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Disparities in infant mortality by maternal race and Hispanic origin, 2017-2018

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Abstract

Disparities in infant mortality by race and Hispanic origin groups continue to persist in the United States. Maternal and infant characteristics known to be associated with infant mortality vary by race and ethnicity. This report describes racial and ethnic disparities in infant mortality in the United States using the 2017-2018 cohort linked birth/infant death files from the National Vital Statistics System. Distributions of births and infant mortality rates are described by selected maternal and infant characteristics. Adjusted rates and rate ratios from logistic regression models, compared to unadjusted rates and ratios, show the extent to which race and Hispanic origin disparities would be attenuated if all groups had the same distributions of select maternal and infant factors. Results support the premise that the different distributions of several variables across racial/ethnic groups, most notably gestational age, account for a significant portion of the disparities in infant mortality between racial/ethnic groups.

Introduction

In the United States, racial and ethnic disparities in infant mortality rates have existed since the collection of these data began more than 100 years ago.[1] While mortality rates have generally declined among infants of all racial/ethnic groups since at least 1995, improvement has been uneven across groups and differences among groups persist, with generally higher rates among infants of non-Hispanic Black and American Indian or Alaska Native (AIAN) women.[2, 3].

The distribution of risk factors for infant death also varies by race/ethnicity. Risk factors such as lower levels of maternal educational attainment, poor prenatal health, lack of access to health care and lower socioeconomic status are typically, but not exclusively, found at higher levels in the racial/ ethnic groups with higher infant mortality rates.[4-11] In addition, there is a strong, positive relationship between length of gestation and infant survival; gestational age distributions vary by race/ethnicity and play a role in racial/ethnic disparities

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in infant mortality. This study uses national vital statistics data to examine the how the magnitude of disparities by racial/ethnic groups may differ if all groups had the same distributions of selected maternal and infant risk factors, with a focus on gestational age.

Data and methods

This report presents infant mortality statistics from the National Vital Statistics System 2017 and 2018 birth cohort linked birth/infant death files (linked files). The data are based on birth and infant death certificates registered in all states and the District of Columbia.[12] Birth cohort linked files are used for multivariate analyses because whether an infant death occurred is known for each birth in a given birth cohort. The data for this study includes all reported births in 2017 or 2018 that were linked to the corresponding death certificate.

Birth distributions and infant mortality rates for the United States for the 2017-2018 birth cohort are presented by maternal race and Hispanic origin, maternal age, education, prepregnancy body mass index (BMI), use of the Special Supplemental Nutrition Program for Women, Infants and Children (WIC), source of payment for delivery, timing of prenatal care (PNC), tobacco use during pregnancy, plurality, sex of the infant, and gestational age as these variables are associated with the risk of infant death.

The multivariate analyses estimate the association between race/ethnicity and infant mortality accounting for the described variables. Logistic regression models hold constant the differing distributions of the variables included in the analysis to statistically remove the effect of these variables on race/ethnic-specific mortality rates. The resulting adjusted rates yield adjusted rate ratios, representing the expected infant mortality rates and related disparities of all groups had the same distributions of the included covariates. The first model includes all variables except gestational age, the second model adds gestational age to estimate how its addition further alters racial/ethnic disparities in mortality risks beyond the factors included in the first model.

SAS v9.4 software was used for all data analyses.[13] Text statements have been tested for statistical significance using a two-tailed z test at the alpha level of 0.05. Logistic regression was used to produce adjusted rates of infant mortality (predicted marginals) and rate ratios based on the ratios of the adjusted rates between race and Hispanic origin groups controlling for maternal and infant characteristics.

Maternal and infant factors

Race and Hispanic origin

Infant mortality rates are presented by race and Hispanic origin of the mother. Race and Hispanic origin of the mother are self-reported and are reported separately on the birth certificate.[14] The maternal race and Hispanic-origin groups follow the 1997 OMB standards.[15] The categories are: non-Hispanic single-race White, non-Hispanic single-race Black or African American, non-Hispanic single-race AIAN, non-Hispanic single-race Asian, and Hispanic (for brevity, text references omit the term “non-Hispanic single-race”). The number of deaths among infants of Native Hawaiian/Other Pacific Islander women was too small to include in analyses. Data are also shown for five specified Hispanic groups: Mexican, Puerto Rican, Cuban, Dominican and Central/South American which are compared and analyzed separately.[14]

Demographic and health variables

This study includes the following demographic and health variables known to be associated with infant mortality and captured on the birth certificate: maternal age, educational attainment, prepregnancy BMI, the receipt of WIC benefits during pregnancy, source of payment for the delivery, timing of initiation of prenatal care, tobacco use during pregnancy, plurality, gestational age and infant sex. Educational attainment is the highest level of school completed by the mother at the time of birth[16,17] and is restricted to women aged 25 and over to allow time for completion of education.

Prepregnancy BMI is the mother's weight before pregnancy divided by the mother's height (inches) squared, multiplied by 703.[18] WIC is a nutritional program intended to help low-income pregnant women, infants, and children through age 5 years.[19] The primary source of payment for the delivery categories are private insurance, Medicaid, self-pay, and other (such as Indian Health Service or CHAMPUS/TRICARE). The timing of PNC is determined by the month PNC began, based on the date of the first prenatal visit, date of birth, and gestational age. Smoking during pregnancy is defined as cigarette smoking at any time while pregnant compared with never smoking while pregnant. Plurality is defined as the number of fetuses delivered at any time in the pregnancy. Gestational age is based on the obstetric estimate of gestation.

