Running the Numbers

A Periodic Feature to Inform North Carolina Health Care Professionals
About Current Topics in Health Statistics

Disparities in Infant Mortality: Examining Perinatal Periods of Risk

The death of an infant in the first year of life is considered a sentinel public health event and an indicator of the overall health of a population. In 2017, approximately 7 infants died for every 1,000 infants born in North Carolina [1]. This was the 10th highest infant mortality rate in the nation in 2017, tied with Louisiana [2].

While the state has experienced substantial declines in overall infant mortality over the last 2 decades, racial disparities in infant mortality persist [3]. As shown in Figure 1, mortality rates for non-Hispanic white and Hispanic infants consistently fell below the state 5-year average over the last 2 decades, while non-Hispanic black and non-Hispanic American Indian infant mortality rates averaged 1.2 to 1.8 times higher than the state rate during the same time period.

Comparing infant mortality rates among babies born to non-Hispanic black mothers with non-Hispanic white mothers, we can see that the disparity ratio remained virtually unchanged from 1998 to 2017, with non-Hispanic black infants having 5-year aggregate infant mortality rates 2.4 to 2.5 times higher than non-Hispanic white infants throughout this time period. Disparity ratios are also high among non-Hispanic American Indians, with rates 1.6 to 1.9 times higher than non-Hispanic white infants over the same period.

A variety of statewide health initiatives are focused on closing the black-white disparity ratio, including Healthy North Carolina 2020, the Perinatal Health Strategic Plan, and the North Carolina Early Childhood Action Plan [4-6]. Both Healthy North Carolina 2020 and the Early Childhood Action Plan aim to reduce the disparity in infant mortality rates between non-Hispanic white and non-Hispanic black infants to 1.92. Assuming the non-Hispanic white rate remained the same as in 2017 (5.0), the non-Hispanic black rate would need to decline another 23% to 9.6 deaths per 1,000 live births in order to achieve this statewide disparity goal.

Examining Perinatal Periods of Risk in North Carolina

The North Carolina State Center for Health Statistics recently initiated a Perinatal Periods of Risk (PPOR) study to provide more information about the disparities in infant mortality rates. The PPOR analytic approach is a 2-phase methodology examining age at death and birth weight to map mortality rates, identify excess mortality, and suggest possible areas for intervention [7-9]. One of the strengths of the PPOR analytic approach is that when fetal-infant mortality is partitioned into 4 periods of risk defined by birth weight and age at time of death, the preventive factors and strategies for consideration can be narrowed and resources targeted to periods of greatest need.

Using Vital Statistics data from the State Center for Health Statistics, PPOR classifies fetal-infant deaths into 4 periods of risk. The Maternal Health/Prematurity period of risk includes all fetal and infant deaths of 500-1,499g and ≥24 weeks for gestation. The Maternal Care period of risk includes fetal deaths of 1,500g or more and ≥24 weeks. The Newborn Care period of risk includes infant deaths of 1,500g or more and <28 days of age. The Infant Health period of risk includes infant deaths of 1,500g or more and ≥28 days of age. These 4 periods of risk can be arranged schematically into a PPOR Mortality Map as shown in Figure 2.
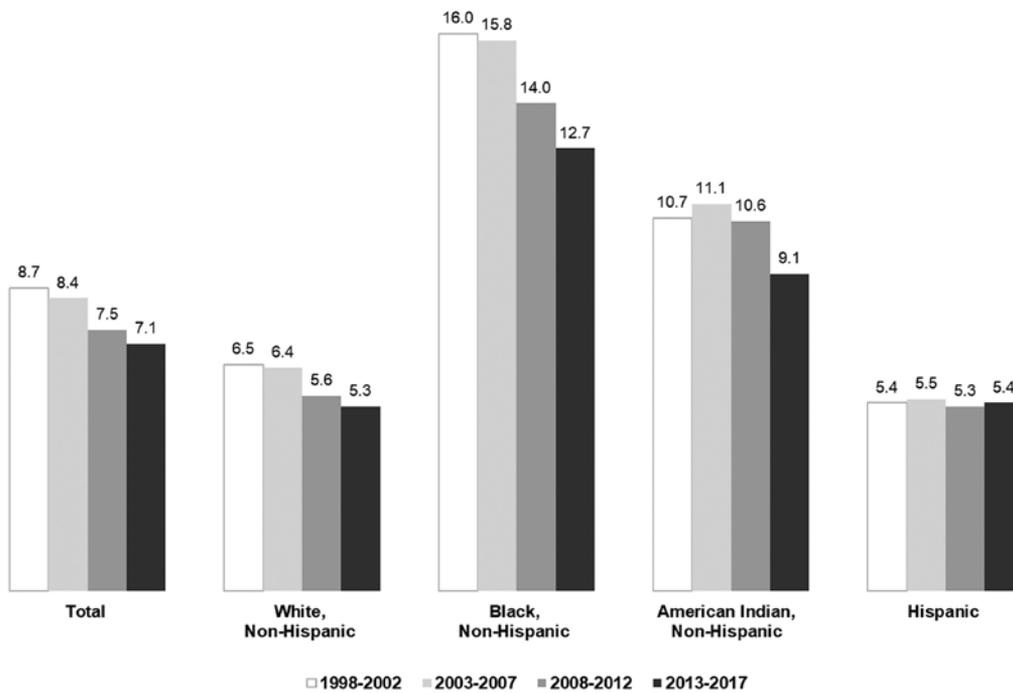
FIGURE 1.

