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PRB's Population Handbook

A quick guide to population dynamics for journalists, policymakers, teachers, students, and other people interested in demographics

BY **ARTHUR HAUPT, THOMAS T. KANE,** AND **CARL HAUB**

6TH EDITION

2011

www.prb.org

POPULATION REFERENCE BUREAU

Sixth edition
Printed in the U.S.A.
Twelfth printing, 2011

Library of Congress Cataloging-in-Publication Data

Haupt, Arthur, 1945-
Population Reference Bureau's Population Handbook
(Sixth edition)

1. Population—Handbooks, manuals, etc.
2. Demography—Handbooks, manuals, etc. I. Kane,
Thomas T. 1951- II. Population Reference Bureau.
III. Title. IV. Title: Population handbook.
HB871.H357 1991 304.6'02'02 91-66596
ISSN 0-917136-12-8

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The suggested citation, if you quote from this publication, is: *Population Reference Bureau's Population Handbook (Sixth Edition)*. For permission to reproduce portions from the *Population Handbook*, write to PRB, Attn: Permissions; or e-mail: popref@prb.org.

POPULATION REFERENCE BUREAU

The Population Reference Bureau **INFORMS** people around the world about population, health, and the environment, and **EMPOWERS** them to use that information to **ADVANCE** the well-being of current and future generations.

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Now in its sixth edition, PRB's Population Handbook is also available online. Each updated chapter is on PRB's website, www.prb.org/Reports/2011/prb-population-handbook-2011.aspx.

Since its publication in 1978, PRB's Population Handbook has appeared in several languages and has been circulated around the world. It has been used by thousands of teachers and students in fields such as sociology, geography, and urban studies. Journalists refer to the handbook as an authoritative guide in preparing population-related stories, while policymakers and planners have found it to be a ready reference to the rates, ratios, and concepts of demography. Understanding the broad implications of population change is important to those who make decisions and inform others about demographic change around the world.

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ABOUT POPULATION

Everyone is a member of a population, and population factors have an impact on many facets of life—from where we live to the prices we pay for goods and services. The need for health care preoccupies the political leaders of the industrialized countries whose populations are "aging," while the need for classrooms, employment opportunities, and housing preoccupies the leaders of countries that are still growing rapidly.

Population conditions influence history. Likewise, historical events can significantly affect populations. Wars can decimate a generation of men, as happened in the 20th century in the then-Soviet Union, France, Iraq, and several other countries. The discovery of new medicines often leads to increases in life expectancy, and different causes of death become more prominent. Alternatively, population change may sound a warning of other important changes. Environmental contamination may be detected first by increased reports of illness and rising mortality rates in certain geographic areas. In all these ways and more, population is news.

Population information is best communicated in terms of numbers and rates. It is not enough to know that life expectancy is increasing. How many years are being added? Over what time period has the change occurred? Which people are affected? What proportion of the population do they represent? Such information is more meaningful when it provides an indication of the magnitude and distribution of the phenomenon, as well as the trend. To be useful, data must be expressed clearly as well as accurately. Birth rates are often confused with growth rates; declining growth rates are sometimes mistakenly equated with declining population size.

Demography is the scientific study of population. Demographers seek to know the levels and trends in population size and its components. They search for explanations of demographic change and their implications for societies. They use censuses, birth and death records, surveys, visa records, even motor vehicle and school registrations. They shape these data into manageable forms such as simple counts, rates, or ratios.

Most of the principal measures used in demography are defined on the following pages, together with recent examples of their use.

The purpose of this Population Handbook is to clarify and explain demographic terms to journalists, policymakers, teachers, students, and others who need to understand and communicate about population.

The Tools of Demography

COUNT

The absolute number of a population or any demographic event occurring in a specified area in a specified time period. (For example, 2,027,000 live births occurred in Egypt in 2010.) The raw quantities of demographic events are the basis of all other statistical refinements and analyses.

RATE

The frequency of demographic events in a population during a specified time period (usually a year) divided by the population "at risk" of the event occurring during that time period. Rates tell how common it is for a given event to occur. (For example, in 2008 in Zambia the death rate was 16 per 1,000 population.) Most rates are expressed per 1,000 population. Crude rates are rates computed for an entire population. Specific rates are computed for a subgroup, usually the population more nearly approximating the population "at risk" of the event. (For example, the general fertility rate is the number of births per 1,000 women ages 15 to 49.) Thus, rates can be age-specific, sex-specific, race-specific, occupation-specific, and so on. In practice, some measures that are referred to as rates would be more accurately termed ratios.

RATIO

The relation of one population subgroup to the total population or to another subgroup; that is, one subgroup divided by another. (For example, the sex ratio in France in 2010 was 94 males per 100 females.)

PROPORTION

The relation of a population subgroup to the entire population; that is, a population subgroup divided by the entire population. (For example, the proportion of Vietnam's population in 2008 classified as urban was 29 percent.)

CONSTANT

An unchanging, arbitrary number (for example, 100 or 1,000 or 100,000) by which rates, ratios, or proportions can be multiplied to express these measures in a more understandable fashion. For example, 0.0184 abortions per woman of reproductive age occured in Hungary in 2008. Multiplying this rate by a constant (1,000) gives the same statistic in terms of 1,000 people. This is a clearer way of expressing the same thing: There were 18.4 abortions per 1,000 women. In the formulas on the following pages, "K" means constant.

COHORT MEASURE

A statistic that measures events occurring to a cohort (a group of people sharing a common demographic experience) who are observed through time. The most commonly used cohort is the birth cohort—people born in the same year or period. Other kinds of cohorts include marriage cohorts and school class cohorts.

PERIOD MEASURE

A statistic that measures events occurring to all or part of a population during one period of time; this measure "takes a snapshot" of a population, in effect. (For example, the emigration rate of the entire Norwegian population in 2009 was 5.5 per 1,000.)

AGE AND SEX COMPOSITION

Age and sex are the most basic characteristics of a population. Every population has a different age and sex composition—the number and proportion of males and females in each age group—and this structure can have considerable impact on the population's current and future social and economic situation.

'Young' and 'Old' Populations

Some populations are relatively young, that is, they have a large proportion of people in the younger age groups. The high-fertility countries of Africa with large proportions of young adults and children are examples. Other populations are relatively old, such as many countries in Europe. These two types of populations have markedly different age compositions; as a consequence, they also have different proportions of the population in the labor force or in school, as well as different medical needs, consumer preferences, and even crime patterns. A population's age structure has a great deal to do with how that population lives.

Developing countries have relatively young populations while most developed countries have old or "aging" populations. In many developing countries, 40 percent or more of the population is under age 15, while 4 percent is 65 or older. On the other hand, in virtually every developed country, less than 25 percent of the population is under age 15 and more than 10 percent is 65 or older.

Median Age

The median age is the age at which exactly half the population is older and half is younger.

The median age of the Costa Rican population in 2009 was 28 years.

In 2009, the median age of Niger, a country with a very young population, was 15, while that of Japan was 45, signifying an older population.

Sex Ratio

The sex ratio is the ratio of males to females in a given population, usually expressed as the number of males for every 100 females.

The sex ratio at birth in most countries is about 105 males per 100 females. After birth, sex ratios vary because of different patterns of mortality and migration for males and females within the population.

$$\frac{\textbf{Number of males}}{\textbf{Number of females}} \quad \mathbf{x} \quad \mathbf{K} \quad = \quad \frac{\mathbf{30{,}413{,}779}}{\mathbf{32{,}379{,}653}} \quad \mathbf{x} \quad \mathbf{100} \quad = \quad \mathbf{93.9}$$

In 2010, there were 94 males per 100 females in France.

In Russia in 2010, the sex ratio for ages 25 to 29 was 101; for ages 70 and older it was 42.

Age-Dependency Ratio

The age-dependency ratio is the ratio of people in the "dependent" ages (those under age 15 and ages 65 and older) to those in the "economically productive" ages (15 to 64 years) in a population.

The age-dependency ratio is often used as an indicator of the economic burden the productive portion of a population must carry—even though some people defined as "dependent" are producers and some people in the "productive" ages are economically dependent.

Countries with very high birth rates usually have the highest age-dependency ratios because of the large proportion of children in the population.

The age-dependency ratio is sometimes divided into old-age dependency (the ratio of people ages 65 and older to those ages 15 to 64) and child dependency (the ratio of people under age 15 to those ages 15 to 64).

$$\frac{\textbf{Population under age 15} + \textbf{Population ages 65 and older}}{\textbf{Population ages 15-64}} \times K = \frac{15{,}384{,}000 + 417{,}000}{14{,}860{,}000} \times 100 = 106.3$$

The age-dependency ratio in Uganda in 2009 was 106. This means that there were 106 people in the dependent ages for every 100 people in the working ages.

By contrast, Guatemala had an age-dependency ratio of 85 in 2010, with 42 percent of its population under age 15 and 4 percent ages 65 and older. In Japan, the age-dependency ratio was only 57 in 2010, with 13 percent of its population under age 15 and 23 percent ages 65 and older.

Population Pyramid

A population pyramid graphically displays a population's age and sex composition. Horizontal bars present the numbers or proportions of males and females in each age group. The sum of all the age-sex groups in the population pyramid equals 100 percent of the population. Pyramids may show single years of age, as does the one for Japan (Figure 1, page 6), or show data in age groups, as do those in Figure 2 (page 7).

The bottom bars in Japan's pyramid show the percentage of the population that was under age 1 in 2006. Each year a new cohort is born and appears at the bottom of the pyramid, while the cohorts above it move up. As the cohorts age, they inevitably lose members because of death and may gain or lose members because of migration. During the older ages, the attrition process accelerates, causing the narrowing peak of all population pyramids. Such pyramids can tell a great deal about a population at a glance. Notice, for example, that females form the substantial majority in the oldest age groups. In most countries, females outlive males.