Results

Descriptive results

Distribution of maternal and infant factors by maternal race and Hispanic origin—Maternal factors varied by race/ethnicity. Higher percentages of Hispanic (31.6%), Black (32.8%) and AIAN (37.1%) women were under age 25 than White (20.5%) and Asian women (7.1%) (Table 1). Lower percentages of Black, AIAN and Hispanic women had at least a college degree than White and Asian women. The percentage of Asian women with obesity (9.4%) was 2.7 to 4 times lower than women in other groups; Black (37.5%) and AIAN women (39.7%) had the highest rates of obesity. The majority of Hispanic and AIAN and Black women received WIC compared with less than one in four White and Asian women. Medicaid was the source of payment for most deliveries for Hispanic and AIAN and Black women (60%-67%) whereas private insurance was the source of payment for most White and Asian women (63%-66%). More than four in five White and Asian women began prenatal care in the first trimester compared with about two in three Black and AIAN women. Higher percentages of AIAN and White women smoked during pregnancy (16.0% and 9.8%, respectively) compared with less than 1% of Asian women. Infants of Black women were most likely to be born in a plural delivery (4.2%); infants of Hispanic women were the least likely (2.5%).

Among Hispanic women, higher percentages of Mexican (33.0%) and Puerto Rican (35.8%) women were under age 25 than Cuban (20.4%), Central/South American (24.5%) and Dominican (27.3%) women (Table 1). A lower percentage of Cuban women had less than a high school education (6.0%) and a higher percentage had at least a college degree (35.2%). About one third of Mexican (32.8%) and Puerto Rican (33.3%) women had obesity compared with one fourth of Dominican women (24.3%) and about one fifth of Cuban (21.7%) and Central/South American women (22.9%). A higher percentage of Dominican women received WIC (59.3%); Cuban women had the lowest percentage (50.9%). A higher percentage of Dominican women (66.2%) had Medicaid as the source of payment for the delivery; Cuban (52.0%) women had the lowest. First trimester prenatal care rates were highest for Cuban women (82.0%) and lowest for Central/South American women (67.7%). A higher percentage of Puerto Rican women smoked during pregnancy (5.6%). Central/South American women had the lowest percentage (0.5%). Infants of Dominican (3.1%), Puerto Rican (3.1%) and Cuban (3.1%) women were more likely to be born in a plural delivery than those born to Mexican (2.4%) and Central/South American women (2.3%).

Among all infants, 9.98% were preterm; 0.67% were born before 28 weeks, 0.91% at 28-31 weeks, 1.17% at 32-33 weeks and 7.22% at 34-36 weeks. The distribution of preterm births varied by maternal race and Hispanic origin (Table 1), ranging from 8.55% of infants of Asian women to 14.03% for infants of Black women. The percent of early term infants (37-38 weeks) ranged from 24.41% of infants of White women to 29.28% of infants of Black women and 29.42% of infants of AIAN women. Among infants born to Hispanic women, about 9% born to Mexican (9.48%), Cuban (9.12%), Dominican (9.33%) and Central/South American (9.18%) women were preterm compared with 11.04% for infants of Puerto Rican women.

Infant mortality by maternal factors and race and Hispanic origin

Maternal race and Hispanic origin.: For 2017-2018 births, infant mortality rates by maternal race and Hispanic origin ranged from 3.63 deaths per 1,000 live births for infants of Asian women to 10.78 for infants of Black women (Table 2). Among Hispanic-origin subgroups, mortality rates ranged from 4.08 for infants of Cuban women to 6.09 for infants of Puerto Rican women.

Maternal age.: Infants born to women in their early thirties had the lowest mortality rates (4.66) while infants born to teen mothers had the highest (8.85) (Table 2). Except for infants of Black women, infants born to women in their late twenties or early thirties had the lowest rates and those born to teens had the highest. For all age groups, infants of Black women generally had the highest mortality rates; those born to Asian women generally had among the lowest rates. Among Hispanic subgroups, infants born to women aged 25-29 or 30-34 had the lowest rates; those born to women aged 40 and over had the highest.

Maternal education.: Infant mortality rates declined with increasing maternal education overall and within race and Hispanic origin groups (Table 2). Infant mortality rates were lowest for infants born to women with a bachelor’s degree or more (3.22 deaths per 1,000 live births) followed by those born to women with some college (5.47). Infants born to

Black women had the highest mortality rates across each education category. The difference between mortality rates for infants of Black and White women widened with increasing education. Among women with less than a high school education, infants of Black women had 1.4 times higher infant mortality rates than those of White women; the ratio widened to 2.6 for infants of women with a bachelor's degree or higher. Among infants born to Hispanic women, differences between the highest and lowest rates narrowed with increasing education. Among infants of women with less than high school, those of Puerto Rican women were almost twice as likely to die as those of Central/South American or Dominican women; among infants of women with a bachelor's degree or higher there was no significant difference in mortality rates across groups.

Prepregnancy BMI.: Overall, by BMI category, infants born to women with obesity had the highest mortality rates (7.03) and infants born to normal weight women had the lowest (4.54), although this pattern was not consistent for all race and Hispanic origin groups. For example, among infants born to White women, those born to underweight women were as likely to die as those born to women with obesity. Mortality rates did not vary across BMI categories for infants born to AIAN women (among the categories with sufficient numbers to calculate reliable rates). Infants of Black women had the highest mortality rates across all BMI categories. Among Hispanic subgroups, infants of Puerto Rican women generally had the highest mortality rates in each BMI category.

WIC.: Overall, infants born to women who received WIC had higher mortality rates compared with those born to women who did not (5.85 compared with 5.40) (Table 2). However, this pattern was found only for infants of White women. Infants of Black and Hispanic women and each of the Hispanic subgroups who received WIC had lower mortality rates than those of women who did not. Among infants of Hispanic women without WIC, those of Cuban and Central/South American women had the lowest mortality rates.

