



Infant Mortality in Tennessee *1997-2006*

TENNESSEE DEPARTMENT OF HEALTH
OFFICE OF POLICY, PLANNING AND ASSESSMENT
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Key Findings

Infant Mortality Rates

- The infant mortality rate in Tennessee in 2006 was 8.7 deaths per 1,000 live births.
- In 2005, Tennessee was ranked 45th among the fifty states in infant mortality.
- There was no statistically significant trend in infant mortality over the period 1997-2006.
- Regional infant mortality rates ranged from 6.0/1,000 in Knox to 13.1/1,000 in Shelby, while county-level rates ranged from 1.1/1,000 in Trousdale to 15.9/1,000 in Hardeman.
- Two-thirds of infant deaths occurred during the neonatal period (birth to 27 days of age).
- The mortality rate among black infants was 2.5 times as high as among white infants.
- There was no statistically significant trend in the mortality rate among black *or* white infants and the racial gap in infant mortality remained unchanged over the period 1997-2006.
- Between 1997 and 2006, the average, annual infant mortality rate among non-Hispanics was 33% higher than among Hispanics.

Leading Causes of Infant Mortality

- The leading causes of infant mortality in Tennessee between 2002 and 2006 were short gestation and low birthweight, congenital defects, sudden infant death syndrome and accidents. Together, these four causes were responsible for approximately half of all infant deaths.
- Heart defects accounted for the highest percentage of infant deaths due to congenital defects.
- Suffocation and strangulation accounted for the highest percentage of accidental infant deaths.
- Short gestation and low birthweight were the leading cause of death among black infants.
- Congenital defects were the leading cause of death among white infants.

Infant Mortality Risk Factors

- Between 1997 and 2006, the prevalence of the following infant mortality risk factors *increased* in Tennessee: low birthweight, preterm birth, multiple birth, older maternal age and unmarried mother.
- The highest relative risks of infant mortality were for low birthweight and preterm birth. Low birthweight infants were 20 times as likely as normal birthweight infants to die during their first year of life, while preterm infants were 15 times as likely as term infants to die.
- Infant mortality increased with decreasing birthweight. Approximately 23% of deaths occurred among extremely low birthweight infants weighing less than 500 grams, and the infant mortality rate among these smallest babies was 892 deaths per 1,000 live births.
- Regionally, the percentage of deaths that occurred among babies weighing less than 500 grams ranged from 10.9% in Upper-Cumberland to 35.4% in Shelby.
- Between 2001 and 2005, 17.9% of infants were born to women who smoked cigarettes during pregnancy. Infants of smoking mothers were twice as likely as those of non-smokers to die during infancy.
- Infants whose mothers received inadequate or intermediate prenatal care were 30% more likely to die during their first year of life than those receiving adequate care, while infants whose mothers received no prenatal care were almost 6 times as likely to die. Almost 2% of mothers received no prenatal care.
- Infants of mothers with high school or lower education were 84% more likely than those with higher levels of education to die during infancy, while those from households with incomes of less than \$25,000 were over twice as likely to die as those from households with higher incomes.
- The following risk factors were more prevalent among infants of black mothers than those of white mothers: low birthweight, preterm birth, multiple birth, teenage mother, unmarried mother, mother with a previous child death, mother with high school or lower education, and no or inadequate/intermediate prenatal care.
- Smoking during pregnancy and older maternal age were more prevalent among infants of white mothers.

Introduction

Infant mortality (the death of a child during the first year of life) is an often used measure of population health as it is associated with a wide variety of factors such as maternal health, quality and access to medical care, socioeconomic conditions and public health practices.¹ Despite a dramatic decline during the 20th century, the infant mortality rate in the United States has plateaued in recent years and is higher than in most other developed countries.¹ Tennessee's 2005 infant mortality rate ranked 45th among the 50 states (i.e. was the 6th highest) and has remained relatively unchanged in recent years.² In addition, there are large and persistent racial disparities in infant mortality, with black babies in Tennessee two-and-a-half times as likely as white babies to die during their first year of life. A recent brief from the National Center for Health Statistics attributes the plateau in the national infant mortality rate to an increase in the percentage of infants born preterm (less than 37 weeks gestation), together with a lack of decline in the infant mortality rate for very preterm infants (less than 32 weeks gestation).¹ It is also noted that although racial disparities in infant mortality are related to differences in risk factors for infant mortality (preterm and low birthweight delivery, socioeconomic status, access to medical care, etc.), these differences only partially explain the observed disparities.¹

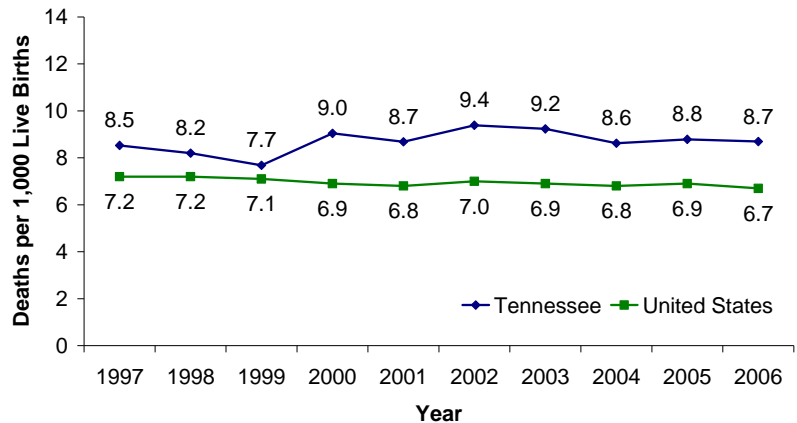
This document provides a comprehensive examination of infant and fetal mortality in Tennessee based on vital statistics data (i.e. data from birth, death and fetal death certificates). It includes infant and fetal mortality rates, leading causes of infant death, the prevalence of infant mortality risk factors, such as low birthweight and preterm birth, as well as the infant mortality rates associated with these risk factors. Special attention is given to racial disparities in infant mortality and risk factor prevalence. Also included in this report is an introduction to perinatal periods of risk (PPOR), which is a tool to help communities better understand and address infant and fetal mortality, and infant mortality profiles for each of the state's 14 Health Department regions. It is hoped that this report will offer the most up-to-date picture possible of the burden of infant mortality in Tennessee, and that it will inform health professionals, policy makers and other organizations and individuals interested in not only lowering the infant mortality rate, but in improving the health of mothers and children throughout the state.

Infant Mortality Rates

Overall Infant Mortality

- Approximately 690 Tennessee infants died each year between 1997 and 2006.
- During this time period, the annual infant mortality rate in Tennessee averaged 8.7 deaths per 1,000 live births.
- There was no statistically significant trend in the infant mortality rate over this time period.

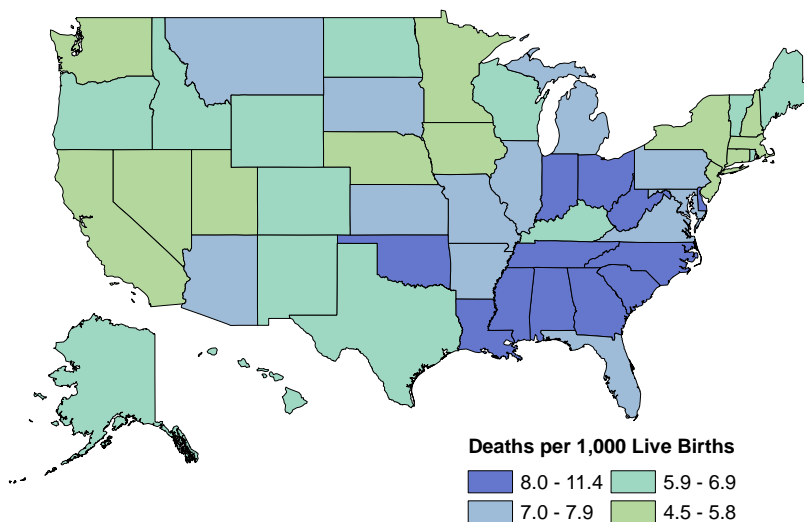
**Infant Mortality
Tennessee and the United States, 1997-2006**



- The infant mortality rate in Tennessee was consistently higher than the rate for the entire United States. In 2006, there were 8.7 infant deaths per 1,000 live births in Tennessee, compared to 6.7/1,000 in the U.S.^{2,3}

Infant Mortality by Location

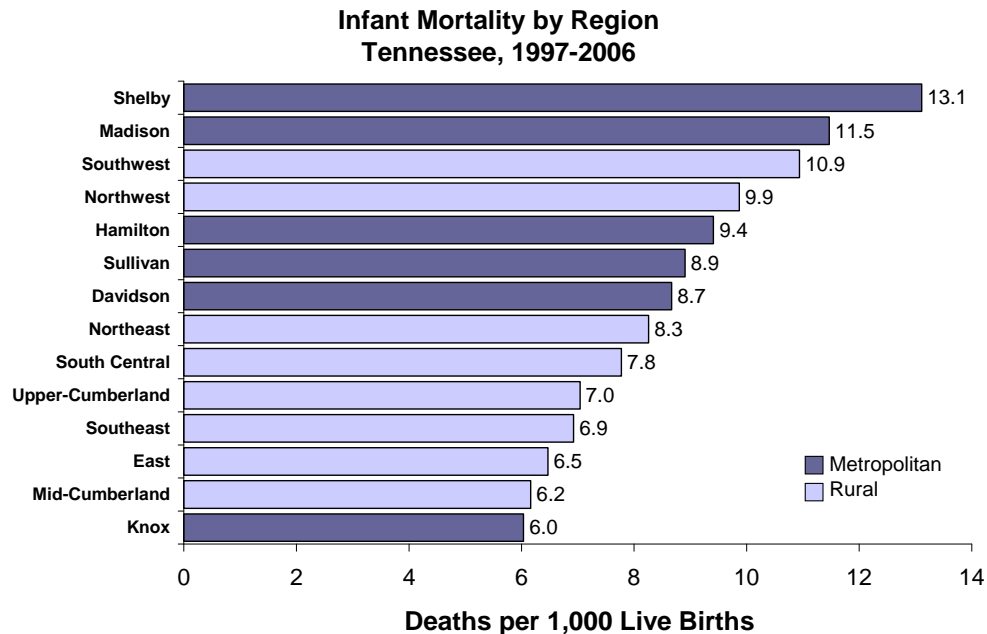
**Infant Mortality
United States, 2005**



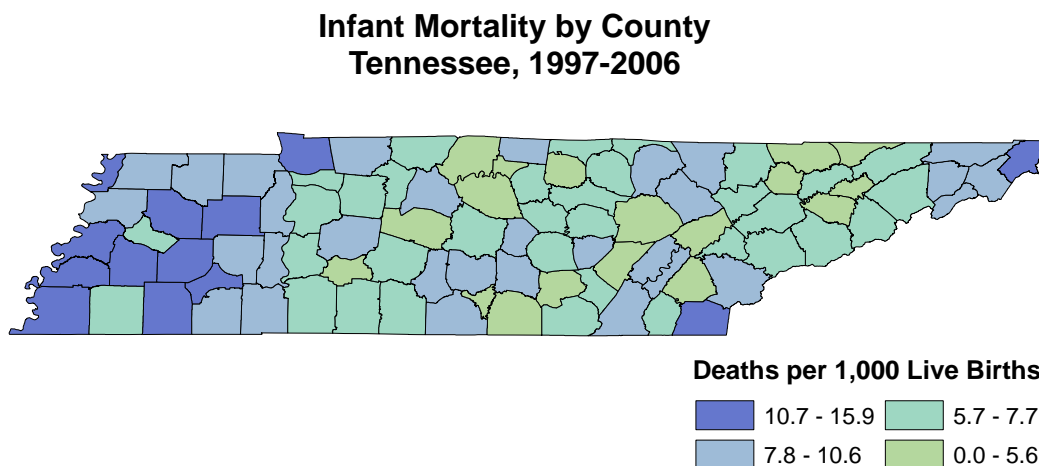
- Among individual states, the 2005 infant mortality rate ranged from 4.5 deaths per 1,000 live births in Utah to 11.4 deaths per 1,000 live births in Mississippi. Tennessee ranked 45th among the 50 states (i.e. had the 6th highest infant mortality rate).²

Infant Mortality by Location *cont.*

- Between 1997 and 2006, the average, annual infant mortality rate in individual Tennessee Health Department regions ranged from 6.0 deaths per 1,000 live births in Knox to 13.1 deaths per 1,000 live births in Shelby.*
- Both the highest and lowest infant mortality rates occurred in metropolitan regions.
- The four regions with the highest infant mortality rates were all in west Tennessee.



- Between 1997 and 2006, the average, annual infant mortality rate in individual Tennessee counties ranged from 1.1 deaths per 1,000 live births in Trousdale County to 15.9 deaths per 1,000 live births in Hardeman County. There were no infant deaths in Moore County during this time period.



* See Appendix B for a regional map of Tennessee.

Infant Mortality by Location *cont.*

- Between 1997 and 2006, there were a total of 789,284 live births and 6,857 infant deaths in Tennessee.
- The highest proportion of both births and infant deaths occurred in the Shelby County Metropolitan Region. Although 18.5% of births occurred in this region, it accounted for 27.9% of infant deaths.
- Together, Tennessee's six metropolitan regions/counties (Davidson, Hamilton, Knox, Madison, Shelby and Sullivan) accounted for 44.8% of births and 53.3% of infant deaths in the state.
- The remaining eight rural regions (representing 89 counties) accounted for 55.2% of births and 46.7% of infant deaths.

