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Disparities in Mortality Trends for Infants of Teenagers: 1996 to 2019

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Abstract

BACKGROUND AND OBJECTIVES: Although mortality rates are highest for infants of teens aged 15 to 19, no studies have examined the long-term trends by race and ethnicity, urbanicity, or maternal age. The objectives of this study were to examine trends and differences in mortality for infants of teens by race and ethnicity and urbanicity from 1996 to 2019 and estimate the contribution of changes in the maternal age distribution and maternal age-specific (infant) mortality rates (ASMRs) to differences in infant deaths in 1996 and 2019.

METHODS: We used 1996 to 2019 period-linked birth and infant death data from the United States to assess biennial mortality rates per 1000 live births. Pairwise comparisons of rates were conducted using z test statistics and Joinpoint Regression was used to examine trends. Kitagawa decomposition analysis was used to estimate the proportion of change in infant deaths because of changes in the maternal age distribution and ASMRs.

RESULTS: From 1996 to 2019, the mortality rate for infants of teens declined 16.7%, from 10.30 deaths per 1000 live births to 8.58. The decline was significant across racial and ethnic and urbanization subgroups; however, within rural counties, mortality rates did not change significantly for infants of Black or Hispanic teens. Changes in ASMRs accounted for 93.3% of the difference between 1996 and 2019 infant mortality rates, whereas changes in the maternal age distribution accounted for 6.7%.

CONCLUSIONS: Additional research into the contextual factors in rural counties that are driving the lack of progress for infants of Black and Hispanic teens may help inform efforts to advance health equity.

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Despite the decline in the overall United States infant mortality rate from 7.57 infant deaths per 1000 live births in 1995 to 5.58 in 2019, disparities persist.[1,2] Mortality rates for infants of Black mothers are 2 to 3 times the rates for infants of white or Hispanic mothers.[1,2] Moreover, infants of mothers living in rural counties have higher mortality rates than those living in urban counties.[3,4]

Infants of teens—whose birth rates have declined 73.0% since 1991[5]—have higher rates of preterm birth, low birth weight, and mortality compared with infants of mothers aged 20 and over.[1,6–9] In 2019, the mortality rate for infants of mothers under age 20 (8.68) was nearly double the rate for infants of mothers aged 30 to 34 (4.57), the group with the lowest rate.[1] Furthermore, the risk of adverse birth outcomes for infants of teens differs by maternal age and race and ethnicity. Mortality rates are highest for infants of younger teens[6,7] and infants of Black teens are more likely to die during their first year of life than infants of white or Hispanic teens.[6–8] To our knowledge, no studies have examined long-term racial and ethnic trends or urban-rural differences in mortality for infants of teens.

In this study, we examined trends in mortality for infants of teens by race and ethnicity and urbanization level from 1996–1997 through 2018–2019 in the United States. In addition, we examined how changes in the distribution of maternal age at birth influenced mortality trends by race and ethnicity and urbanization level for infants of teens.

METHODS

We used 1996 to 2019 period-linked birth and infant death data from the United States, which includes all infant deaths under 1 year of age reported on death certificates that can be linked to their corresponding birth certificates (99.3% in 2019),[1] to examine mortality rates for infants of teens aged 15 to 19, 15 to 17, and 18 to 19. This is the primary data set for analyzing infant mortality trends and characteristics related to birth in the United States and is the preferred source for examining patterns by race and ethnicity.[10,11] Two-year groupings were used to ensure sufficient population counts for analysis (Infants of children under age 15 were excluded from analysis because of the small number of deaths).

Race and ethnicity were based on the self-reported identity of the mother on the birth certificate. Because of the smaller population counts and declining birth rates among teens, analysis was limited to the 3 largest race and ethnicity groups: non-Hispanic white, non-Hispanic Black or African American, and Hispanic or Latina; hereafter termed white, Black, and Hispanic, respectively. To enable comparisons across years, bridged-race categories were used for each year.[12] Records missing information on maternal race and ethnicity (n = 196 live births or <1.0%) were excluded.

Urbanization level was based on the federal information processing code of the mother's resident county at the time of the infant's birth. Counties were categorized using the 2013 National Center for Health Statistics' Urban-Rural Classification Scheme for Counties.[13] Based on metropolitan status, population size, and other factors, counties were classified into 6 urbanization levels, and further grouped into 3 urban categories (large central metro, large fringe metro, and medium and small metro) and a single rural category (micropolitan

and noncore). Records missing information on resident county (n = 24 145 live births or <1.0%) were excluded from the urbanicity analysis.