Source of payment.: Infant mortality rates were lowest for infants of women who used private insurance for the delivery (4.18) and highest for infants of women who used Medicaid (7.26). Among deliveries covered by either Medicaid or private insurance, infants born to Asian and White women had the lowest mortality rates; those born to Black women had the highest. Among infants born to Hispanic women with Medicaid, those of Puerto Rican women had the highest mortality rate (6.62); among those with private insurance, infants of Puerto Rican (4.68), Dominican (4.60) and Mexican women (4.35) had the highest rates.

Timing of prenatal care.: Mortality rates were highest for infants of women who received late or no PNC across all maternal race and Hispanic origin groups (Table 2). Among women who received PNC in the first trimester, infants born to Asian women had the lowest mortality (3.28); those born to Black women had the highest rate (9.64). Among women who received late or no care, the rate of infants born to Asian women (4.60) was less than half of those born to White (10.10), Black (15.65) and AIAN (12.76) women. Among infants of Hispanic women who obtained PNC in the first trimester, those born to Cuban

(3.70) and Central/South American women (3.71) had lower mortality rates than those of Mexican (4.43) and Puerto Rican women (5.25).

Cigarette smoking during pregnancy.: Infant mortality was higher among infants of women who smoked at some point in their pregnancy (10.56 compared with 5.27); this pattern was observed for infants of women of all race and Hispanic origin groups. Among women who smoked during pregnancy, infants born to White (9.27) and Asian women (9.24) had the lowest mortality rates and infants of Black women had the highest (18.35).

Infant mortality by infant factors and maternal race and Hispanic origin

Infant sex.: Mortality rates for were higher for male infants (6.23) than female infants (5.12); this pattern was consistent across maternal race and Hispanic origin groups (Table 2).

Plurality.: Infants born in a plural delivery had higher mortality rates than singleton births (23.05 compared with 5.08). This pattern occurred among all the maternal race and Hispanic origin groups. Among plural births, infants born to Asian (19.80) or White (17.89) women had the lowest mortality rates and infants born to Black or AIAN women had the highest (37.83 and 35.47, respectively). Mortality rates among infants of a plural delivery were 3.9 to 6.3 times higher than those of singleton births. The same pattern was found for Hispanic subgroups; mortality rates of infants of a plural delivery were 4.1 to 5.5 times higher than those of singleton births.

Gestational age.: The infant mortality rate was highest for infants at the shortest gestational ages and declined with increasing gestational age for infants of all maternal race and Hispanic origin groups. The mortality rate for infants declined from 380.73 deaths per 1,000 births at less than 28 weeks to 1.62 for infants born at 39 or more weeks. Infant mortality rates by gestational age varied by maternal race and Hispanic origin. Infants of Asian and White women had the lowest preterm mortality rates (30.47 and 31.23, respectively); infants of Black women had the highest (54.91). Among Hispanic subgroups, preterm mortality rates ranged from 32.07 for infants of Central/South American women to 38.69 for infants of Puerto Rican women.

Logistic regression results

Race and Hispanic origin—The first model controlled for all maternal and infant factors described above except for gestational age. After adjusting for these factors, the mortality rates for infants of White and Asian women were higher while rates for infants of Hispanic and Black and AIAN women were lower (Table 3). The adjusted mortality rate for infants of White women was 6% higher (4.61 to 4.90); it was 36% higher for infants of Asian women (3.63 to 4.93). In contrast, adjusted rates were 14% lower for infants of Black women (10.78 to 9.30), 22% lower for infants of AIAN women (8.69 to 6.80) and 3% lower for infants of Hispanic women (4.96 to 4.83).

Controlling for these factors narrowed the differences in mortality rates between infants of White women and all other groups. The adjusted rate ratios (aRR) for infants of Black (aRR=1.90) and AIAN (aRR=1.39) women remained significant but were smaller than the unadjusted rate ratios. The differences between infants of Hispanic (aRR=0.98) and Asian (aRR=1.00) women and infants of White women were eliminated.

Removing the effect of differing distributions of gestational age across the race and Hispanic origin groups by holding gestational age constant resulted in a higher adjusted mortality rate for infants of White women (4.90 to 5.83), and a lower rate for infants of Black women (9.30 to 6.21). Consequently, the rate ratio between these two groups narrowed from 1.90 to 1.06. Adding gestational age also led to a slightly higher rate for infants of Hispanic women but a lower mortality rate compared with infants of White women (aRR=0.84). Adjusting for gestational age resulted in a smaller increase in the rate for infants of Asian women (4.93 to 5.28) than in the rate of those of White women, resulting in a widening of the difference between these two groups (aRR=0.91). Adding gestational age had little effect on the rate for infants of AIAN women (6.80 to 6.93) but the greater change in the rate for infants of White women resulted in a narrowing of the difference between these two groups (aRR=1.19).

Hispanic subgroups—After removing the effect of different variable distributions across Hispanic origin groups by controlling for all variables except gestational age, the mortality rate for infants of Mexican women was essentially unchanged (4.94 to 4.95) (Table 3). Adjusted rates were 2% lower than unadjusted rates for infants of Puerto Rican women (6.09 to 5.95) and for infants of Central/South American women (4.25 to 4.16). The rate ratios for infants of Puerto Rican and Central/South American women changed little after adjustment (aRR=1.20 and aRR=0.84, respectively). Adjusted rates were 13% higher for infants of Cuban women (4.08 to 4.59) and 8% higher for infants of Dominican women (4.83 to 5.23). Before controlling for maternal factors, infants of Cuban women were less likely to die than infants of Mexican women; after adjusting for controls, the difference between the two groups was not statistically significant. The difference in rates between infants of Dominican and Mexican women remained nonsignificant.

