Chapter 6
Demographic Processes: Fertility

Abstract Fertility patterns are a major focus for demographic analysis. This chapter reviews the factors that demographers address when analyzing the fertility patterns associated with a population along with the measures used for describing fertility patterns. The demographic correlates of fertility are explored along with the ways in which demographers can contribute to our understanding of the reproductive process.

6.1 Introduction

Fertility refers to the reproductive experience of a population. The reproductive experience involves all factors related to sexual behavior, pregnancy, and birth outcome. The number of births as well as the characteristics of those births, along with characteristics of the individuals involved in reproductive activities constitute the basis for fertility analysis.

Fertility is a social process requiring the biological interaction of two persons within a defined economic, social and/or political context. Fertility behavior is viewed broadly here and includes pre-pregnancy behavior, prenatal care, health-related activities during pregnancy (e.g., cigarette smoking), pregnancy outcome (e.g., birth, miscarriage and induced abortion), and short-term post-natal care. The demographic perspective emphasizes the interplay of culture, technology and economic conditions with fertility behavior.

Fertility plays an important role in shaping the size and demographic makeup of a population. For most populations fertility is the primary driver of population growth. Various non-biological factors contribute to a population's fertility pattern, making an understanding of the demographic dimension critical.

R. K. Thomas, *Concepts, Methods and Practical Applications in Applied Demography*, https://doi.org/10.1007/978-3-319-65439-3_6

6.2 Concepts and Measures

Fertility is most often measured in terms of the number of births that occur within a population. For most purposes the number of births within a specified year is considered. Total births are typically broken out on the basis of race and ethnicity as well as other attributes. Year-to-year changes in the number of births represents a fertility trend.

Since virtually all births in the U.S. today are recorded on a standard birth certificate demographers have access to extensive data related to the birth experience, and a number of characteristics of mother, father and newborn are considered by demographers who study fertility. Although the birth certificate technically describes the newborn, much of the information therein relates to the mother. While the physical attributes of the newborn are considered, data are also included on the physical, social and economic attributes (including marital status) of the mother. Less detail—although still important—is collected on the father. Information on the circumstances associated with this birth and previous births is also collected. (More detail on the content of the birth certificate is found later in this chapter.)

Certain factors related to the status of the population vis-à-vis reproduction are considered by demographers. The physical potential for reproduction characterizing a given population is referred to as *fecundity* (in contrast to fertility which is the actual reproductive experience). Fecundity is determined by physiological constraints while fertility is driven primarily by social considerations.

To more accurately determine the level of fertility birth rates are calculated. The calculation of rates facilitates the comparison of fertility levels across areas that differ in size and/or other characteristics. Comparing the number of births for two cities with populations of 100,000 and 1,000,000 respectively, makes little sense given that the base population producing births is 10 times larger in the latter city.

The *crude birth rate* (CBR) is the most basic measure of fertility. It is calculated by dividing the total number of births for a given year (or the average over three years) by the midyear total population for that year (the midyear in the range if a three-year average of births is taken). This quotient is then expressed as the number of births per 1000 population. The crude birth rate for the U.S. was 23.7 births per 1000 persons in 1960 and fell to 12.5 by 2015 (Martin, Hamilton, Osterman, et al. 2017).

The crude birth rate is the simplest measure of fertility but, because it is "crude", it is refined by calculating the general fertility rate that focuses on women of child-bearing age rather than the total population.

While the CBR is adequate for making very general comparisons and has the advantage of requiring only two pieces of information, it has two major shortcomings. First, the denominator includes people who are not *at-risk* of having a birth. Males, very young females, and females beyond menopause are not at-risk of

giving birth, yet they appear in the denominator of the rate. Second, the CBR masks differences between the age composition of populations. Fertility rates are greatly affected by age composition, particularly for women, and the CBR cannot account for this. Two populations of the same size could easily have dissimilar CBRs simply because females in the childbearing ages accounted for 20% of one population but 35% of the other. As a result of these shortcomings, more refined measures of fertility have been developed.

The *general fertility rate* (GFR), sometimes referred to simply as the *fertility rate*, represents a refinement of the CBR. It adjusts the denominator of the rate by focusing on the *population at risk*. It is expressed in terms of births per 1000 females aged 15–44 (or 15–49). In 1960, the GFR was 118 births per 1000 women aged 15–44, and by the mid-1990s it had declined to less than 60. The GFR reached a "modern" high of 69 in 2007 but has been declining since then (Ventura et al., 1999; Martin et al., 2017).

While the GFR expresses fertility in terms of births per 1000 women in the at-risk age group, it provides no information on fertility for specific age intervals (e.g., women aged 15–19). Additional information can be provided by calculating *age-specific birth rates*. Age-specific birth rates are essential in that changes in fertility levels specific to certain ages provide the analyst with much needed information regarding trends in service demand. For example, in 2008 12.4% of all births to women under age 15 were low birth weight, less than 2500 grams, compared to 7.4% of all women 25–29 (Martin, Hamilton, Sutton et al., 2010). Exhibit 6.1 presents the formulas utilized in the calculation of fertility rates.