Three General Profiles

Populations of countries can differ markedly as a result of past and current patterns of fertility, mortality, and migration. However, they all tend to fall into three general profiles of age-sex composition.

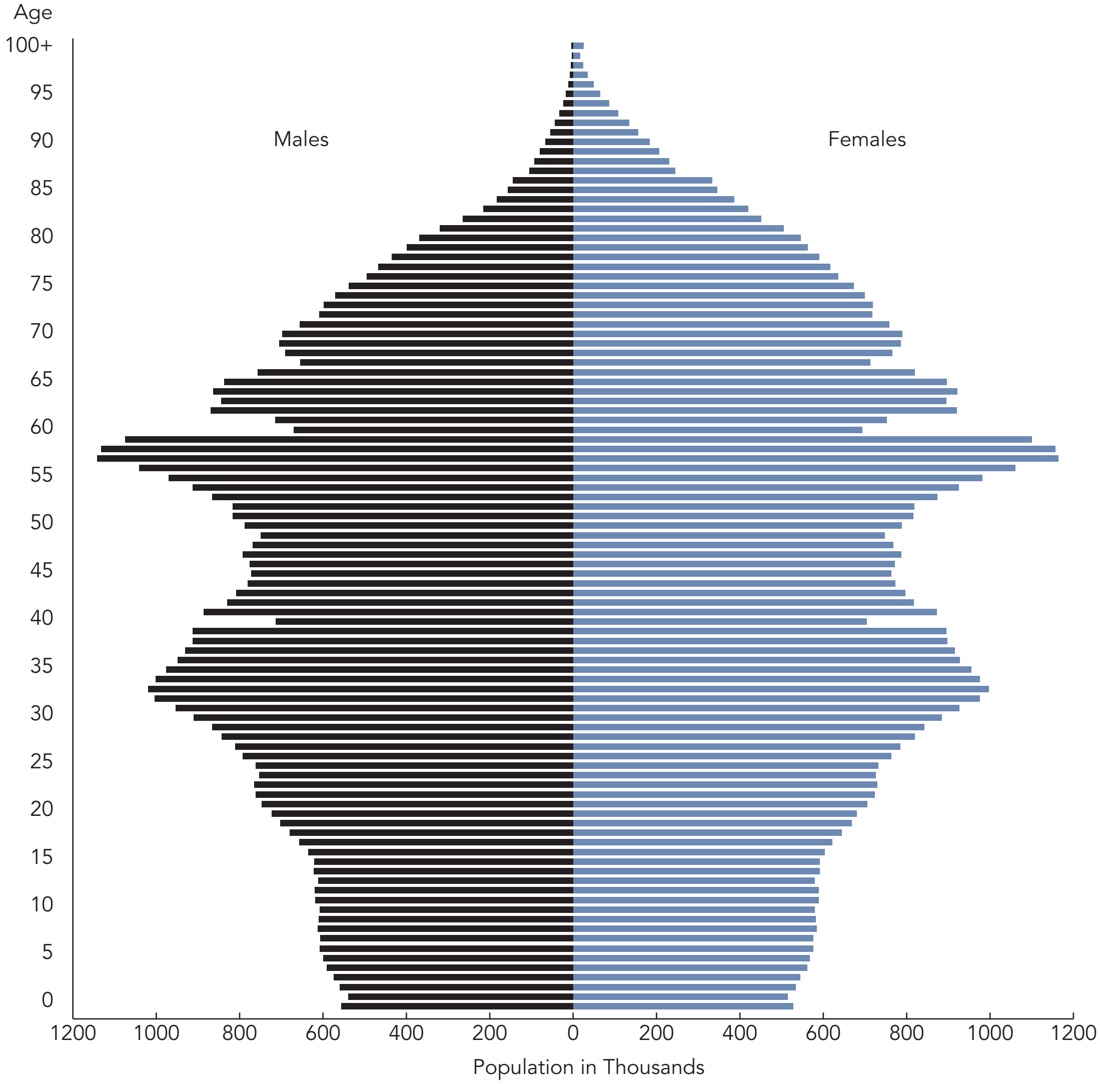
- **Rapid growth** is indicated by a pyramid with a large percentage of people in the younger ages.
- **Slow growth** is reflected in a pyramid with a smaller proportion of the population in the younger ages.
- **Zero growth** or **decline** is shown by decreasing numbers in the younger age groups.

As shown in Figure 2 (page 7), the age structure of Senegal's population is characteristic of countries experiencing rapid growth; each younger cohort is larger than the previous cohort, producing a pyramid shape. This expansive age structure is the result of high birth rates. Italy's population, with decreasing numbers in each younger age cohort, is typical of low-fertility populations experiencing zero growth and facing population decline. The large deficit of young people—potential parents in the future—results in population decrease being virtually "preprogrammed." The shape of the United States' age structure indicates a population that is growing, but at a much slower rate than Senegal's.

The pyramid of Japan in 2006 is a striking example of a population whose age-sex composition has been altered by past events. The low proportion of males above age 80 represents the loss of young men during World War II. The relatively small size of the population ages 67 and 68 (both males and females) is a demographic response to the Sino-Japanese Incident in 1938 and 1939. The population ages 60 and 61 reflects the reduction in the birth rate around the end of World War II. The large group ages 55 to 59 was born during the first "baby boom" period (1947-1951). The very small percentage of 40-year-olds corresponds to the birth year of 1966—"the year of Hinoeuma" or the "year of the Firehorse." Superstition maintains that being born during the year of Hinoeuma, which comes every 60 years, is bad luck for girls.

FIGURE 1

Population Pyramid of Japan, 2006



Source: Japan Statistics Bureau.

The large percentages in ages 32 to 35 show Japan's second "baby-boom" period (1971-1974). Population pyramids that are constructed by single years of age can illuminate reasons for a population's age structure that larger age categories might mask.

Comparing Populations

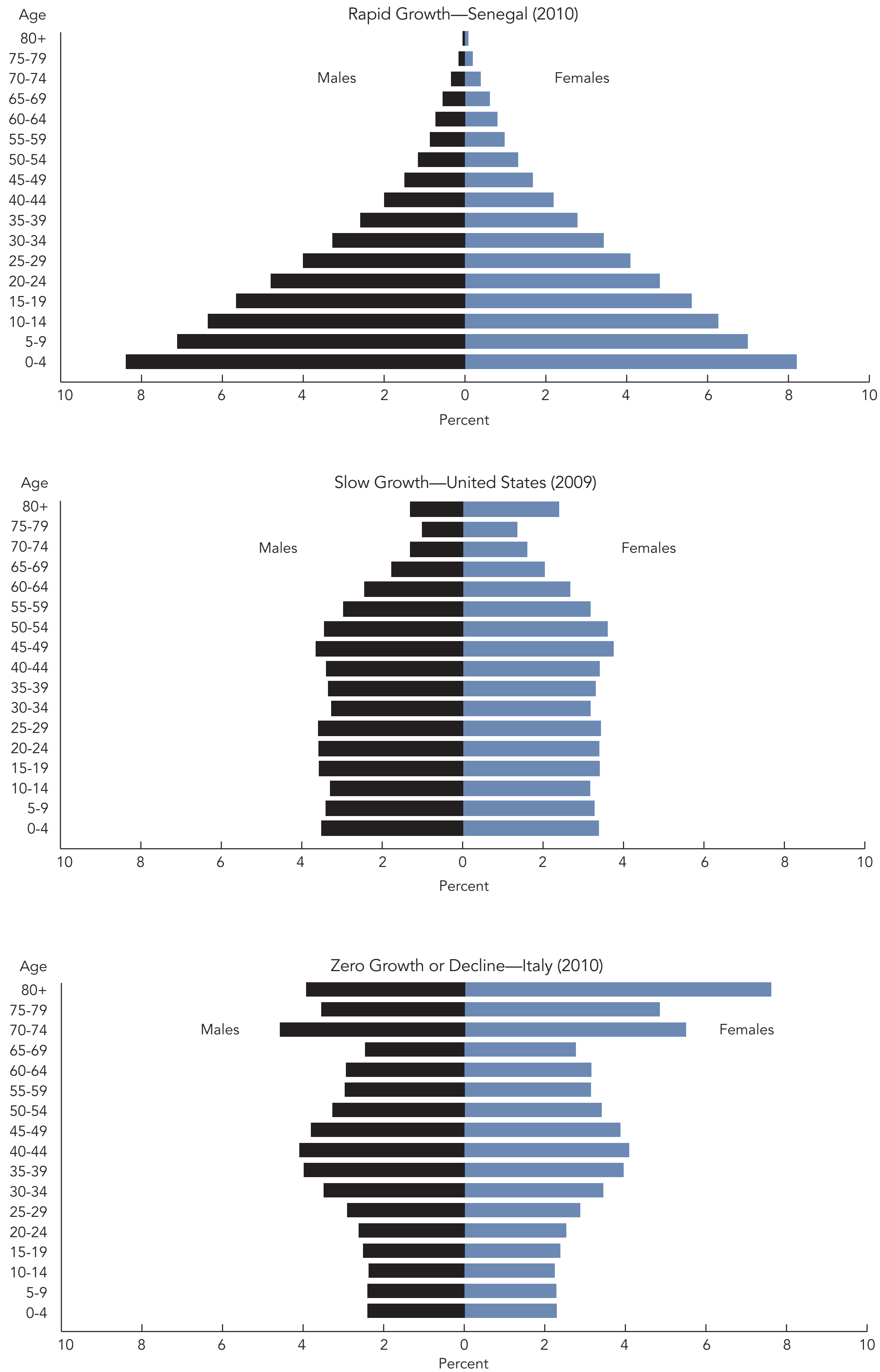
The likelihood of getting married or dying varies at different ages. Populations that have comparatively large numbers of elderly are likely to have more deaths and fewer births each year than will a population of equal size that is largely composed of young families (other factors being equal). As a result, Finland, with a large proportion of older people compared with Albania, will have more deaths per 1,000 people than Albania.