Adding gestational age to the model resulted in a lower rate for infants of Puerto Rican women (5.95 to 5.04) and a higher rate for infants of Mexican women (4.95 to 5.08) eliminating the difference between these two groups (aRR=0.99). The rate ratios for infants of Cuban (aRR=0.88) and Central/South American women (aRR=0.89) were similar after adjusting for gestational age due to a slightly lower adjusted rate for infants of Cuban women (4.59 to 4.46) and a higher adjusted rate for infants of Central/South American women (4.16 to 4.50). The rate for infants of Dominican women was lower (5.23 to 4.79); the difference with infants of Mexican women remained nonsignificant.

Summary and discussion

This study describes how the magnitude of disparities in infant mortality differ by race/ethnicity when all groups are assumed to have the same distributions of select maternal and demographic factors, including gestational age. The results support the premise that these factors, most notably gestational age, account for a significant portion of the differences in infant mortality rates between racial/ethnic groups. In particular, holding gestational age distributions constant narrowed the mortality rate differences between infants of both Black (crude RR = 2.34; aRR = 1.06) and AIAN women (cRR = 1.89; aRR = 1.19) and those of White women. It also eliminated the difference in rates between infants of Puerto Rican and Mexican women (cRR = 1.23; aRR = 0.99).

Infants of Black women had the highest crude mortality rate followed by infants of AIAN women; infants of Asian women had the lowest. Some of these disparities may be related to the fact that infants of Black and AIAN women were more likely to be in high-risk categories, such as being born to women with lower levels of educational attainment, women with obesity or those who received late or no prenatal care.[4,6,20] The differences in the distributions of maternal characteristics contributed to corresponding differences in the risk of infant death between race and Hispanic origin groups. However, even within low- and high-risk sociodemographic categories, the mortality rates of infants of Black and AIAN women tended to be higher than those of other racial/ ethnic groups. Research suggests that these patterns may be related to the "weathering" hypothesis, that is, the physical consequences of social and economic inequality that accumulate throughout people's lives.[21,22]

The widening gap in mortality rates between infants of Black and White women with increasing education suggests that education is not necessarily equally correlated with health benefits across racial/ethnic groups, a pattern found for other health outcomes.[23-25] Research suggests that Black women with higher education may worry about discrimination and experience chronic racism-related stress more than their less educated peers, possibly because they are more likely to be a minority in their workplaces and communities.[23]

The results of the multivariate models suggest that the factors included were associated with the higher crude mortality rates of infants of Black and AIAN women and the lower crude rates for infants of White and Asian women. Controlling for maternal and infant factors (before adding gestational age to the model) narrowed the differences between infants of White women and all other groups, including eliminating differences with infants of Hispanic and Asian women. Although infants of Black and AIAN women continued to have the highest and second highest adjusted mortality rates, the changes in the adjusted rates indicate that not only did the factors included here account for some portion of most groups' mortality rates, they also affected racial/ethnic differences. Adjusting for these factors did not have much effect on the risk of death for infants of Hispanic women.

After adding gestational age to the model, infants of AIAN women had the highest rates followed by infants of Black women; infants of Hispanic women had the lowest. This model showed that the higher preterm and early term birth rates among infants of Black women accounted for a sizable portion of higher Black mortality rates and for much of the remaining difference between Black and White rates, such that the aRR declined to 1.06. The modest increase in AIAN rates net of gestational age reflected their gestational age distribution; their preterm rates were lower than those of infants of Black women but higher than those of the other groups while their early term rates were similar to those of infants of Black women. After including maternal factors and gestational age, the adjusted rate for infants of Hispanic women was lower than that for infants of white women. This result is consistent with the Hispanic paradox, where patterns of health outcomes among Hispanic people are often better than expected given their overall socioeconomic profile.[26]

Some of the remaining racial/ethnic differences in mortality rates within low- and high-risk categories may be explained by sociodemographic and economic factors not included in these analyses, such as income or poverty status and family structure, as well as variation in these factors within racial/ethnic groups.[20,27-31] In addition, interactions between race/ethnicity and the other variables examined here were not explored. The strengths of this analysis include essentially complete coverage of births and infant deaths in the U.S. for the years examined and the inclusion of smaller racial/ethnic groups in the analyses.

Research has identified racism, discrimination and long-term lack of investment in disadvantaged minority communities as a risk to the health of the members of those communities, including infants.[32-38] People in these communities, particularly Black and AIAN persons, have consistently worse health outcomes for a range of health measures from infant mortality to life expectancy.[27-29,36,39] The findings of this report may help inform research on infant mortality disparities and aid efforts to reduce infant mortality and racial/ethnic disparities.

