National Vital Statistics Reports

Volume 69, Number 5 June 25, 2020

Effects of Changes in Maternal Age Distribution and Maternal Age-specific Infant Mortality Rates on Infant Mortality Trends: United States, 2000–2017

by Anne K. Driscoll, Ph.D., and Danielle M. Ely, Ph.D., Division of Vital Statistics

Abstract

Objectives—This report assesses the contributions of the changing maternal age distribution and maternal age-specific infant mortality rates on overall and race and Hispanic origin-specific infant mortality rates in the United States from 2000 to 2017.

Methods—The analyses used 2000–2017 linked birth and infant death data from the National Vital Statistics System. Age-adjusted infant mortality rates, based on the 2000 U.S. maternal age distribution, were calculated for each year. These rates were compared with crude rates for all births and for specific race and Hispanic-origin groups. Decomposition analysis was used to estimate the proportion of the decline due to changes in maternal age distribution and in age-specific mortality rates.

Results—During 2000–2017, the age of women giving birth rose as infant mortality rates declined, although unevenly across maternal age groups. The maternal age-adjusted infant mortality rate in 2017 was 6.13 compared with the crude rate of 5.79, resulting in a 0.34 percentage point difference. Changes in the maternal age distribution accounted for 31.3% of the decline in infant mortality rates for all births and for births to non-Hispanic white women, and for 4.8% of the decline in births to non-Hispanic black women. Declines in age-specific mortality rates accounted for the remainder of the decline for these groups and for all of the decline in births to Hispanic women.

Conclusion—Changes in the age distribution of women giving birth accounted for about one-third of the decline in infant mortality rates from 2000 through 2017; declines in maternal age-specific mortality rates accounted for about two-thirds of this decline. These patterns varied by race and Hispanic origin.

Keywords: infant deaths • age-adjusted • Kitagawa decomposition • National Vital Statistics System

Introduction

The U.S. infant mortality rate declined from 6.89 deaths per 1,000 births in 2000 to 5.79 in 2017 (1). The characteristics of women giving birth, including maternal age composition, also changed during this period. Women were increasingly less likely to be in their teens and early 20s, and more likely to be in their late 20s and older; in particular, births have increased among women aged 40 and over (2,3).

This change impacts the overall infant mortality rate because the risk of an infant death varies by maternal age; infants born to women in the youngest (under age 20) and oldest (age 40 and over) age groups have the highest mortality rates (1). Infants born to women aged 30–34 have had the lowest mortality rates consistently, followed by women aged 35–39 (4). Preterm births and low birthweight, both associated with mortality, are more common for infants born to the youngest and oldest mothers (5).

This report examines how changes in the maternal age distribution and maternal age-specific (infant) mortality rates (ASMRs) are related to changes in the infant mortality rate from 2000 through 2017 for all births and for births to women in the three largest race and Hispanic-origin groups: non-Hispanic white, non-Hispanic black, and Hispanic. Understanding the role of these two factors in infant mortality trends informs efforts to further reduce infant mortality. Given the racial-ethnic differences in infant mortality levels and trends, and in the age distributions of women giving birth, racial-ethnic-specific analyses may advance understanding of the sources of these differences.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
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Methods

The analyses used 2000–2017 linked birth and infant death data from the National Vital Statistics System (6). The linked data are based on all infant deaths in the United States where the death certificate could be matched to the infant's birth certificate. During 2000–2017, linkage rates ranged from 98.4% to 99.6%.

Analyses were conducted for the entire United States (including race and Hispanic-origin groups not shown) and separately for the three largest race and Hispanic-origin groups: non-Hispanic white, non-Hispanic black, and Hispanic. To enable comparisons across years, bridged-race categories were used for each year (6).

The analyses consisted of several steps. First, maternal age distributions and distributions by race and Hispanic-origin group were calculated annually from 2000 through 2017. Six maternal age categories were used: under age 20, 20–24, 25–29, 30–34, 35–39, and 40 and over. Next, ASMRs were calculated for each maternal age group for each year.

Kitagawa decomposition analysis was then used to estimate the contribution of maternal age distributions and age-specific morality rates on the decline in the overall infant mortality rate for 2000–2017. Decomposition analysis corresponds to direct standardization in which, for example, the age distribution of each year is applied to standard ASMRs. It also corresponds to indirect standardization in which maternal age distributions are held constant over time, and year-specific ASMRs are applied to this standard to calculate annual age-standardized rates (7). For this analysis, the 2000 maternal age distribution and ASMRs were used as the standards for this analysis.

The formula developed by Kitagawa (7,8) is used to perform the decomposition analysis:

$$N_2 - N_1 = \sum_i \frac{(R_{1i} + R_{2i})}{2}(F_{2i} - F_{1i}) + \sum_i \frac{(F_{1i} + F_{2i})}{2}(R_{2i} - R_{1i})$$

where N_1 and N_2 denote infant mortality rates in 2000 and 2017; R_1 and R_2 refer to age-specific infant mortality rates in 2000 and 2017; and F_1 and F_2 refer to maternal age distributions in 2000 and 2017. Summing the two components over all maternal age categories (i) produces the total mortality rate difference due to each component. Together, they add to the overall differences in rates over time.

Trends in crude and both adjusted rates from 2000 through 2017 were evaluated using the National Cancer Institute's Joinpoint Regression Program (9). Default settings allowed for as few as three observed time points in each line segment, including the joinpoints. Using these settings, a maximum of three joinpoints were searched for using the grid search algorithm and permutation test and an overall alpha level of 0.05. A z test was used to determine the statistical significance of differences when comparing maternal age distributions by race and Hispanic origin, and infant mortality rates by maternal age and race and Hispanic origin in 2000 and 2017.

Results

Trends in maternal age distribution

The maternal age distribution of women has changed over time for the population as a whole and for the three largest race and Hispanic-origin groups; see Table 1 and Figures 1 and 2. For the total population and each race and Hispanic-origin group, the proportion of women under age 25 giving birth declined from 2000 through 2017, whereas the proportion of women in each group aged 25 and over increased.

All races and Hispanic origins

The percentage of births to women under age 20 declined from 11.8% to 5.1% from 2000 through 2017 (Table 1, Figure 1), a 57% decline. The percentage of births to women aged 20–24 declined 21% over this period from 25.1% to 19.8%. The percentage of births increased for women in all age groups 25 and over, by 9% for women aged 25–29 (from 26.8% to 29.1%), 24% for women aged 30–34 (22.9% to 28.3%), 30% for women aged 35–39 (11.1% to 14.4%), and 39% for women aged 40 and over (2.3% to 3.2%).