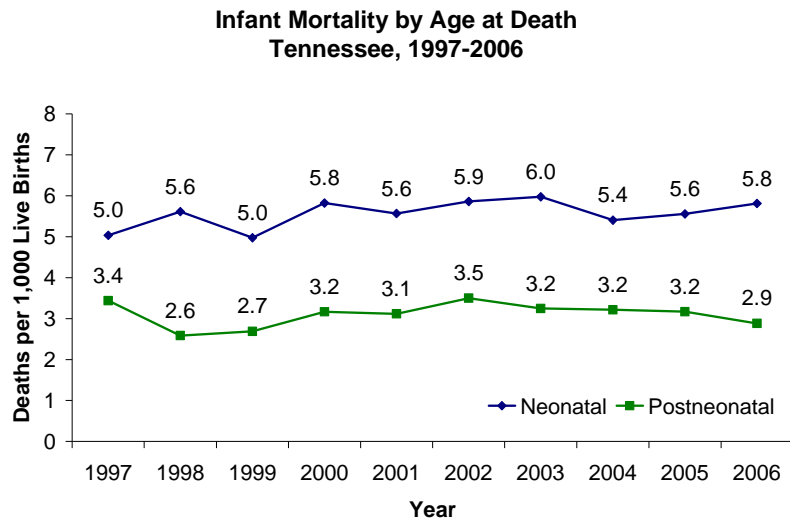
**Distribution of Births and Infant Deaths by Region
Tennessee, 1997-2006***

	Births		Infant Deaths	
	Total Number of Births	Percent of Births	Total Number of Deaths	Percent of Deaths
Davidson	89,197	11.3	773	11.3
East	82,240	10.4	532	7.8
Hamilton	39,529	5.0	372	5.4
Knox	49,032	6.2	296	4.3
Madison	13,257	1.7	152	2.2
Mid-Cumberland	128,685	16.3	793	11.6
Northeast	37,069	4.7	306	4.5
Northwest	30,298	3.8	299	4.4
Shelby	146,069	18.5	1,915	27.9
South Central	46,943	5.9	365	5.3
Southeast	37,835	4.8	262	3.8
Southwest	34,192	4.3	374	5.5
Sullivan	16,733	2.1	149	2.2
Upper-Cumberland	38,202	4.8	269	3.9
Tennessee	789,284	100.0	6,857	100.0

* The denominator used to calculate the percent of births by region (789,281) excluded three infants with missing data on county/region.

Infant Mortality by Age at Death

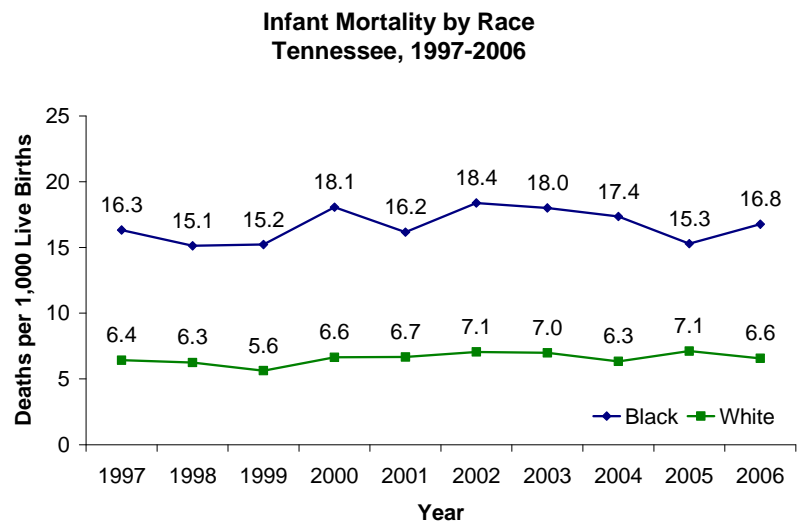
- Approximately two-thirds of infant deaths in Tennessee occurred during the neonatal period (from birth to 27 days of age). The remaining one-third occurred during the postneonatal period (28 days and older).



- Between 1997 and 2006, the annual neonatal mortality rate averaged 5.6 deaths per 1,000 live births. This was almost twice the postneonatal mortality rate (3.1/1,000).
- Over this period, there were no statistically significant trends in either neonatal or postneonatal mortality.

Infant Mortality by Race

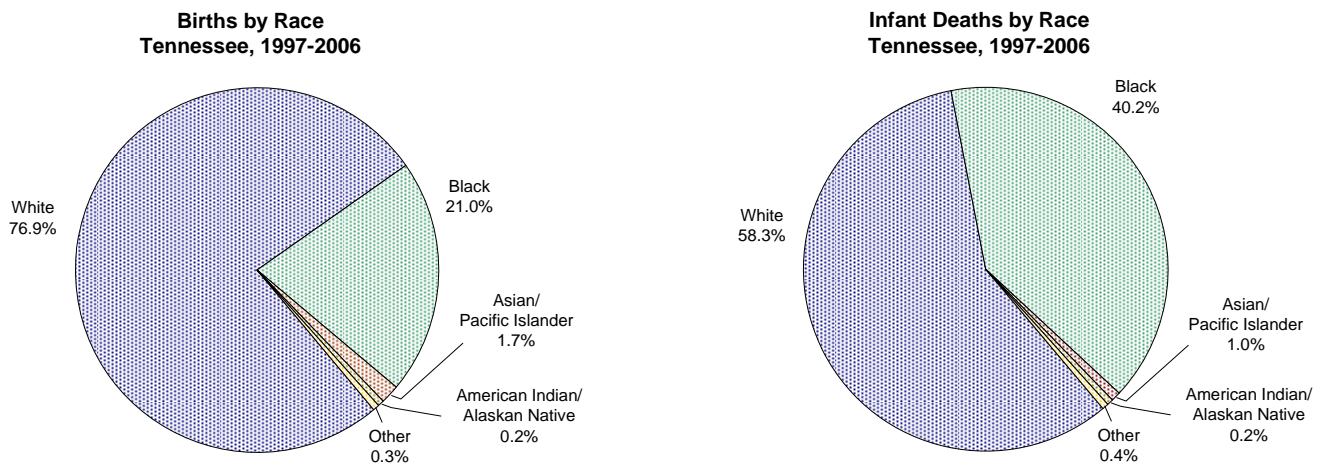
- Between 1997 and 2006, the annual mortality rate among black infants averaged 16.7 deaths per 1,000 live births. This was 2.5 times as high as the mortality rate among white infants (6.6/1,000).*
- Over this period, there were no statistically significant trends in the mortality rate for either black or white infants and the racial gap in infant mortality was stable.



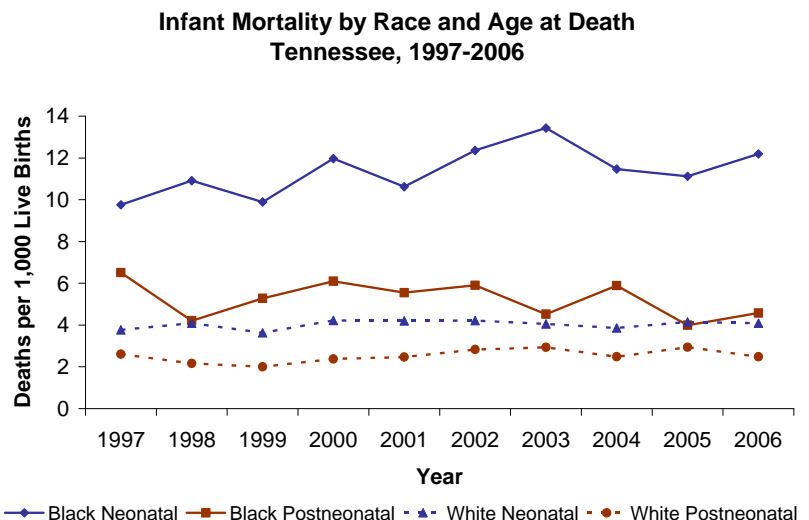
* Unless otherwise noted, "white" and "black" refer to infants of any ethnicity, and "Hispanic" and "non-Hispanic" refer to infants of any race.

Infant Mortality by Race cont.

- Between 1997 and 2006, 1.7% of births and 1.0% of infant deaths in Tennessee occurred in Asians and Pacific Islanders. Less than 1% of both births and infant deaths occurred in American Indians and Alaskan Natives.
- During this time period, the annual infant mortality rate among Asians and Pacific Islanders averaged 4.9 deaths per 1,000 live births, while among American Indians and Alaskan Natives it averaged 7.3/1,000. However, due to the small number of births and deaths among the latter group, this rate should be interpreted with caution.

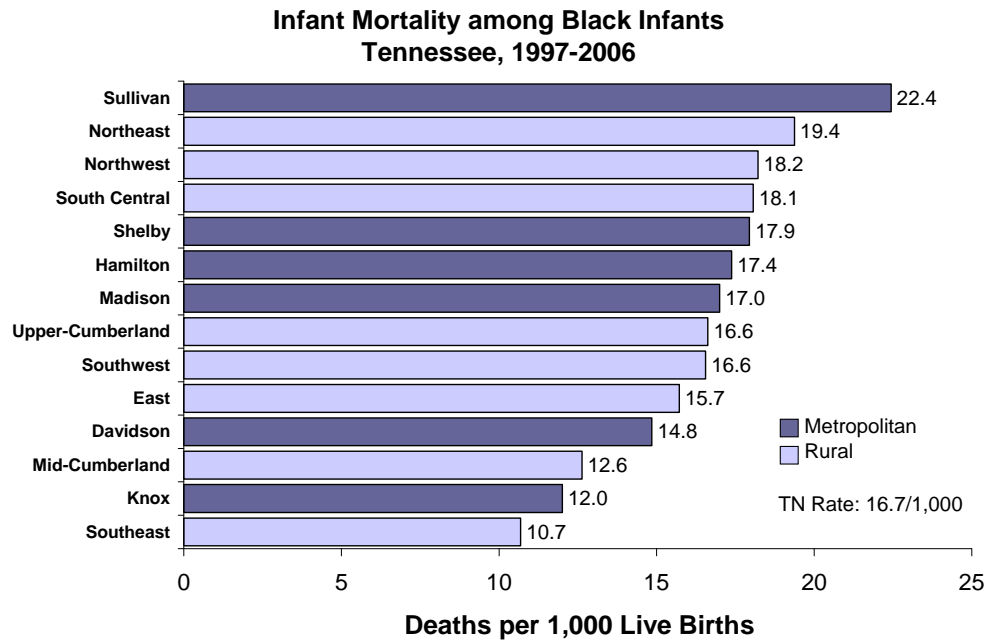


- Between 1997 and 2006, the annual neonatal mortality rate among black infants averaged 11.4 deaths per 1,000 live births, compared to an average of 4.0 per 1,000 among white infants.
- The annual postneonatal mortality rate among black infants averaged 5.2 deaths per 1,000 live births, compared to an average of 2.5 deaths per 1,000 live births among white infants.
- Although both neonatal and postneonatal mortality rates were higher among black infants, the disparity was more pronounced for neonatal deaths.
- Over this period, there were no statistically significant trends in neonatal or postneonatal mortality for either black or white infants.

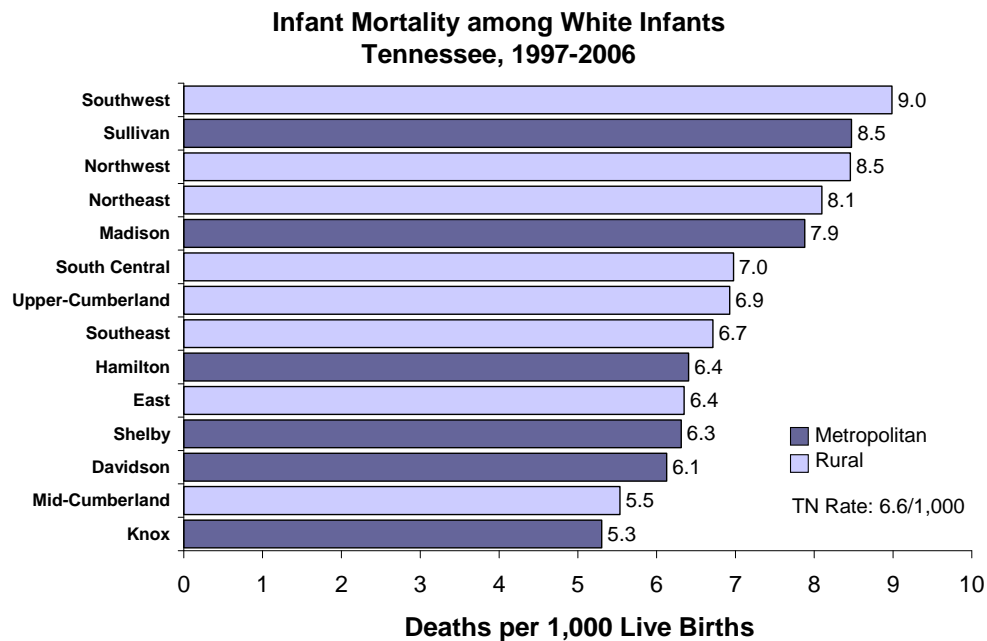


Infant Mortality by Race cont.

- Between 1997 and 2006, the average, annual mortality rate among black infants in individual Tennessee Health Department regions ranged from 10.7 deaths per 1,000 live births in Southeast to 22.4 deaths per 1,000 live births in Sullivan.