Mortality rates per 1000 live births were calculated by maternal age, race and ethnicity, and urbanization level. Pairwise comparisons of rates were conducted using the z test statistics with adjusted significance levels after Bonferroni correction for multiple comparisons, ranging from 2 to 6 comparison groups.[14] To examine trends, the annual percentage change was calculated with the Joinpoint Regression Program (National Cancer Institute) using logistic regression.[15,16] The grid search algorithm and permutation test searched for a maximum of 2 joinpoints with $P < .05$ considered significant.

Decomposition analysis was used to ascertain the contribution of maternal age at birth to changes in the 1996–1997 and 2018–2019 infant mortality rates because of changes in 2 components: (1) the maternal age distribution and (2) maternal age-specific (infant) mortality rates (ASMRs). First, maternal age distributions and distributions by race and ethnicity and urbanization level were calculated annually from 1996–1997 through 2018–2019. Two maternal age categories were used: 15 to 17 and 18 to 19. Next, ASMRs were calculated for each maternal age group for 1996–1997 and 2018–2019.

Kitagawa decomposition analysis[17,18] was then used to estimate the contribution of maternal age distributions and ASMRs on the decline in the overall infant mortality rate during the study period. The 1996–1997 maternal age distributions were held constant over time and the 1996–1997 ASMRs were used to calculate annual age-standardized infant mortality rates.

The formula developed by Kitagawa was 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 1996–1997 and 2018–2019; R_1 and R_2 refer to ASMRs in 1996–1997 and 2018–2019; and F_1 and F_2 refer to maternal age distributions in 1996–1997 and 2018–2019. The sum of the 2 components over all maternal age categories (i) produces the total mortality rate difference because of changes in the maternal age distribution and age-specific mortality, respectively. Together, they add to the overall differences in rates over time.

RESULTS

In 1996–1997, there were 974 797 births to teens aged 15 to 19. From 1996–1997 through 2018–2019, the number of teen births declined by 63.9% to 351 545. Throughout the period, births to teens aged 18 to 19 made up an increasing share of teen births (62.5% in 1996–1997 to 75.7% in 2018–2019).

The overall mortality rate for infants of teens declined by 16.7% from 1996–1997 through 2018–2019 (Fig 1). The rate did not change significantly from 1996–1997 though 2002–2003 and then declined from 10.20 in 2002–2003 to 8.58 in 2018–2019 ($P < .005$). From

1996–1997 through 2008–2009, mortality rates were higher for infants of teens aged 15 to 17 than those aged 18 to 19 (Supplemental Fig 4). From 2010–2011 onwards, mortality rates for infants of teens aged 15 to 17 and 18 to 19 were generally not significantly different.

Race and Ethnicity

From 1996–1997 through 2018–2019 (Fig 1), infants of Black teens aged 15 to 19 consistently had the highest mortality rates, whereas infants of Hispanic teens had the lowest. For infants of Black and white teens, the mortality rate did not significantly change from 1996–1997 through 2002–2003 and 2004–2005, respectively, and then declined from 14.80 in 2002–2003 to 11.96 in 2018–2019 for infants of Black teens ($P < .005$) and from 9.70 in 2004–2005 to 8.36 in 2018–2019 for infants of white teens ($P < .01$). For infants of Hispanic teens, the mortality rate declined steadily from 7.27 in 1996–1997 to 6.44 in 2018–2019 ($P < .001$). In 2018–2019, infants of Black teens were 1.9 times as likely to die as infants of Hispanic teens ($P < .01$) and 1.4 times as likely to die as infants of white teens ($P < .01$), and infants of white teens were 1.3 times as likely to die as infants of Hispanic teens ($P < .01$).

For infants of teens aged 15 to 17 (Table 1), the mortality rates declined for each race and ethnicity group from 1996–1997 through 2018–2019. For teens aged 18 to 19, the mortality rates declined from 1996–1997 through 2018–2019 for infants of white ($P < .01$) and Hispanic ($P < .05$) teens. For infants of Black teens aged 18 to 19, the mortality rate did not change significantly from 1996–1997 through 2004–2005 and then declined from 14.40 in 2004–2005 to 12.13 in 2018–2019 ($P < .005$), resulting in an overall decline of 14.6%. During the period, mortality rates were generally higher for infants of white and Hispanic teens aged 15 to 17 than those aged 18 to 19. For infants of Black teens, mortality rates were generally similar for both age groups.