Exhibit 6.1: Calculating Fertility Rates

Fertility rates are relatively easy to calculate, and in most instances the required data are readily available. Birth data (numerators) are available from vital statistics registries, and population figures (denominators) can be drawn from Census Bureau counts or estimates generated by other sources. These basic rates can be adjusted to reflect other factors such as age and marital status as desired.

$$\text{Crude birth rate (CBR)} = \frac{\text{Number of births in year X}}{\text{Population at midpoint (July 1) in year X}} \times 1000$$

$$\text{General fertility rate (GFR)} = \frac{\text{Number of births in year X}}{\text{Number of women age 15 to 44 (or 49) at midpoint (July 1) in year X}} \times 1000$$

$$\text{Age-specific fertility rate (ASDFR)} = \frac{\text{Number of births in year X to women age y to y + n}}{\text{Number of women age y to y + n at midpoint (July 1) in year X}} \times 1000$$

$$\text{Total fertility rate (TFR)} = \frac{\text{Sum of ASFRs} \times 5}{1000}$$

$$\text{Gross Reproduction Rate (GRR)} = \frac{\text{Female births}}{\text{Female + male births}} \times \text{Total fertility rate}$$

$$\text{Net reproduction rate (NRR)} = \text{Gross reproduction rate adjusted for female mortality}$$

The calculations below illustrate the process for generating various fertility rates for some of the more common metrics:

$$\text{Crude birth rate (CBR)} = \frac{100}{10,000} \times 1000 = 10/1000 \text{ population}$$

$$\text{General fertility rate (GFR)} = \frac{100}{2500} \times 1000 = 40/1000 \text{ women}$$

$$\text{Age - specific fertility rate (ASDFR)} = \frac{45}{1000 \text{ women } 25-29} \times 1000 = 45/1000 \text{ women } 25-29$$

$$\text{Total fertility rate (TFR)} = \frac{386.2 \times 5}{1000} = \frac{1931}{1000} = 1.931 \text{ lifetime births}$$

Demographers typically calculate age-specific fertility rates using five-year age intervals. Five-year intervals are used for convenience and, in cases like adolescent fertility measurement, narrower age intervals may be used. The age-specific fertility rate (ASFR) for women 20–24 years of age, for example, is derived by dividing the number of births to women who are 20–24 years of age by the number of women in the group (mid-year population). The rate is usually calculated for one year (or an average is taken for three consecutive years), and fertility is expressed in terms of births per 1000 women in the given age range. Exhibit 6.2 presents age-specific fertility rates for the United States in 2013. As can be seen, there are wide

differences in the rates with the mode being the 25–29 age group. The rates for women under age 20 and 40 and over are understandably much smaller than those for women age 20–39.

Exhibit 6.2: Age-Specific Birth Rates: United States: 2013

Age group	Rate per 1000 women
10–14	0.3
15–19	26.5
20–24	80.7
25–29	105.5
30–34	98.0
35–39	49.3
40–44	10.4
45.49	0.8

Source National Center of Health Statistics

It is important to recognize that historically ASFRs have shown considerable short-term fertility variation. For example, in 1960 (during the peak of the baby boom) the ASFR for 20- to 24-year-olds was 258 (258 births per 1000 women in this age cohort). By 2013 this rate had declined to 106. While ASFRs have declined markedly since 1960 across the board, a somewhat different trend emerged toward the end of the century that involved an increase in ASFRs at the age intervals 30–34 and 35–39. These increases represent births to baby boom women who had postponed childbirth for various reasons. This development was essentially unanticipated by demographers and illustrates the elasticity that characterizes fertility rates.

There is considerable variation in age-specific fertility rates over time reflecting the social and cultural developments within society.

The *total fertility rate* (TFR) is sometimes utilized as a summary measure for age-specific fertility rates. The TFR reflects hypothetical completed fertility for a population. Technically, the only way to accurately determine how many children a cohort of young women (e.g., those currently under age 15) will have over their lifetimes is to wait 30 or more years until they have completed their childbearing. Therefore, hypothetical measures that allow an analyst to project the completed fertility of a specified cohort without the long wait have been developed. The calculation of the TFR assumes that a group of 15-year-old females will experience the same age-specific fertility rates throughout their lifetimes (e.g., at ages 15–19 56.8 births per 1000 women per year). Adding up all the ASFRs (multiplied by 5) produces a hypothetical total number of births per 1000 women. The TFR calculation yields figures of 1.8 births per woman for 1987, 2.08 for 2008, and 1.9 for 2013, for example.

The TFR has been further modified and refined by demographers. One modification, the *gross reproduction rate* (GRR), adjusts the TFR to include only female births. This adjustment makes intuitive sense since it is only females who can bear children. *Replacement-level fertility*, the number of births required for females to exactly replace themselves, is about one birth per woman over a lifetime, or a GRR of approximately one. While the first reaction with regard to arriving at the GRR might be to multiple TFR by 0.5, to do so would result in an overestimate of the GRR. Instead, the TFR must be multiplied by the inverse of the sex ratio at birth, which is about 105 male births for every 100 female births. In other words, the TFR should be multiplied by 0.488 in order to arrive at the GRR. More detailed calculations can be performed depending upon the need for precision in the GRR.

The total fertility rate is an estimate of the total average number of births for women in society over their lifetime and must equal at least 2.1 births on average in order to maintain replacement levels.