When comparing populations (for example, which country has higher fertility), care should be taken that the age structure of the populations does not seriously affect the comparison. Birth and death rates are affected by the proportions of people in the different ages and can give misleading comparisons (although the death rate is much more likely to do so than the birth rate).

To make consistent comparisons, one can use age-specific rates. Comparing the annual death rate for people ages 60 to 64 in Mexico and the United States shows the probability of someone in that age group in both countries dying in a given year, and the comparison is unaffected by the number of people ages 60 to 64.

FIGURE 2

Population Pyramids: Senegal, United States, and Italy



Sources: United Nations Population Division; U.S. Census Bureau; and ISTAT.

Another way to compare populations is to standardize their overall rates by applying one country's age-specific death rate to the age structure of a second country. The result shows how many deaths one country would have in a year if it had the second country's age structure.

The U.S. crude death rate was 8.1 deaths per 1,000 people in 2008. Mexico's crude death rate that year was reported at 5.0. However, if Mexico's age structure had been the same as that of the United States in that year, Mexico's standardized (age-adjusted) death rate would have been 11.1, higher than in the United States.

In this example, we use the 2008 U.S. age structure as the standard; thus, the standardized U.S. death rate would remain 8.1. We could just as well use Mexico's age structure as the standard, or even use a third country's age structure.

Age Structure and Population Growth

Along with the birth rate, age structure is the demographic "engine" that drives or retards population growth. In many developing countries, large proportions of young people virtually guarantee that population will continue to grow during periods of declining fertility and for quite some time after fertility drops to "replacement level" (2.1 children per woman). The effect of a high birth rate upon age structure can be seen in Nigeria, where women have an average of six children each. In 2010, there were about 8.2 million people ages 35 to 39 in Nigeria; but 25.8 million under age 5, and 22.0 million ages 5 to 9.

FERTILITY

Fertility refers to the number of live births women have. It differs from fecundity, which refers to the physiological capability of women to reproduce. Fertility is directly determined by a number of factors which, in turn, are affected by a great many other factors: social, cultural, environmental, economic, and health.

Birth Rate

The birth rate (also called the crude birth rate) indicates the number of live births per 1,000 population in a given year. Most annual rates, such as the birth rate, relate demographic events to the population at mid-year (July 1), which is considered to be the average population at risk of the event occurring during the year.

$$\frac{\textbf{Number of births}}{\textbf{Total mid-year population}} \times K = \frac{161{,}042}{7{,}485{,}600} \times 1{,}000 = 21.5$$

There were 22 births per 1,000 population in Israel in 2009.

Around the world, birth rates vary widely. Niger's 52 per 1,000 in 2010 is a very high birth rate, while Taiwan's 8 per 1,000 in 2009 is very low.

Births are only one component of population change, and the birth rate should not be confused with the growth rate, which includes all components of change.

General Fertility Rate

The general fertility rate (also called the fertility rate) is the number of live births per 1,000 women ages 15 to 49 in a given year.

The general fertility rate is a somewhat more refined measure than the birth rate because it relates births to the age-sex group at risk of giving birth (usually defined as women ages 15 to 49). This limitation helps eradicate distortions that might arise because of different age and sex distributions among populations. Thus, the general fertility rate is a better basis to compare fertility levels among populations than are changes in the crude birth rate.

$$\frac{\textbf{Number of births}}{\textbf{Number of women ages 15-49}} \times K = \frac{2{,}027{,}000}{22{,}285{,}000} \times 1{,}000 = 91.0$$

There were 91 births per 1,000 women ages 15 to 49 in Egypt in 2010.

Zambia's general fertility rate from 2004 to 2007 was 214 live births per 1,000 women ages 15 to 49—one of the highest in the world. Taiwan's rate of 36 per 1,000 women in 2009 was one of the lowest in the world.

Age-Specific Fertility Rate

Fertility rates can also be calculated for specific age groups to see differences in fertility behavior or to compare over time.

$$\frac{\text{Number of births to women ages 20-24}}{\text{Number of women ages 20-24}} \times K = \frac{1{,}052{,}184}{10{,}215{,}000} \times 1{,}000 = 103.0$$

In the United States in 2008, there were 103 live births for every 1,000 women ages 20 to 24.

In Tanzania from 2007 to 2010, there were 260 live births per 1,000 women ages 20 to 24. From 2006 to 2009, the rate was 163 for Guyana; in 2008, the rate was 38 for Japan.

Compare the fertility rates for women in the United States in the different age groups and time periods in the table below.

LIVE BIRTHS PER 1,000 WOMEN AGES 20-34 BY AGE GROUP, 1970 TO 2008

YEAR	AGES 20-24	AGES 25-29	AGES 30-34
1970	167.8	145.1	73.3
1976	110.3	106.2	53.6
1985	108.3	111.0	69.1
1995	107.5	108.8	81.1
2008	103.0	115.1	99.3

In the United States in 1976, birth rates were at an all-time low. The total fertility rate reached its lowest point in history at 1.738 children per woman. By 2008, the total fertility rate stood at 2.085, one of the highest fertility levels among developed countries (see page 11).

Children Ever Born

The number of "children ever born" at various ages of the mother provides one measure of a population's fertility. This measure is useful only if the age group of women considered is specified. When this measure is calculated for women ages 45 to 49, it is called the completed fertility rate; it shows how many children a certain age cohort of women who have completed childbearing actually produced during their childbearing years.

In 2006, the number of children ever born to women ages 45 to 49 averaged 7.8 in Niger and, in 2007, 1.8 in Ukraine.

Often, though, we wish to summarize what fertility is now, without waiting for the end of the childbearing years. For this purpose the total fertility rate is used.

Total Fertility Rate

The total fertility rate (TFR) is 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. The TFR is one of the most useful indicators of fertility because it gives the best picture of how many children women are currently having.

The TFR sums up, in a single number, the fertility of all women at a given point in time. In effect, it says: This is the total number of children a woman would have if the fertility rates for a given year applied to her throughout her reproductive life. (See table on next page for how the TFR is calculated.)

The TFR is a synthetic measure; no individual woman is very likely to pass through three decades conforming to the age-specific fertility rates of any single year. In reality, age-specific rates change and fluctuate from year to year, even if only gradually. For example, women who were ages 15 to 19 in 2003 may delay childbearing longer than women ages 15 to 19 did in 1990. This delay would lower the TFR slightly in 2003, but then raise it several years later when the women began their childbearing. Thus, year-to-year fluctuations in the TFR may reflect changes in the timing of births rather than changes in the average number of children women bear.

Calculating the Total Fertility Rate

THE UNITED STATES' TFR, 2008

AGE OF WOMEN	(1) NUMBER OF WOMEN	(2) NUMBER OF BIRTHS	(3) AGE-SPECIFIC RATE (2)÷(1)
15-19	10,351,380	434,758	0.042
20-24	10,215,379	1,052,184	0.103
25-29	10,398,034	1,195,774	0.115
30-34	9,663,798	956,716	0.099
35-39	10,401,596	488,875	0.047
40-44	10,597,300	105,973	0.01
45-49	7,109,000	7,109	0.001

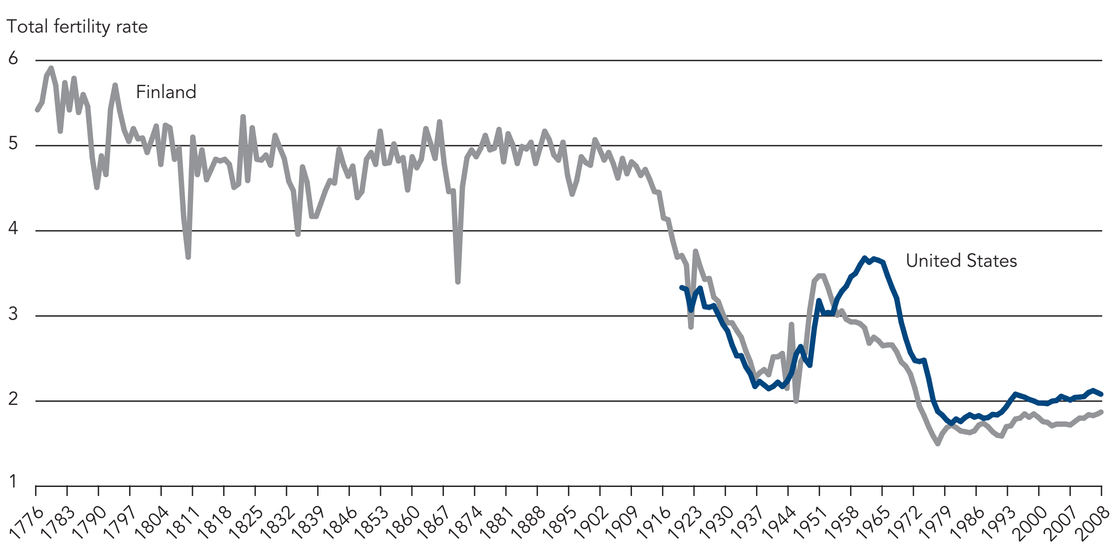
Sum = 0.417
TFR = Sum of age-specific rates * 5 = 2.09

The rates in column (3) simulate the likelihood of a woman giving birth during each year of her childbearing years, approximating the "risk" of having a birth. Multiplying each of these rates by five provides the number of children she would have for each five-year period. Each woman is subject to the annual "risk" of a birth five times in each age group; for example, 0.103 when she is 20, 0.103 when she is 21, and so on. Summing up the rates for all age categories results in the number of children she would have by age 49—the total fertility rate.