Urbanization Level

The mortality rate for infants of teens aged 15 to 19 declined for each urbanization level from 1996–1997 through 2018–2019 (Fig 2). Although infants of teens living in large fringe counties had a lower mortality rate than those living in large central, medium and small, and rural counties in both 1996–1997 and 2018–2019, the differences were not significant.

For infants of teens aged 15 to 17 (Table 2), the mortality rate declined from 1996–1997 through 2018–2019 for those living in large central ($P < .001$), large fringe ($P < .001$), and rural ($P < .05$) counties. For infants of teens aged 15 to 17 living in medium and small counties, the mortality rate did not significantly change from 1996–1997 through 2002–2003 and then declined from 11.75 in 2002–2003 to 9.47 in 2018–2019 ($P < .05$). For infants of teens aged 18 to 19, the mortality rate declined significantly for all 4 urbanization levels from 1996–1997 through 2018–2019.

Urbanization Level and Race and Ethnicity

From 1996–1997 through 2018–2019 (Fig 3 and Supplemental Table 4), mortality rates for infants of teens aged 15 to 19 declined for all 3 race and ethnicity groups within each urbanization level, except for those living in rural counties. In rural counties, the mortality

rate declined for infants of white teens aged 15 to 19 ($P < .001$) but did not change significantly for infants of Black or Hispanic teens.

In large central, large fringe, and medium and small counties, mortality rates were generally higher for infants of Black teens than infants of white and Hispanic teens throughout the period. In rural counties, mortality rates were higher for infants of Black and white teens than infants of Hispanic teens, except in 2004–2005 ($P < .01$) and 2018–2019 ($P < .01$) when infants of Black teens in rural counties had higher mortality rates than infants of white and Hispanic teens.

Decomposition Analysis

The crude 2018–2019 overall infant mortality rate (8.58) was similar to the rate when the 1996–1997 maternal age distribution was held constant (8.67), which indicates that most of the decline in the overall infant mortality rate was not because of changes in the maternal age distribution (Table 3). If the 1996–1997 ASMRs had remained the same, the 2018–2019 infant mortality rate would have been higher at 10.16. These patterns were also observed for each race and ethnicity group with changes in ASMRs accounting for 83.3% to 88.9% of the difference between 1996–1997 and 2018–2019 infant mortality rates, whereas changes in the maternal age distribution accounted for 11.1% to 16.7%.

Similarly, when the 1996–1997 maternal age distribution was held constant, the crude 2018–2019 infant mortality rates for each urbanization level were similar to the adjusted rates. If the 1996–1997 ASMRs had remained the same, the 2018–2019 infant mortality rates would have been higher. The changes in the ASMRs accounted for 91.7% to 96.0% of the difference between 1996–1997 and 2018–2019 infant mortality rates in each urbanization level, whereas changes in the maternal age distribution in urban-rural counties accounted for 4.0% to 8.3%.

DISCUSSION

From 1996–1997 through 2018–2019, the mortality rate for infants of teens declined by 16.7%. The mortality rates declined for all 3 race and ethnicity groups and for each urbanization level. Moreover, the number of teen births in the United States declined by 63.9%, from 974 797 in 1996–1997 (12.5% of all births) to 351 545 in 2018–2019 (4.7% of all births), with births to teens aged 18 to 19 increasingly making up most teen births during the period.

Maternal age is a risk factor for infant mortality. Lower maternal age (17 and younger) has been associated with increased risk of infant death.[6,7] During the study period, births to teens aged 15 to 17 decreased from 37.5% to 24.3% of all teen births, but we found that changes in the maternal age distribution had only a small impact on the decline in infant mortality rates, whereas changes in the ASMRs accounted for most of the difference. This indicates that the decline in infant mortality rates was largely because of factors that caused the rates to decline across all the teen maternal age groups, rather than a shift in the age of teens who gave birth.