While the GRR meets the demand for a measure of replacement, it fails to account for the mortality experience of both children and mothers. Therefore, an additional refinement, the *net reproduction rate* (NRR), has been created in order to adjust the measure of replacement by accounting for the deaths to women and female children that are known to occur. Adjusting for mortality results in NRRs that are smaller than GRRs. However, replacement fertility remains at 1; that is, the NRR must be 1 to have a replacement-level fertility. The factors used to adjust the GRR are derived from observed mortality data and the life tables that are based on these data.

6.3 Trends in Fertility in the U.S.

A number of important fertility-related trends can be identified for the United States population. The number of births increased from 2.9 million in 1945 to 4.3 million annually for 1957 through 1961. The period from 1946 to 1964 is generally recognized as the era of the *post-World War II baby boom*; until 1989, 1964 was the last year in which there were at least 4 million births in the United States. The interval 1965–1972 is seen as the transition to the *baby bust* that lasted from 1972 to 1978. Although some regard post-1978 fertility as evidence of a baby boomlet, a better explanation is to note that there was an *echo baby boom*. In other words, there was an increase in births due to the rapid rise in the number of potential and then actual mothers as the early baby boomers reached their childbearing years.

After 1987 there was an increase in the number of births that could not be explained by the echo effect. The number gradually increased through the end of the twentieth century and continued to rise in the early part of the twenty-first century.

By 2007, the figure for annual births had reached 4.3 million, a number not realized since the 1957–1961 period. Since the latter figure is generated by a population with a much larger base, the increase in births represented an actual decline in the fertility rate. This figure dropped below 4 million in 2010. It should be noted that changes in fertility are increasingly being driven by growing non-white racial and ethnic groups. Exhibits 6.3, 6.4 and 6.5 present trends in the number of births and birth rates for the U.S.

The fertility rate is highly elastic and fluctuates in response to social, economic and political developments within society.

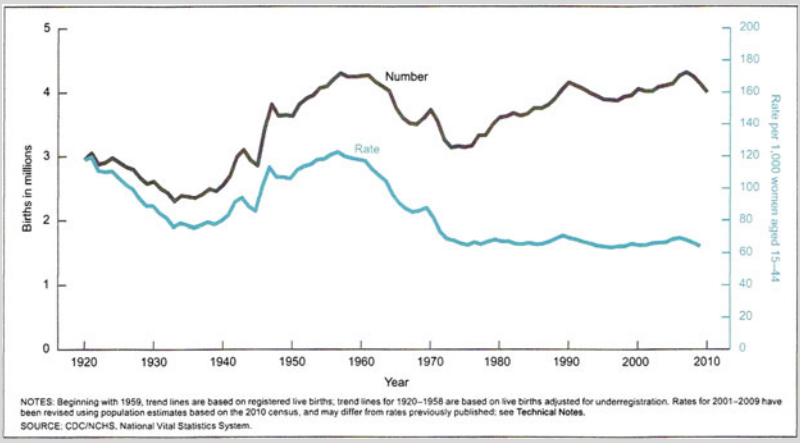
Longer-term fluctuations in the number of births translate into changes in the size of age cohorts over time. Fewer births result in the shrinking of the population at younger ages (e.g., 15–24 years of age). Projections beyond 2010 indicate reductions in the size of other age groups (e.g., 35–50), and this downturn is largely driven by a decline in the number of births at an earlier time. The continued trend toward smaller households and families as well as the reduction in the proportion of persons living in families means that there will be other as yet indiscernible changes in the age distribution in the future.

Exhibit 6.3: Number of Births (000 s)

2014	3932
2010	3999
2000	4058
1990	4158
1980	3612
1970	3700
1960	4300
1950	3600

Source National Center of Health Statistics

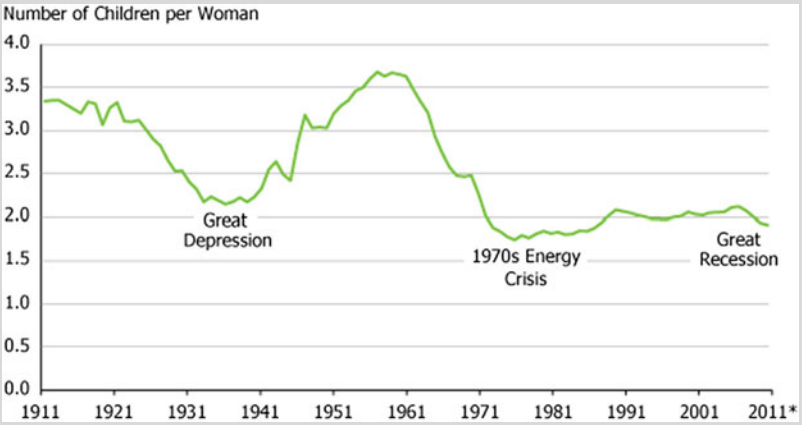
Exhibit 6.4: Annual Births and Fertility Rates: U.S., 1945–2010



Source Martin, Hamilton, Ventura, et al. (2012)

At the state and local levels, fertility patterns may vary significantly from those at the national level. For example, the number of births in Florida and California increased from approximately 115,000 and 363,000 in 1970 to 231,000 and 552,000, respectively, in 2008 (Martin, Hamilton, Sutton et al., 2010). Thus, the annual number of births in these areas increased by 100% and 52%, respectively. Births in Ohio and New York, on the other hand, declined from 200,000 and 318,000 to 141,000 and 250,000, respectively, during the same time interval. These figures represent decreases of 29% and 21%, respectively. Such variation in fertility trends have clear implications for population growth in the respective states.