- Between 1997 and 2006, the average, annual mortality rate among white infants ranged from 5.3 deaths per 1,000 live births in Knoxville to 9.0 deaths per 1,000 live births in Southwest.



Infant Mortality by Race cont.

**Infant Mortality by Race and Region
Tennessee, 1997-2006**

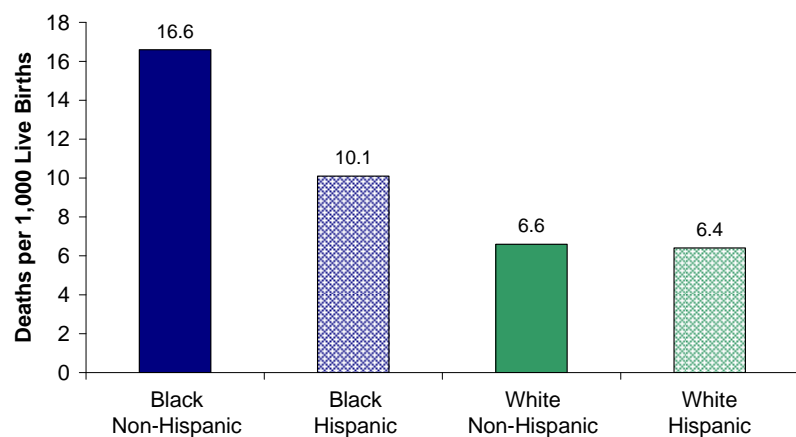
	Black	White	Black:White
Shelby	17.9	6.3	2.8
Hamilton	17.4	6.4	2.7
Sullivan	22.4	8.5	2.6
South Central	18.1	7.0	2.6
East	15.7	6.4	2.5
Davidson	14.8	6.1	2.4
Upper-Cumberland	16.6	6.9	2.4
Northeast	19.4	8.1	2.4
Mid-Cumberland	12.6	5.5	2.3
Knox	12.0	5.3	2.3
Madison	17.0	7.9	2.2
Northwest	18.2	8.5	2.2
Southwest	16.6	9.0	1.8
Southeast	10.7	6.7	1.6
Tennessee	16.7	6.6	2.5

- The lowest regional mortality rate among black infants (10.7/1,000 in the Southeast) was higher than the highest regional mortality rate among white infants (9.0/1,000 in the Southwest).
- Within regions, the mortality rate among black infants was approximately 2-3 times as high as among white infants (see black:white ratio in table to left). The ratio was highest in Shelby and lowest in the Southeast.

Infant Mortality by Ethnicity

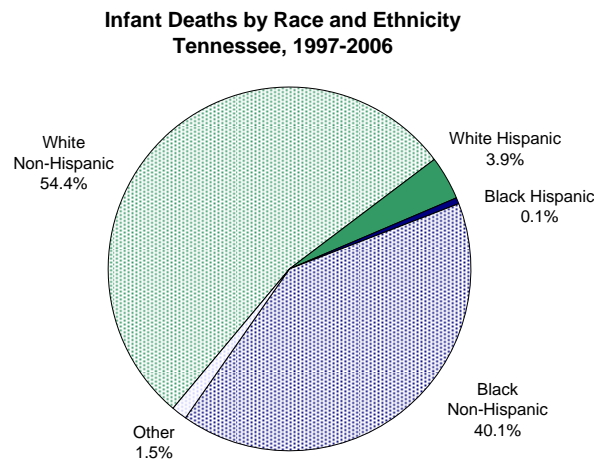
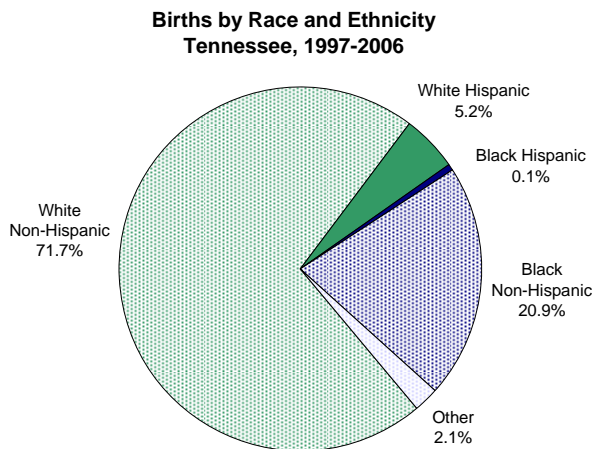
- Between 1997 and 2006, the annual mortality rate among non-Hispanic infants averaged 8.8 deaths per 1,000 live births. This was 33% higher than the mortality rate among Hispanics (6.6/1,000).
- Over this period, there were no statistically significant trends in the mortality rates of either Hispanic or non-Hispanic infants.
- Between 1997 and 2006, infant mortality was highest among black non-Hispanics (16.6/1,000), followed by black Hispanics (10.1/1,000) and white non-Hispanics and Hispanics (6.6 and 6.4/1,000, respectively).

**Infant Mortality by Race and Ethnicity
Tennessee, 1997-2006**

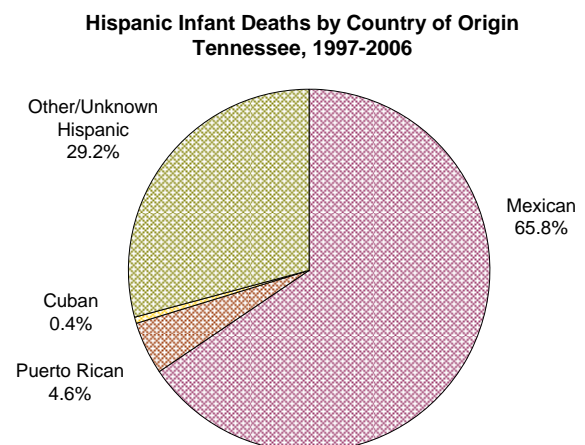
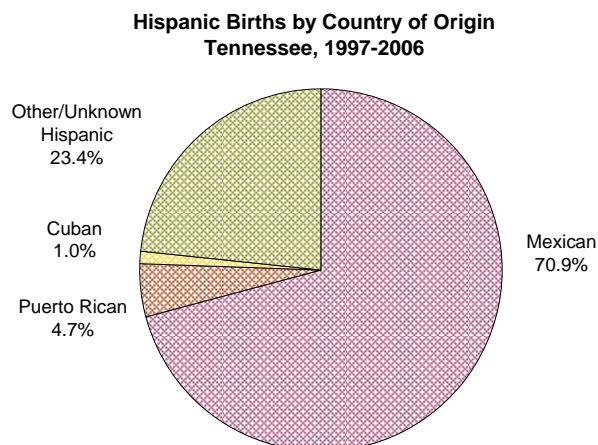


Infant Mortality by Ethnicity *cont.*

- During this 10-year time period, there were very few infant deaths among black Hispanics, who made up 0.1% of both births and infant deaths.
- The infant mortality burden was higher among black non-Hispanics than among white non-Hispanics. Black non-Hispanics made up only 20.9% of births but 40.1% of infant deaths, while white non-Hispanics made up 71.7% of births but only 54.4% of infant deaths.



- Between 1997 and 2006, the majority of Hispanic births in Tennessee (70.9%) occurred among women of Mexican origin. Mexican origin also accounted for the majority of Hispanic infant deaths (65.8%). During this time period, the infant mortality rate among Mexican infants was 6.1 deaths per 1,000 live births.
- A similar percentage of Hispanic births and infant deaths occurred among Puerto Ricans (4.7% and 4.6%, respectively), and the infant mortality rate among this group was 6.5/1,000.
- Cubans made up 1.0% of Hispanic births and 0.4% of Hispanic infant deaths, and the infant mortality rate among this group was 2.2/1,000. However, due to the small number of births and deaths among Cuban infants, this rate should be interpreted with caution.
- For comparison, *national* infant mortality rates are highest among Puerto Ricans (8.3/1,000), followed by Mexicans (5.5/1,000) and Cubans (4.4/1,000).¹



Leading Causes of Infant Mortality

Overall Leading Causes

The following table summarizes the ten leading causes of infant mortality in Tennessee between 2002 and 2006:

**Leading Causes of Infant Mortality
Tennessee, 2002-2006**

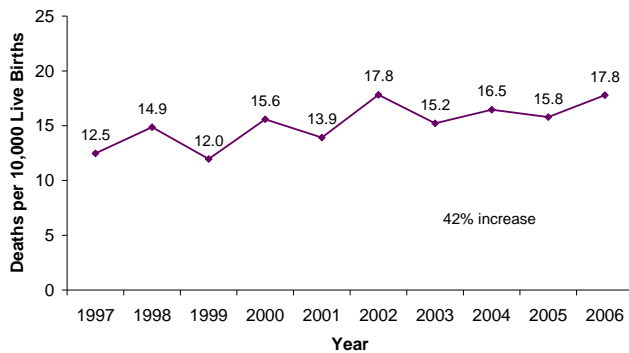
Rank	Cause of Death (ICD-10 codes)	Total Number of Deaths	Average Number of Deaths per Year	Percent of Deaths
--	<i>All Causes</i>	3,592	718	100.0
1	Short gestation and low birth weight (P07)	668	134	18.6
2	Congenital defects (Q00-Q99)	662	132	18.4
3	Sudden infant death syndrome (R95)	362	72	10.1
4	Accidents (V01-X59)	166	33	4.6
5	Respiratory distress (P22)	122	24	3.4
6	Complications of placenta, cord and membranes (P02)	108	22	3.0
7	Maternal complications of pregnancy (P01)	105	21	2.9
8	Bacterial sepsis of newborn (P36)	91	18	2.5
9	Influenza and pneumonia (J10-J11)	85	17	2.4
10	Neonatal hemorrhage (P50-P52, P54)	74	15	2.1
--	All other causes	1,149	230	32.0

- Disorders related to short gestation (i.e. preterm birth) and low birthweight were the number one leading cause of infant mortality, followed closely by congenital defects (includes congenital malformations, deformations and chromosomal abnormalities). Together, these conditions accounted for over one-third of infant deaths.
- Sudden infant death syndrome (SIDS) was the third leading cause of infant mortality.
- Accidents (i.e. unintentional injuries) were the fourth leading cause of infant mortality.
- Together, the top four leading causes of death accounted for approximately half of all infant deaths.

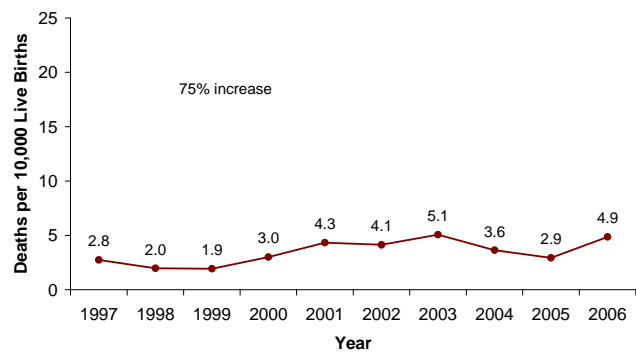
Overall Leading Causes *cont.*

- Over the period 1997-2006, the infant mortality rate due to short gestation and low birthweight increased by 42%, from 12.5 deaths per 10,000 live births to 17.8/10,000.*
- The infant mortality rate due to accidents also increased during this time, from 2.8 deaths per 10,000 live births to 4.9/10,000 – a 75% increase.
- The infant mortality rate due to SIDS decreased 54% during this time, from 14.3 deaths per 10,000 live births to 6.6/10,000.
- There was no statistically significant trend in infant mortality due to congenital defects over the period 1997-2006.

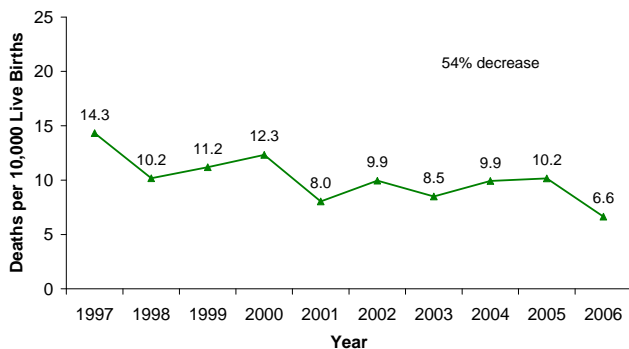
Infant Mortality Due to Short Gestation and Low Birthweight
Tennessee, 1997-2006*



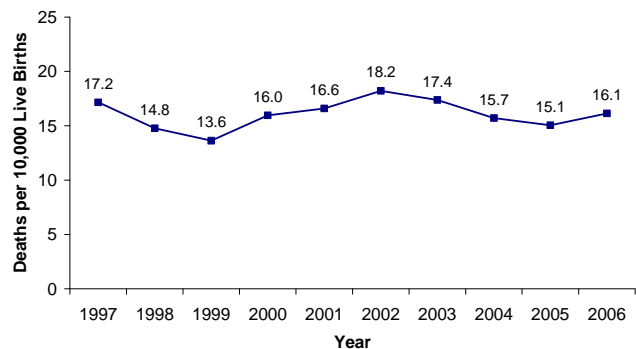
Infant Mortality Due to Accidents
Tennessee, 1997-2006*