The declines in teen births may reflect contextual factors associated with teen sexual behavior and childbearing over time. The teen birth rate has declined 73.0% since 1991 and has continued to fall to a new record low each year since 2009.[5] This downward trend has largely been attributed to later age at first sex,[19,20] increased sex education,[21] and increased contraceptive use among teens.[19,22–24] As a result, the population of teens who gave birth in 2018–2019 may reflect a different—and potentially higher-risk profile—population of teens than those who gave birth in 1996–1997.[23,25]

Moreover, racial and ethnic disparities persisted over time. Throughout the study period, Black and Hispanic teens had higher birth rates than white teens, and mortality rates were highest for infants of Black teens and lowest for infants of Hispanic teens. This disparity in infant mortality rates is likely driven by preterm birth.[26] Infants of Black mothers—regardless of maternal age—are more likely to be born preterm.[5] Preterm-related causes have been found to account for 54.0% of the racial and ethnic disparity in infant mortality.[26] Furthermore, disorders related to short gestation and low birth weight are the leading cause of death for infants of Black teens, with rates that are 2 to 3 times as high as those for infants of white or Hispanic teens.[8]

Preterm birth and preterm-related mortality among infants of Black mothers, regardless of maternal age, have also been linked to racial discrimination.[27] Previous research has demonstrated the impact of discrimination in Black pregnant women, including higher levels of prenatal stress and the receipt of substandard prenatal care.[28] Results shown here suggest that the racial and ethnic disparity in infant mortality endured over the 24-year study period, despite declining teen birth and infant mortality rates, which further suggests that the contextual factors driving the disparity have not improved.

Throughout the study period, mortality rates were consistently highest for infants of Black teens in urban counties. Racial residential segregation in urban counties has been associated with adverse birth outcomes. For example, high levels of segregation in urban counties have been associated with higher odds of preterm birth for Black women.[29] Consequently, Black teens in urban counties may be predisposed to preterm birth, and in turn, an elevated risk of infant mortality because of stressors resulting from socioeconomic factors and segregation that limit mobility in these areas.[30–32]

Racial and ethnic disparities were also seen in rural counties. Although infant mortality rates were higher for infants of white and Black teens in rural counties, the improvements in infant mortality seen for infants of white teens were not seen for infants of Black or Hispanic teens. Inequitable access to health care in rural counties may be driving the racial and ethnic disparities in the lack of improvement over time. In rural counties, 75.0% of women give birth at a local hospital,[33] but less than half of rural counties have hospital-based obstetric services because of hospital closures.[34] These closures have been associated with women seeking prenatal care at later stages of pregnancy—which teens are more likely to do compared with older mothers[5]—and increased risk of preterm birth, delivery in hospitals lacking obstetric services, and higher infant mortality rates.[35,36] However, the findings from this study suggest that the impact of these closures and other access issues contributing to adverse birth outcomes in rural counties may not affect all race and ethnicity groups equally.

The lower mortality rates throughout the period for infants of Hispanic teens, despite their higher birth rates compared with white teens, may be partially explained by the "Hispanic paradox," a phenomenon in which the Hispanic population of the United States has health outcomes that are similar to—or often better than—the white population despite being more likely to be socioeconomically disadvantaged.[37–40] Infants of Hispanic mothers have similar or lower rates of infant mortality and low birth weight compared with their white counterparts.[1] Furthermore, living in communities with a high proportion of Hispanic residents is associated with lower infant mortality, higher birth weight, and lower smoking rates during pregnancy for Hispanic mothers, regardless of their socioeconomic status or health-related behaviors.[41,42] Additional research may help clarify the social and neighborhood-level factors that may contribute to better health outcomes for infants of Hispanic teens.

This study had 2 main limitations. First, although racial and ethnic differences in infant mortality were a primary focus of analysis, the smaller population counts and declining teen birth rates made it difficult to examine mortality rates for all race and ethnicity groups or by Hispanic subgroup. Second, this study relies on data from birth and death certificates, which provide limited information on socioeconomic measures or social and structural determinants of health, such as the education of the teen's mother and the teen's family structure. These measures have been associated with the increased likelihood of teen birth[43–45] and may also be risk factors for infant mortality. Future research could examine how changes over time in socioeconomic or sociocultural drivers may influence trends and differences by race and ethnicity or urbanization level.

CONCLUSIONS

The mortality rate for infants of teens declined from 1996–1997 through 2018–2019, but mortality rates remained higher for infants of Black teens throughout the period and this disparity persisted across all urbanization levels. Although mortality rates for infants of teens declined for all racial and ethnic groups in urban counties, these improvements did not occur equitably for infants of teens in rural counties. To advance health equity in maternal and infant health, additional research may help further elucidate the social and structural factors that have contributed to the lack of progress in mortality rates for infants of Black and Hispanic teens in rural counties.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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ABBREVIATION

ASMRs	age-specific mortality rates

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WHAT'S KNOWN ON THIS SUBJECT:

Overall infant mortality rates have declined since 1995, but disparities by maternal age, race and ethnicity, and urbanicity persist. Mortality rates are highest for infants of females under age 20, infants of Black mothers, and infants living in rural counties.