Exhibit 6.5: Total Fertility Rate: United States: 1911–2011



*Estimated by Population Reference Bureau
Source National Center for Health Statistics

Exhibit 6.6 presents age specific fertility rates for three years: 1960, 1980 and 2010. The variation in age specific birth rates is marked. During the post war baby boom all rates were high, with peak figures at ages 20–24 and 25–29. Twenty years later, during the baby bust, almost all rates had fallen, and by a large margin. However, the figures for 2010 show a shift in pattern. Rates for ages 25 and above all show an increase from those seen in 1980 and for the ages 30 and above the upward movement is substantial.

As noted earlier, a TFR of 2.1 is considered to be replacement level fertility. Very low TFRs, less than 2.1, over a longer period of time result in an aging population and eventual population decline if there is not counter-balancing immigration flow in place. The TFR for the U.S. has been below 2.1 since the mid-1970s, and without significant immigration the U.S. population would achieve zero population growth and subsequent population decline once population momentum was lost. The most recent trends in the TFR in the U.S. show a small increase from 1.9 in 1990 to 2.08 around the turn of the century and back to 1.9 today. Fertility rates for the African American and Hispanic populations are somewhat higher than that for whites, and as the U.S. population becomes more heavily populated by these two minority groups the TFR will rise without any real change in fertility. In 2015, the TFR for whites was 1.89, followed by African Americans, 1.85, and Hispanics, 2.12 (Martin et al., 2017).

Exhibit 6.6: Age Specific Birth Rates in the United States: 1960–2010

Age category	1960[a]	1980[a]	2010[a]
10–14	0.8	1.1	0.6
15–19	89.1	53.0	41.5
20–24	258.1	115.1	103.0
25–29	197.4	112.9	115.1
30–34	112.7	61.9	99.3
35–39	56.2	19.8	46.9
40–44	15.5	3.9	9.8
45–49	0.9	0.2	0.7

[a]Number of Births per 1000 women in age category
Sources Martin et al. (2012); U.S. Bureau of the Census (1996)

There are several trends in factors related to birth outcomes that are important to consider. These factors help explain the hows and whys of fertility variations and trends. With regard to the likelihood of conception, several trends are worthy of note. Not only has contraceptive use increased since the 1970s, but the pattern of use has changed over time. Nearly 62% of women of childbearing age use some type of nonsurgical contraceptive (e.g., oral contraception, intrauterine device [IUD] or diaphragm). Nearly 17% have been sterilized (U.S. Census Bureau, 2010). Reliance on the pill, IUD, and diaphragm has declined since the 1970s, while sterilization as a means of contraception has become increasingly common. There remains a large number of women who do not use contraceptives, leaving them at risk of pregnancy (either wanted and unwanted).

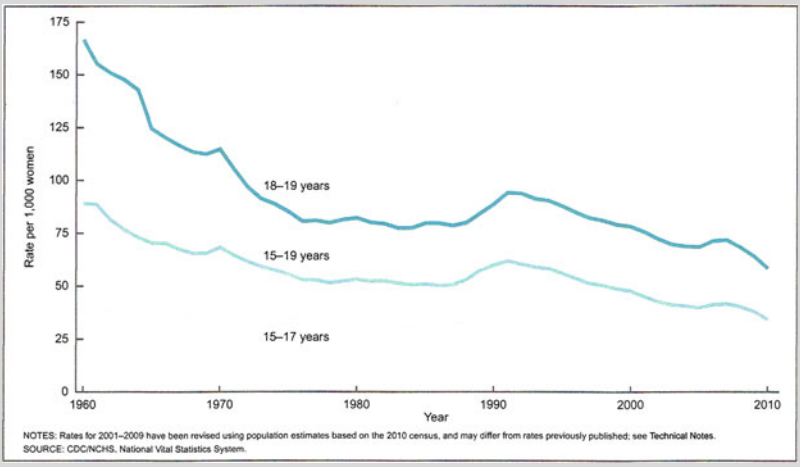
Contemporary U.S. fertility patterns represent a departure from historic patterns reflecting changes in age-specific fertility, births to unmarried women and overall lower fertility among other trends.

A change in the average age at first intercourse can have important implications for the health of a population. Premarital intercourse on the part of teenagers has increased markedly since the 1970s, with earlier age of first intercourse resulting in a rise in the risk of pregnancy and increased exposure to sexually transmitted diseases. Despite the increasingly younger age of first intercourse the birth rate for women 15–19 has steadily declined largely due to increases in the proportion using contraceptives. Exhibit 6.7 presents trends in births to teenagers in the U.S.

