Principles of population & demography

Training Course in Sexual and Reproductive Health Research
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Outline of presentation

- Key definitions
- Population & demography related indicators
- Why family planning is still important
  - SDG, RH Strategy, UNSG Strategy
- Key indicators on family planning
- Conclusions
Population: definition

- “Group of individuals of same species living in the same geographic area at the same time”

- A population is often defined by demographers according to the specific needs of the research and researcher. Three processes are relevant to demography:

  – Fertility, Mortality, and Migration
Population: basic concepts

- There are only **two** ways to **enter** a population by birth and by in-migration.
- There are **two** ways to **leave** a population, by death and by out-migration.

- For example, the population of interest may be that of students attending a specific university during a specific year. In this situation, the students are born (i.e., enter) into the population when they enroll, and they die (i.e., leave) when they graduate.
Global population developments

- Demographic change has been more rapid and more universal in the past six decades than any other period in human history, with birth, death and population growth varying widely across the world regions.
- Fertility rates have declined to below three births per woman in all regions except sub-Saharan Africa.
- Global population reached 7 billion individuals in 2011.
- Africa: doubles in size between 2010-2050 (e.g. Niger triples).
- If projection holds: grown by more than ten-folds i.e. 0.8 to 10 billion - between 1800 and 2100.
- Pressure on public services and infrastructure, i.e. health care, education.
Trends in global population growth

Billions

- 1st Billion
- 2nd Billion
- 3rd Billion
- 4th Billion
- 5th Billion
- 6th Billion
- 7th Billion plus

Years:
- 1804
- 1927
- 1960
- 1974
- 1987
- 1999
- 2014
Projecting future populations

- Human Population since 1980 is J-shaped curve
- Population is increasing however growth rate \((r)\) has started to decline
- Projections for 2050 (2007)
  - Low = 7.7 billion
  - High = 10.6 billion
  - Most likely = 9.1 billion
World population distribution: global overview
## Population projections 2010-2050

<table>
<thead>
<tr>
<th>Region</th>
<th>Population (Billions)</th>
<th>% increase 2010-50</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2010</td>
<td>2050</td>
</tr>
<tr>
<td>Africa</td>
<td>1.02</td>
<td>2.19</td>
</tr>
<tr>
<td>Sub-Saharan</td>
<td>0.86</td>
<td>1.96</td>
</tr>
<tr>
<td>Asia</td>
<td>4.16</td>
<td>5.14</td>
</tr>
<tr>
<td>China</td>
<td>1.34</td>
<td>1.30</td>
</tr>
<tr>
<td>Latin America and Caribbean</td>
<td>0.59</td>
<td>0.75</td>
</tr>
<tr>
<td>Europe</td>
<td>0.74</td>
<td>0.72</td>
</tr>
<tr>
<td>USA and Canada</td>
<td>0.34</td>
<td>0.45</td>
</tr>
<tr>
<td>World wide</td>
<td>6.90</td>
<td>9.31</td>
</tr>
</tbody>
</table>

Reference: Data from UN World Population prospects: The 2010 Revision (UN medium variant)
Population density

- Population density
  - The number of individuals of a species per unit area or volume at a given time

- Ovals below have same population, and different densities
Population density of countries

<table>
<thead>
<tr>
<th>Country</th>
<th>2006 Population (in millions)*</th>
<th>Population Density (per mi²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>1311.4</td>
<td>355</td>
</tr>
<tr>
<td>India</td>
<td>1121.8</td>
<td>884</td>
</tr>
<tr>
<td>United States</td>
<td>299.1</td>
<td>80</td>
</tr>
<tr>
<td>Indonesia</td>
<td>225.5</td>
<td>307</td>
</tr>
<tr>
<td>Brazil</td>
<td>186.8</td>
<td>57</td>
</tr>
<tr>
<td>Pakistan</td>
<td>165.8</td>
<td>539</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>146.6</td>
<td>2637</td>
</tr>
<tr>
<td>Russia</td>
<td>142.3</td>
<td>22</td>
</tr>
<tr>
<td>Nigeria</td>
<td>134.5</td>
<td>377</td>
</tr>
<tr>
<td>Japan</td>
<td>127.8</td>
<td>876</td>
</tr>
</tbody>
</table>

* These figures are from mid-2006. At the end of 2006, the United States reached a population milestone of 300 million people.
Effects of overpopulation

Some of the global effects of overpopulation include:

- Ultimate shortages of energy sources and other natural resources
- Famine
- Serious communicable diseases in dense populations
- Shortage of arable land (where food crops will grow)
- Little surplus food
- Mass extinctions of plants and animals as habitat is used for farming and human settlements
- War over scarce resources such as land area.
Demography: historical perspective

- **Demography** is the study of human population dynamics.

