

INFANT MORTALITY

Infant mortality, or the death of a child within the first year of life, is a sentinel measure of population health that reflects the underlying well-being of mothers and families, as well as the broader community and social environment that cultivate health and access to health-promoting resources. In 2011, 24,001 infants died before their first birthday in the United States, representing an infant mortality rate of 6.07 deaths per 1,000 live births (table 1). Among grouped summary causes of death, preterm-related conditions accounted for 35.4 percent of all infant deaths, followed by congenital anomalies (20.9 percent; see page on birth defects), other perinatal conditions not directly related to prematurity (14.5 percent), and sudden unexpected infant death (SUID, 14.2 percent; see page on sleep-related SUID). About two-thirds of infant deaths occur in the neonatal period or within the first month of life (4.06 per 1,000 live births), with the remaining third occurring in the postneonatal period from 1 month to less than 1 year (2.01 per 1,000 live births). Neonatal mortality is predominantly relat-

ed to prematurity, congenital anomalies, and other perinatal conditions; postneonatal mortality is mostly attributable to SUID, congenital anomalies, infection, and injury.

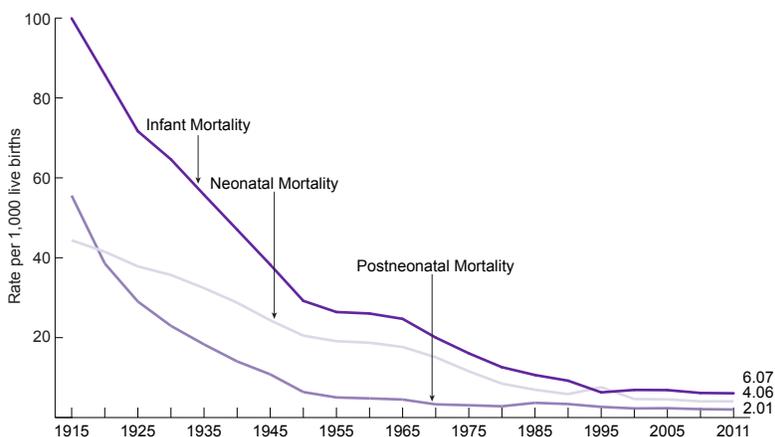
With the exception of 2000–2005, the U.S. infant mortality rate had been consistently declining at least every few years since it was first assessed in 1915 (figure 1). The substantial infant mortality decline over the 20th century has been attributed to economic growth, improved nutrition, new sanitary measures, and advances in clinical medicine and access to care.^{1,2} Infant mortality declines in the 1990s were aided particularly by the approval of synthetic surfactants to reduce the severity of respiratory distress syndrome (a common affliction of preterm infants) and the recommendation that infants be placed on their backs to sleep to prevent sudden infant death syndrome. The lack of progress between 2000 and 2005 has been attributed to increases in preterm birth and obstetric interventions such as inductions and cesareans,³ which have begun to decline in the last several years along with the infant mortality rate.^{4,5}

Table 1: Infant, Neonatal, and Postneonatal Mortality Rates per 1,000 Live Births,* by Summary Cause of Death, 2011**

Summary Cause of Death	Infant Mortality			Neonatal Mortality			Postneonatal Mortality		
	Number	Rate per 1,000 Live Births	Percent of Deaths	Number	Rate per 1,000 Live Births	Percent of Deaths	Number	Rate per 1,000 Live Births	Percent of Deaths
All causes	24,001	6.07	100.0%	16,065	4.06	100.0%	7,936	2.01	100.0%
Preterm-related conditions	8,500	2.15	35.4%	8,188	2.07	51.0%	312	0.08	3.9%
Congenital anomalies	5,016	1.27	20.9%	3,569	0.90	22.2%	1,447	0.05	18.2%
Other perinatal conditions	3,478	0.88	14.5%	3,292	0.83	20.5%	186	0.37	2.3%
SUID	3,399	0.86	14.2%	398	0.10	2.5%	3,001	0.76	37.8%
Infection	906	0.23	3.8%	64	0.02	0.4%	842	0.21	10.6%
Injury	904	0.23	3.8%	85	0.02	0.5%	819	0.21	10.3%
All other causes	1,797	0.45	7.5%	468	0.12	2.9%	1,329	0.34	16.7%