**Trends in Infant Mortality Rates, North Carolina Residents, 1998-2017**

Source. North Carolina State Center for Health Statistics, Vital Statistics.

The first phase of PPOR analysis identifies excess mortality by comparing fetal-infant mortality rates from a reference group with relatively low mortality rates to the higher mortality rates of the other study groups. The underlying premise of the PPOR approach is that the comparison groups should be able to achieve low mortality rates similar to those of the reference group. The reference population

FIGURE 2.

Perinatal Periods of Risk Mortality Map
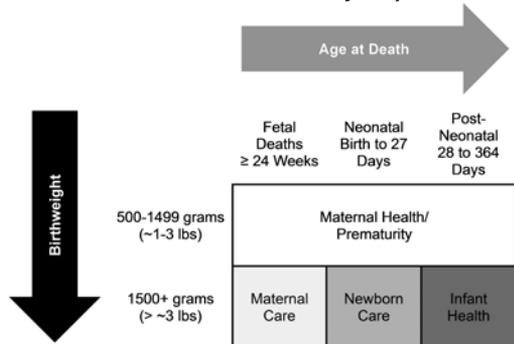
Source. Sappenfield WM, Peck MG, Gilbert CS, Haynatzka VR, Bryant T. Perinatal periods of risk: analytic preparation and phase 1 analytic methods for investigating feto-infant mortality. Matern Child Health J. 2010;14(6):838-850.

for the North Carolina PPOR analysis consists of infants born to non-Hispanic white women aged 21 years and older and with more than 12 years of education. Separate PPOR Mortality Maps are created for non-Hispanic American Indian, non-Hispanic white, non-Hispanic black, and Hispanic infants and then compared with the Mortality Map of the reference population to determine the excess mortality rate for each risk period and the number of excess deaths.

The data used for the North Carolina PPOR analysis are derived from information collected on North Carolina resident vital records from 2014 to 2017, including fetal death certificates and infant death certificates linked with birth certificate records. The analytic dataset was determined to be of sufficient size and quality for PPOR analysis and retained 481,388 birth records, 1,923 fetal death records, and 2,427 infant death records.

As shown in Table 1, there were 4,350 fetal and infant deaths in North Carolina during 2014-2017, and a total fetal-infant mortality rate of 9.0 deaths per 1,000 live births and fetal deaths as compared to the rate of the reference group of 5.87 per 1,000. Within all 4 periods of risk, non-Hispanic black

infants have higher fetal-infant mortality than the other race/ethnicity study groups and—apart from the reference group—Hispanic infants have lower mortality in every risk period. For all study groups, the Maternal Health/Prematurity period has the highest fetal-infant mortality rate, and the Newborn Care period has the lowest. However, there are differences between groups in how mortality is distributed among the periods of risk. For non-Hispanic black infants, over 43% and 19% of deaths occur within the Maternal Health/Prematurity and Infant Health periods, respectively. This result is in contrast to the 30% and 29% of deaths of non-Hispanic white infants born to mothers not in the reference group during those same periods of risk.

Table 1 also presents excess fetal-infant mortality rates and excess deaths for the study groups. The excess mortality rate is calculated as the difference between the rate of the reference population and that of the study group, and the number of excess deaths for a risk period is calculated as the product of the excess mortality rate and the number of births and fetal deaths in the subgroup. Non-Hispanic black infants had the highest excess mortality rates across all risk periods and account for more than half of the total excess deaths in the state (968 excess deaths) during the study period. The overall excess mortality rate for non-Hispanic black infants is approximately 60% higher than the rate for non-Hispanic whites, and Maternal Health/Prematurity is the period of risk with the highest excess mortality rate. The proportion of excess mortality contributed by each risk period also varied by race/ethnicity study group. Excess fetal-infant deaths occurring within the Maternal Health/Prematurity period of risk make up half or more of all excess deaths of non-Hispanic black and Hispanic infants while for non-Hispanic white infants, the 41% of excess deaths within the Infant Health period of risk make up the largest contribution. In 2017, among non-Hispanic black infants, the leading causes of death in the Infant Health period included birth defects and ill-defined causes such as Sudden Unexpected Infant Death (SUID) [1].

