frac{\begin{array}{l} \# \text{ children } \text{ under} \\ \text{age } 5 \end{array}}{\begin{array}{l} \# \text{ women } \text{ ages} \\ 15 - 49 \end{array}} = \frac{3,153,122}{3,771,496} \times 1000 = 836$$



# Child-Woman Ratio: Examples

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Source of data: US census bureau, 1999

# Crude Birth Rate

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Number of live births per 1000 population  
in a given year.

$$\frac{\text{Number of Births/Year}}{\text{Total Mid - year Population}} \times 1000$$

# Crude Birth Rate: Example

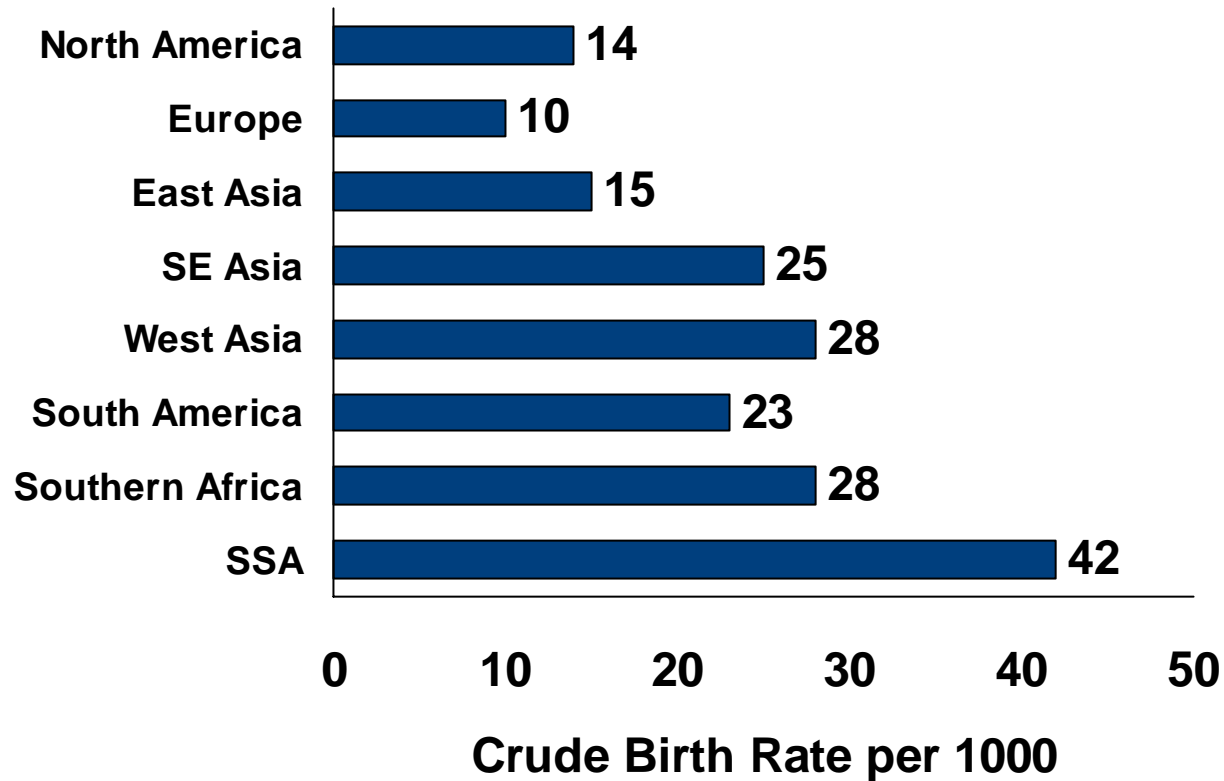
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- ◆ Uganda's estimated crude birth rate in the year 1999 is:

$$\begin{aligned} & \frac{\text{\# of births in 1999}}{\text{Mid - year population}} \times k \\ &= \frac{1,106,953}{22,804,973} \times 1000 \\ &= 48.5 \end{aligned}$$