Infant Mortality Due to Sudden Infant Death Syndrome
Tennessee, 1997-2006*



Infant Mortality Due to Congenital Defects
Tennessee, 1997-2006*

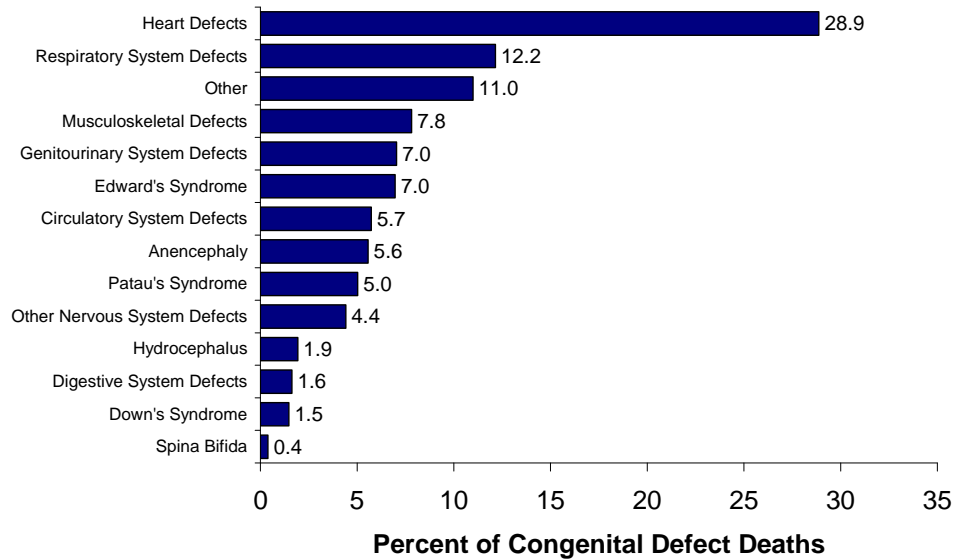


* Since 1999, deaths have been coded using ICD-10 classification. Prior to 1999, the ICD-9 classification system was in use. Deaths before and after 1999 cannot be compared without adjusting for this change in coding. Therefore, cause-specific mortality rates for years prior to 1999 have been comparability adjusted.⁴

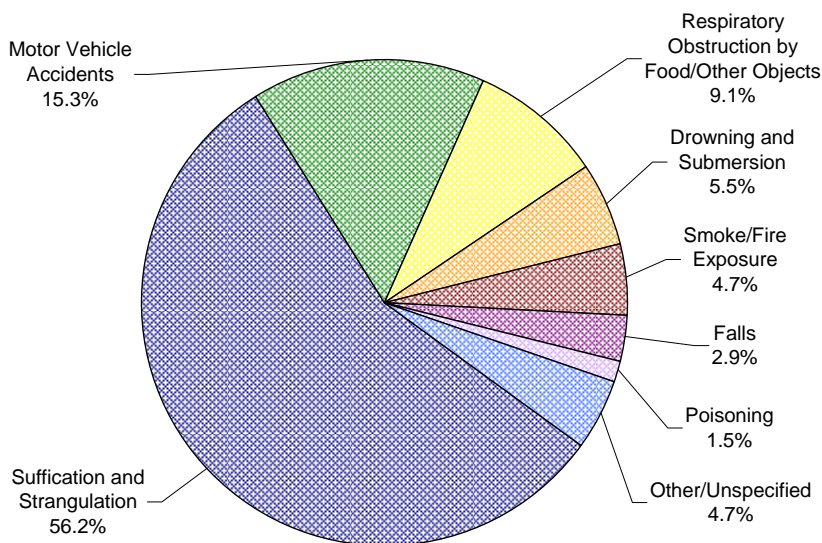
Overall Leading Causes *cont.*

- Between 1997 and 2006, heart defects accounted for the highest percentage of infant deaths due to congenital defects (28.9%).

**Congenital Defect Deaths by Type of Defect
Tennessee, 1997-2006**



**Accidental Deaths by Type of Accident
Tennessee, 1997-2006**



- During this same time period, suffocation and strangulation accounted for the highest percentage of accidental infant deaths (56.2%).
- Approximately two-thirds of suffocation and strangulation deaths occurred in bed (e.g. as a result of bed linen, pillows, or someone's body). The remaining one-third were classified as 'other.'

Leading Causes by Race

The following table ranks the leading causes of mortality among black infants and white infants in Tennessee:

**Leading Causes of Infant Mortality by Race
Tennessee, 2002-2006**

Cause of Death (ICD-10 codes)	Rank		Percent of Deaths	
	Black	White	Black	White
Short gestation and low birth weight (P07)	1	2	26.7	13.3
Congenital defects (Q00-Q99)	2	1	12.3	22.5
Sudden infant death syndrome (R95)	3	3	9.6	10.5
Maternal complications of pregnancy (P01)	4	7	3.5	2.6
Respiratory distress (P22)	5	5	3.4	3.4
Accidents (V01-X59)	6	4	3.3	5.5
Complications of placenta, cord and membranes (P02)	7	6	3.1	2.9
Bacterial sepsis of newborn (P36)	8	9	2.6	2.5
Necrotizing enterocolitis (P77)	9	14	2.3	1.2
Influenza and pneumonia (J10-J11)	10	7	2.0	2.6
Neonatal hemorrhage (P50-P52)	12	10	1.8	2.2
All other causes	--	--	29.4	30.8

- Short gestation and low birthweight were the leading cause of death among black infants, and the second leading cause of death among white infants.
- Congenital defects were the leading cause of death among white infants, and the second leading cause of death among black infants.
- Sudden infant death syndrome was the third leading cause of death among both black and white infants.
- Maternal complications of pregnancy were the fourth leading cause of death among black infants, whereas accidents were the fourth leading cause among white infants.

Leading Causes by Age at Death

The following table ranks the leading causes of infant mortality in Tennessee by age at death:

**Leading Causes of Infant Mortality by Age at Death
Tennessee, 2002-2006**

Cause of Death (ICD-10 codes)	Neonatal			Post-neonatal
	<60 minutes	1-23 hours	1-27 days	28 days-12 months
Short gestation and low birth weight (P07)	1	1		
Congenital defects (Q00-Q99)	2	2	1	2
Maternal complications of pregnancy (P01)	3	4		
Complications of placenta, cord and membranes (P02)	4	3		
Atelectasis (P28.0-P28.1)	5			
Respiratory distress (P22)		5	3	
Bacterial sepsis of newborn (P36)			2	
Neonatal hemorrhage (P50-P52)			4	
Necrotizing enterocolitis (P77)			5	
Sudden infant death syndrome (R95)				1
Accidents (V01-X59)				3
Influenza and pneumonia (J10-J11)				4
Diseases of the circulatory system (I00-I99)				5

- Short gestation and low birthweight were the leading cause of death among infants who died within 60 minutes and within 24 hours of birth.
- Congenital defects were the leading cause of death among infants aged 1 to 27 days.
- Congenital defects ranked among the top 2 leading causes of death for all age groups.
- Sudden infant death syndrome was the leading cause of death among infants aged 28 days and older.

Leading Causes by Region

The following table ranks the leading causes of infant mortality in Tennessee by Health Department region:

**Top Five Leading Causes of Death by Region
Tennessee, 1997-2006^{*†}**

Cause of Death (ICD-10 codes)	Tennessee	Davidson	East	Hamilton	Knox	Madison	Mid-Cumberland	Northeast	Northwest	Shelby	South Central	Southeast	Southwest	Sullivan	Upper-Cumberland
Congenital defects (Q00-Q99)	1	1	1	1	1	2	1	1	1	2	1	1	1	1	1
Short gestation and low birth weight (P07)	2	2	4	2	2	1	2	3	1	1	2	3	2	3	3
Sudden infant death syndrome (R95)	3	3	3	3	3	3	3	2	3	3	3	2	3	4	2
Accidents (V01-X59)	4		2		4		5	5		5	4				5
Respiratory distress (P22)	5					5		4	5	4		4	5	2	4
Complications of placenta, cord and membranes (P02)	6	5					4		5			5		5	
Bacterial sepsis (P36)	7		5			5			4				4		
Maternal complications of pregnancy (P01)	8	4		4		4									5
Intrauterine hypoxia and birth asphyxia (P20-P21)	10				5										
Influenza and pneumonia (J10-J11)	11										5	5			
Necrotizing enterocolitis (P77)	13			5	5				5						

- With the exceptions of East and Sullivan, congenital defects, short gestation and low birthweight, and SIDS were the top three leading causes of infant mortality for all regions (although their exact order varied).
- In the East region, accidents were the second leading cause of infant mortality.
- In the Sullivan region, respiratory distress was the second leading cause of infant mortality.

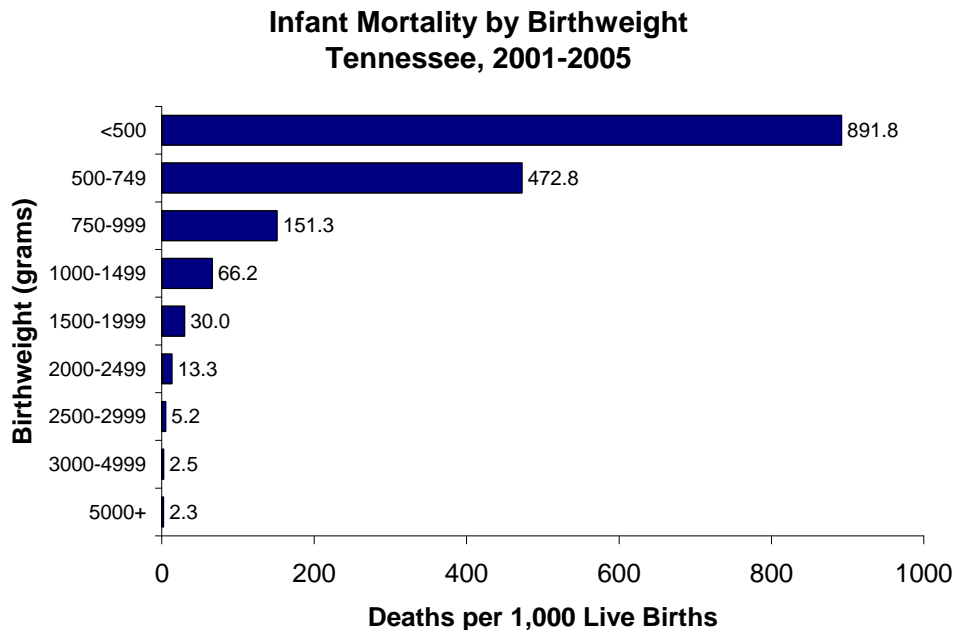
^{*} Due to small regional-level counts, leading causes are presented for 1997-2006 (10 yr) rather than for 2002-2006 (5 yr). As a result, state-level rankings differ slightly from those presented earlier.

[†] In cases of ties (i.e. multiple causes with the same number of deaths), causes were assigned the same ranking.

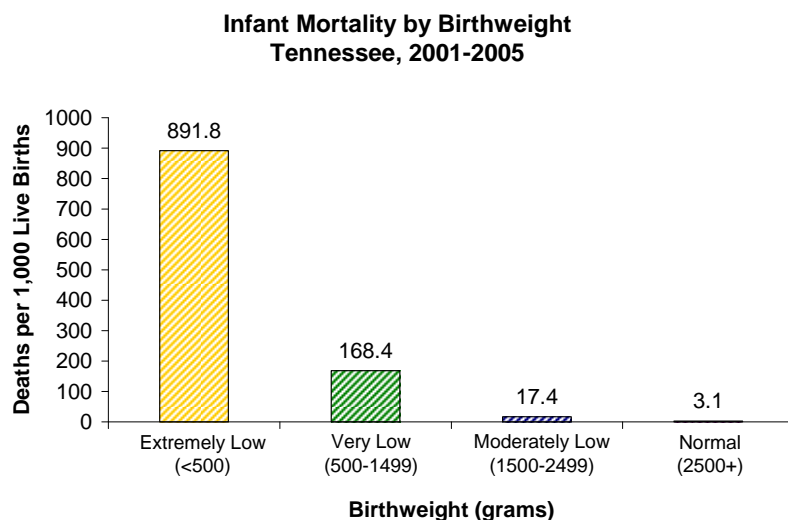
Infant Mortality Risk Factors

Low Birthweight

- Infant mortality increased exponentially with decreasing birthweight.



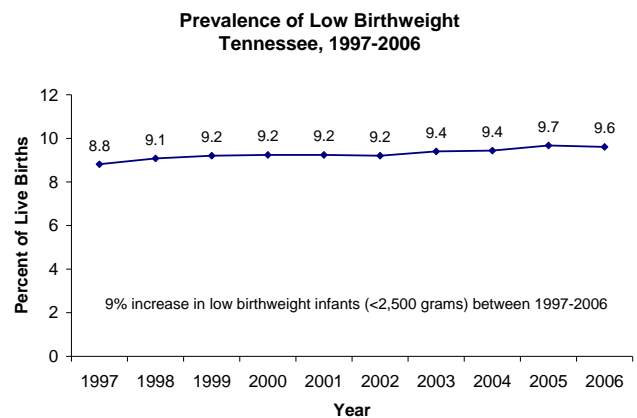
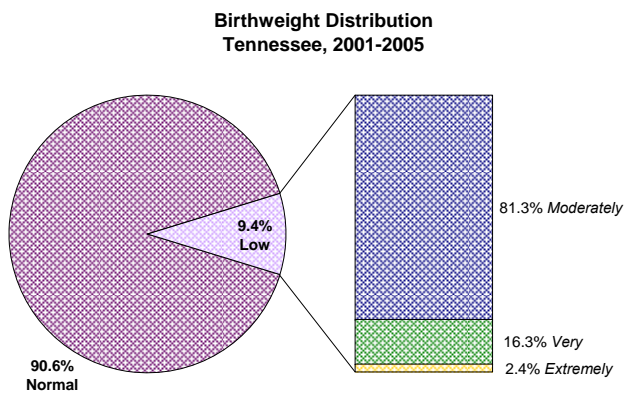
- Between 2001 and 2005, the mortality rate among infants with low birthweight (< 2,500 grams) was 62.6 deaths per 1,000 live births, compared to 3.1/1,000 among normal birthweight infants (\geq 2,500 grams). Low birthweight infants were 20 times as likely as normal birthweight infants to die during their first year of life.