*Infant deaths are of those less than 1 year old; neonatal deaths are of those less than 28 days old; postneonatal deaths are of those at least 28 days old and less than 1 year old. **Preterm-related conditions: infant born preterm (<37 weeks) and an ICD-10 underlying cause-of-death code of K550, P000, P010, P011, P015, P020, P021, P027, P070–P073, P102, P220–229, P250–279, P280, P281, P360–369, P520–523, or P77. Developed by: Callaghan WM, MacDorman MF, Rasmussen SA, Qin C, Lackritz EM. The contribution of preterm birth to infant mortality rates in the United States. *Pediatrics*. October 2006;118(4):1566–1573. Other perinatal conditions: All other codes in P00–P96, regardless of prematurity. Congenital anomalies: Q00–Q99. SUID: R95–R99 and W75. Infections: A00–B99, G00, G03, I30, I33, I40, and J00–J42. Injury: J69, U01, V01–W74, and W76–Y36.

Figure 1. Infant, Neonatal, and Postneonatal Mortality Rates per 1,000 Live Births,* 1915–2011**



*Infant deaths are of those less than 1 year old; neonatal deaths are of those less than 28 days old; postneonatal deaths are of those at least 28 days old and less than 1 year old. **Data from 1915–1932 are a subset from states with birth registration, which became 100 percent by 1933.

In 2011, the U.S. infant mortality rate ranked 27th among industrialized nations, behind most European countries, Australia, Canada, Israel, and South Korea (table 2). Sweden had the lowest infant mortality rate, 2.1 per 1,000 live births, followed by Japan and Finland with infant mortality rates of 2.3 and 2.4 deaths per 1,000 live births, respectively. The United States did not always rank this low; in 1960, it ranked 11th, with Norway, the Netherlands, and Sweden reporting the three lowest rates among industrialized nations that year. Differences in infant mortality rates among industrialized nations may reflect variation in the definition, measurement, and reporting of fetal and infant deaths. However, analyses by gestational age indicate that this disparity is most likely related to the high rate of preterm birth in the United States.⁶ Although the United States compares favorably with European countries with respect to the survival of preterm infants, the higher rate of preterm birth in the United States significantly affects the infant mortality rate. Mortality among infants born at term (37 or more weeks' gestation) is also higher in the United States.

Large and persistent disparities by race and ethnicity and educational attainment may also contribute to higher rates of infant mortality in the United States relative to other countries. With respect to maternal education, infant mortality decreases with increasing levels of education. In 2011, among the 33 states and the District of Columbia that had implemented the 2003 U.S. Standard Certificate of Live Birth as of January 1, 2010, infants born to mothers with less than a high school degree were more than twice as likely to die in their first year of life than infants born to mothers with a bachelor's degree or higher (7.54 versus 3.63 per 1,000). Educational disparities in both neonatal and postneonatal mortality were present; however, the postneonatal disparity was higher, with infants of mothers with less than a high school diploma 1.69 times as likely to die in the first month of life and 3.26 times as likely to die between 1 month and 1 year of life as infants of mothers with a college degree or higher. If all infants in the United States had the same risk of death as those born to mothers with a college degree or higher, the United States would climb from 27th to 16th in international infant mortality rankings and tie with Austria, Germany, and the Netherlands.

Table 2: International Infant Mortality Rates and Rankings,* Selected Countries, 1960 and 2011**

Country	1960		2011	
	Rate per 1,000 Live Births	Rank	Rate per 1,000 Live Births	Rank
Australia	20.2	5	3.8	19
Austria	37.5	19	3.6	16
Belgium	31.4	17	3.4	10
Canada	27.3	12	4.8	23
Chile	120.3	27	7.7	28
Czech Republic	20.0	4	2.7	5
Denmark	21.5	8	3.5	12
Finland	21.0	6	2.4	3
France	27.7	13	3.5	12
Germany	35.0	18	3.6	16
Greece	40.1	20	3.4	10
Hungary	47.6	23	4.9	24
Ireland	29.3	15	3.5	12
Israel	NA	NA	3.5	12
Italy	43.9	22	2.9	6
Japan	30.7	16	2.3	2
South Korea	NA	NA	3.0	7
Mexico	92.3	26	13.7	30
Netherlands	16.5	2	3.6	16
New Zealand	22.6	10	5.2	26
Norway	16.0	1	2.4	3
Poland	56.1	24	4.7	22
Portugal	77.5	25	3.1	8
Slovak Republic	28.6	14	4.9	24
Spain	43.7	21	3.2	9
Sweden	16.6	3	2.1	1
Switzerland	21.1	7	3.8	19
Turkey	189.5	28	7.7	28
United Kingdom	22.5	9	4.3	21
United States	26.0	11	6.1	27