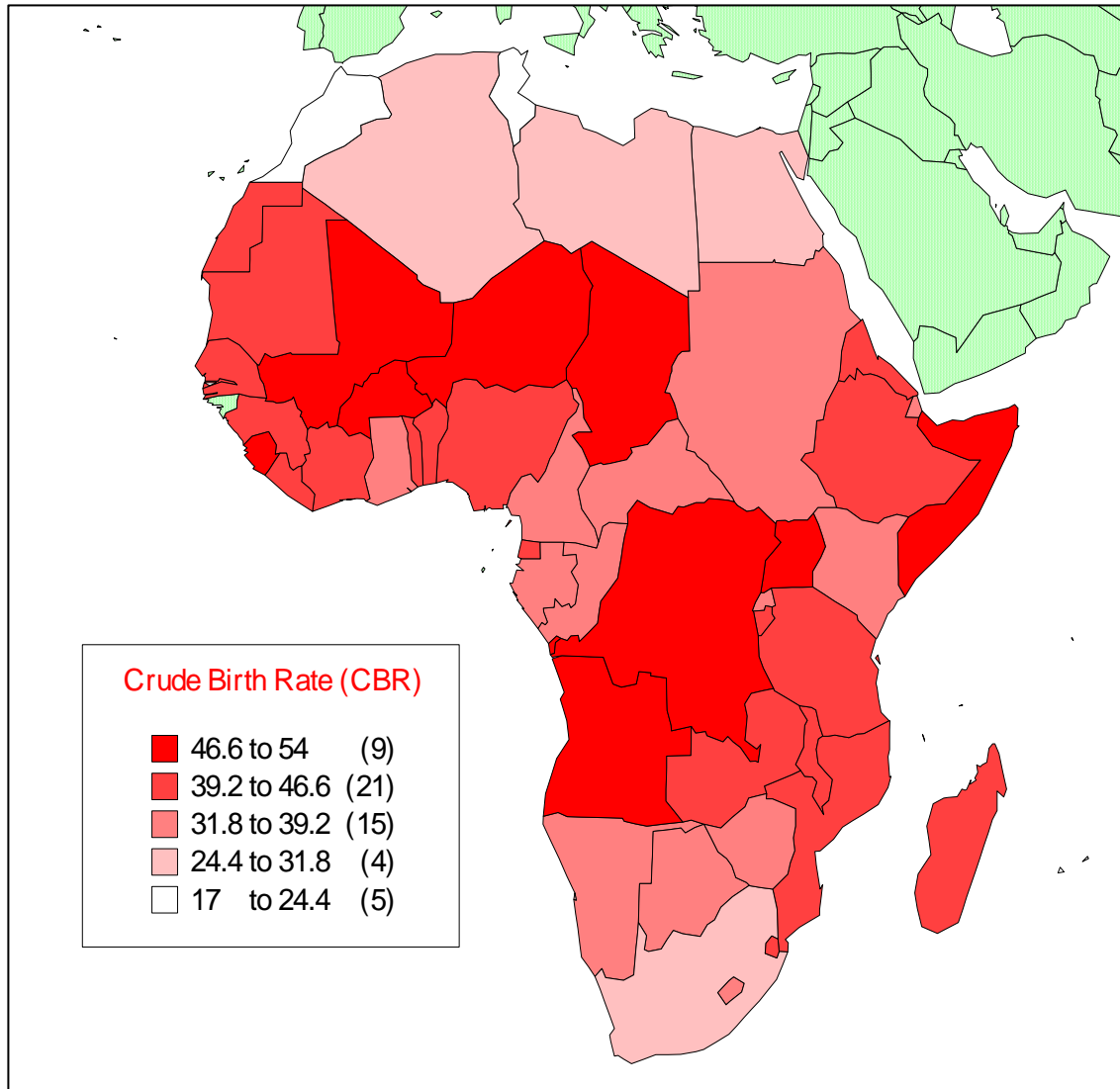
# Crude Birth Rates Around the World, 1999

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Source: Fact sheet, 1999. Population Reference Bureau

# Crude Birth Rates in Africa



Data Source:  
World  
Population  
Data Sheet,  
1999, PRB

# Crude Birth Rate: Data Requirements and Limitations

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- ◆ Need a complete and accurate vital registration system
- ◆ Only a crude estimate of fertility
  - All the population included in the denominator is not exposed to the risk of pregnancy
- ◆ Not good for comparing fertility across populations, as variations in age distribution of the populations being compared will affect the birth rate

# General Fertility Rate (GFR)

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Number of live births per 1000 women ages 15-49 in a given year

$$\frac{\text{Number of births/year}}{\text{Number of women ages 15 to 49}} \times 1000$$

# General Fertility Rate: Example

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- ◆ The GFR of Uganda in year 1999 is:

$$\frac{\text{\# of births}}{\text{\# of women ages 15 - 49}} \times k = \frac{1,106,953}{4,739,981} \times 1000 = 233.5$$

- ◆ Czech Republic' GFR of 34/1000 in 1996, was very low



# General Fertility Rate: Data Sources

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- ◆ Vital registration system for births
- ◆ May also be estimated from national censuses or survey data using the child-women ratio when birth statistics are not available

*continued*

# General Fertility Rate

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- ◆ Relates births to the age-sex group at risk of giving births (usually defined as women ages 15-49 years)
- ◆ More refined measure than crude birth rate to compare fertility across populations
- ◆ Approximately equals to 4 times the crude birth rate

# Summary Slide

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- ◆ This concludes this module. The key concepts introduced in this module include:
  - Sources of data for fertility measurement
  - Fertility measures calculated from census data
  - Crude birth rate and crude death rate