Achille Guillard first used the title on his book: "Eléments de Statistique Humaine ou Démographie Comparée".

- Two Greek roots:
  - **demos** (people)
  - **graphy** (branch of knowledge regarding a particular science in this case, human populations).

- Guillard then defined demography as: ‘the mathematical knowledge of populations, their general movements, and their physical, civil, intellectual and moral state’ (Guillard 1855:xxvi).
Today demography encompass...

- ...the determinants and consequences of population change and is concerned with **virtually everything** that influences or can be influenced by:

  - Population Size
  - Population growth or decline
  - Population processes (levels and trends in mortality, fertility and migration that are determining population size and change).
  - Population characteristics (education, religion, or ethnicity)
  - Population structure (how many by age)
Population pyramid: age structure

- The number and proportion of people at each age in a population
Demographics of specific countries

(a) Rapid growth
   Nigeria

(b) Slow growth
   United States

(c) Decline in growth
   Germany

Age

<table>
<thead>
<tr>
<th>Age</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>80+</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>75–79</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>70–74</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>65–69</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>60–64</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>55–59</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>50–54</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>45–49</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>40–44</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>35–39</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>30–34</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>25–29</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>20–24</td>
<td>0</td>
<td>0</td>
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<tr>
<td>15–19</td>
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<td>0</td>
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<td>10–14</td>
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<td>0</td>
</tr>
<tr>
<td>5–9</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0–4</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Number of people (in millions)
Demographic stages

STAGE 1
Preindustrial

STAGE 2
Transitional

STAGE 3
Industrial

STAGE 4
Postindustrial

Birth and death rates
(number per 1000 population)

Time

Size of population

Birth rate

Death rate

High

Relative population size

Low
Demographic indicators

- Because demography is interested in changes in human populations, demographers focus on specific indicators of change.

- Two of the most important indicators are birth and death rates, which are also referred to as **fertility** and **mortality**.

- Additionally, demographers are interested in migration trends or the movement of people from one location to another.
Fertility and fecundity

- **Fertility**, in demography, refers to the ability of females to produce healthy offspring in abundance. **Fecundity** is the potential reproductive capacity of a female. Some of the more common demographic measures used in relation to fertility and/or fecundity include:

  - Crude birth rate
  - General fertility rate
  - Age-specific fertility rate
  - Total fertility rate
  - Gross reproduction rate
  - Net reproduction rate
Replacement level fertility

- It refers to the number of children that a woman (or monogamous couple) must have in order to replace the existing population. Replacement level fertility is generally set at 2.1 children in a woman's lifetime (this number varies by geographic region given different mortality rates).

- The reason the number is set to 2.1 children per woman is because two children are needed to replace the parents and an additional one-tenth of a child is needed to make up for the mortality of children and women who do not reach the end of their reproductive years.
Total fertility rate

- The **total fertility rate (TFR)** of a population is the average number of children that would be born to a woman over her lifetime if;

  - (1) she were to experience the exact current age-specific fertility rates (ASFRs) through her lifetime, and
  - (2) she were to survive from birth through the end of her reproductive life. It is obtained by summing the single-year age-specific rates at a given time.
<table>
<thead>
<tr>
<th>Years</th>
<th>TFR</th>
<th>Years</th>
<th>TFR</th>
<th>Years</th>
<th>TFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975–1980</td>
<td>3.84</td>
<td>2025–2030</td>
<td>2.29</td>
<td>2075–2080</td>
<td>2.06</td>
</tr>
<tr>
<td>1980–1985</td>
<td>3.59</td>
<td>2030–2035</td>
<td>2.25</td>
<td>2080–2085</td>
<td>2.05</td>
</tr>
<tr>
<td>1995–2000</td>
<td>2.79</td>
<td>2045–2050</td>
<td>2.17</td>
<td>2095–2100</td>
<td>2.03</td>
</tr>
</tbody>
</table>
Trends in TFR 1950-2050