REFERENCES

1. Shapiro S, Schlesinger ER, Nesbitt REL Jr. Infant, perinatal, maternal and childhood mortality in the United States. Cambridge, MA: Harvard University Press; 1968.
2. MacDorman MF. Race and ethnic disparities in fetal mortality, preterm birth, and infant mortality in the United States: an overview. Semin Perinatol. 2011;35(4):200–208. [PubMed: 21798400]
3. Rossen LM, Schoendorf KC. Trends in racial and ethnic disparities in infant mortality rates in the United States, 1989–2006. Am J Public Health. 2014;104(8):1549–1556. [PubMed: 24028239]
4. Ely DM, Driscoll AK Infant mortality in the United States, 2019: data from the period linked birth/infant death file. National Vital Statistics Reports; vol 70 no 14. Hyattsville, MD: National Center for Health Statistics. 2021. DOI: 10.15620/cdc:111053.
5. Jacob J, Kamitsuka M, Clark RH, Kelleher AS, Spitzer AR. Etiologies of NICU deaths. Pediatrics. 2015;135(1):e56–e59.
6. Ely DM, Gregory ECW, Drake P Infant mortality by maternal prepregnancy body mass index: United States, 2017–2018. National Vital Statistics Reports; vol 69 no 9. Hyattsville, MD: National Center for Health Statistics. 2020.
7. Declercq E, MacDorman M, Cabral H, Stotland N. Prepregnancy body mass index and infant mortality in 38 U.S. states, 2012–2013. Obstet Gynecol. 2016;127(2):279–287. [PubMed: 26942355]
8. Kim HJ, Min KB, Jung YJ, Min JY. Disparities in infant mortality by payment source for delivery in the United States. Prev Med. 2021;145:106361. [PubMed: 33309872]
9. McLemore MR, Berkowitz RL, Oltman SP, et al. Risk and protective factors for preterm birth among black women in Oakland, California. J Racial Ethn Health Disparities. 2020. 10.1007/s40615-020-00889-2.
10. Finch BK. Socioeconomic gradients and low birth-weight: Empirical and policy considerations. Health Serv Res. 2003;38(6):1819–1841: Pt 2. [PubMed: 14727799]
11. Partridge S, Balayla J, Holcroft CA, Abenhaim HA. Inadequate prenatal care utilization and risks of infant mortality and poor birth outcome: a retrospective analysis of 28,729,765 US deliveries over 8 years. Am J Perinatology. 2012;29(10):787–794.
12. National Center for Health Statistics. User guide to the 2019 period/2018 cohort linked birth/infant death public use file. Hyattsville, MD. Available from https://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/DVS/period-cohort-linked/19PE18CO_linkedUG.pdf.

13. SAS Institute, Inc. SAS® 9.4 Statements: Reference. Cary, NC: SAS Institute Inc; 2013.
14. National Center for Health Statistics. User guide to the 2019 natality public use file. Hyattsville, MD. 2020 Available from https://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/DVS/natality/UserGuide2019-508.pdf.
15. Office of Management and Budget. Revisions to the standards for the classification of federal data on race and ethnicity. Fed Regist. 1997;62(210):58782–58790.
16. National Center for Health Statistics. U.S. standard certificate of live birth. 2003 Available from https://www.cdc.gov/nchs/data/dvs/birth11-03final-ACC.pdf.
17. National Center for Health Statistics. Mother's worksheet for child's birth certificate. 2022 Available from https://www.cdc.gov/nchs/data/dvs/momswkstf_improv.pdf.
18. National Heart, Lung, and Blood Institute. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults: The evidence report. 1998.
19. U.S. Department of Agriculture. About WIC: WIC at a glance. 2022 Available from https://www.fns.usda.gov/wic/about-wic.
20. Phelan JC, Link BG. Is racism a fundamental cause of inequalities in health? Ann Rev Sociol. 2015;41:311–330.
21. Geronimus AT. Black/white differences in the relationship of maternal age to birthweight: a population-based test of the weathering hypothesis. Soc Sci Med. 1996;42(4):589–597. [PubMed: 8643983]
22. Geronimus AT, Hicken M, Keene D, Bound J. Weathering" and age patterns of allostatic load scores among Blacks and Whites in the United States. Am J Public Health. 2006;96(6):826–833. [PubMed: 16380565]
23. Braveman P, Heck K, Egerter S, Dominguez TP, Rinki C, Marchi KS, Curtis M. Worry about racial discrimination: a missing piece of the puzzle of Black-White disparities in preterm birth? PLoS One. 2017;12(10):1–17.
24. Fuller-Rowell TE, Curtis DS, Doan SN, Coe CL. Racial disparities in the health benefits of educational attainment: A study of inflammatory trajectories among African American and White adults. Psychosom Med. 2015;77:33–40. [PubMed: 25490696]
25. Green T, Hamilton TG. Maternal educational attainment and infant mortality in the United States: does the gradient vary by race/ethnicity and nativity? Demogr Res. 2019;41:713–752.
26. Ruiz JM, Steffen P, Smith TB. Hispanic mortality paradox: a systematic review and meta-analysis of the longitudinal literature. Am J Public Health. 2012;103(3):e52–e60.
27. Williams DR, Mohammed SA, Leavell J, Collins C. Race, socioeconomic status and health: complexities, ongoing challenges and research opportunities. Ann NY Acad Sci. 2010;1186(1):69–101. [PubMed: 20201869]
28. Williams DR, Rucker TD. Understanding and addressing racial disparities in health care. Health Care Financ Rev. 2000;21(4):75. [PubMed: 11481746]
29. Williams DR, Jackson PB. Social sources of racial disparities in health. Health Aff. 2005;24(2):325–334.
30. LaVeist TA. Disentangling race and socioeconomic status: a key to understanding health inequalities. J Urban Health. 2005;82:iii26–iii34. [PubMed: 15933328]
31. Thoma ME, Ah DLBH, Kim TY, Fenelon A, Shenassa ED. Black-White disparities in preterm birth: Geographic, social and health determinants. Am J Prev Med. 2019;57(5):675–686. [PubMed: 31561920]
32. Bishop-Royse J, Lange-Maia B, Murray L, Shah RC, DeMaio F. Structural racism, socio-economic marginalization and infant mortality. Public Health. 2021;190:55–61. [PubMed: 33348089]
33. Chae DH, Clouston S, Martz CD, et al. Area racism and birth outcomes among Blacks in the United States. Soc Sci Med. 2018;199:49–55. [PubMed: 28454665]
34. Chambers BD, Baer RJ, Mclemore MR, Jelliffe-Pawlowski LL. Using index of concentration at the extremes as indicators of structural racism to evaluate the association with preterm birth and infant mortality: California, 2011–2012. J Urban Health. 2019;9:159–170.
35. Grimm M, Cornish DL. Infant mortality and racism in the United States. Int J Undergrad Res Creative Act. 2018;10(2).