# Fertility and Reproduction

## Age Adjusted Indicators of Fertility

### Module 4b

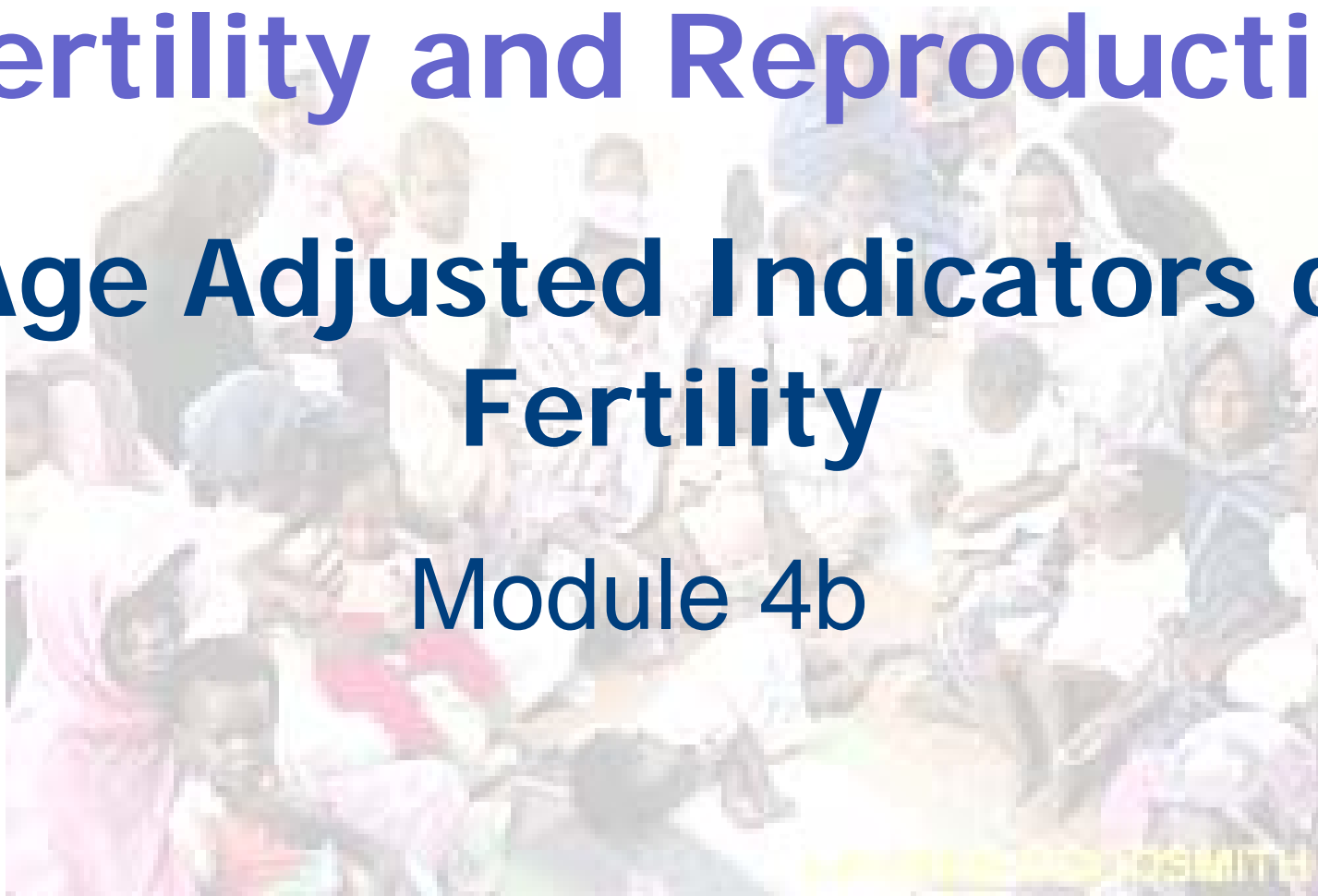


Photo: © 1991 Lauren Goodsmith, Courtesy of Photoshare

# Learning Objectives

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

- ◆ Calculate and interpret different age independent indicators of fertility

# Age Specific Fertility Rate (ASFR)

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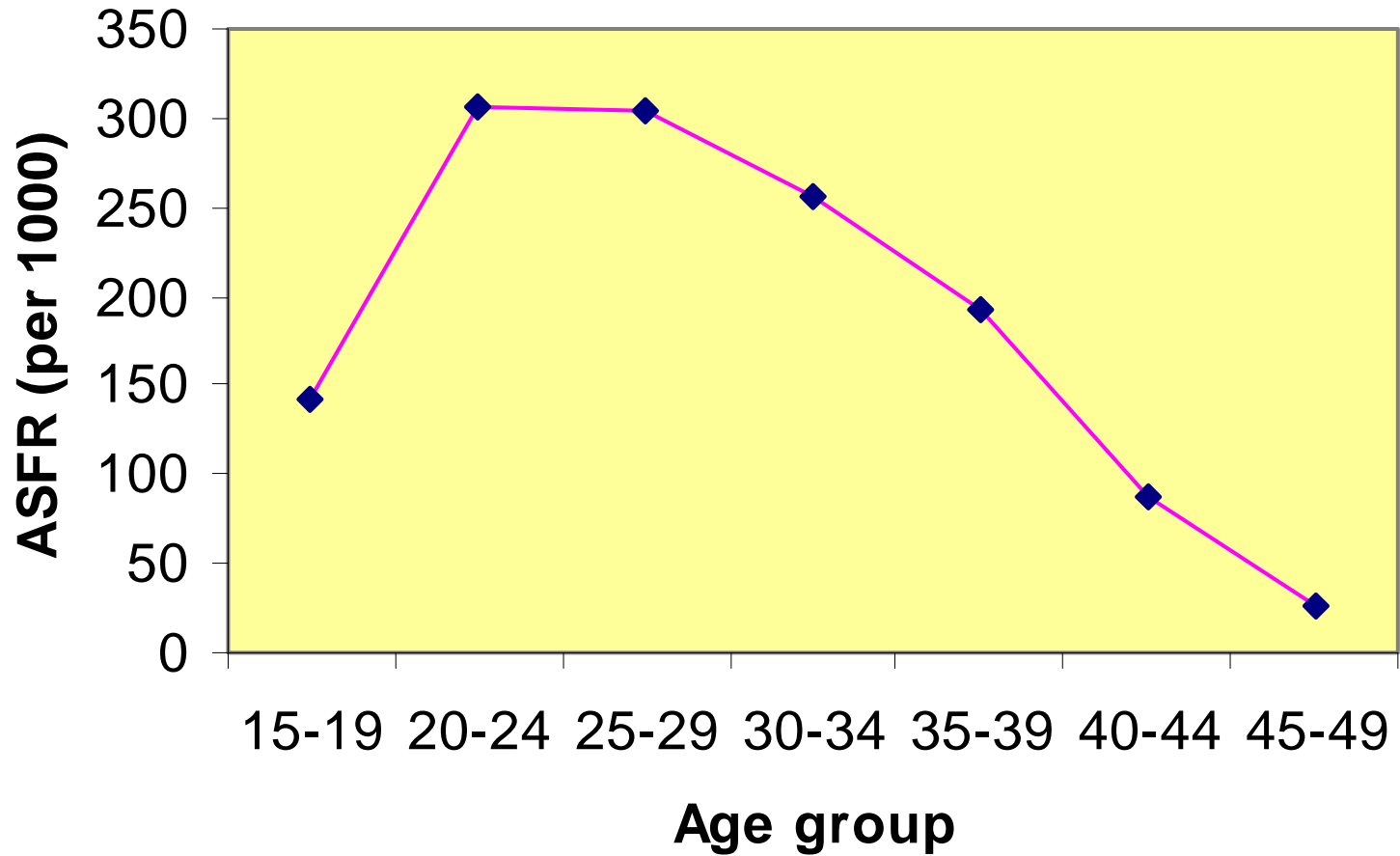
- ◆ Number of births per year per 1000 women of a specific age (group)

$$\frac{\text{Number of births to women age } a}{\text{Number of women age } a} \times 1000$$

## Uganda calculation of ASFR, 1991

| Age of women | (1)<br>Number of women | (2)<br>Number of births | (3)<br>ASFR<br>(2)÷(1) |
|--------------|------------------------|-------------------------|------------------------|
| 15-19        | 936480                 | 133,901                 | 142.9                  |
| 20-24        | 815627                 | 250,361                 | 306.9                  |
| 25-29        | 673084                 | 204,436                 | 303.7                  |
| 30-34        | 479915                 | 122,778                 | 255.8                  |
| 35-39        | 353079                 | 67,755                  | 191.9                  |
| 40-44        | 280223                 | 24,275                  | 86.6                   |
| 45-49        | 233088                 | 6,089                   | 26.1                   |