WHAT THIS STUDY ADDS:

This study examines trends in mortality for infants of teens by race and ethnicity and urbanicity Over a 24-year period, mortality rates remained the highest for infants of Black teens and this disparity persisted regardless of urbanization level.

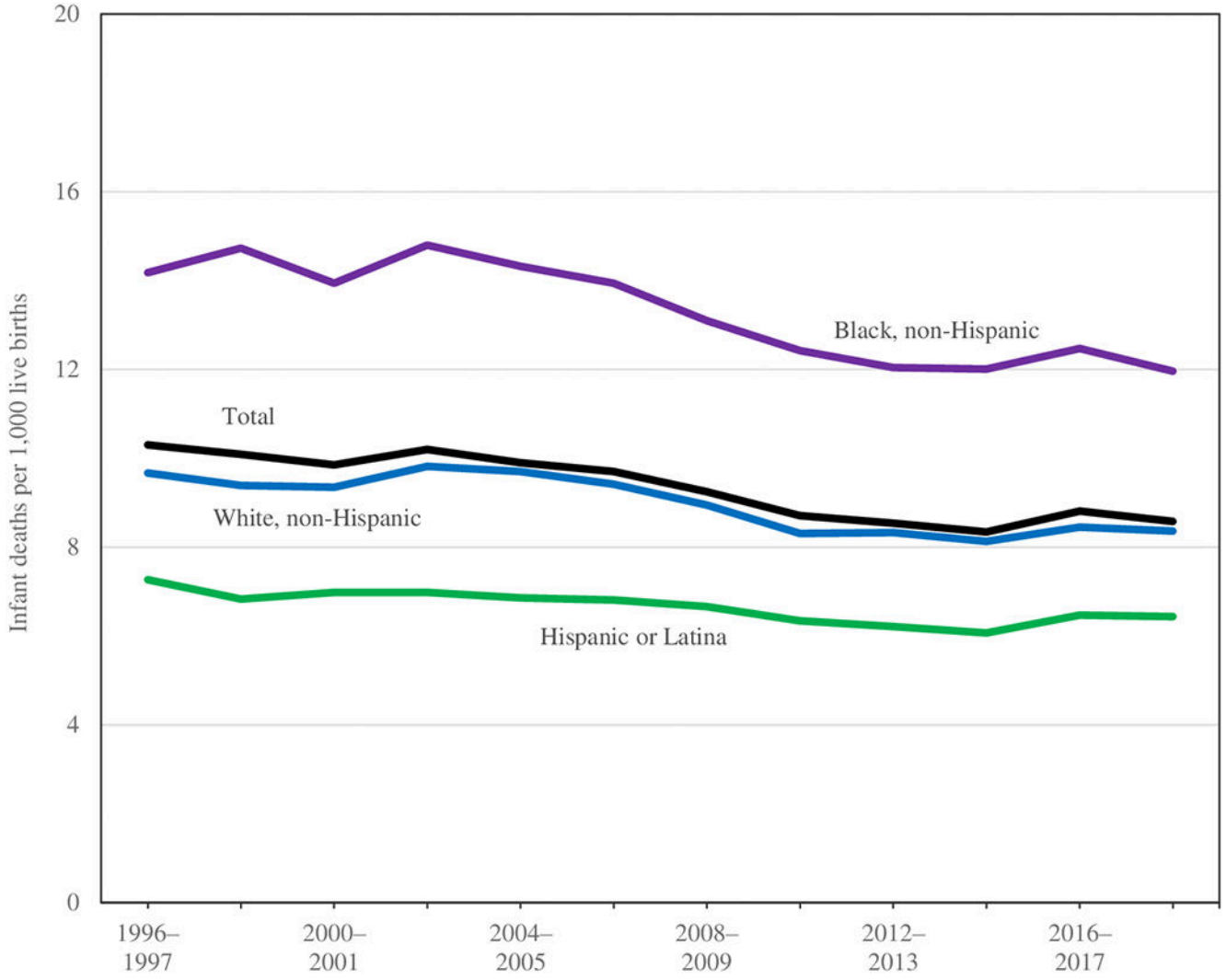

FIGURE 1.

Trends in mortality rates for infants of non-Hispanic white, non-Hispanic Black, and Hispanic or Latina teens aged 15 to 19: United States, 1996–1997 through 2018–2019. Source: National Center for Health Statistics (NCHS), National Vital Statistics System (NVSS), linked birth and infant death file.