Non-Hispanic white women

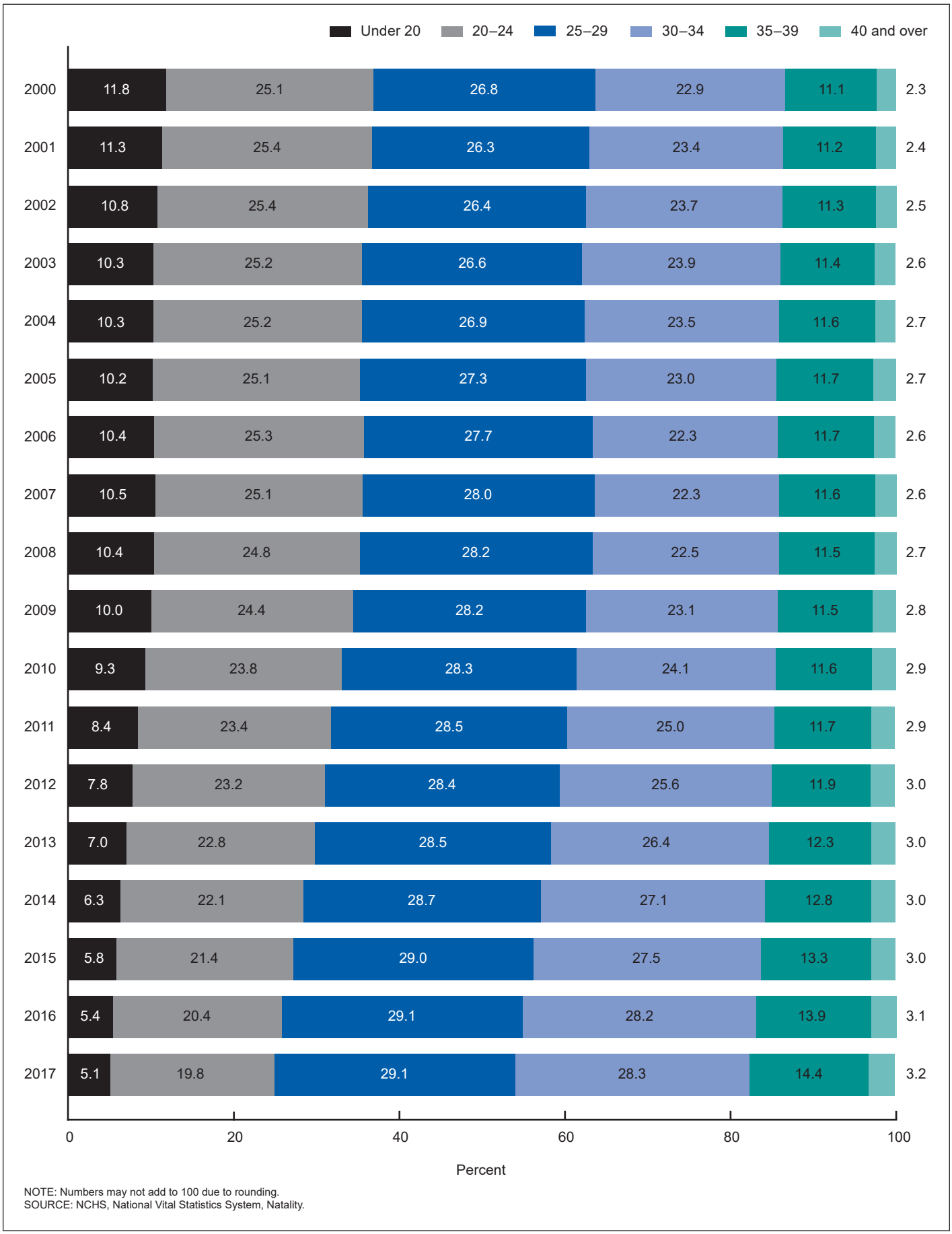
In 2000, 8.7% of non-Hispanic white women giving birth were under age 20, declining by more than one-half (58%) to 3.7% in 2017 (Table 1, Figure 2). The percentage of women aged 20–24 giving birth declined by 22%, from 22.2% in 2000 to 17.4% in 2017. Among women aged 25 and over, the increase was 8% for women aged 25–29 (from 27.6% to 29.8%), 20% for women aged 30–34 (26.1% to 31.3%), 16% for women aged 35–39 (12.8% to 14.9%), and 12% for women aged 40 and over (2.6% to 2.9%).

Non-Hispanic black women

In 2000, 19.8% of non-Hispanic black women giving birth were under age 20, declining by 62% to 7.5% in 2017 (Table 1, Figure 2). The percentage of women aged 20–24 also declined, from 32.6% in 2000 to 26.8% in 2017. Among women aged 25 and over, the percentage increase was 31% for women aged 25–29 (from 22.8% to 29.8%), 43% for women aged 30–34 (15.1% to 21.6%), 44% for women aged 35–39 (7.9% to 11.4%), and 61% for women aged 40 and over (1.8% to 2.9%).

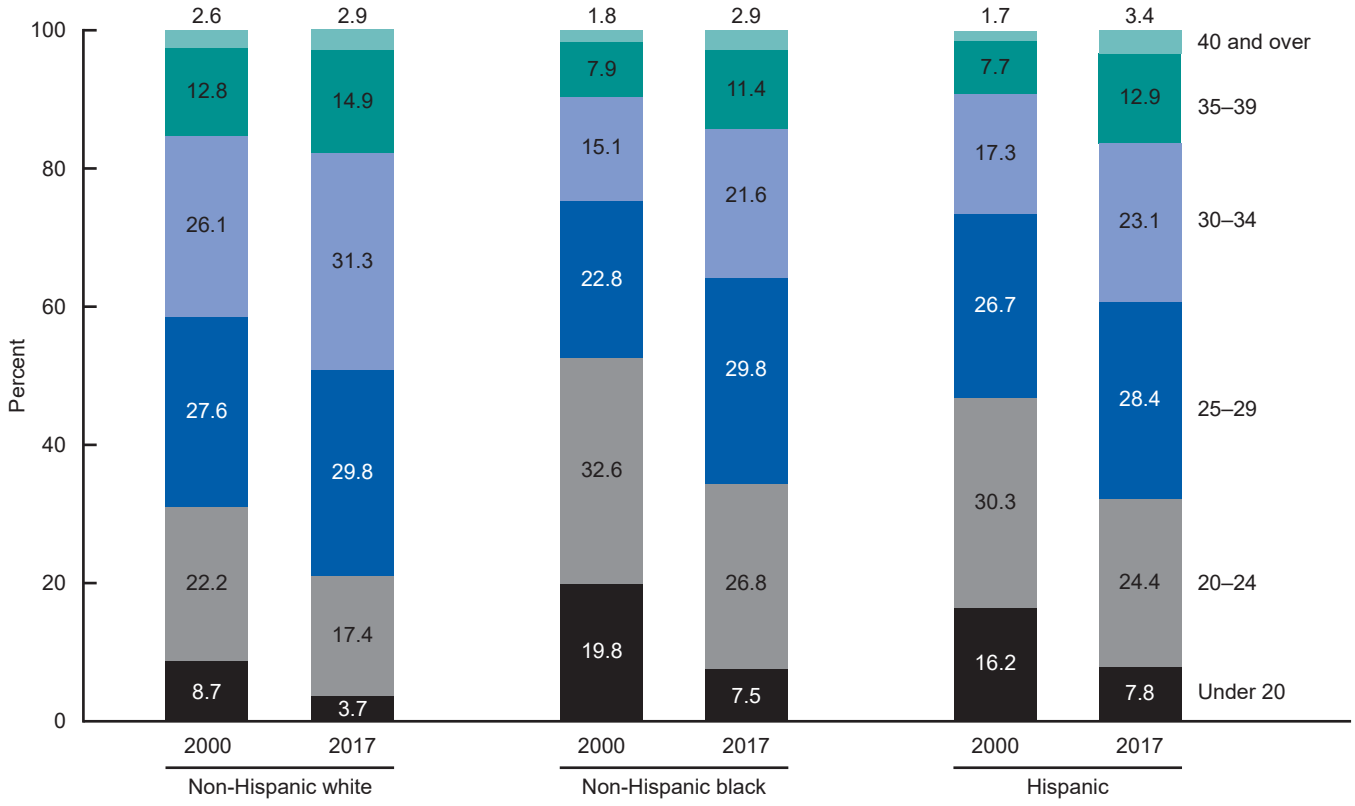
Hispanic women

In 2000, 16.2% of Hispanic women giving birth were under age 20, declining by one-half (52%) to 7.8% in 2017 (Table 1, Figure 2). The percentage of women aged 20–24 also declined, from 30.3% in 2000 to 24.4% in 2017. Among women aged 25 and over, the percentage increase was 6% for women aged 25–29 (from 26.7% to 28.4%), 34% for women aged 30–34 (17.3% to 23.1%), 68% for women aged 35–39 (7.7% to 12.9%), and 100% for women aged 40 and over (1.7% to 3.4%).



NOTE: Numbers may not add to 100 due to rounding.
SOURCE: NCHS, National Vital Statistics System, Natality.

Figure 1. Maternal age distribution: United States, 2000–2017



NOTE: Numbers may not add to 100 due to rounding.
SOURCE: NCHS, National Vital Statistics System, Natality.