# Age-Specific Fertility Rates, Uganda: 1991





# Age Specific Fertility Rates: Why do we need them?

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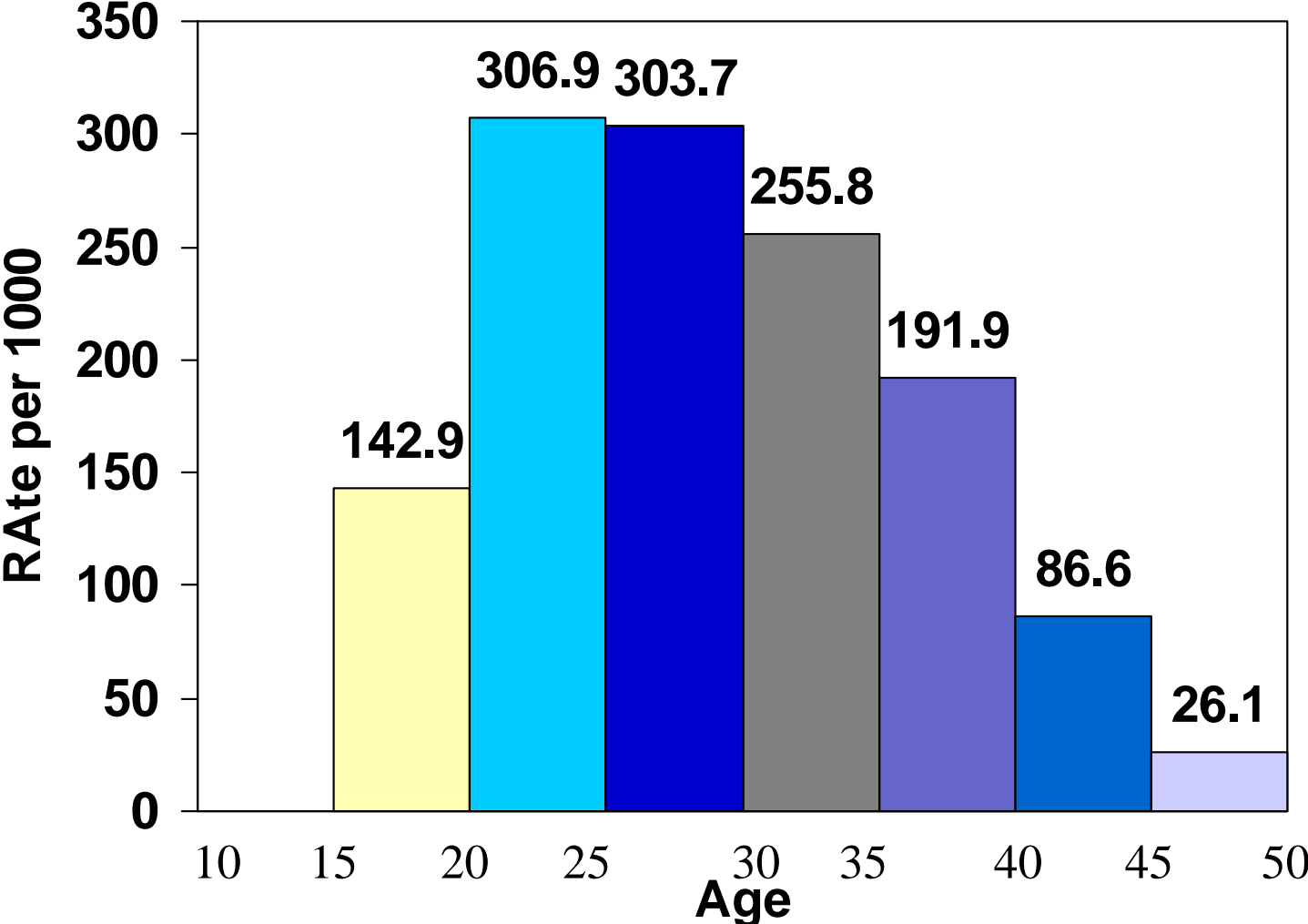
- ◆ For comparisons in fertility behavior at different ages
- ◆ For comparison of fertility at different ages over time
- ◆ For comparison of fertility across countries/populations

# Total Fertility Rate (TFR): Definition

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The average number of children that would be born to a woman by the time she ended childbearing if she were to pass through all her childbearing years conforming to the age-specific fertility rates of a given year