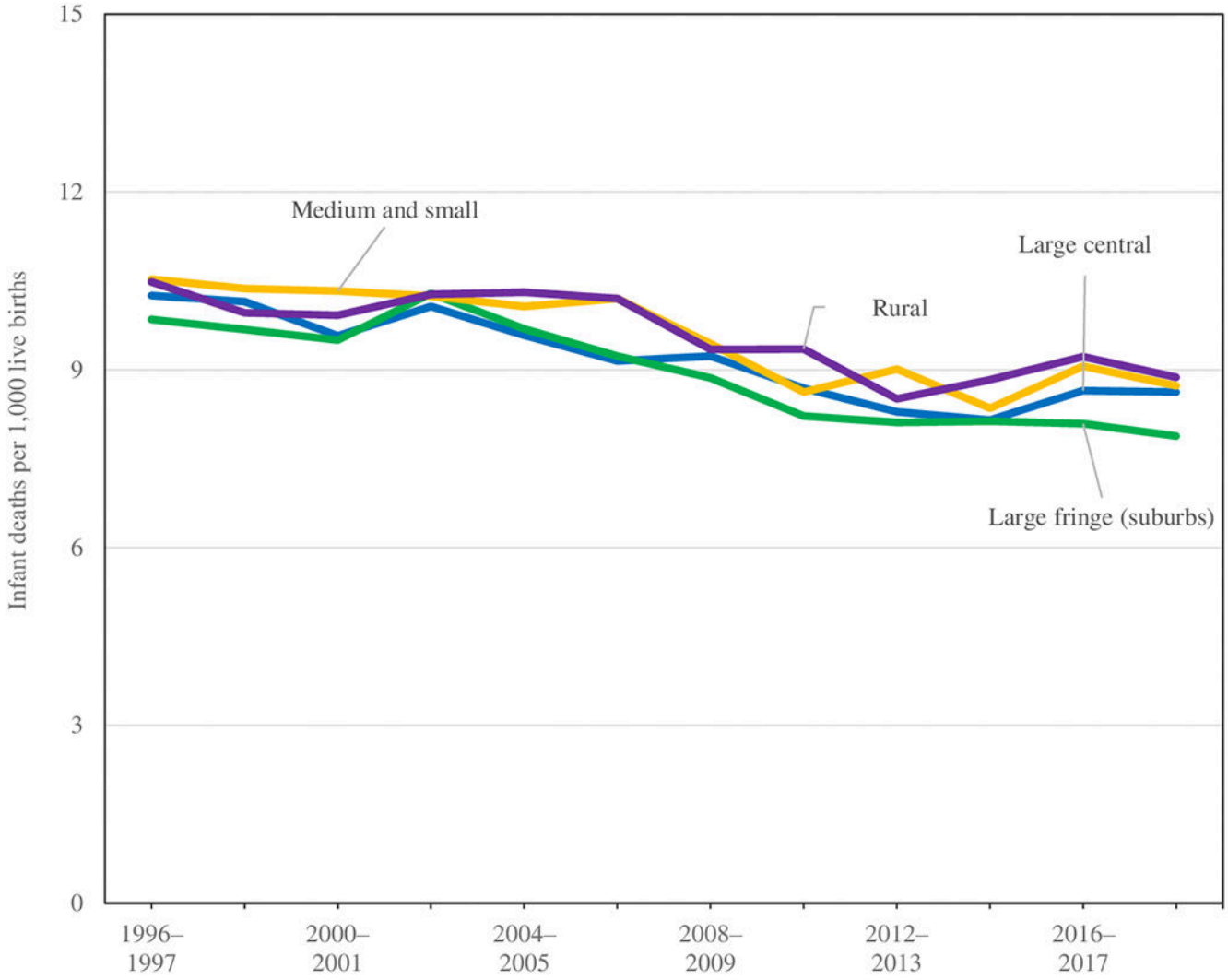

FIGURE 2.

Trends in mortality rates for infants of teens aged 15 to 19 who live in large central, large fringe (suburbs), medium and small, and rural counties: United States, 1996–1997 through 2018–2019. Source: NCHS, NVSS, Linked birth and infant death file.