Figure 2. Maternal age distribution, by race and Hispanic origin: United States, 2000 and 2017

Trends in maternal age-specific infant mortality rates

All races and Hispanic origins

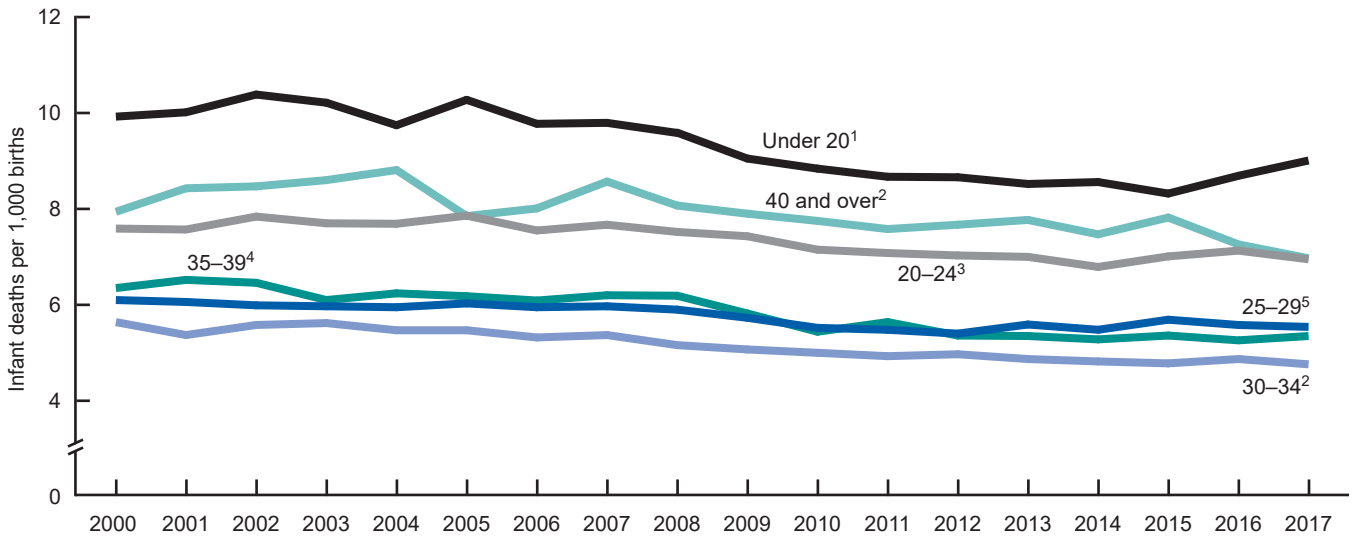
The infant mortality rate declined for all maternal age groups from 2000 through 2017. The mortality rate for infants born to women under age 20 declined 9% from 9.93 deaths per 1,000 births in 2000 to 9.01 in 2017, and 8% for births to women aged 20–24 (7.59 to 6.95) (Table 2). Infant mortality rates did not change from 2000 through 2005 for women under age 25, but they declined from 2005 to 2013 (for women under age 20) or 2014 (for women aged 20–24), and then did not change significantly in subsequent years (the observed increase among women under 20 between 2015 and 2017 was not significant according to either joinpoint or *z* tests) (Figure 3). Infant mortality rates for women aged 25–29 declined from 2000 through 2012, then were stable from 2012 through 2017, resulting in a 9% decline from 2000 through 2017 (6.10 to 5.54). Rates for women aged 30–34 declined 16% (5.64 to 4.76). For women aged 35–39, the infant mortality rate declined from 2000 through 2012, and was stable from 2012 through 2017, resulting in a 16% decline (6.35 to 5.35). The mortality rate for infants born to women aged 40 and over declined 12% during this period (7.94 to 6.97).

Non-Hispanic white women

No significant decline was observed from 2000 through 2017 in the mortality rate for infants born to non-Hispanic white women under age 20. The mortality rates for infants born to women in their 20s declined 9% from 2000 (6.69 for 20–24; 5.02 for 25–29) through 2017 (6.11 for 20–24; 4.59 for 25–29) (Table 2, Figure 4). The percent decline was at least twice as high for women in their 30s: 18% for infants born to women aged 30–34 (from 4.56 to 3.75) and 21% for infants born to women aged 35–39 (5.20 to 4.12). The rate declined 16% for women aged 40 and over (6.32 to 5.30).

Non-Hispanic black women

The mortality rates for infants born to non-Hispanic black women under age 20 and aged 40 and over did not decline significantly from 2000 through 2017 (Table 2, Figure 4). For infants born to women aged 20–39, the rate of decline ranged from 13% for infants born to women aged 20–24 (from 13.15 to 11.39) to 31% for those born to women aged 35–39 (14.56 to 10.08).



[1]Stable trend from 2000 through 2005; significant decreasing trend from 2005 through 2013; stable trend from 2013 through 2017, $p < 0.05$.
[2]Significant decreasing trend from 2000 through 2017, $p < 0.05$.
[3]Stable trend from 2000 through 2005; significant decreasing trend from 2005 through 2014; stable trend from 2014 through 2017, $p < 0.05$.
[4]Significant decreasing trend from 2000 through 2012 with different rates of change; stable trend from 2012 through 2017, $p < 0.05$.
[5]Significant decreasing trend from 2000 through 2012; stable trend from 2012 through 2017, $p < 0.05$.
SOURCE: NCHS, National Vital Statistics System, Linked birth/infant death file.

Figure 3. Maternal age-specific infant mortality rates: United States, 2000–2017

Hispanic women

The mortality rate for infants born to Hispanic women declined significantly only for women aged 30–34 (from 5.01 to 4.47) and aged 40 and over (9.66 to 7.16) from 2000 through 2017 (Table 2, Figure 4).

Infant mortality rate trends and contributions of changes in maternal age distribution and ASMRs

All races and Hispanic origins

The crude infant mortality rate declined 16% from 2000 (6.89 per 1,000 births) through 2017 (5.79), compared with an 11% decline in the maternal age-adjusted rate (6.13 in 2017) and a 5% decline in the ASMR-adjusted rate (6.57 in 2017) (Table 3). The crude infant mortality rate did not change significantly from 2000 through 2007, then declined an average of 2.8% annually from 2007 through 2011. The rate then declined 0.6% annually from 2011 through 2017 (Figure 5).

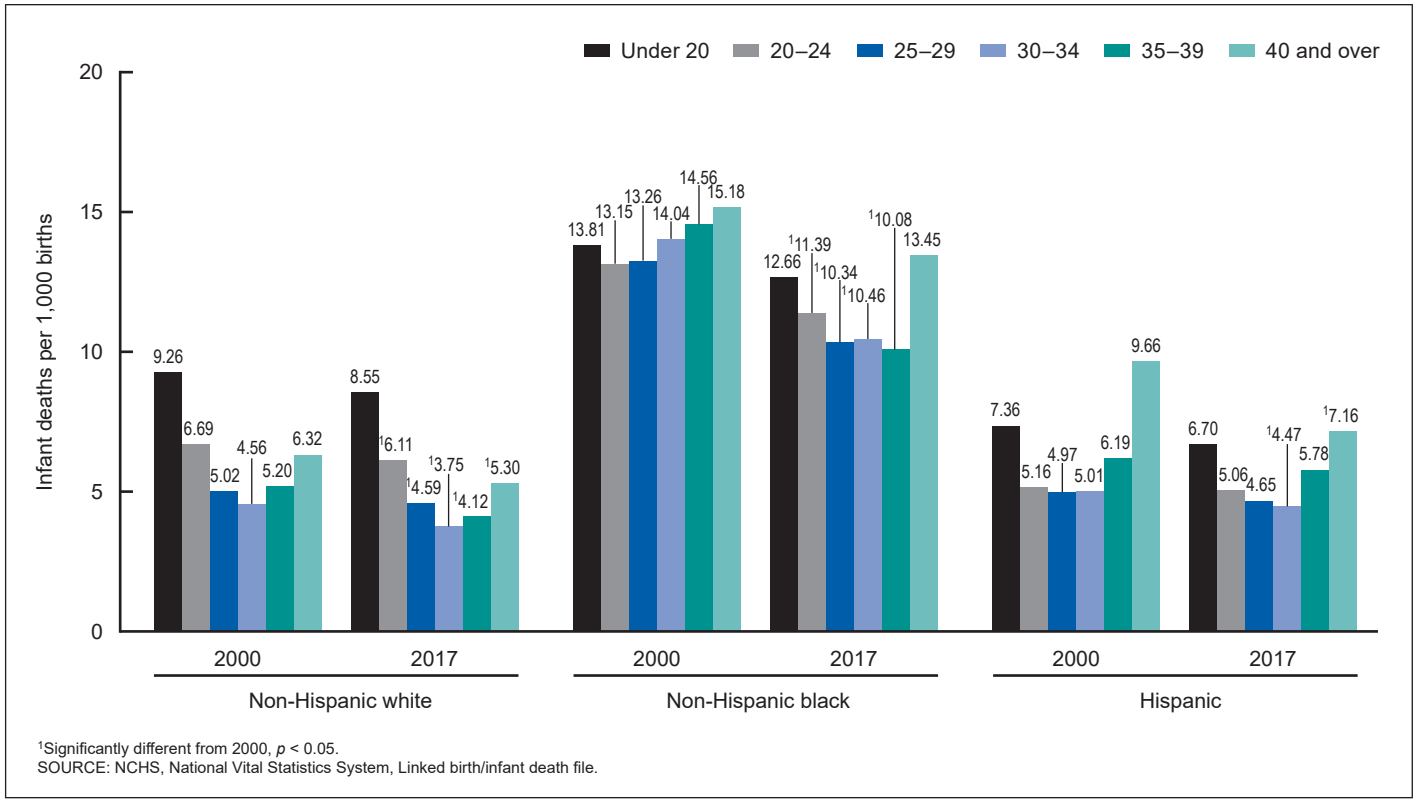
The age-adjusted rate was also stable from 2000 through 2007, declined an average of 2.5% annually from 2007 through 2011, and was then stable from 2011 through 2017. The ASMR-adjusted rate declined by 0.2% annually from 2000 through 2004, and was stable from 2004 through 2008. It then declined 0.5% annually from 2008 through 2015 and 0.3% annually from 2015 through 2017.