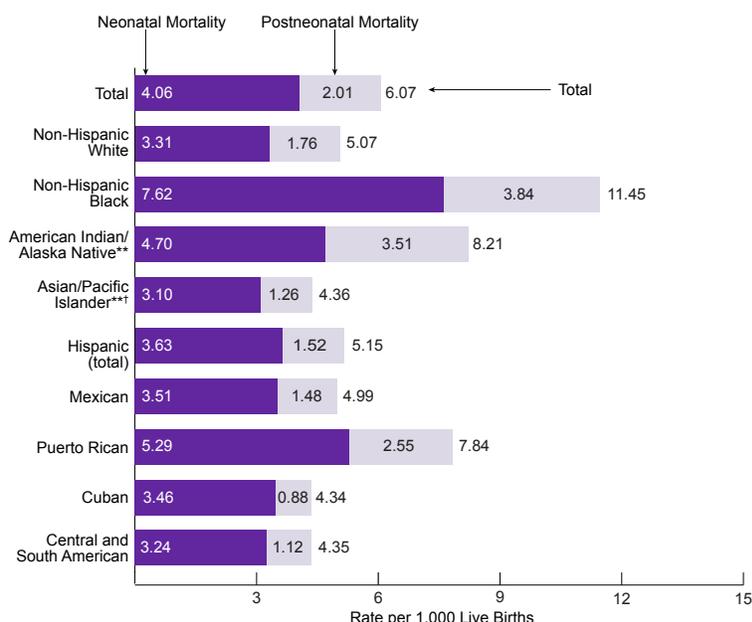
*Rankings are from lowest to highest infant mortality rates (IMRs). Countries with the same IMR receive the same rank. Relative rankings may be affected if not all countries have reported data.
 **Countries with at least 2.5 million people and listed in the Organisation for Economic Co-operation and Development database. NA = data not available.

In 2011, the infant mortality rate was highest for infants of non-Hispanic Black mothers (11.45 per 1,000 live births)—a rate 2.3 times that of non-Hispanic Whites (5.07 per 1,000; figure 2). Infant mortality was also higher among infants born to American Indian/Alaska Native and Puerto Rican mothers (8.21 and 7.84 per 1,000, respectively). Infant mortality was lowest among Cubans, Central and South Americans, and Asian/Pacific Islanders (~4.35 per 1,000); however, there is considerable variability within the Asian/Pacific Islander population, and higher infant mortality has been shown among Native Hawaiians.⁷ Excess prematurity and SUID tend to be the largest proximate causes of racial and ethnic disparities in infant mortality.⁸ If all U.S. infants had the same risk of dying as non-Hispanic Whites, the U.S. ranking among industrialized countries would move from 27th to 26th.

Infant mortality prevention strategies include clinical and population-based efforts to promote the health of women before and between pregnancies to prevent and manage chronic conditions and risk factors, such as diabetes, hypertension, smoking, unintended

pregnancy, and short birth intervals, which may lead to prematurity, low birth weight, and congenital anomalies.⁹ Improving access to risk-appropriate prenatal and newborn care, such as progesterone therapy, antenatal steroids, and regionalized perinatal systems, can also reduce prematurity or morbidity among preterm infants.¹⁰ In addition, efforts to promote positive postpartum behaviors, such as breastfeeding, smoking cessation, and safe sleep practices, can help reduce the risk of SUID.¹¹ Finally, programmatic and policy interventions to address the fundamental social determinants of health, such as education and housing, would reduce virtually all causes of infant death.¹² Many of these prevention opportunities are being addressed through various state and community-based initiatives such as the Collaborative Improvement and Innovation Network (CoIIN) to reduce infant mortality, the Healthy Babies Initiative, the Strong Start Initiative, Healthy Start,¹² Best Babies Zones,¹³ and the Institute for Equity in Birth Outcomes,¹⁴ with support from multiple prevention components of the Affordable Care Act.¹⁵

Figure 2. Infant, Neonatal, and Postneonatal Mortality Rates,* by Maternal Race/Ethnicity, 2011



*Infant deaths are of those less than 1 year old; neonatal deaths are of those less than 28 days old; postneonatal deaths are of those at least 28 days old and less than 1 year old. **May include Hispanics. †Separate data for Asians, Native Hawaiians, and other Pacific Islanders are not available.

Data Sources

Table 1. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics. 2011 Linked Birth/Infant Death File. Analyzed by the U.S. Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau.