Trends in Total Fertility Rate by Region, 1950-2050.
Mortality

- **Mortality** refers to the finite nature of humanity: people die. Mortality in demography is interested in the number of deaths in a given time or place or the proportion of deaths in relation to a population. Some of the more common demographic measures of mortality include:

  - **crude death rate**: the annual number of deaths per 1000 people
  - **infant mortality rate**: the annual number of deaths of children less than 1 year old per thousand live births
  - **life expectancy**: the number of years which an individual at a given age can expect to live at present mortality rates
Life expectancy at birth by region, 1950-2050

Life Expectancy at Birth by Region, 1950-2050.
Change in population size

On global scale the change in a population is due to the number of births and deaths.
Migration: change in population size

Increases population:
- Births
- Immigration

Decreases population:
- Deaths
- Emigration

In local populations, such as the population of the United States, the number of births, deaths, immigrants, and emigrants affect population size.
Calculating population change

Birth (b), Death (d), Immigration (i) and Emigration (e) are calculated per 1000 people.

\[ r = (b - d) + (i - e) \]
FAMILY PLANNING: WHY IT IS STILL RELEVANT
Background: Post 2015 Agenda

- Opportunity to redefine the global agenda for reproductive health & development
- Reflecting on ICPD and Beijing programme of action
- FP 2020 (120/20)
- Sustainable Development Goals (3.7 and 5.6)
SDGs – 3.7 and 5.6

- 3.7 - By 2030, ensure universal access to sexual and reproductive health-care services, including for family planning, information and education, and the integration of reproductive health into national strategies and programmes

- 5.6 - Ensure universal access to sexual and reproductive health and reproductive rights as agreed in accordance with the Programme of Action of the International Conference on Population and Development and the Beijing Platform for Action and the outcome documents of their review conferences
Current situation on family planning

Constraints:

- 26 countries have CPR below 20%
- 225 million couples have an unmet need for family planning
- Decreased investment in contraceptive research and development by industry, despite increased demand
- Shifting international priorities in the past decades
- Mis and dis-information

Opportunities:

- MDG 5b: Universal access to reproductive health
  - FP and other SRH services
- Renewed interest in supporting family planning internationally
Contraceptive Guidelines

- **Continuous Identification of Research Evidence (CIRE) system:**
  - identifies,
  - critically appraises,
  - and synthesize best available evidence for FP intervention

- Next MEC revision completed in 2015
<table>
<thead>
<tr>
<th>Most effective</th>
<th>How to make your method more effective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generally 2 or fewer pregnancies per 100 women in one year</td>
<td>One-time procedures; nothing to do or remember</td>
</tr>
<tr>
<td>About 15 pregnancies per 100 women in one year</td>
<td>Need repeat injections every 1, 2 or 3 months</td>
</tr>
<tr>
<td>About 30 pregnancies per 100 women in one year</td>
<td>Must take a pill each day</td>
</tr>
<tr>
<td>Least effective</td>
<td>Must follow LAM instructions</td>
</tr>
<tr>
<td>Must use every time you have sex; requires partner’s cooperation</td>
<td>Must use every time you have sex</td>
</tr>
<tr>
<td>Must use every time you have sex; requires partner’s cooperation</td>
<td>Must abstain or use condoms on fertile days; requires partner’s cooperation</td>
</tr>
</tbody>
</table>

- Injectables
- Pill
- LAM
- Male condoms
- Diaphragm
- Female condoms
- Sterilisation for women
- Vasectomy
- Implants
- IUD
- Spermicides
- Fertility Awareness-Based Methods (selected)
- Male condoms
- Female condoms
- Sterilisation for women
- Vasectomy
- Implants
- IUD
- Spermicides
- Fertility Awareness-Based Methods (selected)
FAMILY PLANNING AND ECONOMIC ASPECTS
Decrease in fertility strengthens economy

- Family planning programs can reduce fertility in resource poor settings such as rural Bangladesh and Ghana.