# Calculating TFR: Uganda, 1991



# Calculating TFR: Uganda 1991

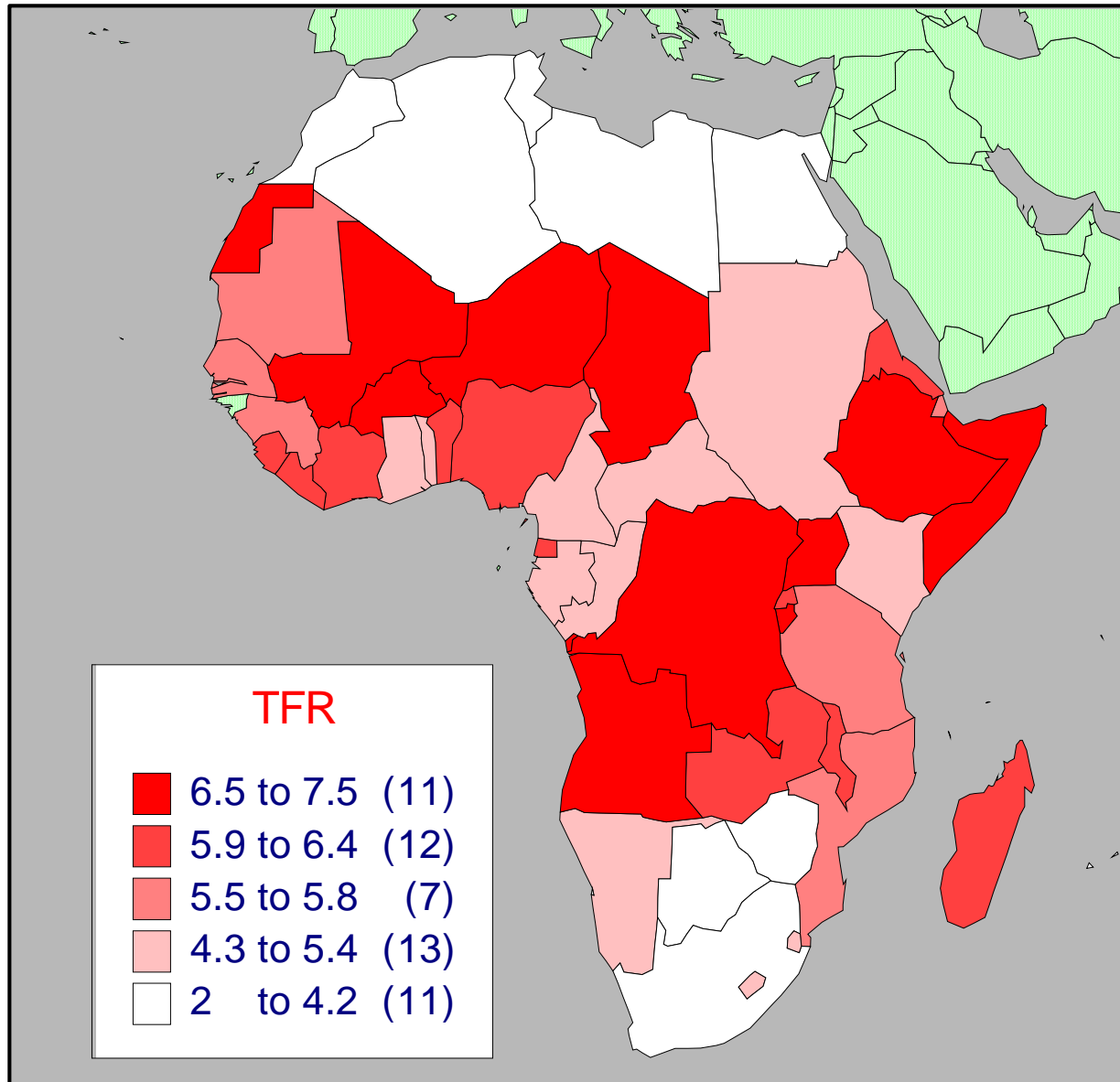
| Age of women | (1)<br>Number of women | (2)<br>Number of births | (3)<br>ASFR<br>(2)÷(1) | (4)<br>ASFR<br>x<br>5/1000 |
|--------------|------------------------|-------------------------|------------------------|----------------------------|
| 15-19        | 936480                 | 133,901                 | 142.9                  | 0.71                       |
| 20-24        | 815627                 | 250,361                 | 306.9                  | 1.53                       |
| 25-29        | 673084                 | 204,436                 | 303.7                  | 1.52                       |
| 30-34        | 479915                 | 122,778                 | 255.8                  | 1.28                       |
| 35-39        | 353079                 | 67,755                  | 191.9                  | 0.96                       |
| 40-44        | 280223                 | 24,275                  | 86.6                   | 0.43                       |
| 45-49        | 233088                 | 6,089                   | 26.1                   | 0.13                       |
| TFR          |                        |                         |                        | 6.57                       |

# Total Fertility Rate: Notes

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- ◆ TFR is a “synthetic” measure of fertility that is independent of age structure of a population
- ◆ Best single measure to compare fertility across populations
- ◆ Does not give a measure of actual number of births any woman will have all through her reproductive years

# Total Fertility Rates in Africa, 1999



*Data source:  
World  
Population  
Data Sheet,  
1999, PRB*

## Children Ever Born (CEB)

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- ◆ This is computed from censuses or sample surveys by asking women their age and number of live births they ever had (including those having died since birth)

# Children Ever Born (CEB): Notes

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- ◆ Provides one measure of population fertility
- ◆ Useful only if age group of women is considered
- ◆ Data can be used by demographers to indirectly estimate ASFR and TFR in a population



# Children Ever Born (CEB): Notes

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- ◆ CEB for women over age 49 is called **Completed Fertility Rate**; it shows how many children on average a certain cohort of women who have completed childbearing actually produced during their childbearing years
- ◆ In 1991, the number of children ever born on average to women ages 45-49 was 6.9 in Uganda.