Figure 1. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics. Natality. *Vital Statistics of the United States, 1993*, vol. I. Hyattsville, MD: National Center for Health Statistics; 1999.

U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics. Mortality, part A. *Vital Statistics of the United States, 1993*, vol. II. Hyattsville, MD: National Center for Health Statistics; 2002.

U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics. Compressed mortality file 1979–1998. CDC WONDER Online Database. 2003. Available at: <http://wonder.cdc.gov/cmfi-icd9.html>. Accessed August 11, 2014.

U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics. Compressed mortality file 1999–2011. CDC WONDER Online Database. July 2014. Available at: <http://wonder.cdc.gov/cmfi-icd10.html>. Accessed August 11, 2014.

Table 2. Organisation for Economic Co-operation and Development. OECD.StatExtracts: Maternal and Infant Mortality. Available at: http://stats.oecd.org/index.aspx?DataSetCode=HEALTH_STAT. Accessed August 11, 2014.

Figure 2. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics. 2011 Linked Birth/Infant Death File. Analyzed by the U.S. Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau.

Endnotes

- Guyer B, Freedman MA, Strobino DM, and Sondik EJ. Annual summary of vital statistics: trends in the health of Americans during the 20th century. *Pediatrics*. 2000;106:1307–1317.
- U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. Advancements in public health, 1900–1999: healthier mothers and babies. *Morbidity and Mortality Weekly Report*. 1999;48:849–858.
- MacDorman MF, Mathews TJ. *Recent Trends in Infant Mortality in the United States*. NCHS data brief, no 9. Hyattsville, MD: National Center for Health Statistics; 2008.
- Hamilton BE, Martin JA, Osterman MJK, Curtin SC. Births: preliminary data for 2013. *National Vital Statistics Reports*, vol. 63, no. 2. Hyattsville, MD: National Center for Health Statistics; 2014.
- Osterman MJK, Martin JA. *Recent Declines in Induction of Labor by Gestational Age*. NCHS data brief, no. 155. Hyattsville, MD: National Center for Health Statistics; 2014.
- MacDorman MF, Mathews TJ, Mohangoo AD, Zeitlin J. International comparisons of infant mortality and related factors: United States and Europe, 2010. *National Vital Statistics Reports*, vol. 63, no. 5. Hyattsville, MD: National Center for Health Statistics; 2014.
- Mathews TJ, Menacker F, MacDorman MF. Infant mortality statistics from the 2002 period linked birth/infant death data set. *National Vital Statistics Reports*, vol. 53, no. 10. Hyattsville, Maryland: National Center for Health Statistics; 2004.
- MacDorman MF, Mathews TJ. *Understanding Racial and Ethnic Disparities in U.S. Infant Mortality Rates*. NCHS data brief, no. 74. Hyattsville, MD: National Center for Health Statistics; 2011.
- Johnson K, Posner SF, Biermann J, et al. Recommendations to improve preconception health and health care—United States. A report of the CDC/ATSDR Preconception Care Work Group and the Select Panel on Preconception Care. *MMWR Recommendations and Reports: Morbidity and Mortality Weekly Report*. April 21, 2006;55(RR-6):1–23.
- Berns S, Kott A, eds. *Toward Improving the Outcome of Pregnancy III*. White Plains, NY: March of Dimes Foundation; December 2010.
- Task Force on Sudden Infant Death Syndrome, Moon RY. SIDS and other sleep-related infant deaths: expansion of recommendations for a safe infant sleeping environment. *Pediatrics*. November 2011;128(5):1030–1039.
- Lu MC, Johnson KA. Toward a national strategy on infant mortality. *American Journal of Public Health*. February 2014;104(Suppl 1):S13–S16.
- W.K. Kellogg Foundation. Best Babies Zone: A holistic, Neighborhood-Based Approach to Improving Birth Outcomes. Available at: <http://www.wkkf.org/what-we-do/featured-work/best-babies-zone-a-holistic-neighborhood-based-approach-to-improving-birth-outcomes>. Accessed September 22, 2014.
- CityMatCH. Institute for Equity in Birth Outcomes. Available at: <http://www.citymatch.org/projects/institute-equity-birth-outcomes-0>. Accessed September 22, 2014.
- Koh HK, Sebelius KG. Promoting prevention through the Affordable Care Act. *New England Journal of Medicine*. September 30, 2010;363(14):1296–1299.

Suggested Citation

U.S. Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau. *Child Health USA 2014*. Rockville, Maryland: U.S. Department of Health and Human Services, 2015. Online at <http://mchb.hrsa.gov/chusa14/>