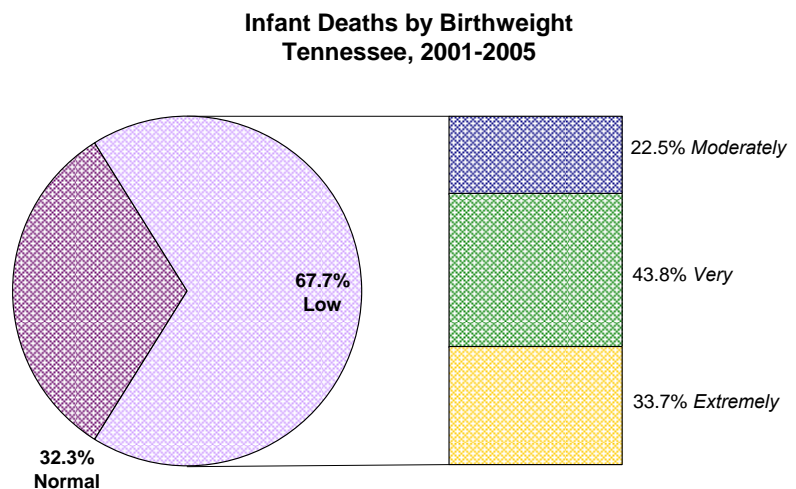
- Among the subset of *moderately* low birthweight infants the mortality rate was 17.4/1,000, compared to 168.4/1,000 among *very* low birthweight infants and 891.8/1,000 among *extremely* low birthweight infants with birthweights less than 500 grams.
- Babies born at less than 500 grams were approximately 288 times as likely as those with normal birthweight to die during their first year of life.

Low Birthweight cont.

- There were no statistically significant trends in mortality rates among extremely, very or moderately low birthweight infants over the period 1996-2005. The mortality rate among normal birthweight infants also remained unchanged.
- Between 2001 and 2005, 9.4% of infants were born at less than 2,500 grams. The majority of these low birthweight infants were moderately low birthweight (81.3%), while 16.3% were very low birthweight and 2.4% were extremely low birthweight.
- Between 1997 and 2006, the percentage of infants born low birthweight increased by 9%, from 8.8% to 9.6% of live births.



- Between 2001 and 2005, 67.7% of infant deaths occurred among low birthweight babies.
- Among these low birthweight deaths, 22.5% occurred among moderately low birthweight infants, 43.8% among very low birthweight infants, and 33.7% among extremely low birthweight infants.



Low Birthweight cont.

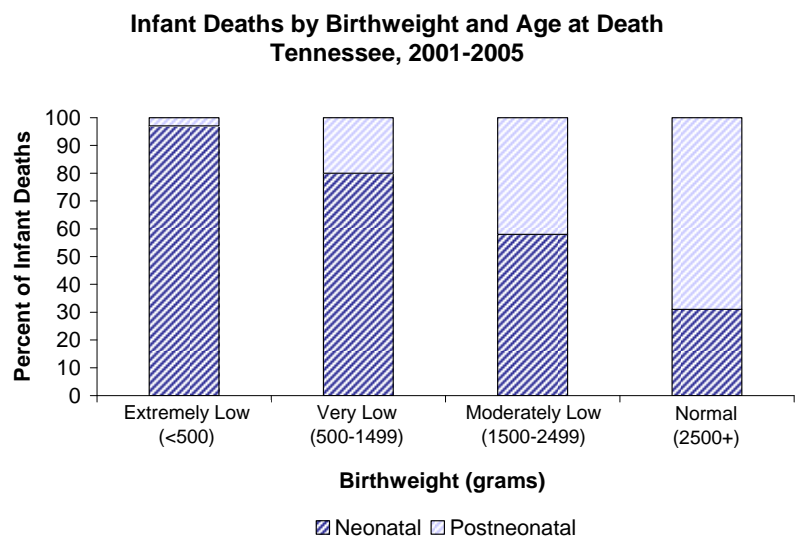
The following table summarizes the distribution of infant deaths by birthweight for each Tennessee Health Department region for the period 2001-2005:

**Infant Deaths by Birthweight and Region
Tennessee, 2001-2005**

	Percent of Infant Deaths			
	Normal	Moderately Low	Very Low	Extremely Low
Davidson	31.8	15.9	32.1	20.1
East	42.3	20.2	25.7	11.8
Hamilton	29.4	11.1	32.8	26.7
Knox	34.3	22.4	23.1	20.3
Madison	17.2	14.9	46.0	21.8
Mid-Cumberland	41.4	17.1	24.8	16.7
Northeast	35.4	12.0	30.9	21.7
Northwest	30.6	16.0	40.3	13.2
Shelby	22.8	11.6	30.2	35.4
South Central	39.5	19.2	27.5	13.8
Southeast	41.9	16.9	22.3	18.9
Southwest	32.1	17.9	26.8	23.2
Sullivan	26.9	13.4	41.8	17.9
Upper-Cumberland	44.2	14.7	30.2	10.9
Tennessee	32.3	15.3	29.6	22.8

- Overall, 22.8% of infant deaths in Tennessee occurred among extremely low birthweight infants.
- The percentage of extremely low birthweight infant deaths in individual regions ranged from 10.9% in Upper-Cumberland to 35.4% in Shelby.

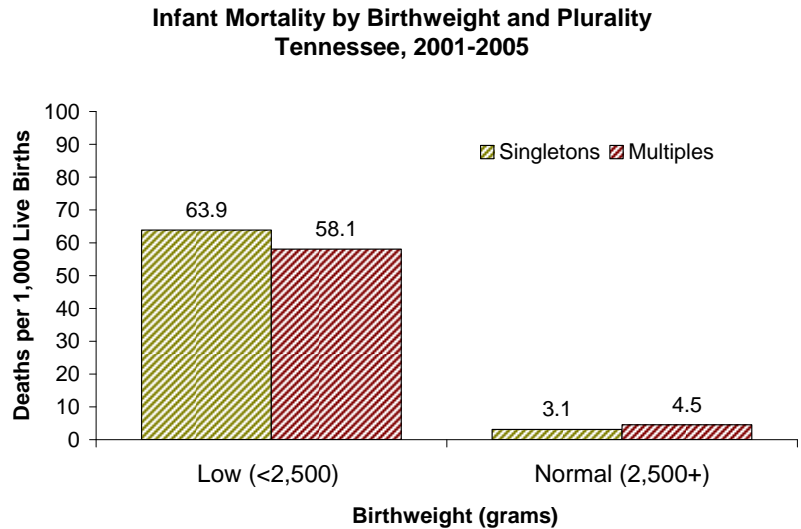
- The percentage of infant deaths that occurred during the neonatal period (from birth to 27 days of age) was highest among extremely low birthweight infants (97%), followed by very low (80%), moderately low (58%) and normal birthweight (31%) infants.
- The leading cause of death among extremely/very low birthweight infants was disorders related to short gestation and low birthweight (33% of deaths).
- Congenital defects were the leading cause of death among moderately low birthweight infants (45%).
- Sudden infant death syndrome was the leading cause of death among normal birthweight infants (24%).



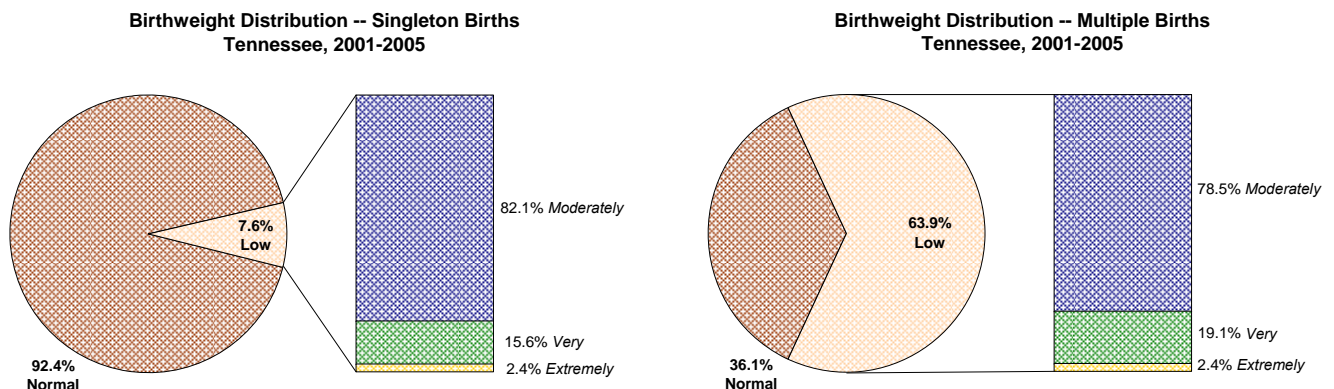
Low Birthweight cont.

Because birthweight and plurality are correlated, birthweight-specific mortality rates were examined separately for single and multiple births.

- The relationship between infant mortality and birthweight was similar for singletons and multiples.
- Among both low birthweight and normal birthweight infants, there was not a statistically difference in the infant mortality rate among singletons versus multiples.

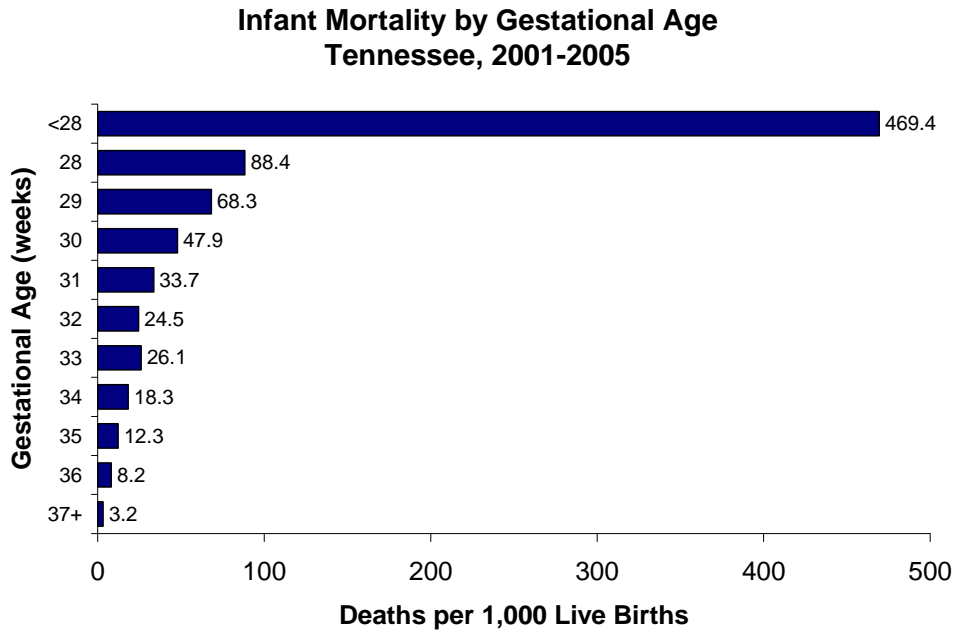


- Although the infant mortality rate among low birthweight infants was similar among singletons and multiples, multiples were more likely to be born low birthweight. Between 2001 and 2005, 63.9% of multiples were born low birthweight, compared to 7.6% of singletons.
- Among low birthweight infants, the percentage that were born moderately, very and extremely low birthweight was similar among singletons and multiples.



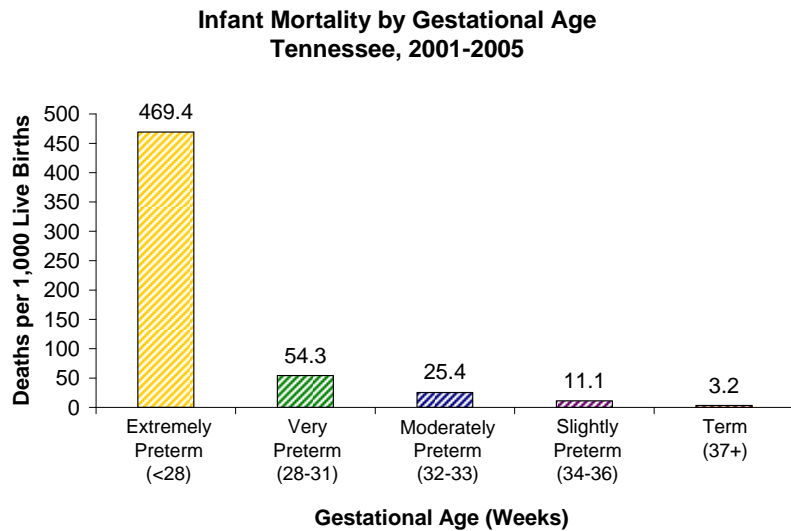
Preterm Birth

- Infant mortality increased with decreasing gestational age.



- Between 2001 and 2005, the mortality rate among preterm infants (<37 weeks gestation) was 47.9 deaths per 1,000 live births, compared to 3.2/1,000 among term infants (≥37 weeks). Preterm infants were 15 times as likely as term infants to die during their first year of life.