Another major trend in fertility variation relates to children born to unmarried women. In 2015, nearly 40% of all births in the United States were to unmarried mothers. Approximately 71% of all African-American births were to women who were unmarried, but only 29% of non-Hispanic white births were so classified

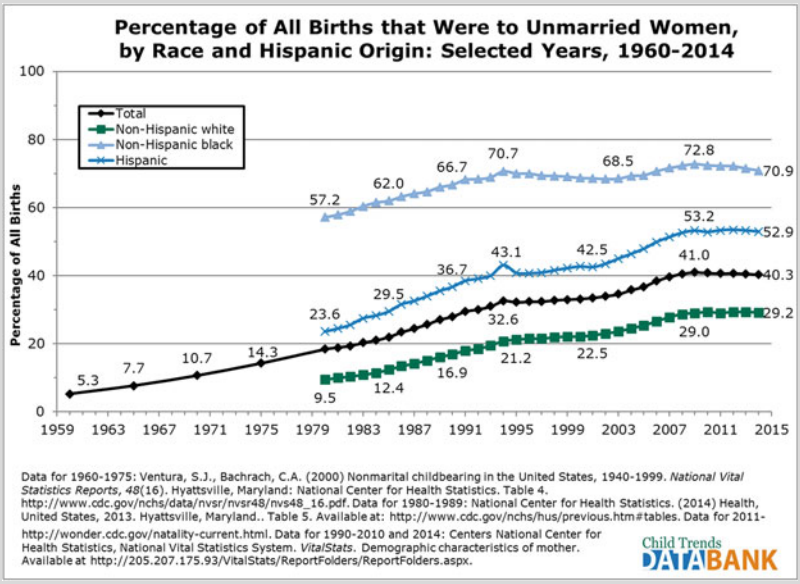
(Child Trends, 2014). Since 2007 the proportion of births occurring out of wedlock appears to have leveled off across the board. When the age of the mother is adjusted for race and ethnicity the differential narrows. At ages 15–19, 82% and 98% of all white and African-American births, respectively, are to mothers who are unmarried. At ages 30–34, 11% of white births and 19% of African-American births are to unmarried mothers.

Exhibit 6.7: Trends in Births to Teenagers: United States: 1960–2010



The fertility trend with perhaps the most implications in terms of future population characteristics is the shift in the preponderance of births from non-Hispanic whites to various racial and ethnic minorities that has occurred over the past 20 years. In 2015 the white population recorded a lower fertility rate than any racial or ethnic minority group tracked but American Indians. This trend has already led to a predominance of minority children over majority children within the U.S. population. This pattern can expect to be maintained for the foreseeable future as the size of the minority population continues to increase relative to the non-Hispanic white population and fertility rates continue to favor various racial and ethnic minorities. Exhibit 6.8 presents recent trends in the percentage of births to mothers who are unmarried by race and ethnicity.

Exhibit 6.8: Births to Unmarried Women By Race and Hispanic Orign, 1960–2014



One of the more controversial trends related to fertility in the United States is the growth in the number of annual abortions since that procedure was declared legal in the 1970s. The number of legal abortions climbed steadily from the liberalization of abortion laws from 200,000 in 1970 to a high of around 1.6 million in 1980. Since 1980 the number has steadily decreased, representing a decline of about 400,000 annually. Exhibit 6.9 describes some of the issues associated with reproductive health.

Exhibit 6.9: Reproductive Health Issues

The U.S. population is plagued by a number of issues related to reproductive health. These issues are particularly glaring when comparisons are made with other developed countries. The health of American women and their children should be a concern based on the available statistics.

Despite all of the advantages available to the U.S. population nearly 12% of the births in 2014 involved low birth-weight babies. This is actually a somewhat higher figure than five years earlier. The majority of these low-birth weight babies were delivered to non-white mothers. The proportion of low birth-babies is viewed unfavorably in international comparisons with

the U.S. rate being worse than most countries in Europe, Latin America and the Caribbean and even some countries in Africa.

Low birth-weight is often associated with prematurity, and the U.S. compares unfavorably here as well. Although the number of preterm births (before 37 weeks of pregnancy) has declined since 2007, nearly 10% of U.S. infants were born prematurely in 2014. The earlier an infant is born, the more likely he or she is to require intensive and prolonged hospitalization and have higher medical costs. Further, premature infants are also more likely to have lifelong health problems. Infant death rates related to preterm birth are three times higher for black infants than for white infants. Approximately two-thirds of the world's countries exhibit lower rates for premature births than the U.S.

In 2014, the teen birth rate (women aged 15–19 years) for the U.S. was 24.2 per 1000 women. Although this is an historic low for U.S. teens and a drop of 9% from 2013, it is still high by international standards. Although the reasons for the decline are not clear, it is thought that more teens are delaying or reducing sexual activity, and more sexually active teens are using birth control than in previous years. Still, racial/ethnic and geographic disparities in teen birth rates persist. Black and Hispanic teen birth rates are more than two times higher than those for non-Hispanic white teens; American Indian/Alaska Native teen birth rates remained more than one and a half times higher than the non-Hispanic white teen birth rate. The U.S. teen pregnancy rate is substantially higher than in other western industrialized nations. In fact, the U.S. rate is twice that of the next closest country and five times the rate of some other developed countries.

Despite widespread access to contraceptives the U.S. population still records a relatively high rate of unwanted and/or unintended pregnancies. An unintended pregnancy is a pregnancy that is reported to have been either unwanted (that is, the pregnancy occurred when no children, or no more children, were desired) or mistimed (that is, the pregnancy occurred earlier than desired). Unintended pregnancy is associated with an increased risk of problems for both mother and baby. Nearly half of the births in the U.S. today are unintended. African-American women are three times as likely as white women to experience an unintended pregnancy, and low-income Latinas are nearly twice as likely as low-income white women to have an unintended pregnancy. The rate of unintended pregnancy in the U.S. is significantly higher than the world average and nearly twice the European average.