For all births, the change in the maternal age distribution from 2000 through 2017 accounted for 31.3% of the difference between the 2000 and 2017 crude infant mortality rates; the change in the ASMRs accounted for 68.7% of the difference (Table 4). Changes in the mortality rates for infants born to women aged 30–34 accounted for 29.7% of the difference due to changes in ASMRs, followed by women aged 25–29 (20.7%) and 20–24 (19.0%).

Non-Hispanic white women

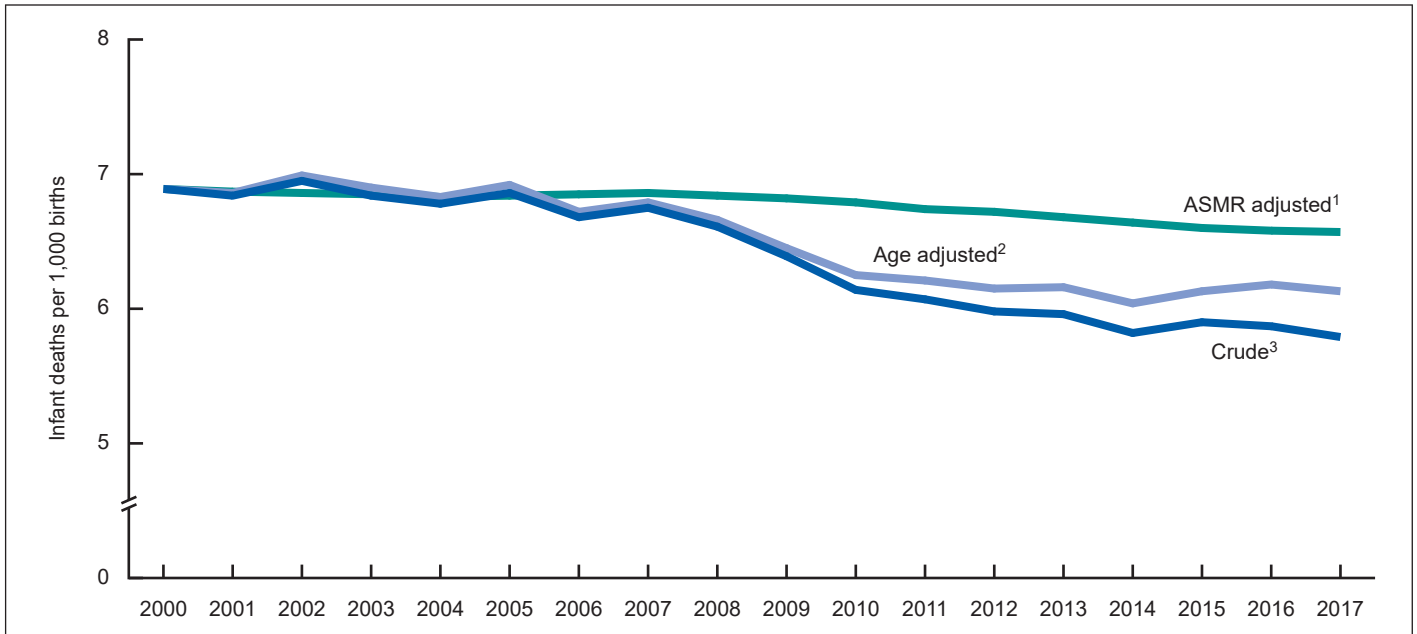
The crude mortality rate for infants born to non-Hispanic white women declined 18% from 2000 (5.70) through 2017 (4.69), compared with a 12% decline in the age-adjusted rate (to 5.01 in 2017) and a 6% decline in the ASMR-adjusted rate (5.38 in 2017) (Table 3). No significant change was observed in the crude infant mortality rate from 2000 through 2005; it then declined an average of 1.6% annually from 2005 through 2017 (Figure 6). The age-adjusted rate was also stable from 2000 through 2005, and then declined 1.7% annually from 2005 through 2011. The ASMR-adjusted rate declined 0.3% annually from 2000 through 2003, was stable from 2003 through 2007, then declined 0.6% annually from 2007 through 2017.

The change in the maternal age distribution from 2000 through 2017 accounted for 31.3% of the difference between the 2000 and 2017 crude infant mortality rates; the change in the ASMRs accounted for 68.7% of the difference (Table 4). Changes in the mortality rates for infants born to women aged 30–34 accounted for 33.6% of the difference due to changes in ASMRs, followed by changes among women aged 35–39 (21.6%).



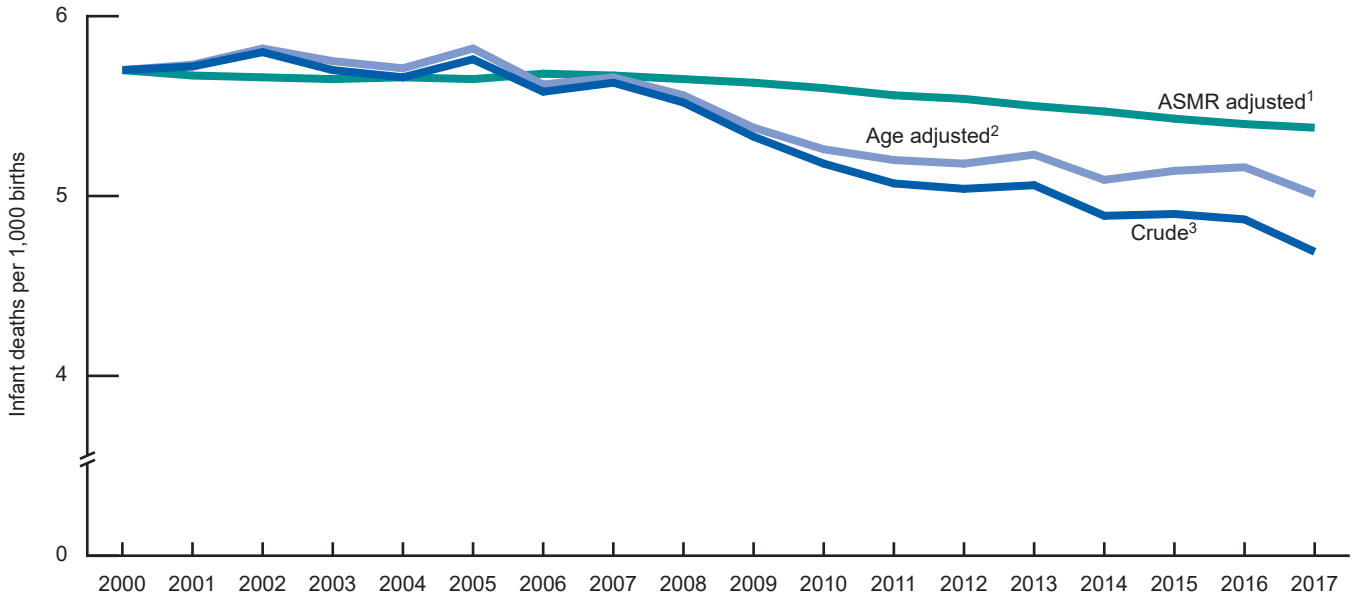
[1]Significantly different from 2000, $p < 0.05$.
SOURCE: NCHS, National Vital Statistics System, Linked birth/infant death file.