# Summary Slide

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- ◆ This concludes this module. The key concepts introduced in this module include:
  - Age specific fertility
  - Total fertility rate
  - Children ever born as measure of fertility

# Fertility and Reproduction

## Indicators of Reproduction

### Module 4c

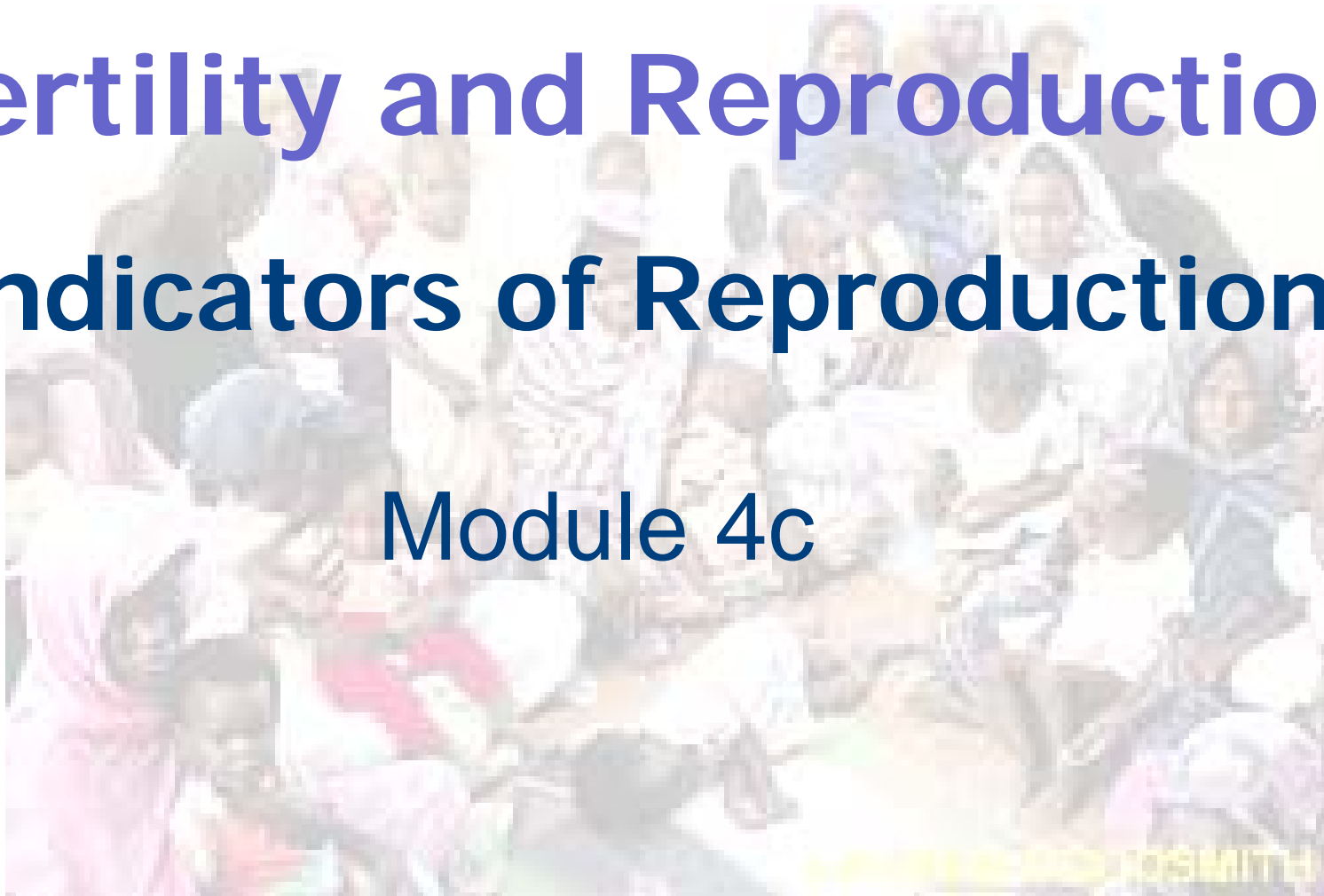


Photo: © 1991 Lauren Goodsmith, Courtesy of Photoshare

# Learning Objectives

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

- ◆ Define and interpret some indicators of reproduction in populations
- ◆ Define and interpret population momentum

# Measures of Reproduction

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## Gross Reproduction Rate (GRR): Definition

Average number of *daughters* that would be born to a woman during her lifetime if she passed through her child-bearing years conforming to the age specific fertility rates of a given year

**Note:** GRR is exactly like TFR, except that it counts only daughters and literally measures “reproduction” – a woman reproducing herself in the next generation by having a daughter

# Gross Reproduction Rate: Calculation

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Let  $B^f$  = Number of female births

$B^{m+f}$  = Number of male and female  
births i.e. all births

*continued*

# Gross Reproduction Rate: Calculation

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$$GRR = \sum ASFR * \frac{B^f}{B^{m+f}}$$

$$GRR = TFR * (\text{Proportion of female births})$$

GRR, Uganda ,1991: Sex ratio at birth = 1.03M/F

$$= TFR \times \frac{\text{\# of female births}}{\text{\# of total births}} = 6.7 \times \frac{100}{100 + 103} = 3.3$$