In 2014 40% of U.S. births were attributed to unmarried women. Some 71% of black births were out-of-wedlock births compared to 29% of the white births. To the extent that being an unmarried mother carries health risks for both mother and child, it is found that Hispanics record the highest rate of births to unmarried mothers, followed closely by African-Americans. The proportion of births to unmarried women has grown steadily since the 1950s and only leveled off since 2007. While the U.S. rate is comparable to the average for participants in the Organisation for Economic Co-operation and

Development (OECD), 19 OECD countries report lower rates of out-of-wedlock births.

The infant mortality rate for the U.S. has declined steadily over time and has leveled off with around 6 deaths/1000 live births recorded in 2014. The leading causes of infant death are birth defects, preterm birth or low birth weight, maternal complications of pregnancy, sudden infant death syndrome (SIDS), and unintentional injuries. When it comes to infant mortality African-Americans stand out for their high rates, followed by American Indians and Hispanics (Matthews and MacDorman, 2013). The U.S. infant mortality rate is worse than 25 other countries and two or more times that of other developed countries.

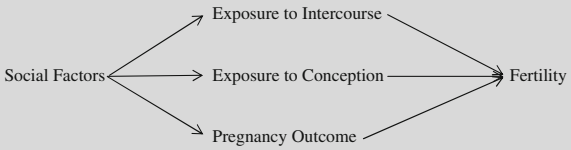
Despite advances in medicine and medical technologies, the rate of pregnancy-related deaths in the United States has increased over the past 25 years, with the maternal mortality rate in the U.S. more than doubling between 2000 and 2010. Much of the mortality (and particularly the recent uptick) can be can be attributed primarily to the black population (although poorly educated whites have also exhibited an increase). The U.S. is the only developed country to experience such an uptick in modern times. There are 48 countries with more favorable maternal mortality rates than the U.S.

6.4 Factors Affecting Fertility

Fertility rates are highly elastic and a number of social factors affect them. A model for understanding these factors was developed during the 1950s by Davis and Blake (1956) and is still useful today. The model as presented in Exhibit 6.10 illustrates the factors influencing fertility outcomes. These factors do not act independently of each other, although each category represents a separate stage in the fertility process. That is, intercourse must occur first, followed by conception, and last, by successful gestation. The intercourse variable is operationalized in terms of age at first intercourse, frequency of intercourse, time spent in and out of marriage, and age at first marriage.

The second set of factors, "exposure to conception," reflects the level of contraceptive use, sterilization, and infertility. The last group of factors focuses on pregnancy outcomes measured in terms of frequency of normal deliveries as well as miscarriages, stillbirths, and induced abortions. Together with social factors such as age, socioeconomic status, race-ethnicity, and marital status of mothers, these factors determine the level of fertility for a defined population. Note that the focus of the Davis-Blake model, as well as that for most fertility analyses, is on the study of women. Few data are available on men in this regard, and the interest in fertility analysis from a male perspective is a relatively recent phenomenon (e.g., Zhang, 2011).

Exhibit 6.10: Factors Affecting Fertility



Source Davis and Blake (1956).

There is a close correlation between fertility patterns and demographic attributes. The implications of the age distribution of women within a population for fertility have previously been addressed, but a number of other demographic attributes play into fertility patterns. The racial and ethnic makeup of a population is an important consideration when it comes to fertility rates, with several differences in fertility patterns apparent. In 2015, the general fertility rate for white women aged 15–44 was 63.1 births per 1000, compared to 64.0 for African Americans and 62.5 for Hispanics (Martin et al., 2017). Even among these major groupings there is variation with the rate for Hispanics ranging from 52.1 for Cuban-Americans to 95.0 for those of Central and South American origin. The fertility rates generated for 2015 indicate a narrowing of differences in fertility for various racial and ethnic groups. However, the long-term trend suggests a decline in fertility for non-Hispanic whites and continued relatively high fertility for most other racial and ethnic groups.

Fertility differences based on the educational attainment of the mother are even greater than those for race and ethnicity. Women with less than a high school education will have the most children over their lifetimes, followed by high school graduates and college graduates, with those with an advanced degree recording half the number of births over their lifetimes as those without a high school diploma. College-educated women in particular have exhibited a dramatic shift to a later age of childbearing over the past 35 years.

Fertility rates are correlated with a a variety of demographic variables and are influenced by racial and ethnic mix, marital status, income, education and labor force participation among other demographic attributes.

Of particular interest to demographers is the marital status of women who give birth. Two generations ago virtually all births in the U.S. occurred to married women. Since then the proportion of out-of-wedlock births has increased steadily to the point today that barely half of births occur to married women. In 1960 only 5% of births occurred to unmarried women compared to 40% in 2015. The likelihood of being an unmarried mother decreases markedly as the age of the mother increases.

For example, while nearly 75% of all births to 15-year-old women are to those classified as unmarried, only 15% of the births to 30- to 34-year-old women are so classified. The increased level of nonmarital fertility reflects the rise in nonmarital sex over time.