The total fertility rate in 2008 in the United States was 2.09 births per woman (or 2,090 births per 1,000 women). So, if age-specific rates for 2008 stayed the same throughout their lives, U.S. women of childbearing age would have an average of 2.1 children each.

In some developing countries, the TFR is more than five children per woman. In most developed countries, it is below two.

Total Fertility Rate, Finland, 1776-2009; and United States, 1917-2008



Sources: Statistics Finland and the U.S. National Center for Health Statistics.

Gross Reproduction Rate

The gross reproduction rate (GRR) is the average number of daughters that would be born to a woman (or group of women) during her lifetime if she passed through her childbearing years conforming to the age-specific fertility rates of a given year. This rate is like the TFR except that it counts only daughters and literally measures "reproduction"—a woman reproducing herself by having a daughter.

Net Reproduction Rate

The net reproduction rate (NRR) is the average number of daughters that would be born to a woman (or group of women) if she passed from birth to the rest of her life conforming to the age-specific fertility and mortality rates of a given year. This rate is like the GRR, but it is always lower because it takes into account the fact that some women will die before completing their childbearing years.

EXAMPLES OF GRR AND NRR

COUNTRY, YEAR	GRR	NRR
Angola, 2005-2010	2.91	2.14
Netherlands, 2009	0.87	0.86

In 2005 to 2010, Angola had a GRR of 2.91, while that of the Netherlands was 0.87. That means that, if 2005 to 2010 fertility levels were to continue, a woman in Angola would have 2.9 daughters, on average, during her lifetime. In the Netherlands, by contrast, a woman would have fewer than one daughter, on average.

In Angola, nearly one daughter would die, on average, before completing her childbearing years. In the Netherlands virtually all daughters would survive.

Child-Woman Ratio

The child-woman ratio is the number of children under age 5 per 1,000 women of childbearing age in a given year. This measure can be calculated from national censuses or survey data, providing some information on fertility where registered birth statistics are not available.

$$\frac{\textbf{Number of children under age 5}}{\textbf{Number of women ages 15-49}} \times K = \frac{3{,}850{,}422}{14{,}406{,}534} \times 1{,}000 = 267$$

There were 267 children under age 5 per 1,000 women of childbearing age in France as of March 2010.

In 2010, the child-woman ratio for South Korea was 170; in Uganda it was 892.

Replacement-Level Fertility

Replacement-level fertility is the level of fertility at which women in the same cohort have exactly enough daughters (on average) to "replace" themselves in the population. A NRR of 1.00 is equal to replacement level.

Once replacement-level fertility has been reached and remains there, births will gradually reach equilibrium with deaths, and in the absence of immigration and emigration, a population ultimately will stop growing and become stationary in both size and age structure. The time this process takes varies greatly depending upon the current age structure of the population.

Today, virtually all developed countries are at or below replacement-level fertility. In 2009, Sweden, with an NRR of 0.93, was below replacement level; still the Swedish population is growing.

The TFR can also be used to indicate replacement-level fertility by showing the average number of children sufficient to replace both parents in the population. In developed countries today, a TFR of about 2.1 is considered to be replacement level. Replacement-level TFRs higher than 2.0 (one child for each parent) are needed because there are slightly more males than females born and not all females survive to their childbearing years. In developing countries with much higher mortality rates, TFRs of more than 2.1 result in replacement-level fertility.

Population Momentum

Population momentum refers to the tendency of a population to continue to grow after replacement-level fertility has been achieved. A population that has achieved replacement or below-replacement fertility may still continue to grow for some decades because past high fertility leads to a high concentration of people in the youngest ages. Total births continue to exceed total deaths as these youths become parents. Eventually, this large group becomes elderly and deaths increase to equal the number of births or outnumber them. Thus it may take two or three generations (50 to 70 years) before each new birth is offset by a death in the population. Although replacement-level fertility was reached in Sweden by the late 1960s, there are still about 22,000 more births than deaths each year.

Birth Rate for Unmarried Women

The birth rate of unmarried women is the number of live births by unmarried women per 1,000 unmarried women ages 15 to 49 years in a given year. This rate indicates the number of infants born to unmarried women and should not be confused with the percentage of births to unmarried women described below.

$$\frac{\textbf{Number of births to unmarried women}}{\textbf{Number of unmarried women ages 15-49}} \times K = \frac{1{,}726{,}566}{32{,}866{,}971} \times 1{,}000 = 52.5$$

There were 53 births per 1,000 unmarried women ages 15 to 44 in the United States in 2008.

Percentage of Births Outside Marriage

The percentage of births outside marriage is the number of live births to unmarried women (never married, widowed, or divorced) per 100 total live births in a given year. This measure relates births to unmarried women to total births overall.

$$\frac{\textbf{Number of births to unmarried women}}{\textbf{Total live births}} \times K = \frac{1{,}726{,}566}{4{,}247{,}694} \times 100 = 40.6$$

In 2008, 41 percent of births in the United States were outside marriage.

In 2009, the percentage of births outside marriage was 55.1 in Norway and 6.6 in Greece.

FACTORS AFFECTING FERTILITY

Fertility is affected by cultural, social, economic, and health factors. Most of these factors operate through four other factors:

- Proportion of women in sexual unions.
- Percentage of women using contraception.
- Proportion of women who are not currently fecund (primarily because of breastfeeding).
- Level of induced abortion.

Knowledge about these four factors provides clues to potential changes in fertility and aids our understanding of past change.

The proportion of women who are in union is affected by other demographic factors including the age at first marriage or union; the pervasiveness of marriage and other unions; rates of divorce, separation, and remarriage; and male mortality levels.

Percentage of Women in Married or in Union

The percentage of women in sexual unions is sometimes approximated by the percentage of women of reproductive age who are legally married.

$$\frac{\textbf{Number of married women ages 15-49}}{\textbf{Number of women ages 15-49}} \times 100 = \frac{216{,}476{,}000}{289{,}406{,}000} \times 100 = 74.8$$

In India, 75 percent of women ages 15 to 49 were currently married in 2006.

The percentage married by age group can also be very useful for analysis. In India in 2006, 27 percent of women ages 15 to 19 were married, while 93 percent of women ages 30 to 34 were married.

In countries where consensual unions are also prevalent, they may be included with formal marriage to approximate the percentage of women in union.

Percentage of Women Breastfeeding

The percentage of women who are breastfeeding is helpful in determining the number of women who are at risk of pregnancy, because exclusive breastfeeding of an infant can lengthen the period of time before menstruation resumes.

$$\frac{\textbf{Number of women with infants under age 1 who are breastfeeding}}{\textbf{Number of women with infants under age 1}} \times 100 = \frac{6{,}120{,}000}{6{,}400{,}000} \times 100 = 95.6$$

Virtually all of Nigerian women surveyed in 2008 who had an infant under age 1 were breastfeeding.

Contraceptive Prevalence Rate

The contraceptive prevalence rate is the number of women of reproductive age who are using contraception per 100 women of reproductive age. This measure provides an indication of the number of women who have a lower risk of conception at a given time. This measure may be calculated for all women or subpopulations such as married women, unmarried women, or women who are sexually active. It is usually published for all contraceptive methods including modern methods (the pill, the condom), and "traditional" methods (withdrawal, natural methods).

$$\frac{\text{Number of married women ages 15-49 using contraception}}{\text{Number of married women ages 15-49}} \times 100 = \frac{885{,}000}{1{,}460{,}000} \times 100 = 60.6$$

In Bolivia in 2008, the contraceptive prevalence rate for all methods among currently married women ages 15 to 49 was 61 percent, whereas the modern method contraceptive prevalence rate for married women was 35 percent.

Women's use of contraception ranges from less than 20 percent in many African countries to 75 percent or more in many European countries, Australia, Brazil, and a few countries in East and Southeast Asia.

Abortion Rate

$$\frac{\text{Number of abortions}}{\text{Number of women ages 15-49}} \times K = \frac{44{,}089}{2{,}398{,}909} \times 1{,}000 = 18.4$$

In 2008, there were 18 abortions in Hungary per 1,000 women of childbearing ages 15 to 49.

In 2009, the abortion rate in Estonia was 29. In Japan in 2005, it was 10.

The abortion rate is the number of induced abortions per 1,000 women of reproductive age in a given year. This rate should not be confused with the abortion ratio, which is described below.

Abortion Ratio

The abortion ratio is the number of abortions per 1,000 live births in a given year. This ratio should not be confused with the abortion rate, described above.

$$\frac{\text{Number of abortions}}{\text{Number of live births}} \times K = \frac{43{,}181}{96{,}442} \times 1{,}000 = 447.7$$

In 2008, there were 448 abortions in Hungary per 1,000 live births.

In 2009, the abortion ratio in Russia was 734. In Italy in 2007, it was 222.

MORTALITY

Mortality refers to deaths that occur within a population. The probability of dying during a given time period is linked to many factors, such as age, sex, race, occupation, and economic status. The incidence of death can reveal much about a population's standard of living and health care.

Death Rate

The death rate (also called the crude death rate) is the number of deaths per 1,000 population in that population in a given year.

$$\frac{\textbf{Number of deaths}}{\textbf{Total population}} \times K = \frac{8{,}504{,}709}{1{,}149{,}285{,}000} \times 1{,}000 = 7.4$$

In the 2008, the death rate in India was 7 per 1,000.