36. Krieger N, Rehkopf DH, Chen JT, Waterman PD, Marcelli E, Kennedy M. The fall and rise of US inequities in premature mortality: 1960—2002. PLoS Med. 2008;5(2):e46. [PubMed: 18303941]
37. Orchard J, Price J. County-level racial prejudice and the black-white gap in infant health outcomes. Soc Sci Med. 2017;181:191–198. [PubMed: 28404321]
38. Vilda D, Hardeman R, Dyer L, Theall KP, Wallace M. Structural racism, racial inequities and urban-rural differences in infant mortality in the US. J Epidemiol Commun Health. 2021;75:788–793.
39. Ananth CV, Joseph KS, Oyelese Y, Demissie K, Vintzileos AM. Trends in preterm birth and perinatal mortality among singletons: United States, 1989 through 2000. Obstet Gynecol. 2005;105(5):1084–1091. [PubMed: 15863548]

Table 1 –

Distribution of maternal and infant factors by maternal race and Hispanic origin: United States 2017-2018

	Total[1]	Race and Hispanic origin									
		Non-Hispanic				Hispanic					
		White	Black	Asian	AIAN	Total Hispanic[2]	Mexican	Puerto Rican	Cuban	Dominican	Central/South American
N	7,647,212	3,948,874	1,112,744	490,048	59,049	1,784,974	1,007,957	142,427	46,833	64,440	293,044
Maternal age											
Under age 20	4.9	3.5	7.1	0.7	9.3	7.6	8.0	8.0	3.3	5.4	6.0
20-24	19.5	17.0	25.7	6.4	27.8	24.0	25.0	27.8	17.1	21.9	18.5
25-29	29.1	29.7	30.1	24.7	31.0	28.5	28.6	29.9	31.8	31.0	26.1
30-34	28.5	31.7	22.2	39.7	20.4	23.3	22.5	20.8	30.8	24.3	27.1
35-39	14.7	15.2	11.9	23.2	9.4	13.1	12.5	10.9	13.5	13.8	17.4
40 and over	3.3	3.0	3.1	5.4	2.1	3.5	3.3	2.6	3.5	3.6	4.9
Maternal education[3]											
Less than high school	9.7	4.2	10.1	5.6	15.2	25.3	28.1	11.2	6.0	13.7	34.5
High school	19.8	15.6	29.1	10.4	33.2	27.9	30.0	27.3	30.5	24.5	21.3
Some college	28.6	28.7	36.1	15.7	38.5	27.5	26.6	37.3	28.4	35.3	20.3
Bachelor’s degree or higher	41.9	51.5	24.7	68.3	13.0	19.3	15.2	24.2	35.2	26.4	23.9
Prepregnancy BMI											
Underweight	3.3	3.2	3.1	7.2	2.1	2.5	2.2	3.6	3.4	3.0	2.2
Normal weight	42.7	46.3	32.6	60.6	30.8	36.6	34.6	36.1	45.7	41.2	42.2
Overweight	26.4	25.1	26.8	22.8	27.4	30.3	30.4	27.1	29.2	31.4	32.6
Obesity	27.6	25.4	37.5	9.4	39.7	30.7	32.8	33.3	21.7	24.3	22.9
WIC receipt											
Received WIC	37.1	24.4	55.9	21.2	56.2	57.2	58.2	55.8	50.9	59.3	55.9
Source of payment for delivery											
Medicaid	42.7	30.2	65.6	24.6	66.7	59.6	60.8	60.2	52.0	66.2	54.4
Private insurance	49.4	63.2	28.1	66.1	19.9	29.0	27.8	34.0	43.7	27.8	27.2
Self-pay	4.1	3.1	3.0	6.3	1.8	6.7	6.8	1.4	1.7	3.2	12.9
Other	3.8	3.5	3.4	3.0	11.5	4.7	4.6	4.3	2.6	2.8	5.5
Trimester of first prenatal care											

	Total[1]	Race and Hispanic origin									
		Non-Hispanic				Hispanic					
		White	Black	Asian	AIAN	Total Hispanic[2]	Mexican	Puerto Rican	Cuban	Dominican	Central/South American
1st trimester	77.4	82.4	66.9	81.5	63.0	72.5	72.4	75.7	82.0	73.4	67.7
2nd trimester	16.4	13.1	23.1	13.5	24.1	19.8	19.9	18.1	14.0	19.4	22.9
3rd trimester/None	6.2	4.5	10.0	5.0	12.8	7.7	7.8	6.1	4.1	7.2	9.4
Smoked during pregnancy											
Yes	6.7	9.8	5.4	0.5	16.0	1.7	1.4	5.6	1.8	0.9	0.5
No	93.3	90.2	94.6	99.5	84.0	98.3	98.6	94.4	98.2	91.1	99.5
Infant sex											
Male	51.1	51.3	50.8	51.5	51.0	50.9	50.9	51.1	51.5	50.8	50.9
Female	48.9	48.7	49.2	48.5	49.0	49.1	49.1	48.9	48.5	49.2	49.1
Plurality											
Singleton	96.6	96.4	95.8	97.1	97.3	97.5	97.6	96.9	96.9	96.9	97.7
Twin and higher	3.4	3.6	4.2	2.9	2.7	2.5	2.4	3.1	3.1	3.1	2.3
Gestational age											
Less than 37 weeks	9.98	9.07	14.03	8.55	11.69	9.67	9.48	11.04	9.12	9.33	9.18
Less than 28 weeks	0.67	0.45	1.52	0.48	0.67	0.62	0.59	0.86	0.63	0.70	0.55
28-31 weeks	0.91	0.76	1.61	0.71	1.04	0.85	0.81	1.07	0.84	0.97	0.79
32-33 weeks	1.17	1.06	1.75	0.96	1.42	1.09	1.06	1.33	1.09	1.15	1.00
34-36 weeks	7.22	6.79	9.14	6.40	8.56	7.11	7.02	7.77	6.57	6.52	6.84
37-38 weeks	26.26	24.41	29.28	28.31	29.42	27.81	27.88	27.66	26.14	25.35	27.54
39 weeks and more	63.76	66.51	56.69	63.15	58.89	62.51	62.64	61.31	64.74	65.32	63.28

BMI: Body mass index

[1] Includes births to race and Hispanic origin groups not shown separately.