The implications of a high rate of births to unmarried women are significant, with this trend contributing to a radical modification of household structures in the U.S. and making single female heads-of-household the fastest growing household type. In addition, there are important social and economic implications of a high rate of births to unmarried women. The potential consequences for the mental and physical health of both the mother and the baby are significant, especially since unmarried mothers typically have limited access to health services.

Fertility levels vary widely by labor force status and income level as well. The overall birth rate for those in the labor force 2015 was 7.9/1000 versus 9.2 for those not in the labor force. The highest fertility rate is for the unemployed whose rate of 16.7 compares to 7.3 for the employed.

In regard to income, those living at or below the poverty level report a GRR of 81.7. The rate declines sharply with increases in income with the GFR for those with incomes 200% or more of poverty reporting a rate of 44.8 (Martin et al., 2017). Exhibit 6.11 describes the variation in fertility levels of various demographic subgroups in U.S. society.

Exhibit 6.11: Who's Having Babies?

Global fertility rates mask the significant variation that exists among various groups within the U.S. population when it comes to reproductive patterns. Fertility rates vary widely along a number of demographic dimensions. Some of the more important distinctions are illustrated below (with most figures based on 2015 data):

Age of Mother/Father	Rate/1000	
	Mother	Father
10–19	24.2	9.0
20–24	76.8	51.6
25–29	**104.3**	87.4
30–34	101.5	**103.8**
35–39	51.8	69.1
40–44	11.0	28.6

Race and Ethnicity	Rate/1000
White	12.0
Black	14.3
American Indian	9.7
Asian/Pacific Islander	14.0
Hispanic	**16.3**

Educational Level	Rate/1000
Less than high school	**17.4**
High school only	10.1
Some college	8.8
Associate degree	7.0
Bachelor's degree	3.6
Graduate/professional degree	4.0

Marital Status	Rate/1000 women
Currently married	**88.7**
Not married	51.8

Labor Force Status	Rate/1000
In labor force	7.9
Employed	7.3
Unemployed	**16.7**
Not in labor force	9.2

Poverty Status	Rate/1000 women
At or below poverty level	**81.7**
100–199% of poverty level	62.8
200% or more above poverty level	44.8

Source Martin et al. (2017)

The above discussion does not present an exhaustive list of the factors having potential impact on fertility with the factors worthy of concern varying from community to community. Compositional change (e.g., changing age or racial/ethnic composition) over time is equally important given the population redistribution patterns underway in the United States.

6.5 Data Sources for Fertility Analyses

Fertility data are drawn from a variety of sources, although official vital statistics registries represent the most reliable source. Relatively high-quality birth registration systems exist in each state, and the standard birth certificate includes a variety of data on the characteristics of the child, mother, and father. Data from these state systems are compiled at the national level by the National Center for Health Statistics. Exhibit 6.12 provides a list of items on the standard birth certificate.

Exhibit 6.12: Items Included on the Standard Certificate of Live Birth

Child	Mother	Father	Pregnancy
Name	Name	Name	Pregnancy history
Sex	Age	Age	Date of last normal menses
Date of birth	State of birth	State of birth	Month prenatal care began
Hospital/facility name	Place of residence	Race/ethnicity	Prenatal visits
County of birth	Race/ethnicity	Education	Pregnancy complications
Birth weight	Marital status	Relation to child	Concurrent illnesses
Apgar score	Education		Congenital anomalies
			Method of delivery
			Medical risk factors
			Obstetric procedures

Source National Center for Health Statistics

In addition to the birth registration system, sample surveys are a source of data on fertility-related behavior. Surveys provide information on such issues as contraceptive use, infertility, and breast-feeding practices. Surveys like the National Survey of Family Growth conducted by the National Center for Health Statistics make it possible to track trends in fertility-related behavior.

The U.S. Census Bureau collects data on a limited number of fertility issues through both the American Community Survey (ACS) and the Current Population Survey (CPS). In the ACS, women are asked whether or not they had given birth within the previous year. The CPS has a more extensive list of fertility inquiries, including questions with regard to actual and expected fertility whose answers are cross-tabulated by other demographic factors.

For statistical purposes, births are assigned to both the mother's *place of residence* and the *place of occurrence*. For most purposes, place of residence is the most important consideration. Fertility rates and associated statistics are relevant for the community in which the mother resides and not for the place where the birth occurred, especially if the delivery takes place outside the community of residence. This has become a more frequent occurrence as an increasing number of rural areas lack obstetrical facilitates, and expectant mothers are required to travel outside their home communities for care. There are also the rare occasions where an expectant mother is traveling away from home when an unexpected delivery occurs. From an applied perspective, information on births by place of occurrence may be useful especially to health demographers involved in the planning of obstetrical services. Case Study 6.1 describes efforts to reduce infant mortality within a disadvantaged community.

Case Study 6.1: Reducing Infant Mortality Among a Disadvantaged Population

Infant mortality remains a problem in the U.S. particularly among low-income minority populations. Many disadvantaged communities exhibit infant mortality rates comparable to "third-world" countries. The problem of low birth weight has emerged as the single most important cause of infant death and subsequent health problems in infancy and childhood. Although low birth weight babies represent a small percentage of all babies born, well over half of all infant deaths occur among this group. The relationship between infant mortality/morbidity and low birth weight has been known for many years and, despite dramatic overall changes and medical advances, the incidence of low birth weight among high-risk populations continues to be a perennial problem.