In 2009, Zambia's death rate was estimated at 16 per 1,000, while Singapore's was 4.

The crude death rate can be particularly affected by age structure. It is therefore prudent, when comparing death rates between countries, to adjust for differences in age composition before making inferences about a country's health, economic, or environmental conditions.

For example, in 2009, Sweden's crude death rate was twice as high as Panama's—10 per 1,000 compared with 5 per 1,000—despite the fact that life expectancy in Sweden was 81 years, compared with 76 for Panama. The higher Swedish rate is attributable to the differences in age composition between the two countries. In "old" Sweden, 18 percent of its population is ages 65 and older, so deaths are more likely to occur, while "young" Panama's proportion of elderly people is only 6 percent of the total population. Thus, despite Sweden's better health conditions, it has a higher proportion of deaths in the total population each year than Panama.

Age-Specific Death Rate

Death rates can be calculated for specific age groups in order to compare mortality at different ages or at the same age over time. Comparisons also can be made between countries or areas.

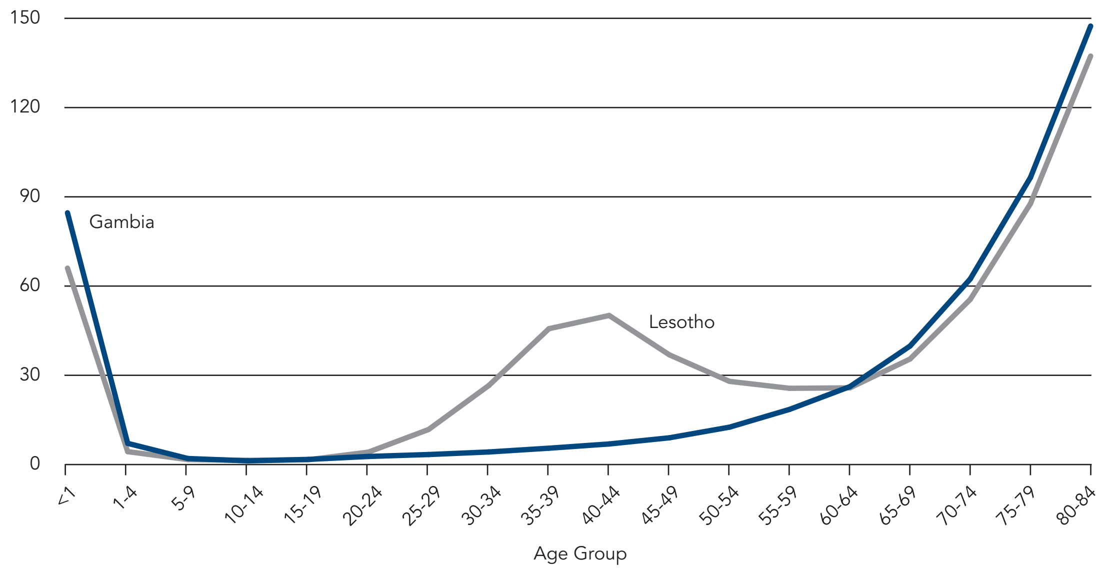
Because mortality varies greatly by sex and race, age-specific death rates are often given separately for males and females and for different racial groups in a population.

$$\frac{\textbf{Deaths of population ages 15-24}}{\textbf{Population ages 15-24}} \times K = \frac{32{,}208}{42{,}546{,}900} \times 1{,}000 = 0.8$$

In the United States in 2008, the age-specific death rate for ages 15 to 24 was 0.8 per 1,000.

By comparison, Puerto Rico's 2008 age-specific death rate for ages 75 to 84 was 50.2 per 1,000.

Age-Specific Death Rates, Gambia and Lesotho, 2008



Source: World Health Organization.

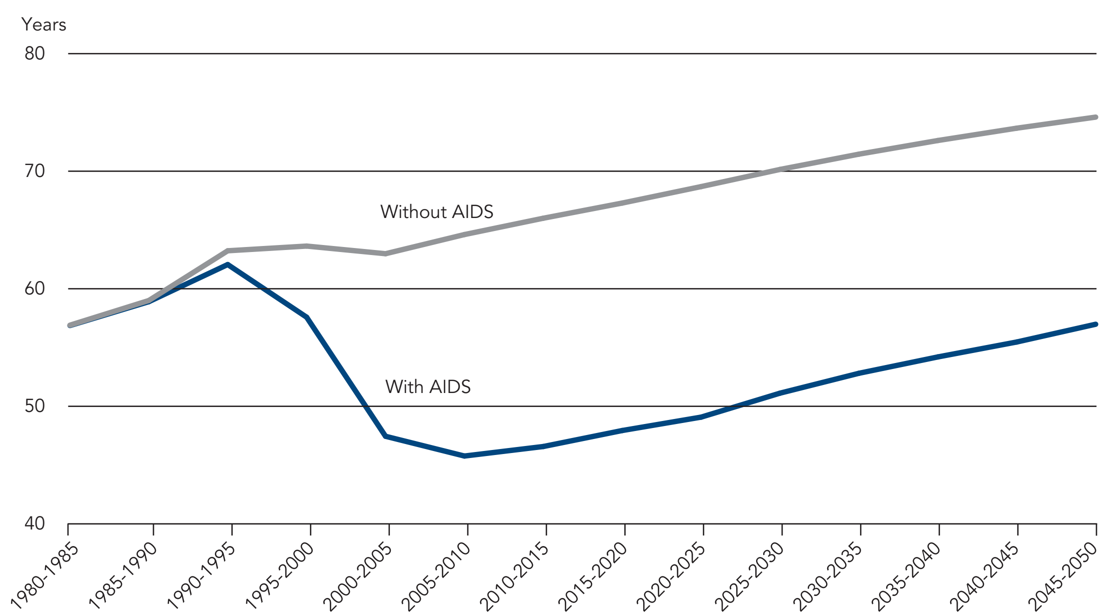
Cause-Specific Death Rate

Cause-specific death rates are usually expressed in deaths per 100,000, because for most causes of death, the rates of occurrence are very low.

$$\frac{\textbf{Deaths from heart disease}}{\textbf{Total population}} \times K = \frac{617{,}527}{304{,}050{,}700} \times 100{,}000 = 203.1$$

In 2008, 203 people per 100,000 died of heart disease, the leading cause of death in the United States.

Life Expectancy at Birth in Lesotho: With and Without the Effect of HIV/AIDS, 2050



Source: UN Population Division.

Proportion Dying From a Specific Cause

Deaths from a specific cause can be expressed as a percentage of all deaths.

$$\frac{\text{Number of deaths from heart disease}}{\text{Total deaths}} \times K = \frac{617{,}527}{2{,}472{,}699} \times 100 = 25.0$$

In 2008, 25 percent of all deaths in the United States were from heart disease.

The causes of death vary greatly from population to population and from period to period and are influenced by many factors, including health and environmental conditions. In 1900 in the United States, the pneumonia-bronchitis-influenza class of diseases was the leading cause of death, accounting for 17.2 percent of all deaths, while heart disease accounted for 7.1 percent of all deaths. By 2008, however, heart disease became the leading cause of death (25.0 percent of all deaths), while pneumonia-bronchitis-influenza accounted for only 2.3 percent of deaths. The proportion of people who die from a specific cause should not be confused with the cause-specific death rate.

Infant Mortality Rate

The infant mortality rate is the number of deaths of infants under age 1 per 1,000 live births in a given year.

$$\frac{\text{Number of deaths of infants under age 1 in a given year}}{\text{Total live births in that year}} \times K = \frac{78{,}400}{3{,}227{,}000} \times 1{,}000 = 24.3$$

There were 24 deaths of infants under age 1 per 1,000 live births in Brazil in 2007.

In 2009, Sweden reported the world's lowest infant mortality rate, 2.2 per 1,000. An example of a high national rate would be Chad's, which was estimated at 130 between 2005 to 2010.

The infant mortality rate is considered a good indicator of the health status of a population.

Maternal Mortality Ratio

The maternal mortality ratio is the number of women who die as a result of complications from pregnancy or childbearing in a given year per 100,000 live births in that year. Deaths due to complications from spontaneous or induced abortions are included.

$$\frac{\text{Number of maternal deaths}}{\text{Total live births}} \times K = \frac{670}{1{,}713{,}900} \times 100{,}000 = 39$$

There were an estimated 39 maternal deaths per 100,000 live births in Russia in 2008.

This measure is sometimes referred to as the maternal mortality rate; it is best to specify the denominator when using either measure. A true maternal mortality rate would divide the number of maternal deaths by the number of women of childbearing age in the population.

In practice, a maternal death is most often defined as the death of a woman while pregnant or within 42 days of termination of pregnancy from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes.

Life Expectancy

Life expectancy is an 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 the rest of his or her life. Life expectancy is a hypothetical measure because it is based on current death rates and actual death rates change (usually improving) over the course of a person's lifetime. Each person's life expectancy changes as he or she grows older and as mortality trends change.

If the age-specific death rates between 2005 to 2010 remain unchanged, males born in Argentina during that period can expect to live 72 years at the time they are born. Females can expect to live 79 years.

Because life expectancy also differs significantly depending on sex, present age, and race, these categories are usually listed separately. Life expectancy at birth, a good indicator of current health conditions, is the most commonly cited life expectancy measure.

Life expectancies also differ widely among countries. Between 2005 and 2010, life expectancy was estimated at 48 years of age in the Democratic Republic of the Congo compared with 83 in Japan. Women in Japan enjoy the world's highest life expectancy, at 86 years in 2008.

Note that low life expectancies in developing countries are consequences of high infant mortality rates. In 2008, for example, life expectancy at birth for females in Somalia was 49 years, but if a Somali female survived to age 1, she could expect to live to age 54.