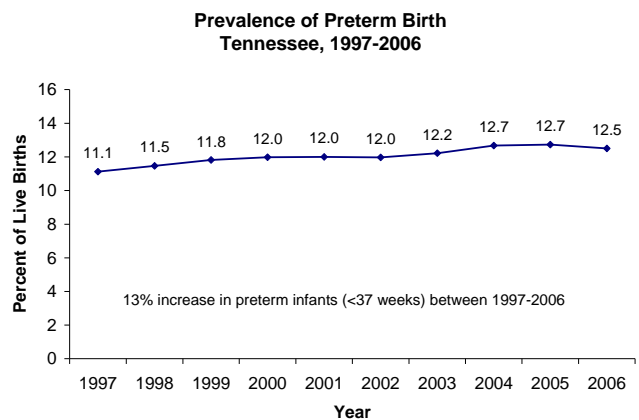
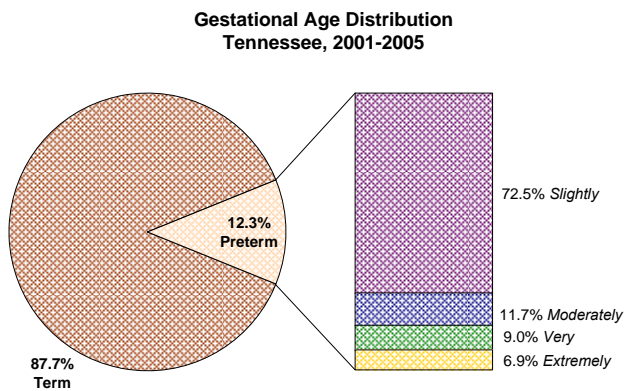
- Among the subset of *slightly* preterm infants the mortality rate was 11.1/1,000, compared to 25.4/1,000 among *moderately* preterm infants, 54.3/1,000 among *very* preterm infants and 469.4/1,000 among *extremely* preterm infants.



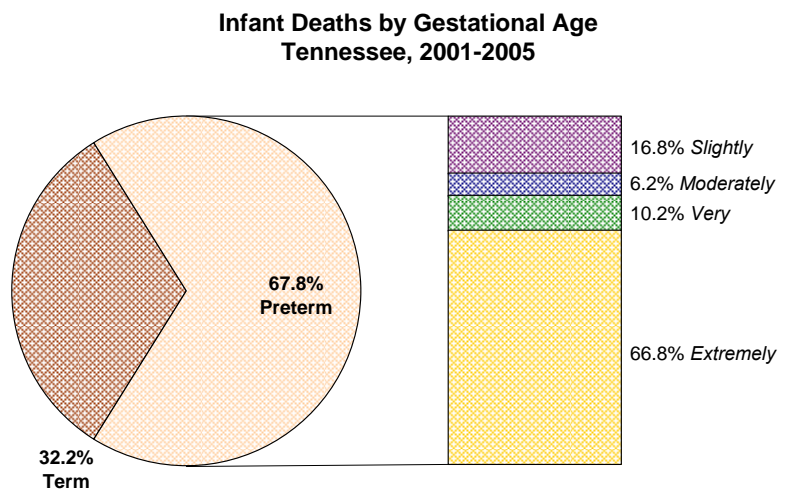
- Extremely preterm infants were almost 150 times as likely as term infants to die during their first year of life.

Preterm Birth cont.

- There were no statistically significant upward or downward trends in mortality rates among extremely, very, moderately or slightly preterm infants over the period 1996-2005. The mortality rate among term infants also remained unchanged.
- Between 2001 and 2005, 12.3% of infants were born at less than 37 weeks gestation. The majority of these preterm infants were slightly preterm (72.5%), while 11.7% were moderately preterm, 9.0% were very preterm and 6.9% were extremely preterm.
- Between 1997 and 2006, the percentage of infants born preterm increased by 13%, from 11.1% to 12.5% of live births.

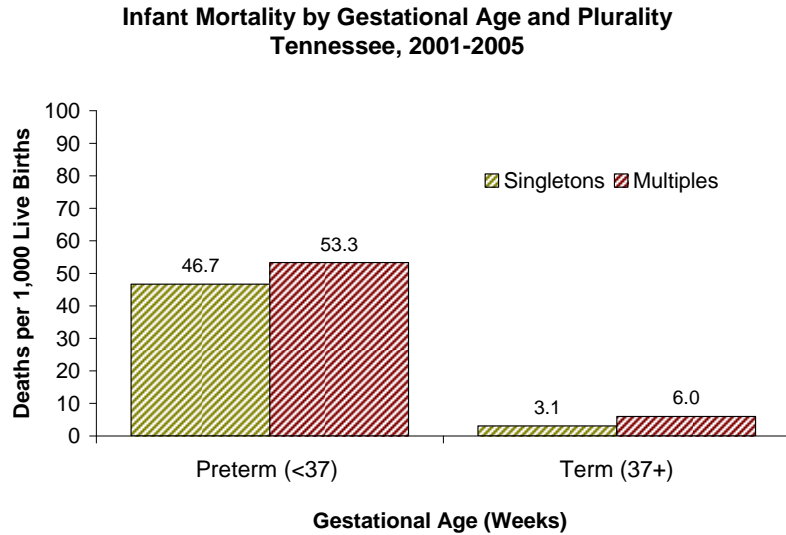


- Between 2001 and 2005, 67.8% of infant deaths occurred among preterm babies.
- Among these preterm deaths, 16.8% occurred among slightly preterm infants, 6.2% among moderately preterm infants, 10.2% among very preterm infants, and 66.8% among extremely preterm infants.



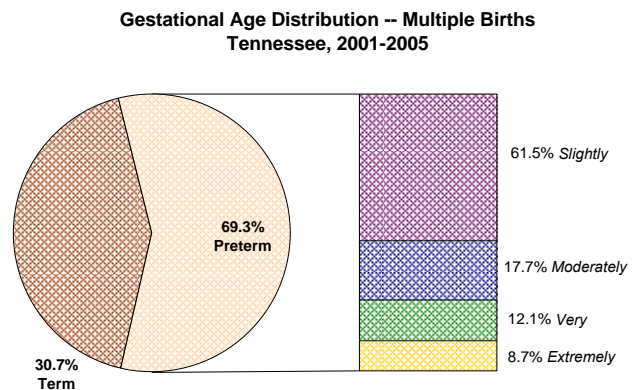
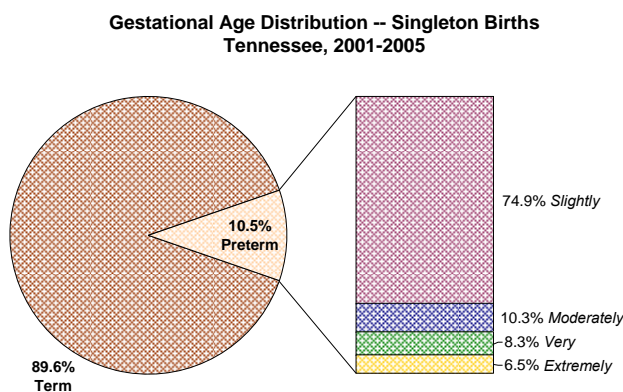
Preterm Birth cont.

Because gestational age and plurality are correlated, gestational age-specific mortality rates were examined separately for single and multiple births.



- The infant mortality rate among both preterm and term infants was higher among multiples compared to singletons.

- Between 2001 and 2005, 69.3% of multiples were born preterm, compared to 10.5% of singletons.
- Among preterm infants, the percentage that were born slightly preterm was higher among singletons, while the percentage that were born moderately, very or extremely preterm was higher among multiples.



Why are babies born preterm?

About 25% of preterm births result from early induction of labor or cesarean delivery due to pregnancy complications or health problems in the mother or fetus. Most preterm births are the result of spontaneous preterm labor, either by itself or following premature rupture of membranes (PROM). The causes of preterm labor and PROM are not fully understood, and in 40% of preterm births the exact cause is unknown. However, studies suggest there may be four main routes leading to preterm labor:

1. Infections and inflammation
2. Maternal or fetal stress
3. Uterine bleeding
4. Uterine stretching

Why are babies born low birthweight?

There are two main reasons babies are born low birthweight:

1. Preterm birth
2. Fetal growth restriction

Some babies are born both premature *and* growth restricted

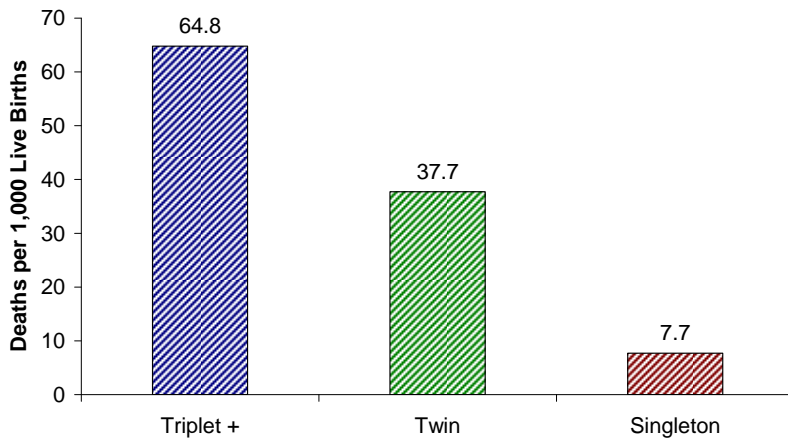
There are numerous factors that may contribute to preterm birth and/or fetal growth restriction:

- Previous preterm birth
- Multiple birth
- Uterine and cervical abnormalities
- Placental problems
- Chronic maternal health problems (high blood pressure, diabetes, obesity)
- Being underweight before pregnancy
- Inadequate pregnancy weight gain
- Short time period between pregnancies
- Single fetus after in vitro fertilization
- Maternal infections
- Fetal infections
- Birth defects
- Socioeconomic factors
- Domestic violence
- Lack of social support
- High levels of stress
- Late or no prenatal care
- Smoking
- Alcohol and illegal drug use

Source: March of Dimes Low Birthweight and Premature Birth Fact Sheets. Accessed 13 January 2009 at www.marchofdimes.com.

Multiple Births

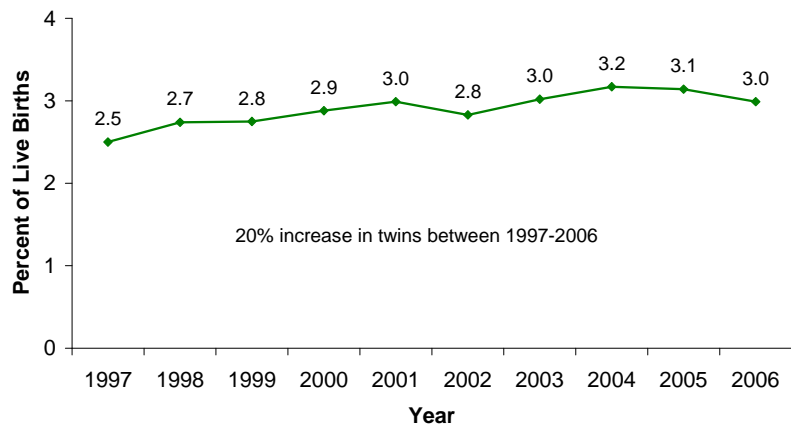
**Infant Mortality by Plurality
Tennessee, 2001-2005**



- Between 2001 and 2005, the infant mortality rate among singleton births was 7.7 deaths per 1,000 live births, compared to 37.7/1,000 among twins and 64.8/1,000 among triplets and higher order multiples.
- Twins were five times as likely as singletons to die during their first year of life.
- Triplets and higher order multiples were almost eight-and-a-half times as likely as singletons to die during their first year of life.

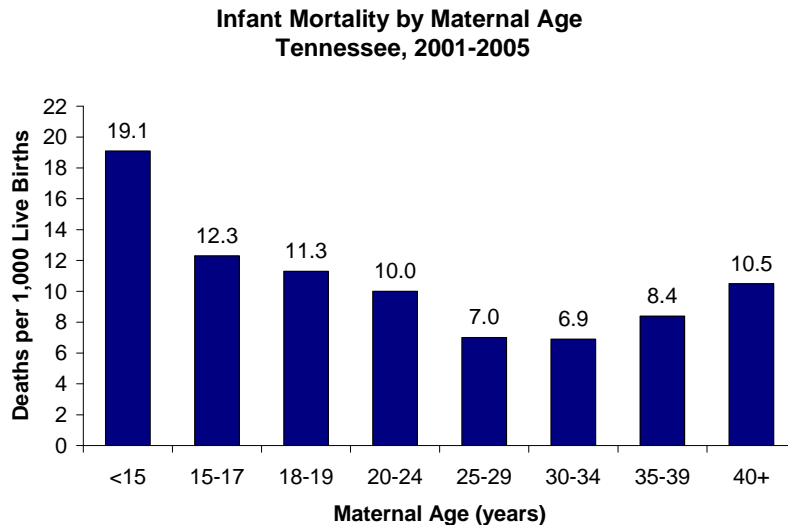
- Between 2001 and 2005, 3.0% of infants were born as twins and 0.2% were born as triplets or higher order multiples.
- Between 1997 and 2006, the percentage of infants born as twins increased by 20%, from 2.5% to 3.0% of live births.
- Over the same time period, there were no statistically significant trends in the percentages of triplets or higher order multiples.

**Prevalence of Twin Births
Tennessee, 1997-2006**



Maternal Age

- Infant mortality is highest among infants born to teenage mothers (<18 years). As maternal age begins to increase, infant mortality decreases, reaching its lowest point at a maternal age of 25-34 years. As maternal age continues to increase, infant mortality begins to rise again.
- Between 2001 and 2005, the infant mortality rate among infants born to 18-34 year olds was 8.5 deaths per 1,000 live births, compared to 12.7/1,000 among those born to girls less than 18 years of age and 8.7/1,000 among those born to women 35 years of age and older.