The existence of high infant mortality rates reflects the convergence of multiple demographic attributes. Low-birth weight (and hence infant mortality) is not randomly distributed among the population, but is endemic within certain demographic subgroups. The demographic attributes associated with low-birth weight are age (i.e., under 16 years/over 35 years), race (i.e. African-American), income (i.e., at or below poverty level), marital status

(i.e., unmarried), and education (i.e., low educational attainment). Any one of these factors could contribute to the likelihood of low birth weight and a combination of these almost assures an at-risk pregnancy.

One solution offered to address the issue of low-birth weight was a program that identified at-risk mothers early in the process. Working through various social service agencies and health facilities, at-risk mothers were identified and targeted for the risk-reduction program. Educational materials were developed customized to resonate with women in these risk categories. More important, a home visitation program was developed to provide on-going attention to the at-risk mothers. Importantly, peer mentors were utilized who were matched with the at-risk mothers on the basis of their demographic characteristics.

After two years of program operation, there is evidence that the infant mortality rate is actually being affected. There has also been a reduction in the number of low-birth weight babies in the community. Although it is difficult to isolate the effects of this particular infant mortality reduction program (given that there were other programs operating as well), there is evidence that leveraging information on the demographic attributes of the at-risk population allowed for the development of an informed risk-reduction program.

Exercise 6.1: Calculating Age-Specific Fertility Rates

For this exercise students will calculate age-specific fertility rates using the cohorts of child-bearing age women in North County. Column 1 lists the age interval for child-bearing age women, Column 2 the number of women in each cohort, and Column 3 the number of births generated by that age cohort. Students must perform the calculations to generate the entries for the empty columns.

Age interval	No. of women	No. of births	No. of births/No. of women	Multiplier	ASFR
10–14	6600	6	_____	1000	_____
15–19	5745	300	_____	1000	_____
20–24	4331	478	_____	1000	_____
25–29	5454	621	_____	1000	_____
30–34	6162	526	_____	1000	_____
35–39	6754	244	_____	1000	_____
40–44	6217	44	_____	1000	_____
Total	41,163	2219	_____	1000	_____

Exercise 6.2: Calculating Changes in Racial/Ethnic Mix
Using the data supplied below, calculate the births and new population for these racial/ethnic groups:

Racial/ethnic group	Annual birth rate	Original population (%)	Annual births	10-year change	New population
Non-hisp. whites	10/1000	10,000 (48%)	____	_____	_____ (___%)
Hispanics	25/1000	5000 (24%)	____	_____	_____ (___%)
African Americans	20/1000	5000 (24%)	____	_____	_____ (___%)
Asian-Americans	15/1000	1000 (5%)	____	_____	_____ (___%)
Total		21,000	____	_____	_____ (100%)

References

Child Trends. (2014). *Child indicator*. Downloaded from URL: https://www.childtrends.org/wp-content/uploads/2014/10/2014-47ChildIndicatorFall2014.pdf.

Davis, K., & Blake, J. (1956). Social structure and fertility: An analytical framework. *Economic Development and Cultural Change, 4*(3), 211–235.

Martin, J. A., Hamilton, B. E., Sutton, P. D., et al. (2010). Births: Final data for 2008. *National vital statistics reports, 59*(1). Hyattsville, MD: National Center for Health Statistics.

Martin, J. A., Hamilton, B. E., Ventura, S. J., et al. (2012). Births: Final data for 2010. *National Vital Statistics Reports, 61*(1). Hyattsville, MD: National Center for Health Statistics.

Martin, J. A., Hamilton, B. E., Osterman, M. J. K., et al. (2017). Births: Final data for 2015. *National Vital Statistics Report, 61*(1).

Mathews, M. S., & MacDorman, M. F. (2013). Infant mortality statistics from the 2009 period linked birth/infant death data set. *National Vital Statistics Report, 61*(8).

U.S. Census Bureau (1996). *Statistical abstract of the United States*. Washington, DC: U.S. Government Printing Office.

U.S. Census Bureau (2010). *Statistical abstract of the United States 2010*. Washington, DC: U.S. Government Printing Office.

Ventura et al. (1999). Births: Final data for 1997. *National Vital Statistics Report*, *45*(11), Washington DC: U.S. Government Printing Office.

Zhang, L. (2011). *Male fertility patterns and determinants*. New York: Springer.

Additional Resources

Carmichael, G. A. (2016). *Fundamentals of demographic analysis: Concepts, measures and methods*. New York: Springer.

Goldstein, J., Lutz, W., & Testa, M. R. (2003). The emergence of sub-replacement family size ideals in Europe. *Population Research and Policy Review, 22,* 479–496.

Kent, M. M. (2011). U.S. fertility in decline. Population Reference Bureau. Downloaded from URL: http://www.prb.org/Articles/2011/us-fertility-decline.aspx?p=1.

Moultrie, T. A. (2013). Introduction to fertility analysis. In T. A. Moultrie, R. E. Dorrington, A. G. Hill, et al. (Eds.), *Tools for demographic estimation*. Paris: International Union for the Scientific Study of Population.

Pol, Louis, & Thomas, Richard K. (2012). *The demography of health and health care* (3rd ed.). New York: Springer.