The Life Table

The life table, one of the most powerful tools in demography, is used to simulate a population's lifetime mortality experience. It does so 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. For each year in the life table, death inevitably thins the hypothetical population's ranks, until in the bottom row of statistics, even the oldest people die.

The life table below shows selected portions of an abridged life table for the United States in 2007. This table is based on death rates and is abridged to display data at 5-year age intervals rather than for single years.

How Life Tables Work

Abridged Life Table for the United States, 2007

AGE	(1) PROPORTION DYING IN THE AGE INTERVAL	(2) NUMBER LIVING AT BEGINNING OF THE AGE INTERVAL	(3) NUMBER DYING IN THE AGE INTERVAL	(4) PERSONS LIVING IN THE AGE INTERVAL	(5) PERSONS LIVING IN THIS AND ALL SUBSEQUENT AGE INTERVALS	(6) YEARS OF LIFE REMAINING (LIFE EXPECTANCY)
<1	0.0068	100,000	676	99,406	7,793,477	77.9
1-5	0.0011	99,324	113	397,024	7,694,071	77.5
5-10	0.0007	99,211	68	495,870	7,297,047	73.6
10-15	0.0008	99,143	83	495,563	6,801,177	68.6
65-70	0.0778	83,588	6,503	402,523	1,558,706	18.6
70-75	0.1190	77,085	9,175	363,859	1,156,183	15.0
75-80	0.1913	67,910	12,990	308,633	792,325	11.7
80+	1.0000	54,919	54,919	483,692	483,692	8.8

Source: U.S. National Center for Health Statistics.

Column 1 shows the proportion of each age group dying in each age interval. These data are based on the observed mortality experience of a population.

Column 3 includes the number who would die within each age interval.

Column 1 x Column 2 = Column 3

Column 2 has the number of people alive at the beginning of each age interval, starting with 100,000 at birth. Each age group contains the population that survived from the immediately preceding group.

The total number of person-years to be lived within each age interval is contained in **Column 4**.

Life expectancy is shown in **Column 6**. The total person-years lived in a given interval plus subsequent intervals, when divided by the number of persons living at the start of that interval, equals life expectancy—the average number of years remaining for a person at a given age interval.

Column 5 ÷ Column 2 = Column 6

For example, dividing the number of person-years associated with the U.S. population who survive to age 70 (1,156,183) by the number alive at the beginning of that age interval (77,085) shows they have an additional life expectancy of 15.0 years, on average.

Column 6 shows the total number of years of life to be shared by the population in that age interval and in all subsequent intervals. This measure takes into account the frequency of deaths for this and all intervals afterward. As age increases and the population shrinks, the total person-years that the survivors have to live also decreases.

With age, life expectancy actually rises—a kind of "bonus" for surviving. The 77,085 Americans who survive to age 70, for example, can expect to live 15 additional years, well past their life expectancy at birth of 78 years. And, during their lifetimes, death rates are expected to decline from what they were when they were born, so that life expectancy at each age would increase even more.

MORBIDITY

Morbidity refers to disease and illness, injury, and disability in a population. Data about the frequency and distribution of a disease can aid in controlling its spread and, in some cases, may lead to the identification of its cause.

Incidence Rate

The incidence rate is the number of people contracting a disease during a given time period per 1,000 population at risk. The incidence rate and other morbidity rates vary so widely in magnitude that any constant may be used that expresses the rate in a clear manner (from "per 100" or "percent" to "per 100,000").

$$\frac{\textbf{Number of people developing tuberculosis during a given time period}}{\textbf{Population at risk}} \times K = \frac{252{,}316}{67{,}827{,}000} \times 100{,}000 = 372$$

The incidence of tuberculosis in the Democratic Republic of the Congo in 2009 was 372 per 100,000 population.

Prevalence Rate

The prevalence rate is the number of people who have a particular disease at a given point in time per 1,000 population. This rate includes all known cases that have not resulted in death, cure, or remission, as well as new cases developing during the specified period. The prevalence rate is a "snapshot" of an existing health situation; it describes the health status of a population at a point in time.

$$\frac{\textbf{Number of people ages 15-49 with HIV/AIDS}}{\textbf{Total population ages 15-49}} \times K = \frac{892{,}750}{6{,}243{,}000} \times 100 = 14.3$$

The prevalence of HIV/AIDS in Zimbabwe among adults (ages 15-49) in 2009 was 14.3 per 100 population.

In 2009, the prevalence rate of HIV/AIDS for males ages 15-49 in Botswana was 20.6 percent and for females, 29.2. Corresponding rates in Argentina were 0.6 and 0.3, respectively.

Case Rate

The case rate is the number of reported cases of a specific disease or illness per 100,000 population during a given year. The case rate is a special type of incidence rate, instead being based on the number of reported cases, which is not necessarily the number of persons contracting the disease (that is, some people may get the disease more than once).

$$\frac{\textbf{Number of estimated cases of H1N1 flu during a given year}}{\textbf{Total population}} \times K = \frac{60{,}000{,}000}{307{,}513{,}569} \times 100{,}000 = 19{,}511$$

From April 2009 to March 2010, the U.S. Centers for Disease Control and Prevention estimates that there were 19,511 cases of H1N1 flu in the United States per 100,000 population.

Case Fatality Rate

The case fatality rate is the proportion of people contracting a disease who die of that disease during a specified time period.

$$\frac{\textbf{Number of persons dying from the disease}}{\textbf{Number of persons contracting the disease during a period}} \times K = \frac{12{,}270}{60{,}000{,}000} \times 100{,}000 = 20.5$$

From April 2009 to March 2010, the U.S. Centers for Disease Control and Prevention estimates that there were 12,270 deaths from H1N1 flu in the United States, or 21 deaths for every 100,000 cases.

NUPTIALITY

Nuptiality refers to marriage as a population phenomenon, including the rate at which it occurs, the characteristics of people united in marriage, and the dissolution of such unions (through divorce, separation, widowhood, and annulment).

Marriage Rate

The marriage rate (also called the crude marriage rate) is the number of marriages per 1,000 total population in a given year. This rate is calculated using the number of marriages—not the number of people getting married—and includes both first marriages and remarriages.

$$\frac{\text{Number of marriages}}{\text{Total population}} \times K = \frac{707{,}700}{126{,}375{,}000} \times 1{,}000 = 5.6$$

In 2009, the crude marriage rate in Japan among Japanese nationals was 5.6 per 1,000 population. In Panama, it was 3.4 and in Jordan it was 10.4 in 2008.

Median Age at First Marriage

Half the people marrying for the first time in a given year got married before the median age, half after. The median age at first marriage is usually computed separately for males and females, because females typically marry at younger ages. The median age at first marriage has an effect on a population's fertility. The significance of this factor depends on the extent to which childbearing is limited to marriage.

In 2009, the median age at first marriage in France was 31.7 years for males and 29.8 for females. In 1990, it had been 27.6 for males and 25.6 for females.

Median age at first marriage varies widely. In Niger in 2006, median age at first marriage was 16 for females and 23 for males. In India, between 2005 and 2006, it was 23 for males and 17 for females.

Divorce Rate

The divorce rate (or crude divorce rate) indicates the number of divorces per 1,000 population in a given year. This rate is calculated using the number of divorces—not the number of people getting divorced.

$$\frac{\text{Number of divorces}}{\text{Total population}} \times K = \frac{253{,}400}{126{,}375{,}000} \times 1{,}000 = 2.0$$

In 2009, the crude divorce rate in Japan among Japanese nationals was 2.0 per 1,000 population. In Panama, it was 0.9 and in Jordan it was 2.2 in 2008.

MIGRATION

Migration is the geographic movement of people across a specified boundary for the purpose of establishing a new permanent or semipermanent residence. Along with fertility and mortality, migration is a component of population change. The terms “immigration” and “emigration” are used to refer to moves between countries (international migration). The parallel terms “in-migration” and “out-migration” are used for movement between areas within a country (internal migration).

Immigration Rate

The immigration rate is the number of immigrants arriving at a destination per 1,000 population at that destination in a given year.

$$\frac{\textbf{Number of immigrants}}{\textbf{Total mid-year population at destination}} \times K = \frac{65{,}210}{4{,}825{,}552} \times 1{,}000 = 13.5$$

In 2009, the Norwegian immigration rate was 13.5 per 1,000 residents.

In some countries, immigration plays a significant role in population growth. In Sweden in 2009, 66 percent of all population growth was a result of immigration.

Emigration Rate

The emigration rate is the number of emigrants departing an area of origin per 1,000 population at that area of origin in a given year.

$$\frac{\textbf{Number of emigrants}}{\textbf{Total mid-year population at origin}} \times K = \frac{26{,}576}{4{,}825{,}552} \times 1{,}000 = 5.5$$

In 2009, the Norwegian emigration rate was 5.5 emigrants per 1,000 residents.

Net Migration Rate

The net migration rate shows the net effect of immigration and emigration on an area’s population, expressed as an increase or decrease per 1,000 population of the area in a given year.

$$\frac{\textbf{Number of immigrants} - \textbf{Number of emigrants}}{\textbf{Total mid-year population}} \times K = \frac{65{,}210 - 26{,}576}{4{,}825{,}552} \times 1{,}000 = +8.0$$

In 2009, Norway experienced a net increase of 8.0 persons per 1,000 population through migration.

In 2010, Australia had a net migration rate of 11.0 per 1,000 population; the United States’ rate was 2.8; while Bulgaria had a net migration rate of -2.1 per 1,000 in 2009 (the net result was a loss of 2.1 persons per 1,000 population due to migration).

Net Migration

The net effect of immigration and emigration on an area's population (increase or decrease) is referred to as net migration.