TABLE 1.
Rates (Frequency) of Fetal-Infant Mortality and Excess Mortality by Race and Ethnicity, North Carolina Residents, 2014-2017

	Fetal-Infant Mortality Rates[a]					Frequencies
	Maternal Health/ Prematurity	Maternal Care	Newborn Care	Infant Health	Total	Fetal Deaths and Live Births
NC Total	3.45 (1,669)	2.46 (1,190)	1.22 (588)	1.87 (903)	9.00 (4,350)	483,311
NH White[b]	3.30 (240)	3.05 (222)	1.47 (107)	3.24 (236)	11.06 (805)	72,775
NH Black	6.18 (711)	3.67 (422)	1.66 (191)	2.77 (319)	14.28 (1,643)	115,096
NH AIAN[c]	5.30 (34)	*** (17)	*** (4)	*** (19)	11.54 (74)	6,415
Hispanic	2.88 (210)	2.23 (162)	0.99 (72)	1.28 (93)	7.38 (537)	72,795
Reference	2.13 (413)	1.68 (325)	0.96 (186)	1.11 (215)	5.87 (1,139)	194,009
	Excess Fetal-Infant Mortality Rates					Excess Deaths
NC Total	1.32	0.79	0.26	0.76	3.13	1,513
NH White[b]	1.17	1.38	0.51	2.13	5.19	378
NH Black	4.05	1.99	0.70	1.66	8.40	968
NH AIAN[c]	***	***	***	***	***	***
Hispanic	0.76	0.55	0.03	0.17	1.51	110

Source. NC DHHS.
[a]Rates are computed per 1,000 live births and fetal deaths
[b]Non-Hispanic white subgroup includes infants not in the reference group (born to mothers under 20 years old OR less than 13 years of education)
[c]Rates are not presented and replaced with '***' when the Relative Standard Error (RSE) exceeds 23%

Results from the North Carolina PPOR analysis showing racial disparities in reported fetal-infant mortality rates are consistent with other results found in the published literature [9, 10]. As is the case for infant mortality rates, the fetal-infant mortality rates for non-Hispanic black infants are greater than rates for other groups. Further, non-Hispanic black infants account for well over half of excess fetal-infant deaths in the state. There is a developing body of literature that suggests racial discrimination may be driving some of these disparities [11, 12]. Despite generally lower levels of maternal educational attainment and later initiation of prenatal care, Hispanic infants have fetal-infant mortality rates similar to that of the reference group and few excess deaths reported during the study period—an example of the well-documented "Hispanic Paradox" [13]. Though the study groups were primarily defined by race and ethnicity, non-Hispanic white infants were split into 2 groups defined by maternal educational attainment and maternal age. Non-Hispanic whites who were not members of the reference population had higher rates of mortality and were about twice as likely to die in the first year of life as those in the reference group. While it is not clear which characteristics of this group are driving this disparity, this finding reinforces that social and environmental determinants apart from race exert a considerable influence on fetal-infant mortality.

By stratifying the population by race and ethnicity for the PPOR Phase 1 analysis, results can be used to further tailor interventions to meet the specific needs of subpopulations. For example, knowing that in North Carolina, among non-Hispanic black and Hispanic infants, the majority of excess deaths occurred in the Maternal Health/ Prematurity period means that interventions that address preconception care might have the most impact for these groups. The North Carolina State Center for Health Statistics is currently completing the second phase of the PPOR analysis, which will systematically investigate excess mortality to determine the risk factors and prevention measures that will be most effective in reducing overall fetal-infant mortality rates. **NCMJ**

Vito Di Bona, MS statistician, State Center for Health Statistics, North Carolina Division of Public Health, NC Department of Health and Human Services, Raleigh, North Carolina.
Kathleen Jones-Vessey, MS epidemiologist, Women's and Children's Health Section, North Carolina Division of Public Health, NC Department of Health and Human Services, Raleigh, North Carolina.
Sarah McCracken Cobb, MPH project coordinator, Women's and Children's Health Section, North Carolina Division of Public Health, NC Department of Health and Human Services, Raleigh, North Carolina.

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