- Fertility declines are associated with an increase in women's health, earnings, and participation in paid employment.

- Children of women with better access to FP and health services are healthier and better educated than those women without access.

- Household level behavioral effects on the female labour supply, child health, and education can lead to large macroeconomic demographic benefits.
Going beyond health: findings from Matlab, Bangladesh

To comparison area, after 19 years: (1977-1996):

- Child-to-women ratio: 16% lower
- Women aged 35-54 years in 1996 had 23% fewer children
- Mortality in children under 5 years was 30% lower
- Women (aged 25-54) average BMI: > 1 kg/m²
- Monthly earnings in 1996: 40% higher
- Married women reported 25% more physical assets per adult in their household
- Children: better BMI and more completed schooling

Reference: Canning and Schultz, 2012
STATUS OF UNMET NEED IN FAMILY PLANNING
Family Planning Methods, Worldwide

- Not Using: 39%
- Married or In-Union Women of Reproductive Age Using Family Planning, 1999
- Pill: 8%
- IUD: 14%
- Male Condom: 5%
- Injectable or Implant: 3%
- Male Sterilization: 7%
- Female Sterilization: 21%
- Other Modern Methods: 1%
- Traditional Methods: 3%

Note: Total exceeds 100 due to rounding.

Family Planning Methods, Developing Countries

- Married or In-Union Women of Reproductive Age Using Family Planning, 1999

- Not Using a Method: 41%
- Female Sterilization: 22%
- Pill: 6%
- Injectable or Implant: 4%
- Male Condom: 3%
- Male Sterilization: 3%
- Traditional Methods: 6%
- Other: <1%

*Note: Total exceeds 100 due to rounding.
There are large variations in married women’s level of unmet need for and use of modern contraception among subregions of the developing world in 2012.

Reference: Singh and Darroch, Adding it up, 2012
Reasons for high unmet need

- Perceived lack of exposure to pregnancy was the most common reason cited
  - Between one-third and two-thirds of women with unmet need said they were never or infrequently having sex.
  - Believed they could not become pregnant because of menopause, breastfeeding, or another reason.

- Opposition to family planning (by women, their husbands, or others).

- Gender imbalance –
  - Men’s unmet need tends to be lower because men want to have more children (or sooner) than do women

- Method-related problems were cited by about one-third of women with unmet need.
  - Problems related to side effects and health concerns
  - Cost and access also mentioned.

- Lack of knowledge about methods or sources of supply
IF UNMET NEEDS ARE MET IN DEVELOPING COUNTRIES...

- Serving all women in developing countries who currently have an unmet need for modern methods would prevent

  - unintended pregnancies would drop by 70%, from 74 million to 22 million per year;
  - maternal deaths would drop by 67%, from 290,000 to 96,000;
  - newborn deaths would drop by 77%, from 2.9 million to 660,000;
  - the burden of disability related to pregnancy and delivery experienced by women and newborns would drop by two-thirds

Singh and Darroch, Adding it up. 2014
FAMILY PLANNING AND EFFECTS ON MATERNAL HEALTH
Maternal mortality ratio and contraceptive use in married women in 40 countries over time

Estimates of contraceptive use were obtained from Demographic and Health surveys, done between 1986 and 2009, in 40 developing countries (countries and dates listed in the appendix). The WHO time series of estimates was used to obtain maternal mortality ratios that corresponded to the dates of each of the contraceptive use estimates. The first datapoint corresponds to the earliest Demographic and Health survey data available for that country, and the second datapoint corresponds to the most recent survey data. The average length of time between surveys was 12 years (ranging from 4–21 years). Median slope -8.5 (IQR -22.2 to -2.3).
To summarize, decline in fertility has several benefits...

- Maternal and infant mortality benefit from widespread use of contraception
- Less acute stresses on public services and infrastructure
- Boost to the economy (the demographic dividend): labour force grows rapidly (women also works)
- Benefit economy by improving general health and reducing fertility
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