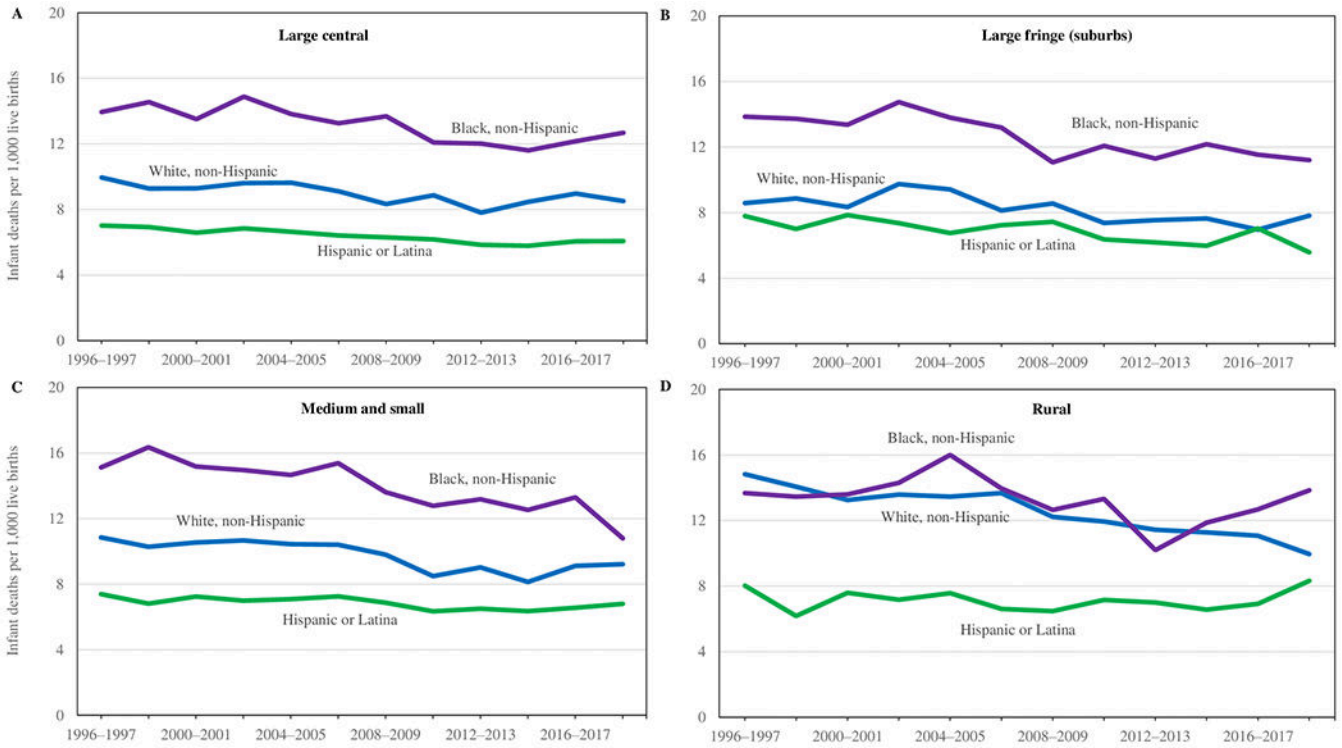

FIGURE 3.

Trends in mortality rates for infants of teens aged 15 to 19 by maternal race and ethnicity in (A) large central, (B) large fringe (suburbs), (C) medium and small, and (D) rural counties: United States, 1996–1997 through 2018–2019. Source: NCHS, NVSS, Linked birth and infant death file.

Table 1.

Number of deaths and mortality rates for infants born to teens aged 15–19 by maternal age group and maternal race/ethnicity: United States, 1996–1997 and 2018–2019

	1996–1997				2018–2019		
Characteristic	**Infant deaths[a] (n)**	**Births (n)**	**Rate[b]**		**Infant deaths[a] (n)**	**Births (n)**	**Rate[b]**
15–19							
Total[c,d]	10,045	974,797	10.30		3,017	351,545	8.58
Race/ethnicity:							
White, non-Hispanic[e]	4,303	445,054	9.67		1,094	130,857	8.36
Black, non-Hispanic[d]	3,587	252,959	14.18[f]		960	80,261	11.96[f]
Hispanic or Latina	1,724	237,000	7.27[g]		823	127,776	6.44[g]
15–17							
Total[c]	4,021	365,875	10.99		775	85,372	9.08
Race/ethnicity:							
White, non-Hispanic	1,565	146,937	10.65[h]		260	26,278	9.89[h]
Black, non-Hispanic	1,518	107,140	14.17[f]		238	20,732	11.48
Hispanic or Latina	769	96,760	7.95[g,h]		247	35,274	7.00[g]
18–19							
Total[c]	6,024	608,922	9.89		2,242	266,173	8.42
Race/ethnicity:							
White, non-Hispanic	2,737	298,117	9.18		834	104,579	7.97
Black, non-Hispanic[e]	2,070	145,819	14.20[f]		722	59,529	12.13[f]
Hispanic or Latina	956	140,240	6.82[g]		576	92,502	6.23[g]

[a]The number of infant deaths in the linked file are weighted to equal the sum of the linked plus unlinked infant deaths by age at death and state. The number of infant deaths shown in this table have been rounded to the nearest integer.