[2] Includes births to Hispanic origin groups not shown separately.

[3] Restricted to women age 25 and over

Table 2 –

Infant mortality rates by maternal race and Hispanic origin and maternal and infant factors: United States, 2017-2018

		Race and Hispanic origin									
		Non-Hispanic				Hispanic					
	Total[1]	White	Black	Asian	AIAN	Total Hispanic[2]	Mexican	Puerto Rican	Cuban	Dominican	Central/South American
Total	5.69	4.61	10.78	3.63	8.69	4.96	4.94	6.09	4.08	$^{M,C}4.83$	$^{C,D}4.25$
Maternal age											
Under age 20	8.85	8.46	12.70	$^{W}7.19$	$^{W,B,A}11.43$	$^{A}6.54$	6.53	$^{M}6.83$	*	$^{M,P}6.35$	$^{M,P,D}5.32$
20-24	6.85	5.99	11.16	4.67	9.14	$^{A}5.07$	4.87	6.63	$^{M,P}4.00$	$^{M,P}6.22$	$^{M,C}4.32$
25-29	5.50	4.59	10.40	3.22	7.92	$^{W}4.49$	4.53	$^{M}4.93$	$^{M,P}4.56$	$^{M,C}4.55$	$^{C,D}3.63$
30-34	4.66	3.64	10.26	$^{W}3.44$	7.47	4.41	4.49	5.96	$^{M}3.61$	$^{M,C}3.58$	$^{C,D}3.72$
35-39	5.15	4.05	10.07	3.66	$^{B}9.20$	5.33	5.18	6.91	$^{M,P}4.11$	$^{M,P,C}4.39$	$^{M,C,D}4.78$
40 and over	7.06	5.49	13.52	$^{W}5.11$	*	7.02	7.42	$^{M}9.23$	*	*	$^{M,P}7.09$
Maternal education[3]											
Less than high school	7.18	8.52	12.33	5.21	$^{W,B}10.15$	$^{A}5.32$	5.27	9.02	*	$^{M}4.56$	$^{M,D}4.77$
High school	7.01	6.27	11.83	4.99	9.38	$^{A}5.14$	5.05	6.41	$^{M,P}4.62$	$^{M,P,C}5.09$	$^{M,C,D}4.45$
Some college	5.47	4.47	10.16	3.94	7.26	$^{W}4.48$	4.50	$^{M}5.30$	$^{M,P}4.01$	$^{M,P,C}4.20$	$^{C,D}3.41$
Bachelor's degree or higher	3.22	2.78	7.19	$^{W}2.97$	*	3.32	3.38	$^{M}3.77$	$^{M,P}2.92$	$^{M,P,C}3.26$	$^{M,P,C,D}3.12$
Prepregnancy BMI											
Underweight	5.88	5.72	10.18	2.48	*	$^{W}5.46$	4.95	$^{M}8.09$	*	*	$^{M,P}4.31$
Normal weight	4.54	3.86	9.04	2.98	$^{B}8.18$	4.30	4.40	$^{M}5.06$	3.25	$^{M,P,C}4.11$	$^{C,D}3.44$
Overweight	5.10	4.14	9.37	$^{W}4.06$	7.82	$^{A}4.44$	4.33	5.69	$^{M,P}5.00$	$^{M,P,C}4.53$	$^{M,C,D}4.09$
Obesity	7.03	5.61	11.94	$^{W}6.16$	8.54	$^{W,A}5.67$	5.66	6.45	$^{M,P}4.58$	$^{M,P,C}5.72$	$^{M,C,D}5.16$
WIC receipt											
Received WIC	5.85	5.78	8.74	3.29	$^{B}7.91$	4.21	4.20	5.41	$^{M}3.68$	$^{M,C}3.91$	$^{CD}3.50$
Did not receive WIC	5.40	4.14	12.85	3.65	9.30	5.81	5.88	6.64	4.42	$^{M,P}6.00$	$^{C,D}5.03$
Source of payment for delivery											