Figure 4. Maternal age-specific infant mortality rates, by race and Hispanic origin: United States, 2000 and 2017



[1]Decreasing trend from 2000 through 2004; stable trend from 2004 through 2008; decreasing trend from 2008 through 2017 with different rates of change, $p > 0.05$.
[2]Stable trend from 2000 through 2007; decreasing trend from 2007 through 2011; stable trend from 2011 through 2017, $p < 0.05$.
[3]Stable trend from 2000 through 2007; decreasing trend from 2007 through 2017 with different rates of change, $p < 0.05$.
NOTE: ASMR is age-specific mortality rate.
SOURCE: NCHS, National Vital Statistics System, Linked birth/infant death file.

Figure 5. Crude and adjusted infant mortality rates: United States, 2000–2017



[1]Decreasing trend from 2000 through 2003; stable trend from 2003 through 2007; decreasing trend from 2007 through 2017, $p < 0.05$.
[2]Stable trend from 2000 through 2005; decreasing trend from 2005 through 2011; stable trend from 2011 through 2017, $p < 0.05$.
[3]Stable trend from 2000 through 2005; decreasing trend from 2005 through 2017, $p < 0.05$.
NOTE: ASMR is age-specific mortality rate.
SOURCE: NCHS, National Vital Statistics System, Linked birth/infant death file.

Figure 6. Crude and adjusted mortality rates for infants born to non-Hispanic white women: United States, 2000–2017

Non-Hispanic black women

The crude mortality rate for infants born to non-Hispanic black women declined 20% from 2000 (13.59) to 2017 (10.88), compared with an 18% decline in the age-adjusted rate (11.19 in 2017) and no change in the ASMR-adjusted rate (13.65 in 2017) (Table 3). From 2000 through 2007, there was no significant change in any rate (Figure 7). The crude rate declined an average of 5.1% annually from 2007 through 2010, and 0.7% annually from 2010 through 2017. The age-adjusted rate declined 4.2% annually from 2007 through 2011, and was stable from 2011 through 2017. The ASMR-adjusted rate was stable from 2000 through 2010, then increased 0.1% annually from 2010 through 2017.

The change in the maternal age distribution from 2000 to 2017 accounted for 4.8% of the difference between the 2000 and 2017 crude infant mortality rates; the change in the ASMRs accounted for 95.2% of the difference (Table 4). Changes in the mortality rate for infants born to women aged 25–29 accounted for 29.8% of the difference due to changes in ASMRs, followed by the change among women aged 30–34 (25.5%).

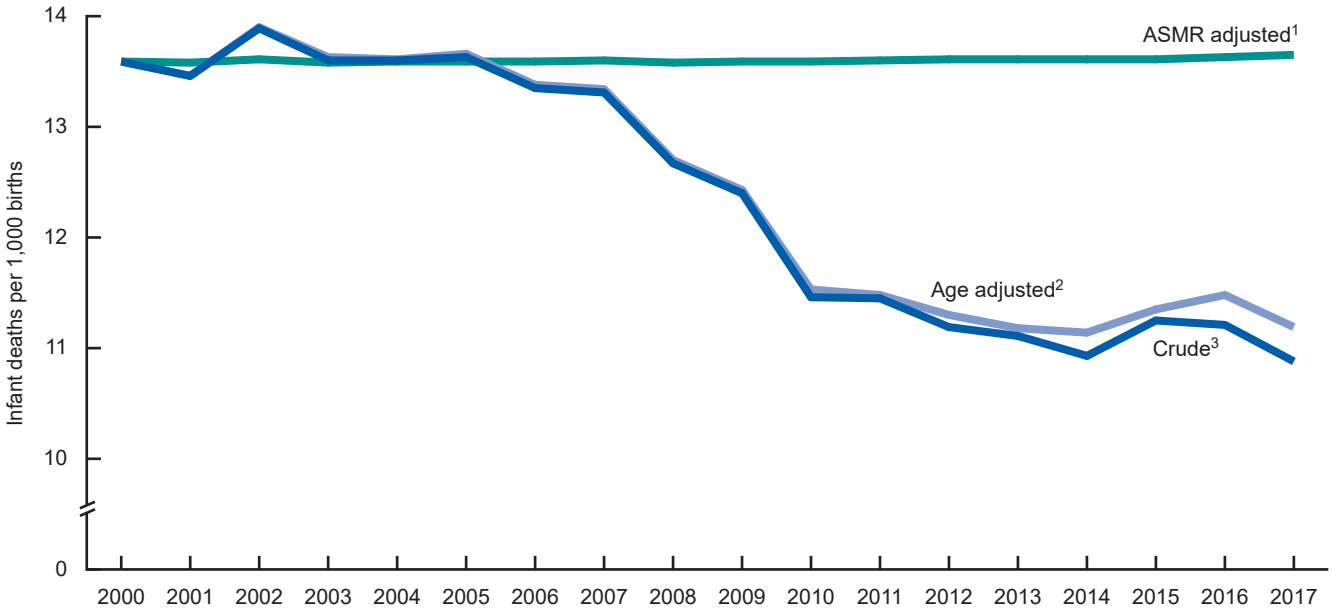
Hispanic women

The crude mortality rate for infants born to Hispanic women declined 9% from 2000 (5.59) through 2017 (5.10), compared with a 7% decline in the age-adjusted rate (5.21 in 2017) and a 1% decline in the ASMR-adjusted rate (5.53 in 2017) (Table 3). The crude rate was stable from 2000 through 2008, then declined an average of 2.0% annually through 2013; it was stable from 2013 through 2017 (Figure 8). The age-adjusted mortality rate declined 0.7% annually from 2000 through 2017. The ASMR-adjusted rate was stable from 2000 through 2009, then declined 0.1% annually from 2009 through 2017.

The change in the maternal age distribution from 2000 through 2017 accounted for –33.7% of the difference between the 2000 and 2017 crude infant mortality rates; the change in the ASMRs accounted for 133.7% of the difference (Table 4). The change in ASMRs substantially offset changes in maternal age distribution; that is, they were large enough to both offset the effect of the changes in the age distribution and lower the crude rate. If no changes occurred in the ASMRs, the changes in the maternal age distribution would have resulted in a higher mortality rate in 2017. Declines in the mortality rates for infants born to women aged 30–34 accounted for 26.7% of the difference due to decreases in ASMRs, followed by decreases among women aged 25–29 (21.6%).