Net international immigration	+	Net domestic migration	=	Change due to migration
165,600		**-98,798**		**66,802**

In the year ending July 1, 2009, the U.S. state of California had a net international immigration of +165,600 but it had a net outflow of -98,798 to the rest of the country. The state's gain in population due to migration was +66,802.

Domestic Net Migration

Subnational areas, such as U.S. states, can grow or decline both by international immigration balances and by exchange of population with the remainder of the country (domestic migration).

RACE AND ETHNICITY

Race, ethnicity, language group, and national heritage are often used for analyses of population groups. These data may reveal much about a population's origins and are often used in the administration of government programs.

In many countries, demographic data are reported for race, ethnic group, national origin, and religious affiliation. Definitions of race and ethnicity vary from country to country and over time. Even within academic disciplines, not everyone agrees on how to define these concepts. Each country investigating racial or ethnic characteristics of its population should apply the definitions and criteria determined by the groups that it wants to identify.

Race is frequently collected in censuses and surveys, normally by self-identification, a concept that may change over time.

Race

Race is not a scientific term. There are no universally accepted categories. Neither is there consensus about how many races there are or about what exactly distinguishes a race from an ethnic group. Race is frequently collected in censuses and surveys, normally by self-identification, a concept that may change over time. Many social scientists agree that while race may have a biological or a genetic component, race is defined primarily by society, not by genetics.

Ethnicity

Ethnicity usually is defined by cultural practices, language, cuisine, and traditions—not by biological or physical differences.

$$\frac{\textbf{Population of Russian origin}}{\textbf{Total population}} \times K = \frac{342{,}379}{1{,}340{,}127} \times 100 = 25.5$$

In 2010, 25 percent of Estonia's population was of Russian ethnicity.

In 2010, 1.3 percent of the population of Japan was of foreign origin.

Foreign-Born Population

The foreign-born population represents people born outside the borders or territories of a country. Place of birth is an objective characteristic—it does not change.

$$\frac{\textbf{Number of foreign-born people}}{\textbf{Total population}} \times K = \frac{38{,}517{,}000}{307{,}007{,}000} \times 100 = 12.5$$

In 2009, 12 percent of the population of the United States was foreign-born.

In 2009, 14 percent of Sweden's population was born abroad.

HOUSEHOLDS AND FAMILIES

Households and families are the basic units in which most people live. Trends in the number, type, and composition of households are important to sociologists, planners, and policymakers. For example, municipal services are provided to households, not to each individual. Other living situations include homelessness; group arrangements such as college dormitories, nursing homes, and military quarters; and institutions like psychiatric units and prisons.

Household

A household is often defined as one or more people who occupy a single housing unit. Households consist of unrelated people or people related by birth, marriage, or adoption.

Average Household Size

By knowing the number of people who live in households and the number of households, we can calculate the average size of households.

$$\frac{\textbf{Number of people living in households}}{\textbf{Total households}} = \frac{60{,}702{,}000}{25{,}689{,}000} = 2.3$$

In 2005, the average size of a household in France was 2.3 people.

In rural areas of India, the average household contained 5.4 in 2001, while in urban India, it was 5.1.

Average household exceeds 6 in some developing countries.

Family

The definition of family varies by country. In Norway, a single person is regarded as a family. For the country as a whole, nearly half of the families consisted of single people in 1997. It is important to be aware of such differences in definitions when making comparisons across countries.

Family is usually defined as a group of two or more people residing together and related by birth, marriage, or adoption. Family households are households maintained by a family, although the household may also contain other unrelated people.

$$\frac{\textbf{Number of married-couple families}}{\textbf{Total family households}} \times K = \frac{58{,}410{,}000}{78{,}883{,}000} \times 100 = 74.0$$

In 2010, 74 percent of family households in the United States were headed by a married couple.

In 1970, 87 percent of U.S. families consisted of married couples. In 2010, 19 percent of family households were female-headed, up from 11 percent in 1970.

Single-Parent Family

A single-parent family is one in which children are maintained by one parent as a result of a birth outside marriage, divorce, separation, or death of a spouse.

$$\frac{\textbf{Number of single-parent families}}{\textbf{Total family households}} \times K = \frac{134{,}830}{623{,}763} \times 100 = 21.6$$

About 22 percent of family households with children below age 18 were maintained by a single parent in 2010 in Norway.

URBANIZATION AND DISTRIBUTION

Urbanization is the increase in the proportion of the population living in urban areas—the process of people moving to cities or other densely settled areas. Population distribution refers to the patterns of settlement and dispersal of population within a country or other area.

Urban

Countries differ in their definitions of urban, although it is fairly common for the urban population to consist of those living in towns and cities of a few thousand or more, especially if the population of such areas is largely nonagricultural. In densely populated Japan, the term "urban" refers to cities with populations of 50,000 or more, and with 60 percent of the houses in the main built-up area and 60 percent of the population engaged in urban type employment, such as manufacturing and trade.

Percent Urban

The population living in urban areas can be expressed as a percentage of the area's total population and is a measure of urbanization. Usually the remainder of the population is considered rural, although some countries also have a middle category designated "semiurban." Urban growth refers to an increase in the physical size of an urban area.

$$\frac{\textbf{Number living in urban areas}}{\textbf{Total population}} \times K = \frac{24{,}674{,}000}{85{,}122{,}000} \times 100 = 29.0$$

In 2008, the population of Vietnam was 29 percent urban.

Singapore was 100 percent urban, while Cuba was 75 percent urban and Malawi was only 14 percent urban.

Metropolitan Area

A metropolitan area is defined as a large concentration of population, often an area with a population of about 100,000 or more people with an important city at its core, plus suburban and "exurban" areas that surround the city and are socially and economically integrated with it. Metropolitan areas are also often referred to as "urban agglomerations."

In 2008, the Budapest metropolitan area had a population of 2,489,471; 1,707,254 were in Budapest itself and 782,217 in surrounding, contiguous localities outside the city proper.

Population Density

Population density is expressed as the number of people per square kilometer or square mile of area. Density figures are often more meaningful if given as population per unit of arable (capable of producing crops) land. For example, in 2010, Egypt had an estimated 80 people per square kilometer of its total area, but about 2,365 people per square kilometer of arable land. Other useful density measures are the average number of people per household or per room—measures that are sometimes used to show crowding.

$$\frac{\textbf{Total population}}{\textbf{Total area (km}^2\textbf{)}} = \frac{28{,}900{,}000}{330{,}803} = 87.4$$

In 2010, Malaysia had a population density of 87 people per square kilometer.

By contrast, Singapore had a density of 7,526 people per square kilometer in 2010, Bangladesh had a population density of 1,142, and Australia had a population density of 3.

POPULATION CHANGE

Population change has three components: births, deaths, and migration. As people are born, die, or move, their total numbers in an area change. Throughout most of history, world population increased very slowly, but during the 20th century, that growth accelerated.

The Balancing Equation

The most basic method of calculating numerical population change over time is the “balancing equation,” shown below.

$$P_1 + (B - D) + (I - E) = P_2$$

Where P_2 is the population at the later date and P_1 is the population at the earlier date; B is births and D is deaths between the two dates; and I is immigration (or in-migration) and E is emigration (or out-migration) between the two dates.

Jan. 2009 population	+	(2009 Births-Deaths)	+	(2009 Immigration-Emigration)	=	Jan. 2010 population of Sweden
9,256,000	+	(111,800 – 90,080)	+	(102,280 – 39,000)	=	9,341,000

During 2009, the population of Sweden increased by 85,000.

Natural Increase

Natural increase is the surplus (or deficit) of births over deaths in a population in a given time period.

$$NI = B - D$$

Where NI is the natural increase during a period; B is the number of births; and D is the number of deaths during that period.

Rate of Natural Increase

The rate of natural increase is the rate at which a population is increasing (or decreasing) in a given year due to a surplus (or deficit) of births over deaths, expressed as a percentage of the base population. This rate does not include the effects of immigration or emigration.

$$\frac{\text{Births in 2009} - \text{Deaths in 2009}}{\text{Total population 2009}} \times K = \frac{111{,}800 - 90{,}080}{9{,}299{,}000} \times 100 = 0.23$$

In 2009, the rate of natural increase in Sweden was 0.23 percent.

The rate of natural increase can also be calculated from birth and death rates:

$$\frac{\text{Birth rate} - \text{Death rate}}{10} = \frac{12.0 - 9.7}{10} = 0.23$$

Growth Rate

The growth rate is the rate at which a population is increasing (or decreasing) in a given year due to natural increase and net migration, expressed as a percentage of the base population.

The growth rate takes into account all components of population growth: births, deaths, and migration. It should never be confused with the birth rate, but it sometimes is.

$$\frac{\textbf{Births 2009} - \textbf{Deaths 2009} \pm \textbf{Net migration 2009}}{\textbf{Total population 2009}} \times \mathbf{K} = \frac{\mathbf{111{,}800 - 90{,}080 - 63{,}280}}{\mathbf{9{,}299{,}000}} \times \mathbf{100} = \mathbf{0.91}$$

In 2009, the annual growth rate in Sweden was 0.91 percent.

The growth rate can also be calculated from natural increase and net migration rates:

$$\textbf{Rate of natural increase + Net migration rate} = \mathbf{0.23} + \mathbf{0.68} = \mathbf{0.91}$$

Birth rates and population growth characteristically fluctuate. A growth rate that is declining does not necessarily mean that an area's population is declining. Rather, it may indicate only that the population is growing at a slower rate. A negative growth rate means that an area is losing population. Today, about a dozen countries in Europe are experiencing a decline in total population, but many other countries are experiencing a decline in their rates of population growth.