# Gross Reproduction Rate: Notes

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- ◆ GRR, like TFR, assumes that the hypothetical cohort of women pass from birth through their reproductive life without experiencing mortality.
- ◆ This assumption is satisfactory when one wants to compare levels of fertility and/or gross reproduction across populations and over time.
- ◆ But, for a more realistic assessment of the reproductive potential of a population, taking into account mortality, one needs to calculate the Net Reproduction Rate (NRR) >



# Net Reproduction Rate (NRR): Definition

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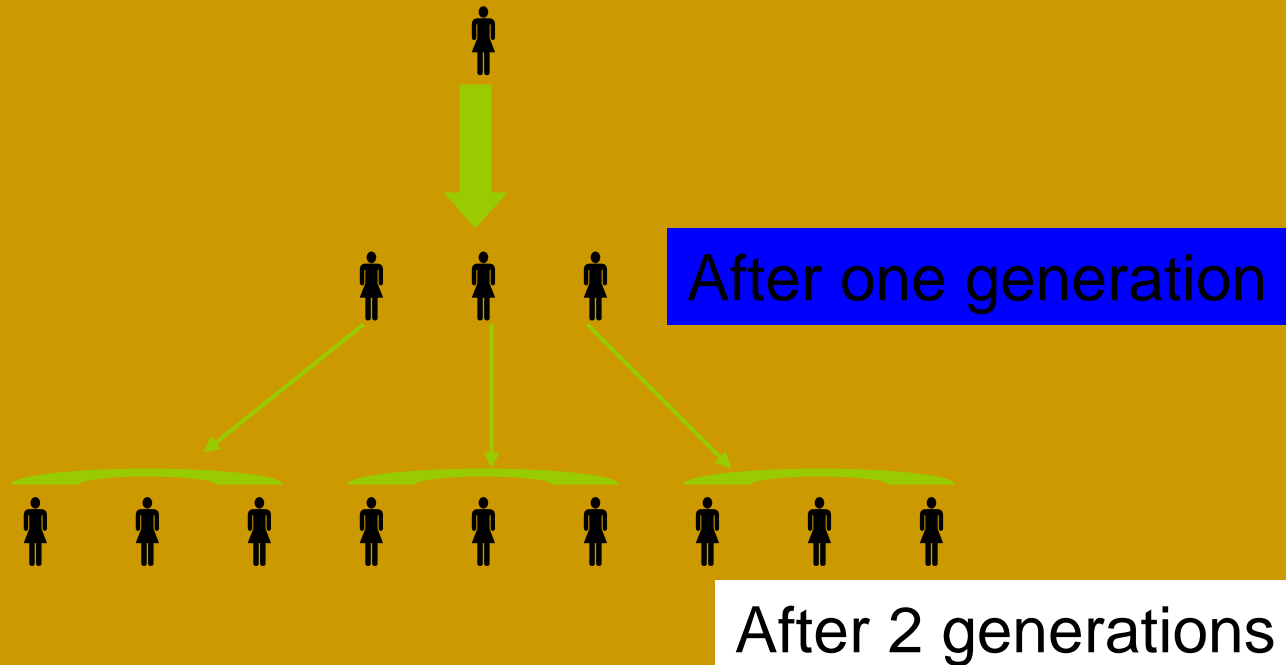
- ◆ Average number of daughters that would be born to a woman if she passed through her life-time from birth to the end of her reproductive years conforming to the age-specific fertility and mortality rates of a given year

# Net Reproduction Rate: Relationship with GRR and TFR

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- ◆ NRR is always lower than GRR, because it takes into account the fact that some women will die before entering and completing their child-bearing years
- ◆ Correspondingly NRR will be *less* than half the magnitude of the TFR

# Reproduction of Population When $NRR=3$



# Replacement Fertility

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- ◆ Replacement Level Fertility is said to have been reached when  $NRR=1.0$ 
  - Surviving women in the hypothetical cohort have exactly enough daughters (on average) to replace themselves in the population
- ◆ At this time  $GRR>1$  and  $TFR>2$ . (Roughly, this is when couple have an average of two children.)
- ◆ When  $NRR=1.00$  it does *not* imply:
  - $CBR=CDR$
  - Population growth rate = 0

# Relationship between Reproduction Measures and Population Growth

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- ◆ *Population momentum* is the propensity for a population to grow for many years after fertility declines to reach the replacement level of the “two-child family”. (TFR ~2.2 and NRR=1.0).
- ◆ This population momentum during the fertility transition is a function of young age structure of the population due to high levels of fertility in the past.

# Summary Slide

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- ◆ This concludes this session, the key concepts introduced include
  - Gross reproduction rate
  - Net reproduction rate
  - Population momentum