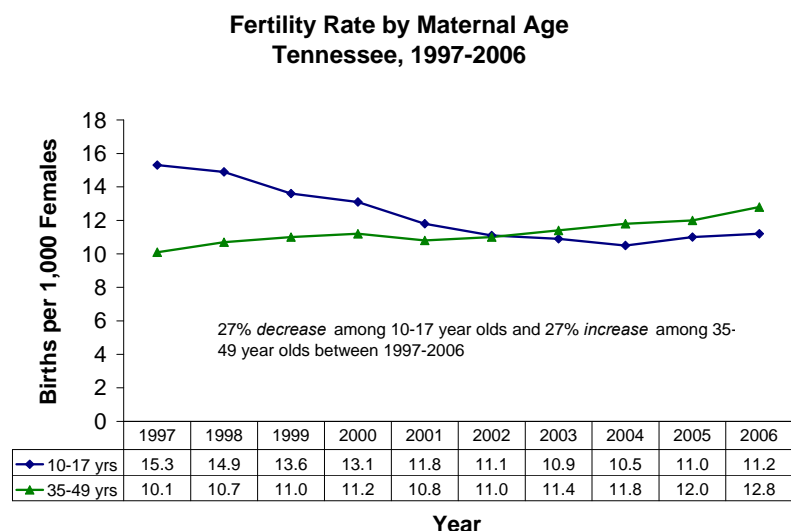


- Infants born to teenage mothers were 50% more likely than those born to women aged 18-34 to die during their first year of life.
- The difference in the risk of infant mortality among infants born to women 35 years and older and those born to 18-34 year olds was not statistically significant.

- Between 2001 and 2005, 4.3% of infants were born to teenage mothers and 9.7% were born to women 35 years and older.

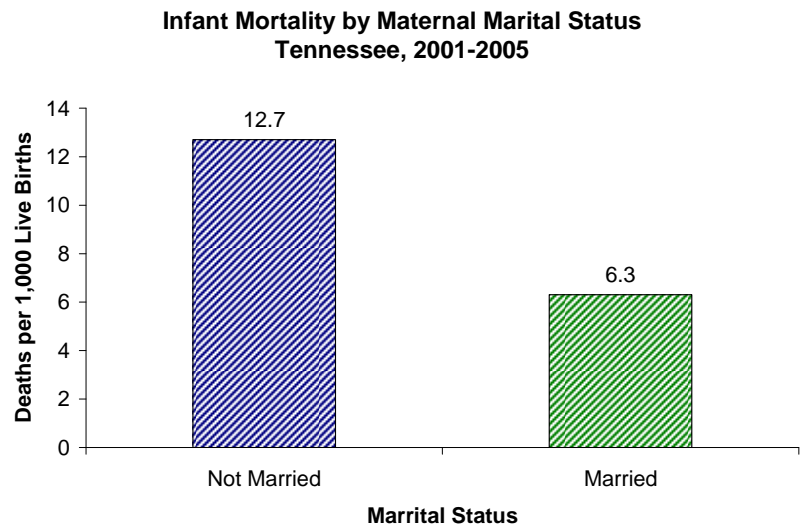
- Between 1997 and 2006, the fertility rate among girls aged 10-17 years decreased by 27%, from 15.3 births per 1,000 females in the population to 11.2/1,000.

- During the same time period, the fertility rate among women aged 35-49 years increased by 27%, from 10.1 births per 1,000 females in the population to 12.8/1,000.

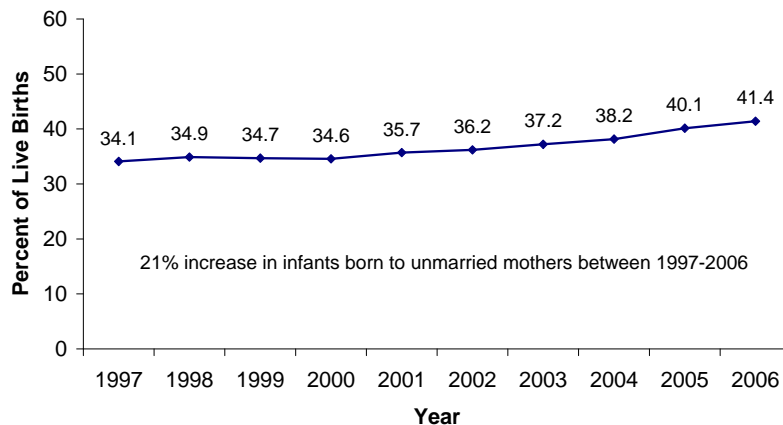


Marital Status

- Between 2001 and 2005, the mortality rate among infants born to unmarried mothers was 12.7 deaths per 1,000 live births, compared to 6.3/1,000 among those born to married mothers.
- Infants born to unmarried mothers were twice as likely to die during their first year of life as those born to married mothers.



**Prevalence of Unmarried Mothers
Tennessee, 1997-2006**



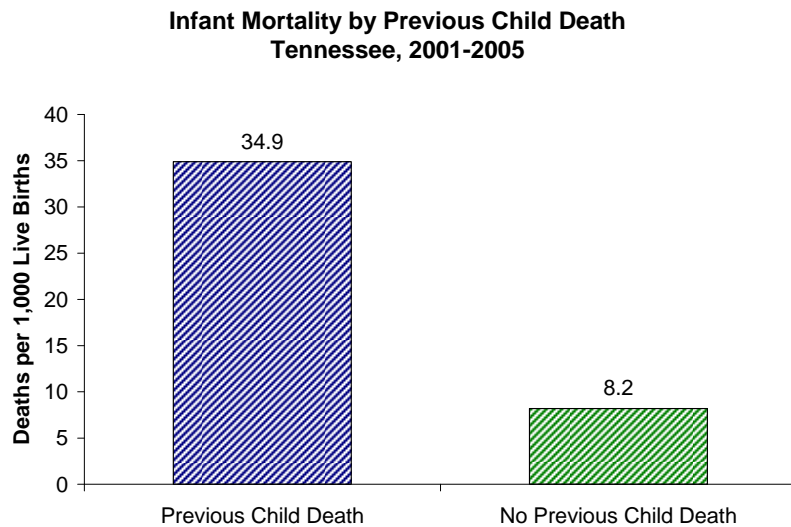
- Between 2001 and 2005, 37.5% of infants were born to unmarried mothers.
- Between 1997 and 2006, the percentage of infants born to unmarried mothers increased by 21%, from 34.1% to 41.4% of live births.

Previous Death of a Child

- Between 2001 and 2005, the mortality rate among infants born to primiparous women (i.e. those who *had not* given birth previously) was 8.1/1,000.
- Among infants born to multiparous women (i.e. those who *had* previously given birth), the infant mortality rate was higher among those whose mother had previously experienced the death of a child (34.2/1,000) than among those whose mother had never lost a child (8.3/1,000). Note that the previous death may have occurred anytime during childhood and not necessarily during infancy.

Previous Death of a Child *cont.*

- Infants born to women with a previous child death were approximately four times as likely as those born to primiparous women or to multiparous women without such a death to die during their first year of life.



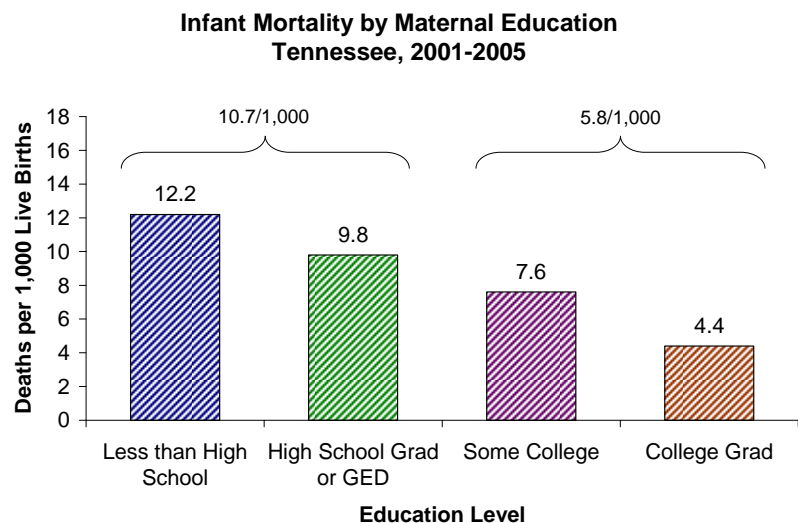
- Between 2001 and 2005, 1.7% of infants (regardless of parity) were born to women who had experienced the previous death of a child.
- There was no statistically significant trend in the percentage of infants born to women with a previous child death over the period 1997-2006.

Socioeconomic Status

- Infant mortality increased with decreasing maternal education level.

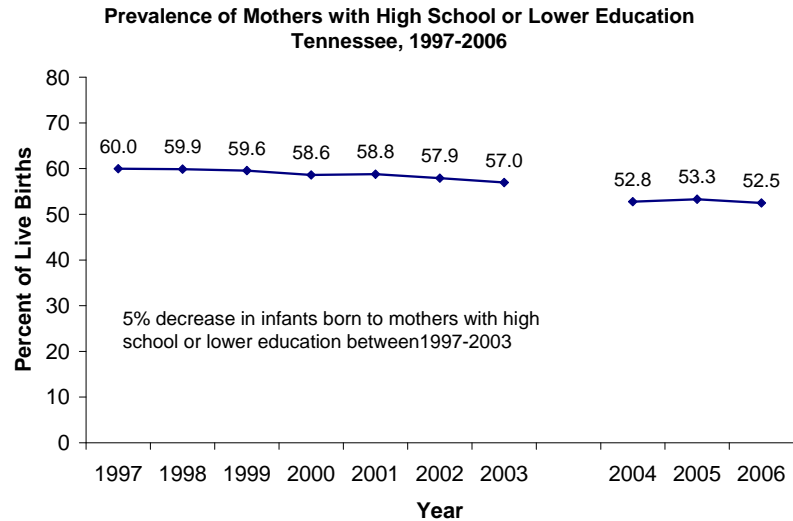
- Between 2001 and 2005, the mortality rate among infants born to women with high school or lower education was 10.7 deaths per 1,000 live births, compared to 5.8/1,000 among those whose mothers had higher levels of education.

- Infants born to women with high school or lower education were 84% more likely than those born to women with higher levels of education to die during their first year of life.

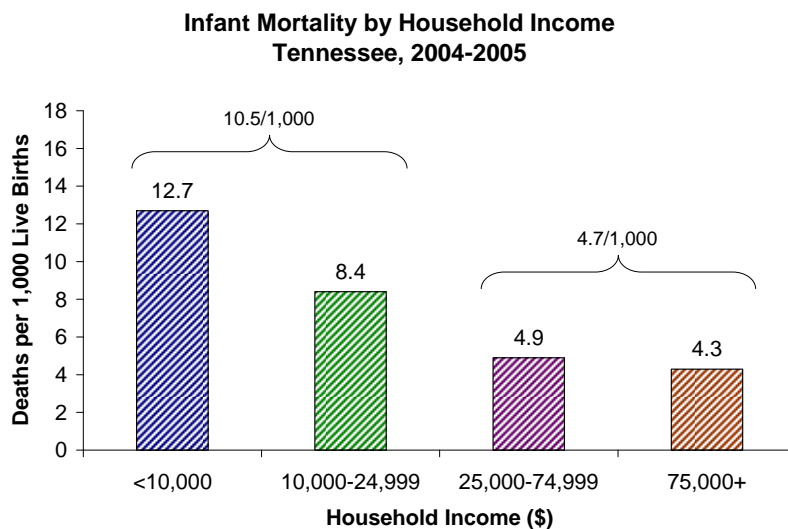


Socioeconomic Status cont.

- Between 2001 and 2005, 55.9% of infants were born to women with high school or lower education.
- Between 1997 and 2003, the percentage of infants born to mothers with high school or lower education decreased by 5%, from 60.0% to 57.0% of live births. Because of changes to the birth certificate that went into effect in 2004, it was not possible to determine if this downward trend continued after 2003.



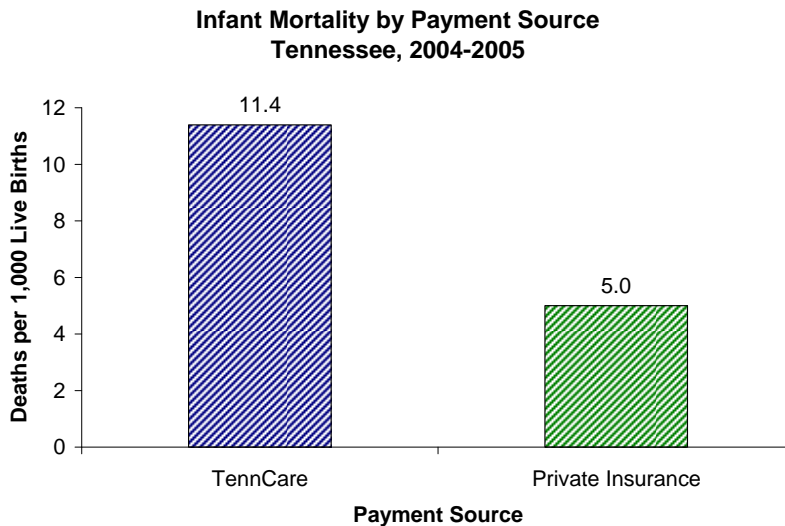
- Infant mortality also increased with decreasing household income.
- Between 2004 and 2005, the mortality rate among infants from households with incomes of less than \$25,000 was 10.5 deaths per 1,000 live births, compared to 4.7/1,000 among those from households with incomes of \$25,000 or more.
- Infants from households with incomes of less than \$25,000 were over two times as likely as those from households with higher incomes to die during their first year of life.