[b]Infant deaths per 1,000 live births. All rates declined significantly throughout the period unless otherwise noted.

[c]Includes all other races not shown separately.

[d]Rates did not significantly change from 1996–1997 to 2002–2003 and then declined from 2002–2003 to 2018–2019.

[e]Rates did not significantly change from 1996–1997 to 2004–2005 and then declined from 2004–2005 to 2018–2019.

[f]Significantly higher than rates for infants of White, non-Hispanic and Hispanic teens.

[g]Significantly lower than rates for infants of White, non-Hispanic and Black, non-Hispanic teens.

[h]Rate is significantly higher compared with teens aged 18–19 in same race and ethncity group.

Table 2.

Number of deaths and mortality rates for infants born to teens aged 15–19 by maternal age group and maternal urbanization level: United States, 1996–1997 and 2018–2019

	1996–1997				2018–2019		
Characteristic	**Infant deaths[a] (n)**	**Births (n)**	**Rate[b]**		**Infant deaths[a] (n)**	**Births (n)**	**Rate[b]**
15–19							
Total[c,d]	10,045	974,797	10.30		3,017	351,545	8.58
Urbanization level:							
Large central	3,256	317,595	10.25		854	99,115	8.62
Large fringe	1,552	157,624	9.85		481	61,011	7.88
Medium/Small	3,255	309,060	10.53		1,070	122,549	8.73
Rural	1,922	183,333	10.48		611	68,870	8.87
15–17							
Total[c]	4,021	365,875	10.99		775	85,372	9.08
Urbanization level:							
Large central	1,351	125,267	10.78		228	25,576	8.91
Large fringe	623	57,584	10.82		108	14,128	7.64
Medium/Small	1,300	114,505	11.35		282	29,783	9.47
Rural	726	65,719	11.05		156	15,885	9.82
18–19							
Total[c]	6,024	608,922	9.89		2,242	266,173	8.42
Urbanization level:							
Large central	1,905	192,328	9.90		626	73,539	8.51
Large fringe	929	100,040	9.29		373	46,883	7.96
Medium/Small	1,956	194,555	10.05		787	92,766	8.48
Rural	1,197	117,614	10.18		455	52,985	8.59

[a]The number of infant deaths in the linked file are weighted to equal the sum of the linked plus unlinked infant deaths by age at death and state. The number of infant deaths shown in this table have been rounded to the nearest integer.

[b]Infant deaths per 1,000 live births. All rates declined signficiantly throughout the period unless otherwise noted.

[c]Includes all other races not shown separately.

[d]Rates did not significantly change from 1996–1997 to 2002–2003 and then declined from 2002–2003 to 2018–2019.

Table 3.

Decomposition of changes in infant mortality by distribution of maternal age and age-specific mortality rates: United States, 1996–1997 and 2018–2019

		Race/ethnicity				Urbanization level			
Decomposition	**Total**[a]	**White, non-Hispanic**	**Black, non-Hispanic**	**Hispanic or Latina**		**Large central**	**Large fringe**	**Medium and small**	**Rural**
Crude rate,[b] **2018–2019**	8.58	8.36	11.96	6.44		8.62	7.88	8.73	8.87
2018–2019 adjusted rate[b] **due to holding constant:**									
1996–1997 maternal age distribution	8.67	8.61	11.85	6.54		8.67	7.84	8.84	9.03
1996–1997 age-specific mortality rate	10.16	9.48	14.19	7.13		10.13	9.64	10.37	10.38
Percent difference due to change in:									
Maternal age distribution	6.7	16.7	11.1	15.0		5.3	4.0	8.0	8.3
Age-specific mortality rate	93.3	83.3	88.9	85.0		94.7	96.0	92.0	91.7

[a] Includes all other races not shown separately.

[b] Infant deaths per 1,000 live births.