In 2010, the world's population was growing at an annual rate of 1.2 percent, or increasing by 12 people per 1,000 population. At this growth rate, the world increased by nearly 83 million people in 2010.

Niger, with a growth rate of 3.5 percent in 2010, had one of the world's highest growth rates. Ukraine's population, on the other hand, was shrinking at an annual rate of -0.4 percent.

Doubling Time

Growth expressed as a percentage is not very descriptive for many purposes. Is a 3 percent growth rate fast or slow? A more vivid way of showing population growth is to calculate how long, at its current growth rate, a population would take to double in size. A country with a constant growth rate of 1 percent would double its population in about 70 years; at 2 percent, in 35 years; at 3 percent, in 23 years.

A quick way to approximate doubling time is to divide 70 by the growth rate expressed as a percent.

$$\frac{\mathbf{70}}{\textbf{Growth rate (\%)}} = \frac{\mathbf{70}}{\mathbf{0.08}} = \mathbf{875}$$

If its 2009 growth rate of 0.08 percent continued unchanged, Poland would double its population in about 875 years.

With an annual growth rate of 1.4 percent in 2010, the Bangladesh would require about 50 years to double its population. Uganda would take 21 years, at 3.4 percent. Austria, at its present low annual growth rate of 0.2 percent, would take 350 years to double its population.

Doubling time cannot be used to project future population size, because it assumes a constant growth over decades, whereas growth rates change. Nonetheless, calculating doubling time helps sketch how fast a population is growing at the present time.

The Demographic Transition

The demographic transition refers to the change that populations undergo from high rates of births and deaths to low rates of births and deaths. Historically, high levels of births and deaths kept most populations from growing rapidly. In fact, many populations not only failed to grow but also completely died out when birth rates did not compensate for high death rates. Death rates eventually fell as living conditions and nutrition improved. The decline in mortality usually precedes the decline in fertility, resulting in population growth during the transition period. In Europe and other industrialized countries, death rates dropped slowly. With the added benefit of medical advances, death rates fell more rapidly in the countries that began the transition in the 20th century. Fertility rates fell neither as quickly nor as dramatically as death rates, and thus population grew rapidly.

BOX 1

The Demographic Transition

Finland is a good example of a country that has passed through the four stages of the demographic transition.

Stage I

High birth rate, high death rate = little or no growth

(Finland in 1785-1790)

Birth rate: 38 per 1,000

Death rate: 32 per 1,000

Rate of natural increase: 0.6 percent

Stage II

High birth rate, falling death rate = high growth

(Finland in 1825-1830)

Birth rate: 38 per 1,000

Death rate: 24 per 1,000

Rate of natural increase: 1.4 percent

Stage III

Declining birth rate, relatively low death rate = slowed growth

(Finland in 1910-1915)

Birth rate: 29 per 1,000

Death rate: 17 per 1,000

Rate of natural increase: 1.2 percent

Stage IV

Low birth rate, low death rate = very low population growth

(Finland in 2009)

Birth rate: 11 per 1,000

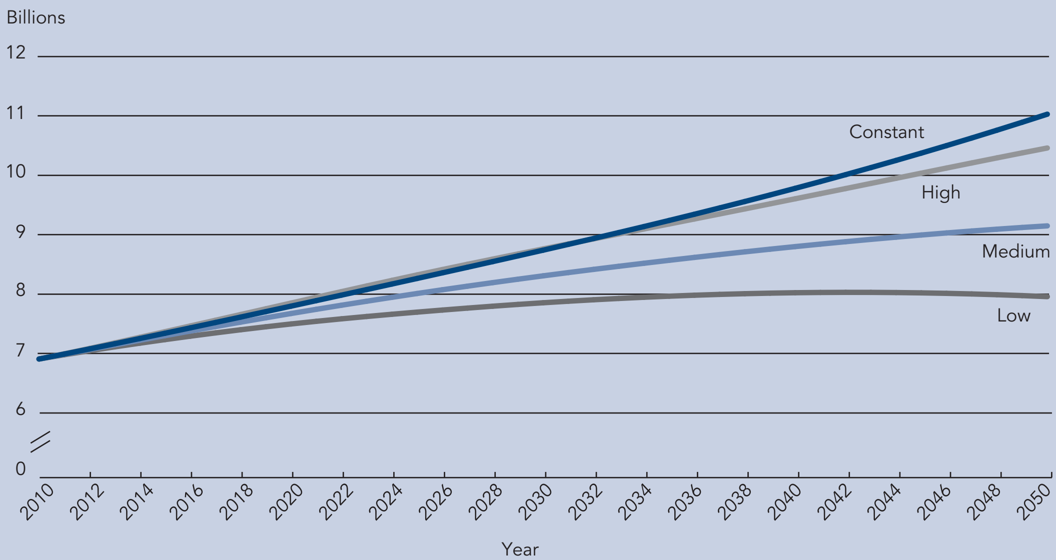
Death rate: 9 per 1,000

Rate of natural increase: 0.2 percent

BOX 2

World Population Projections

World Population Projections 2010-2050, Four Variants



Source: United Nations Population Division, *World Population Prospects: The 2008 Revision.*

High Fertility
The high fertility scenario assumes that the global average TFR (children per woman) will decline to 2.5 by 2045 to 2050 and will eventually end its decline at 2.35 children. Under this assumption, the world's population would grow to 10.5 billion by 2050 and be growing at 0.8 percent. At present, it is growing by 1.2 percent annually.

Medium Fertility
The medium fertility scenario assumes that the global average TFR will decline to 2.0 by 2045 to 2050 and will eventually end its decline at 1.85 children. Under this assumption, the world's population would grow to 9.1 billion by 2050 and be growing at 0.3 percent.

Low Fertility
The low fertility scenario assumes that the global average TFR will decline to 1.5 by 2045 to 2050 and will eventually end its decline at 1.35 children. Under this assumption, the world's population would grow to 8.0 billion by 2050 and be declining at -0.2 percent.

Constant Fertility
For illustrative purposes, the UN also produces a constant fertility scenario. This scenario assumes that the TFR will remain constant in every country from the present. Under this assumption, the world's population would grow to 11.0 billion by 2050 and be growing at 1.2 percent. The total fertility rate in 2045 to 2050 would actually rise to 3.2 children per woman and continue increasing since higher fertility countries would increase their share of world population, pushing up the average.

Projecting any population size requires *assumptions*. These assumptions concern the three components of population growth: fertility, the birth rate; mortality, the death rate, expressed in terms of life expectancy at birth; and the effect of net migration when the projection is for a country or area. If the birth rate is high, will it come down and when? If it is low, will it rise? How high will life expectancy rise?

When projecting the total world population, the primary issue is the assumptions made for developing countries. Low fertility in developed countries ensures these countries are likely to have very little population growth and may even decline in overall size.

The United Nations Population Division prepares global projections every other year. The figure illustrates four different projections made by the UN. How well any of these assumptions will be realized is unknown at this point.

Beyond the Transition

There is a fifth stage to the demographic transition. When fertility falls to very low levels and stays there for a protracted period, a slow rate of population growth can turn into a negative one. Many developed countries now have total fertility rates (TFRs) below—often well below—the replacement level of about 2 children per woman. By the late 1990s, a long list of countries, Austria, Belarus, Bulgaria, the Czech Republic, Estonia, Germany, Greece, Hungary, Italy, Japan, Latvia, Romania, Russia, Slovakia, Slovenia, Spain, and Ukraine had all seen their TFR sink to 1.3 or less and some were barely above that.

The experience to date shows that declining fertility may drop below replacement level and remain low. Most developed countries have addressed the issue of low fertility and unprecedented aging but incentives for couples to have children have resulted in infrequent success. The present population of Japan could be reduced by one-fourth by mid-century if current rates continue.

Countries such as Hungary, Singapore, and Spain have instituted pro-growth policies with little success, although fertility could have fallen even further without these policies. Many of the factors that lowered fertility in the first place—greater involvement of women in the workplace, a rising cost of living, and preferences in how people want to spend their time—appear to be keeping fertility rates low.

The needs of an aging population and the abilities of diminishing number of workers to provide for their health care needs and pension funding are important concerns for such populations.

Historical Perspective

During most of human history, population increased very slowly. It took hundreds of thousands of years for world population to reach 1 billion, in about 1800. At that point, growth began to accelerate as death rates fell. World population reached 2 billion 130 years later, around 1930. It passed the 3 billion mark in 1960 and reached 4 billion only 14 years later, in 1974. World population reached 5 billion in 1987; it reached 6 billion in 1999, just twelve years later. The seventh billion benchmark is expected in 2011, once again in just 12 years.

In 2010, the world birth rate was 20 births per 1,000 population, with women averaging about 2.5 children each. The death rate was 8 per 1,000 population; this combination results in a growth rate of 1.2 percent annually. This growth rate was down from a peak of about 2.1 percent in the late 1960s but was still high enough to result in a historically rapid rate of growth. If this rate were to remain constant, the world would reach nearly 20 billion by the year 2100. No one expects this to actually happen. Long before that point is reached, the growth curve should level off—a result of the birth rate going down, the death rate going up, or some combination of the two. That slowdown in growth, however, is dependent upon birth rates in developing countries declining to the same lower levels as in developed countries—and for that to happen with a minimum of delay.

The characteristics of population growth during the 20th century were unique in world history. At the beginning of the last century, the world had 1.6 billion people, and at the end it had 6.1 billion—over 80 percent of them living in developing countries. The demographic story over the next few decades will reveal the degree to which developing countries' growth will slow while developed countries' populations largely stagnate or decline—and age. The world was a demographically different place in 2000 than it had been in 1900, and the world of 2050 will be very different from the present.

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