		Race and Hispanic origin									
		Non-Hispanic				Hispanic					
	Total[1]	White	Black	Asian	AIAN	Total Hispanic[2]	Mexican	Puerto Rican	Cuban	Dominican	Central/South American
Medicaid	7.26	6.69	11.22	4.33	9.79	5.08	4.93	6.62	^{M}4.65	^{M,C}4.66	^{C,D}4.38
Private insurance	4.18	3.51	9.38	^{W}3.49	5.75	4.24	4.35	^{M}4.68	3.09	^{M,P,C}4.60	^{C,D}3.38
Self-pay	6.49	5.83	12.03	2.01	*	6.52	6.91	14.90	*	*	5.07
Other	5.78	4.60	11.02	^{W}4.15	^{B}7.72	^{A,I}5.34	5.34	^{M}7.33	*	*	^{M,P}5.28
Trimester of first prenatal care											
1st trimester	4.72	3.79	9.64	3.28	6.85	4.41	4.43	5.25	3.70	^{M,C}4.44	^{C}3.71
2nd trimester	6.31	6.04	9.20	3.96	^{B}9.96	4.71	4.68	5.87	*	^{M,P}4.36	^{D}4.05
3rd trimester/None	10.62	10.10	15.65	4.60	^{W,B}12.76	7.56	7.54	10.68	*	^{M,P}7.59	^{D}6.01
Smoked during pregnancy											
Yes	10.56	9.27	18.35	^{W}9.24	^{A}13.00	^{W,A}10.23	8.72	^{M}12.25	*	*	*
No	5.27	4.05	10.23	3.59	7.69	4.85	4.88	5.69	4.07	^{M,C}4.67	^{C,D}4.24
Infant sex											
Male	6.23	5.09	11.91	3.97	9.53	5.34	5.37	6.67	4.32	^{M}5.53	^{C}4.26
Female	5.12	4.10	9.62	3.27	7.81	4.57	4.50	5.49	^{M}3.83	^{M,C}4.10	^{M,C,D}4.24
Plurality											
Singleton	5.08	4.11	9.60	3.14	7.95	4.50	4.49	5.55	3.63	^{M,C}4.23	^{C,D}3.89
Twin and higher	23.05	17.89	37.83	^{W}19.80	^{B}35.47	22.78	23.69	^{M}23.00	^{M,P}18.14	^{M,P,C}23.19	^{P,C,D}19.51
Gestational age											
Less than 37 weeks	37.79	31.23	54.91	^{W}30.47	40.36	35.06	35.05	38.69	^{M,P}33.26	^{M,P,C}37.92	^{C}32.07
Less than 28 weeks	380.73	383.77	^{W}375.36	^{W,B}380.59	^{W,B,A}381.68	^{W,B,A,I}368.00	378.24	^{M}366.75	^{M,P}353.74	^{M,P,C}354.63	^{M,P,C,D}356.97
28-31 weeks	42.73	43.16	^{W}42.07	32.95	65.57	^{W,B}42.18	43.87	^{M}38.89	*	^{M,P}46.62	^{M,P,D}38.11
32-33 weeks	21.19	20.43	23.83	^{W}15.38	^{W,B,A}27.41	^{W,B,A,I}20.86	21.77	^{M}17.37	*	*	^{M,P}21.26
34-36 weeks	8.27	8.09	9.88	5.97	^{B}12.88	7.29	7.43	^{M}5.96	*	^{M,P}5.95	^{M,P,D}6.88
37-38 weeks	3.18	3.07	4.75	1.64	5.94	2.58	2.69	^{M}2.79	*	^{M,P}2.20	^{D}1.98
39 weeks and more	1.62	1.49	2.78	0.85	3.52	1.32	1.34	1.64	^{M,P}0.99	^{M,P,C}1.12	^{M,C,D}1.19

BMI: Body mass index

[*] Rate does not meet NCHS stands of reliability; based on <20 deaths.

[1] Includes births to race and Hispanic origin groups not shown separately.

[2] Includes births to Hispanic origin groups not shown separately.

[3] Restricted to women age 25 and over

[w] Not significantly different from non-Hispanic White

[B] Not significantly different from non-Hispanic Black

[A] Not significantly different from non-Hispanic Asian

[I] Not significantly different from non-Hispanic AIAN

[M] Not significantly different from Mexican

[P] Not significantly different from Puerto Rican

[C] Not significantly different from Cuban

[D] Not significantly different from Dominican

Table 3 –

Unadjusted and adjusted infant mortality rates and risk ratios of infant mortality: United States, 2017-2018

	Unadjusted			Adjusted[a]			Adjusted[b]		
	Rate	**Rate Ratio**	**95% CI**	**Rate**	**Rate Ratio**	**95% CI**	**Rate**	**Rate Ratio**	**95% CI**
Race and Hispanic origin[1]									
Non-Hispanic White (ref)	4.61	1.00		4.90	1.00		5.83	1.00	
Non-Hispanic Black	10.78	2.34	2.29-2.39	9.30	1.90	1.85-1.94	6.21	1.06	1.04-1.09
Non-Hispanic Asian	3.63	0.79	0.75-0.83	4.93	1.00*	0.96-1.01	5.28	0.91	0.87-0.95
Non-Hispanic AIAN	8.69	1.89	1.73-2.06	6.80	1.39	1.27-1.51	6.93	1.19	1.09-1.29
Hispanic	4.96	1.08	1.05-1.11	4.83	0.98*	0.96-1.01	4.93	0.84	0.82-0.87
N				7,647,212			7,647,212		
−2 Log Liklihood (df)				28,262.04 (32)			172,597.56(38)		
	Unadjusted			**Adjusted[a]**			**Adjusted[b]**		
	Rate	**Rate Ratio**	**95% CI**	**Rate**	**Rate Ratio**	**95% CI**	**Rate**	**Rate Ratio**	**95% CI**
Hispanic subgroups[2]									
Mexican (ref)	4.94	1.00		4.95	1.00		5.08	1.00	
Puerto Rican	6.09	1.23	1.14-1.32	5.95	1.20	1.12-1.30	5.04	0.99**	0.93-1.06
Cuban	4.08	0.83	0.72-0.96	4.59	0.93**	0.80-1.07	4.46	0.88	0.77-1.00
Dominican	4.83	0.98**	0.87-1.10	5.23	1.06**	0.94-1.19	4.79	0.94**	0.85-1.05
Central/South American	4.25	0.86	0.81-0.91	4.16	0.84	0.79-0.90	4.50	0.89	0.84-0.94
N				1,784,974			1,784,974		
−2 Log Liklihood (df)				3,883.31 (31)			36,853.50 (37)		

[1] Models include births to race groups not shown separately.

[2] Models include births to Hispanic origin groups not shown separately.

* Not significantly different from infants of non-Hispanic White women.

** Not significantly different from infants of Mexican women.

[a] Net of maternal age, education, prepregnancy body mass index (BMI), WIC receipt, smoking, payment for delivery, initiation of prenatal care, infant sex, plurality

[b] Net of maternal age, education, prepregnancy BMI, WIC receipt, smoking, payment for delivery, initiation of prenatal care, infant sex, plurality, gestational age