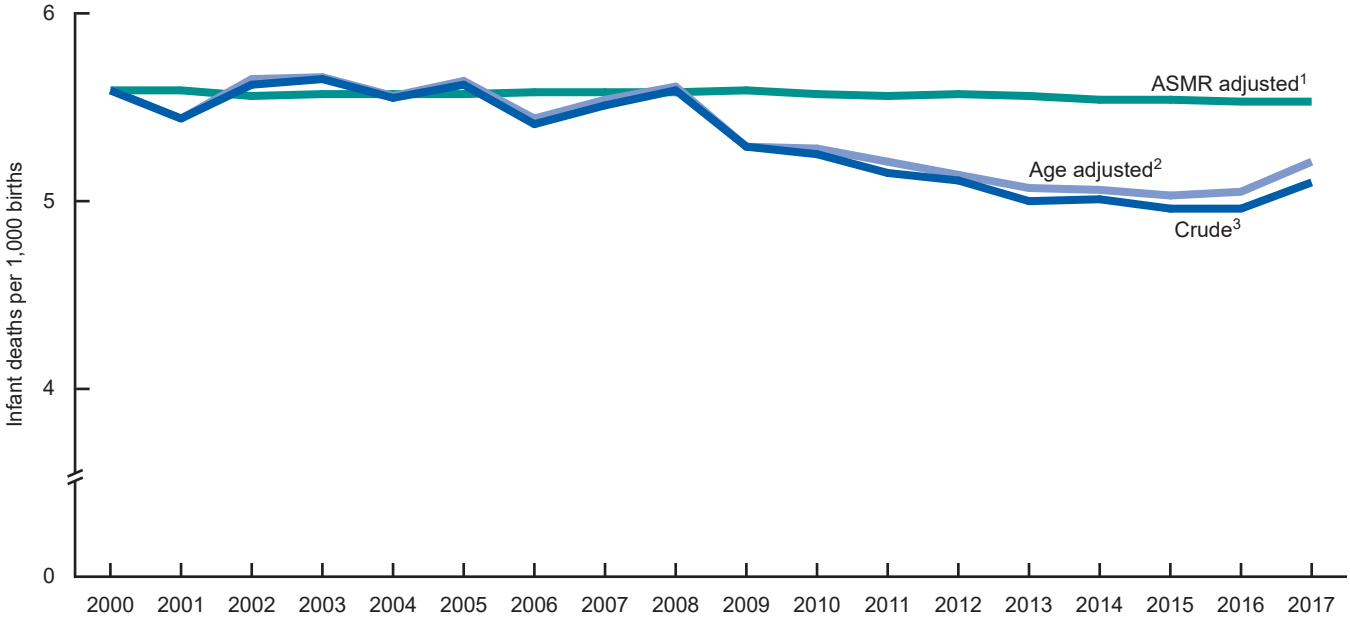
Discussion

The change in ASMRs from 2000 through 2017 had a greater effect on the decline in infant mortality rates than the change in maternal age distribution during that period, although the magnitude of both effects differed by race and Hispanic origin. For all births and for those to non-Hispanic white women, the change in ASMRs accounted for two-thirds of the change in crude rates, nearly all of the decline in mortality rates for infants born to non-Hispanic black women, and all of the decline for infants born to Hispanic women. For infants born to Hispanic women, the change in ASMRs offset the effect of changes in maternal age distribution.



[1]Stable trend from 2000 through 2010; significant decreasing trend from 2010 through 2017, $p < 0.05$.
[2]Stable trend from 2000 through 2007; significant decreasing trend from 2007 through 2011; stable trend from 2011 through 2017, $p < 0.05$.
[3]Stable trend from 2000 through 2007; significant decreasing trend from 2007 through 2017, with different rates of change, $p < 0.05$.
NOTE: ASMR is age-specific mortality rate.
SOURCE: NCHS, National Vital Statistics System, Linked birth/infant death file.

Figure 7. Crude and adjusted mortality rates for infants born to non-Hispanic black women: United States, 2000–2017



[1]Stable trend from 2000 through 2009; significant decreasing trend from 2009 through 2017, $p < 0.05$.
[2]Significant decreasing trend from 2000 through 2017, $p < 0.05$.
[3]Stable trend from 2000 through 2008; significant decreasing trend from 2008 through 2013; stable trend from 2013 through 2017, $p < 0.05$.
NOTE: ASMR is age-specific mortality rate.
SOURCE: NCHS, National Vital Statistics System, Linked birth/infant death file.

Figure 8. Crude and adjusted mortality rates for infants born to Hispanic women: United States, 2000–2017

Infant mortality rates vary by maternal age; consequently, the maternal age distribution in a given year affects the annual infant mortality rate. Accordingly, trends in the maternal age distribution affect trends in the infant mortality rate. For all births and for the three largest race and Hispanic-origin groups, the shift in the maternal age distribution included declines in the percentages of births to women under age 25 and, particularly, of those under age 20.

The percentage of births decreased for women under age 20 and increased for women aged 40 and over from 2000 through 2017 for each race and Hispanic-origin group. The change in the age distribution accounted for almost one-third of the decline in the infant mortality rate for births to non-Hispanic white women, but for little or none of the decline in births to non-Hispanic black and Hispanic women. In part, these differences can be explained by the relative differences in age-specific mortality rates among the race and Hispanic-origin groups. Among non-Hispanic white women, age-specific infant mortality rates were consistently highest for infants born to women under age 20. Contrarily, mortality rates among non-Hispanic black and Hispanic women were generally highest for infants born to women aged 40 and over. Consequently, the decline in births to younger mothers had the greatest impact on infant mortality rates among the non-Hispanic white group.

From 2000 through 2017, infant mortality rates declined for all maternal age groups, although the magnitude of the declines differed across maternal age groups and by race and Hispanic origin. Improved survival among at-risk infants likely contributed to ASMR declines. Preterm birth or low birthweight (LBW) are both leading risk factors and causes of infant death (1,10). Preterm rates declined 1%–2% from 2000 through 2017 for infants of non-Hispanic white and non-Hispanic black women, and increased for infants of Hispanic women; LBW rates increased for infants in all groups (10–12). However, during the same period, the survival rate of preterm and LBW infants improved markedly for infants of non-Hispanic white and black women of all ages and for infants of Hispanic women of some age groups (1,13). Together, these patterns suggest that while little or no progress has been made to lower two key risk factors for poor birth outcomes, progress has been made in lowering the mortality rates of at-risk infants across maternal age and race and Hispanic origin, resulting in lower ASMRs for all age groups (14).

Changes in other factors, such as maternal education and cigarette smoking during pregnancy, may have indirectly resulted in declining ASMRs for all age groups over time. Maternal education is inversely associated with the risk of infant death (15), while smoking during pregnancy is associated with greater risk of adverse birth outcomes, including death (16,17). Over the study period 2000–2017, educational attainment levels rose among women in all age and race and Hispanic-origin groups, and smoking rates declined for all groups. Both trends may have contributed to the declines in ASMRs reported here.

The decomposition analyses found that changes in age-specific infant mortality rates from 2000 through 2017 contributed more to the declines in infant mortality rates than changes in maternal age distributions. Changes in ASMRs accounted for two-thirds of the decline in infant mortality rates for all births and for births to non-Hispanic white women, and for nearly all of the decline in births to non-Hispanic black women. For births to Hispanic women, declines in ASMRs substantially offset the effect of changes in maternal age distribution. Although births to women 40 and over, the age group with the highest infant mortality rate, increased as a percentage of births, the effect of this trend was offset substantially by declines in ASMRs. Despite this large increase, these births accounted for only 3.4% of all births in 2017; this was consistently the smallest maternal age group.

These analyses estimate that the overall 2017 infant mortality rate would have been 6.13 instead of the observed 5.79 (6% higher) if the 2017 maternal age distribution had not changed from 2000. The 2017 rate would have been 14% higher if the 2017 ASMRs had not changed from 2000. If the maternal age distribution had not changed, the 2017 mortality rates for infants born to non-Hispanic white, non-Hispanic black, and Hispanic women would have been 7%, 3%, and 2% higher, respectively. In comparison, if the ASMRs had not changed from 2000 through 2017, the 2017 mortality rates for infants born to non-Hispanic white, non-Hispanic black, and Hispanic women would have been 15%, 26%, and 8% higher, respectively.

These findings show that while the age distributions of women giving birth have changed during 2000–2017, particularly the decline in the percentages of births to teenagers, most of the decline in infant mortality rates is due to declines in rates across maternal age groups. This pattern suggests that these declines are not merely a function of declining birth rates in higher-risk groups, such as teenagers. This is particularly true for the infants of non-Hispanic black and Hispanic women, for whom changes in maternal age distributions had minimum effect on declining mortality rates.

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Table 1. Maternal age distribution, by race and Hispanic origin: United States, 2000–2017

Year	Percent					
	Under 20	20–24	25–29	30–34	35–39	40 and over
	All races and Hispanic origins					
2000	11.8	25.1	26.8	22.9	11.1	2.3
2001	11.3	25.4	26.3	23.4	11.2	2.4
2002	10.8	25.4	26.4	23.7	11.3	2.5
2003	10.3	25.2	26.6	23.9	11.4	2.6
2004	10.3	25.2	26.9	23.5	11.6	2.7
2005	10.2	25.1	27.3	23.0	11.7	2.7
2006	10.4	25.3	27.7	22.3	11.7	2.6
2007	10.5	25.1	28.0	22.3	11.6	2.6
2008	10.4	24.8	28.2	22.5	11.5	2.7
2009	10.0	24.4	28.2	23.1	11.5	2.8
2010	9.3	23.8	28.3	24.1	11.6	2.9
2011	8.4	23.4	28.5	25.0	11.7	2.9
2012	7.8	23.2	28.4	25.6	11.9	3.0
2013	7.0	22.8	28.5	26.4	12.3	3.0
2014	6.3	22.1	28.7	27.1	12.8	3.0
2015	5.8	21.4	29.0	27.5	13.3	3.0
2016	5.4	20.4	29.1	28.2	13.9	3.1
2017	5.1	19.8	29.1	28.3	14.4	3.2
Percent difference: 2000 and 2017	–57	–21	9	24	30	39
	Non-Hispanic white					
2000	8.7	22.2	27.6	26.1	12.8	2.6
2001	8.2	22.5	26.7	26.9	12.9	2.8
2002	7.9	22.6	26.8	27.0	12.9	2.8
2003	7.5	22.5	27.0	27.0	13.1	3.0
2004	7.4	22.5	27.5	26.3	13.2	3.0
2005	7.3	22.6	28.2	25.5	13.4	3.0
2006	7.4	22.9	28.8	24.5	13.4	2.9
2007	7.5	22.8	29.3	24.5	13.1	2.9
2008	7.5	22.6	29.6	24.8	12.7	2.9
2009	7.3	22.2	29.7	25.5	12.3	3.0
2010	6.7	21.5	30.0	26.6	12.2	3.0
2011	6.1	21.1	30.2	27.5	12.1	3.0
2012	5.7	20.8	30.1	28.3	12.3	2.9
2013	5.1	20.3	30.0	29.2	12.6	2.9
2014	4.6	19.6	30.1	29.9	13.1	2.8
2015	4.3	18.7	30.1	30.4	13.7	2.8
2016	3.9	17.9	30.0	31.1	14.3	2.8
2017	3.7	17.4	29.8	31.3	14.9	2.9
Percent difference: 2000 and 2017	–58	–22	8	20	16	12

See footnotes at end of table.

Table 1. Maternal age distribution, by race and Hispanic origin: United States, 2000–2017—Con.

Year	Percent					
	Under 20	20–24	25–29	30–34	35–39	40 and over
			Non-Hispanic black			
2000	19.8	32.6	22.8	15.1	7.9	1.8
2001	18.9	33.0	22.6	15.5	8.1	1.9
2002	18.1	32.9	23.0	15.9	8.1	2.0
2003	17.4	32.8	23.2	16.2	8.3	2.1
2004	17.3	32.6	23.9	16.0	8.1	2.1
2005	17.0	32.3	24.5	15.8	8.1	2.2
2006	17.2	32.2	24.9	15.5	8.1	2.1
2007	17.3	31.9	25.1	15.5	8.1	2.1
2008	17.1	31.8	25.1	15.7	8.1	2.1
2009	16.4	31.8	25.1	16.2	8.2	2.2
2010	15.2	31.9	25.0	17.1	8.4	2.3
2011	13.7	32.0	25.4	17.9	8.6	2.4
2012	12.4	32.1	25.6	18.5	8.8	2.5
2013	10.8	31.8	26.4	19.3	9.2	2.6
2014	9.5	31.0	27.3	19.9	9.8	2.6
2015	8.6	29.8	28.2	20.4	10.3	2.7
2016	8.0	27.9	29.2	21.1	11.0	2.8
2017	7.5	26.8	29.8	21.6	11.4	2.9
Percent difference: 2000 and 2017	–62	–18	31	43	44	61
			Hispanic			
2000	16.2	30.3	26.7	17.3	7.7	1.7
2001	15.6	30.3	26.8	17.6	8.0	1.7
2002	14.9	30.3	26.9	18.0	8.2	1.8
2003	14.3	30.0	27.0	18.5	8.3	1.9
2004	14.3	29.6	26.9	18.8	8.6	1.9
2005	14.1	29.2	27.1	18.9	8.7	2.0
2006	14.3	29.2	27.0	18.7	8.8	2.0
2007	14.2	28.7	27.1	19.0	9.0	2.0
2008	14.1	28.1	27.0	19.2	9.3	2.2
2009	13.8	27.5	27.1	19.6	9.7	2.3
2010	13.1	26.9	27.0	20.2	10.3	2.4
2011	12.1	26.5	27.0	21.0	10.7	2.6
2012	11.5	26.6	26.9	21.3	11.0	2.7
2013	10.5	26.4	27.1	21.8	11.4	2.9
2014	9.5	26.2	27.2	22.3	11.8	3.0
2015	8.8	25.6	27.7	22.7	12.1	3.1
2016	8.2	24.8	28.1	22.9	12.6	3.3
2017	7.8	24.4	28.4	23.1	12.9	3.4
Percent difference: 2000 and 2017	–52	–20	6	34	68	100

NOTES: All percent differences were significant ($p < 0.05$). Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race.

SOURCE: NCHS, National Vital Statistics System, Natality.

Table 2. Maternal age-specific infant mortality rates, by race and Hispanic origin: United States, 2000–2017

Year	Deaths per 1,000 births					
	Under 20	20–24	25–29	30–34	35–39	40 and over
	All races and Hispanic origins					
2000	9.93	7.59	6.10	5.64	6.35	7.94
2001	10.02	7.57	6.06	5.37	6.52	8.43
2002	10.39	7.84	5.99	5.58	6.46	8.47
2003	10.22	7.70	5.97	5.62	6.10	8.60
2004	9.75	7.69	5.95	5.47	6.24	8.81
2005	10.28	7.86	6.03	5.47	6.18	7.85
2006	9.78	7.55	5.95	5.32	6.09	8.01
2007	9.80	7.67	5.97	5.37	6.20	8.57
2008	9.59	7.52	5.90	5.16	6.19	8.07
2009	9.05	7.43	5.73	5.07	5.82	7.90
2010	8.84	7.15	5.52	5.00	5.44	7.75
2011	8.67	7.08	5.48	4.93	5.64	7.58
2012	8.66	7.03	5.40	4.97	5.36	7.67
2013	8.52	7.00	5.59	4.87	5.35	7.77
2014	8.56	6.79	5.48	4.82	5.28	7.47
2015	8.32	7.01	5.69	4.78	5.36	7.82
2016	8.69	7.13	5.58	4.87	5.26	7.26
2017	9.01	6.95	5.54	4.76	5.35	6.97
Percent difference[1]: 2000 and 2017	–9	–8	–9	–16	–16	–12
	Non-Hispanic white					
2000	9.26	6.69	5.02	4.56	5.20	6.32
2001	9.58	6.69	5.05	4.40	5.46	6.78
2002	9.75	6.91	5.05	4.60	5.26	6.78
2003	10.02	6.87	4.93	4.56	4.82	7.12
2004	9.56	6.94	4.88	4.37	5.15	7.12
2005	9.98	7.07	5.06	4.43	5.06	6.63
2006	9.48	6.77	5.02	4.28	4.81	6.35
2007	9.51	6.80	5.02	4.35	4.91	6.44
2008	9.03	6.66	4.88	4.27	5.06	6.68
2009	8.94	6.64	4.71	4.09	4.66	6.31
2010	8.49	6.40	4.68	4.12	4.44	6.28
2011	8.23	6.22	4.67	4.00	4.67	6.12
2012	8.26	6.20	4.64	4.14	4.44	6.00
2013	8.48	6.14	4.74	4.11	4.43	7.01
2014	8.24	5.90	4.71	4.09	4.17	6.23
2015	8.12	6.13	4.79	3.89	4.43	6.23
2016	8.40	6.29	4.70	4.01	4.19	5.83
2017	8.55	6.11	4.59	3.75	4.12	5.30
Percent difference: 2000 and 2017	–8	[1]–9	[1]–9	[1]–18	[1]–21	[1]–16

See footnotes at end of table.

Table 2. Maternal age-specific infant mortality rates, by race and Hispanic origin: United States, 2000–2017—Con.

Year	Deaths per 1,000 births					
	Under 20	20–24	25–29	30–34	35–39	40 and over
			Non-Hispanic black			
2000	13.81	13.15	13.26	14.04	14.56	15.18
2001	14.34	12.97	13.17	13.36	14.02	14.94
2002	15.18	14.02	12.54	13.40	14.60	16.30
2003	14.72	13.08	13.06	13.64	14.10	16.45
2004	14.19	13.15	13.31	13.66	14.08	16.49
2005	14.86	13.62	12.97	12.71	14.30	15.84
2006	14.30	13.18	12.36	13.47	14.28	15.53
2007	13.80	13.39	12.42	12.95	14.51	17.08
2008	13.79	12.70	11.87	11.62	14.04	15.25
2009	12.60	12.53	12.02	11.83	13.34	14.26
2010	12.87	11.30	11.00	10.71	11.66	13.91
2011	12.11	11.31	10.89	11.39	11.86	14.76
2012	12.49	11.56	10.34	10.40	11.06	15.00
2013	11.69	11.23	10.88	10.71	11.34	11.83
2014	12.62	11.14	10.47	10.14	11.21	12.00
2015	11.69	11.68	11.04	10.36	11.25	13.77
2016	12.47	12.06	10.56	10.32	11.00	13.51
2017	12.66	11.39	10.34	10.46	10.08	13.45
Percent difference: 2000 and 2017	–8	[1]–13	[1]–22	[1]–26	[1]–31	–11
			Hispanic			
2000	7.36	5.16	4.97	5.01	6.19	9.66
2001	6.95	5.10	4.86	4.69	6.39	9.83
2002	7.34	5.27	5.08	5.04	6.16	8.86
2003	6.77	5.46	4.97	5.42	6.28	9.10
2004	6.67	5.34	4.82	5.28	6.26	10.02
2005	7.20	5.48	4.88	5.29	6.02	7.74
2006	6.85	5.30	4.78	4.85	5.82	8.78
2007	6.91	5.36	4.89	4.82	6.24	9.39
2008	7.01	5.49	5.11	4.81	6.07	8.61
2009	6.43	5.16	4.82	4.69	5.62	9.06
2010	6.22	5.42	4.67	4.83	5.19	8.40
2011	6.54	5.24	4.60	4.56	5.29	7.82
2012	6.26	5.03	4.50	4.82	5.26	8.86
2013	6.26	5.16	4.54	4.40	5.04	7.78
2014	6.17	5.03	4.47	4.57	5.37	7.97
2015	6.12	4.83	4.70	4.54	4.94	8.24
2016	6.29	4.87	4.64	4.55	5.19	7.09
2017	6.70	5.06	4.65	4.47	5.78	7.16
Percent difference: 2000 and 2017	–9	–2	–6	[1]–11	–7	[1]–26

[1]Significant change from 2000 to 2017 ($p < 0.05$).

NOTES: Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race.

SOURCE: NCHS, National Vital Statistics System, Linked birth/infant death file.

Table 3. Crude and adjusted infant mortality rates, by race and Hispanic origin: United States, 2000–2017

Year	All races and Hispanic origins			Non-Hispanic white			Non-Hispanic black			Hispanic		
	Crude	Age adjusted[1]	ASMR adjusted[2]	Crude	Age adjusted[1]	ASMR adjusted[2]	Crude	Age adjusted[1]	ASMR adjusted[2]	Crude	Age adjusted[1]	ASMR adjusted[2]
	Deaths per 1,000 births											
2000	6.89	6.89	6.89	5.70	5.70	5.70	13.59	13.59	13.59	5.59	5.59	5.59
2001	6.84	6.86	6.87	5.72	5.73	5.67	13.46	13.46	13.58	5.44	5.44	5.59
2002	6.95	6.99	6.86	5.80	5.82	5.66	13.89	13.90	13.61	5.62	5.65	5.56
2003	6.84	6.90	6.85	5.70	5.75	5.65	13.60	13.63	13.58	5.65	5.66	5.57
2004	6.78	6.83	6.83	5.66	5.71	5.66	13.60	13.61	13.59	5.55	5.56	5.57
2005	6.86	6.92	6.84	5.76	5.82	5.65	13.63	13.66	13.59	5.62	5.64	5.57
2006	6.68	6.72	6.85	5.58	5.62	5.68	13.35	13.38	13.59	5.41	5.44	5.58
2007	6.75	6.79	6.86	5.63	5.66	5.67	13.31	13.34	13.60	5.51	5.54	5.58
2008	6.61	6.66	6.84	5.52	5.56	5.65	12.67	12.70	13.58	5.59	5.61	5.58
2009	6.39	6.45	6.82	5.33	5.38	5.63	12.40	12.43	13.59	5.29	5.29	5.59
2010	6.14	6.25	6.79	5.18	5.26	5.60	11.46	11.53	13.59	5.25	5.28	5.57
2011	6.07	6.21	6.74	5.07	5.20	5.56	11.45	11.48	13.60	5.15	5.21	5.56
2012	5.98	6.15	6.72	5.04	5.18	5.54	11.19	11.30	13.61	5.11	5.14	5.57
2013	5.96	6.16	6.68	5.06	5.23	5.50	11.11	11.18	13.61	5.00	5.07	5.56
2014	5.82	6.04	6.64	4.89	5.09	5.47	10.93	11.14	13.61	5.01	5.06	5.54
2015	5.90	6.13	6.60	4.90	5.14	5.43	11.25	11.35	13.61	4.96	5.03	5.54
2016	5.87	6.18	6.58	4.87	5.16	5.40	11.21	11.48	13.63	4.96	5.05	5.53
2017	5.79	6.13	6.57	4.69	5.01	5.38	10.88	11.19	13.65	5.10	5.21	5.53
Absolute difference: 2000 and 2017[3]	–1.10	–0.76	–0.32	–1.01	–0.69	–0.32	–2.71	–2.40	0.06	–0.49	–0.38	–0.06
Percent difference: 2000 and 2017[3]	–16	–11	–5	–18	–12	–6	–20	–18	0	–9	–7	–1

[1]Age-adjusted rates are based on the 2000 maternal age distribution.
[2]ASMR-adjusted rates are based on the 2000 age-specific infant mortality rates.
[3]All differences from 2000 to 2017 were significant ($p < 0.05$).

NOTES: ASMR is age-specific mortality rate. Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race.

SOURCE: NCHS, National Vital Statistics System, Linked birth/infant death file.

Table 4. Decomposition of changes in infant mortality rates, by maternal age distribution and age-specific mortality rates: United States, 2000 and 2017

Decomposition of change	All races and Hispanic origins	Non-Hispanic white	Non-Hispanic black	Hispanic
Percent difference due to change in:				
Age distribution	31.3	31.3	4.8	–33.7
Age-specific mortality rate (ASMR)	68.7	68.7	95.2	133.7
Maternal age:		Distribution of ASMR contribution (percent)		
Under 20	10.3	6.4	6.1	19.4
20–24	19.0	16.6	20.3	6.3
25–29	20.7	17.8	29.8	21.6
30–34	29.7	33.6	25.5	26.7
35–39	16.8	21.6	16.8	10.4
40 and over	3.5	4.1	1.6	15.6
Total	100.0	100.1	100.1	100.0

NOTES: Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race.

SOURCE: NCHS, National Vital Statistics System, Linked birth/infant death file.

Technical Notes

Data sources

The linked birth/infant death data for each year from 2000 through 2017 include two data files. The first file includes all U.S. infant deaths that occurred in the given data year linked to their corresponding birth certificates, whether the birth occurred in that year or the prior year—referred to as the numerator file. The second file is the National Center for Health Statistics (NCHS) natality file for the United States for the given year, which is used to provide denominators for rate computations (6). The data are provided to NCHS through the Vital Statistics Cooperative Program.

Weighting

The number of infant deaths in the linked file for the 50 states and Washington, D.C., was weighted to equal the sum of the linked plus unlinked infant deaths by state of occurrence of birth and age of death (less than 7 days, 7–27 days, and 28 days to under 1 year). The addition of the weight reduced the potential for bias when comparing infant mortality rates by characteristics.

Hispanic origin and race

Hispanic origin and race are reported separately on the birth certificate. This report presents data on race and Hispanic origin based on the 1977 Office of Management and Budget standards, which required tabulations using at least four single-race categories: American Indian or Alaska Native, Asian or Pacific Islander, black, and white (6). Multiple-race categories were bridged to single-race categories.

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National Vital Statistics Reports, Vol. 69, No. 5, June 25, 2020

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Suggested citation

Driscoll AK, Ely DM. Effects of changes in maternal age distribution and maternal age-specific infant mortality rates on infant mortality trends: United States, 2000–2017. National Vital Statistics Reports; vol 69 no 5. Hyattsville, MD: National Center for Health Statistics. 2020.

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National Center for Health Statistics

Jennifer H. Madans, Ph.D., *Acting Director*
Amy M. Branum, Ph.D., *Acting Associate Director for Science*

Division of Vital Statistics

Steven Schwartz, Ph.D., *Director*
Isabelle Horon, Dr.P.H., *Acting Associate Director for Science*

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DHHS Publication No. 2020–1120 • CS316831