- Between 2004 and 2006, 47.4% of infants were born to households with incomes of less than \$25,000. Because information on household income was not collected on birth certificates prior to 2004, it was not possible to examine time trends in the prevalence of this risk factor.

Socioeconomic Status cont.

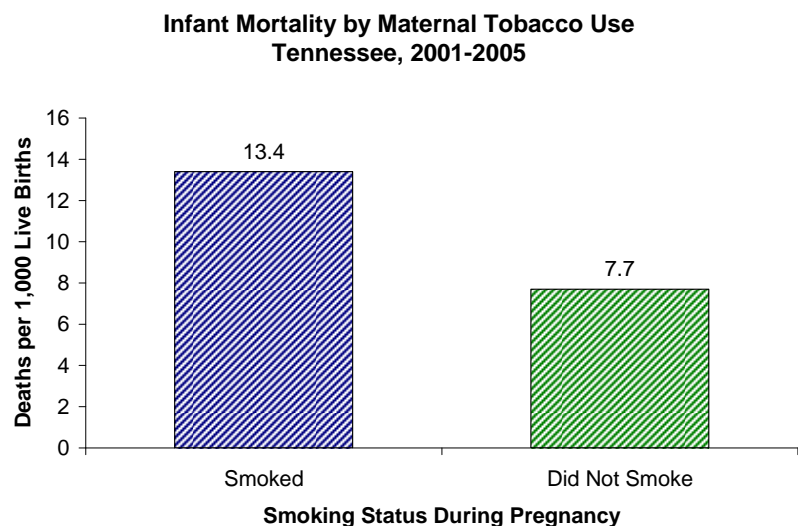
- Between 2004 and 2005, the mortality rate among infants born to mothers who received TennCare was 11.4 deaths per 1,000 live births, compared to 5.0/1,000 among infants whose mothers used private insurance.
- Infants whose mothers received TennCare were over two times as likely as those whose mothers used private insurance to die during their first year of life.



- Between 2004 and 2006, 48.7% of infants were born to mothers who received TennCare. Because information on payment source was not collected on birth certificates prior to 2004, it was not possible to examine time trends in the prevalence of this risk factor.

Tobacco Use

- Between 2001 and 2005, the mortality rate among infants whose mothers smoked during pregnancy was 13.4 deaths per 1,000 live births, compared to 7.7/1,000 among infants whose mothers did not smoke.
- Infants of smoking mothers were 74% more likely than those born to non-smoking mothers to die during their first year of life.

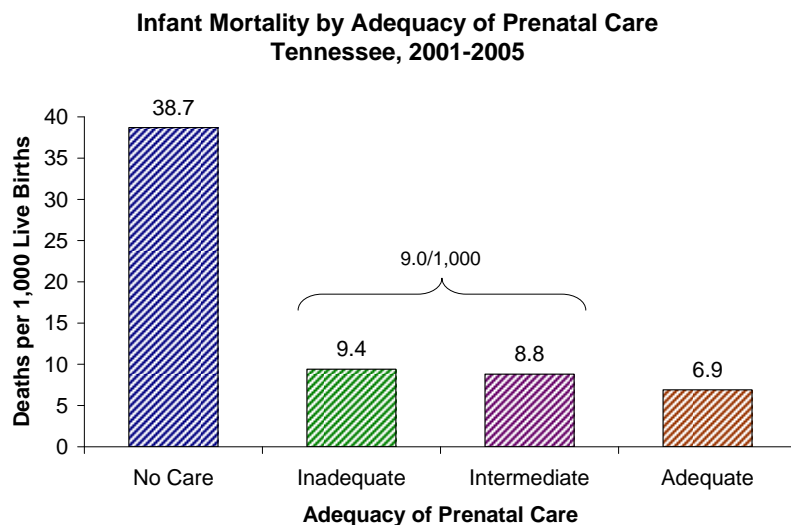


Tobacco Use cont.

- Between 2001 and 2005, 17.9% of infants were born to mothers who smoked during pregnancy.
- There was no statistically significant increase or decrease in the percentage of infants born to smoking mothers over the period 1997-2003. Because of changes to the birth certificate that went into effect in 2004, it was not possible to determine if any upward or downward trend in maternal smoking prevalence occurred between 1997 and 2006.

Prenatal Care

- Between 2001 and 2005, the mortality rate among infants whose mothers received adequate prenatal care was 6.9 deaths per 1,000 live births, compared to 9.0/1,000 among those whose mothers received intermediate or inadequate levels of care and 38.7/1,000 among those whose mothers received no prenatal care.

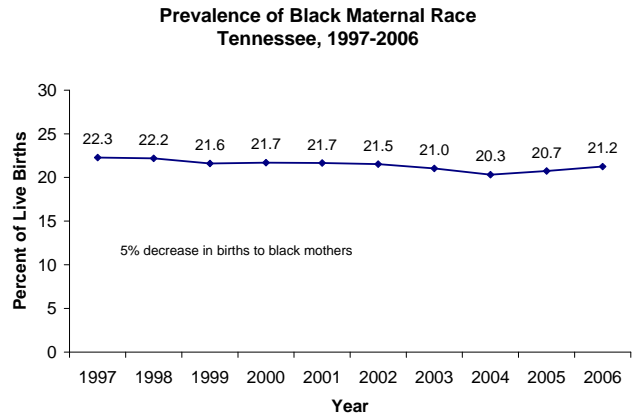
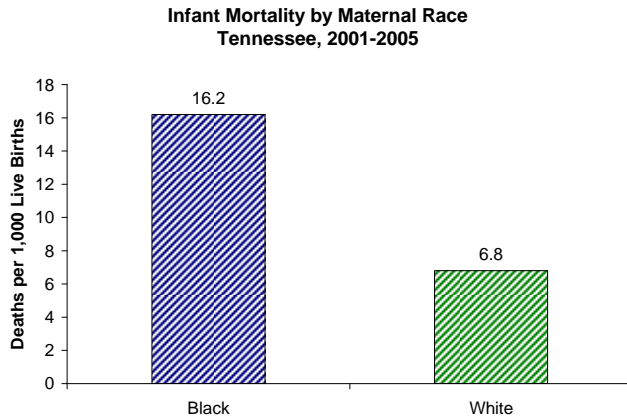


- Infants whose mothers received inadequate or intermediate care were 30% more likely than those whose mothers received adequate care to die during their first year of life.
- Infants whose mothers received no prenatal care were almost six times as likely as those who received adequate care to die during their first year of life.

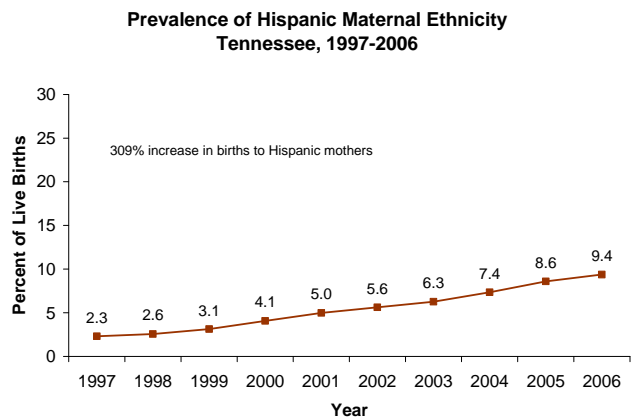
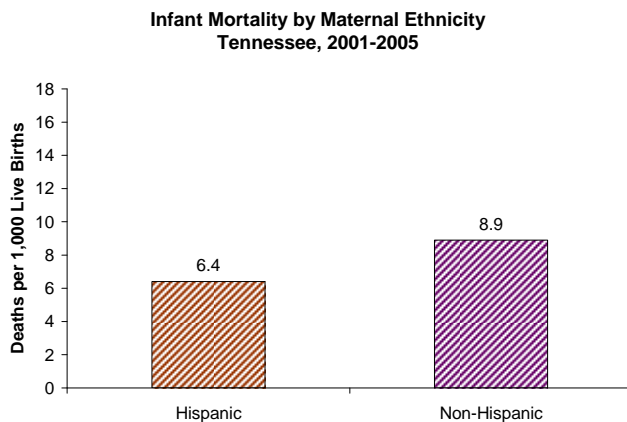
- Between 2001 and 2005, 1.7% of infants were born to mothers who did not receive any prenatal care and 26.3% were born to those who received intermediate or inadequate levels of care.
- There was no statistically significant increase or decrease in the percentage of infants born to mothers who received no or intermediate/inadequate prenatal care over the period 1997-2003. Because of changes to the birth certificate that went into effect in 2004, it was not possible to determine if any upward or downward trend in the percentage of mothers receiving less than adequate care occurred between 1997 and 2006.

Maternal Race and Ethnicity*

- Between 2001 and 2005, the infant mortality rate among babies born to black mothers was 16.2 deaths per 1,000 live births, compared to 6.8/1,000 among those born to white mothers. Infants born to black mothers were almost two-and-a-half times as likely as infants born to white mothers to die during their first year of life.
- Between 2001 and 2005, 21.1% of infants were born to black mothers.
- Between 1997 and 2006, the percentage of infants born to black mothers decreased by 5%.



- Between 2001 and 2005, the infant mortality rate among babies born to non-Hispanic mothers was 8.9 deaths per 1,000 live births, compared to 6.4/1,000 among those born to Hispanic mothers. Infants born to non-Hispanic mothers were almost one-and-a-half times as likely as infants born to Hispanic mothers to die during their first year of life.
- Between 2001 and 2005, 6.6% of infants were born to Hispanic mothers.
- Between 1997 and 2006, the percentage of infants born to Hispanic mothers increased by 309%.



* The following infant mortality rates by race and ethnicity are slightly different from those presented on pages 6-10. The reasons for these slight differences are as follow: different time periods (2001-2005 vs. 1997-2006), different methods of identifying race/ethnicity (maternal vs. infant race/ethnicity), and different data sources (Linked Birth and Death Statistical System vs. Death Statistical System).

Maternal Race and Ethnicity *cont.*

As noted earlier, low birthweight and preterm birth are the leading cause of infant mortality in Tennessee. Low birthweight infants were 20 times as likely as normal weight infants to die during their first year of life. Similarly, preterm infants were 15 times as likely as term infants to die. During the last decade, the infant mortality rate and racial disparities in the state have remained essentially unchanged. Persistent racial disparities have occurred not only in Tennessee, but in the nation as a whole, and several studies have observed that these disparities stem in part from the fact that black women are much more likely to deliver preterm, low birthweight infants.^{5,6}

- Between 2001 and 2005, 14.6% of infants born to black mothers were low birthweight, compared to 8.0% of infants born to white mothers. During this same time period, 15.6% of infants born to black mothers were preterm, compared to 11.6% of infants born to white mothers.
- Racial disparities in the prevalence of low birthweight and preterm birth were more pronounced among the smallest and earliest infants, and it is these infants that have the highest mortality rates.
- The mortality rate among extremely low birthweight infants (<500 grams) was similar among those born to black and to white mothers. However, black infants were six times as likely as white infants to be born at extremely low birthweights.
- The mortality rate among extremely preterm infants (<28 weeks) was similar among those born to black and to white mothers. However, black infants were three times as likely as white infants to be born extremely preterm.

**Births and Deaths by Birthweight and Maternal Race
Tennessee 2001-2005**

Birthweight (grams)	Prevalence (Percent of Live Births)			Mortality (Deaths per 1,000 Live Births)		
	Black	White	<i>Blk:Wht Ratio</i>	Black	White	<i>Blk:Wht Ratio</i>
<500 (extremely low)	0.6	0.1	6.0	916	854	1.1
500-1,499 (very low)	2.7	1.2	2.3	184	159	1.2
1,500-2,499 (moderately low)	11.3	6.7	1.7	19	17	1.1
2,500 (normal)	85.4	92.0	0.9	4	3	1.3

**Births and Deaths by Gestational Age and Maternal Race
Tennessee 2001-2005**

Gestational Age (weeks)	Prevalence (Percent of Live Births)			Mortality (Deaths per 1,000 Live Births)		
	Black	White	<i>Blk:Wht Ratio</i>	Black	White	<i>Blk:Wht Ratio</i>
<28 (extremely preterm)	1.8	0.6	3.0	512	430	1.2
28-31 (very preterm)	1.7	1.0	1.7	58	52	1.1
32-33 (moderately preterm)	2.1	1.3	1.6	22	27	0.8
34-36 (slightly preterm)	10.0	8.7	1.1	14	10	1.4
37+ (term)	84.4	88.5	1.0	4	3	1.3

Maternal Race and Ethnicity cont.

- In addition to low birthweight and preterm birth, the prevalence of the following infant mortality risk factors were also higher among infants born to black mothers than among those born to white mothers: multiple birth, teenage mother, unmarried mother, mother with a previous child death, mother with high school or lower education, no prenatal care, and intermediate or inadequate prenatal care.
- The prevalence of the following infant mortality risk factors were higher among infants born to white mothers than among those born to black mothers: older mother and mother who smoked during pregnancy.

**Infant Mortality Risk Factors and Relative Risk by Maternal Race
Tennessee 2001-2005**

Risk Factor	Risk Factor Prevalence (%)		Relative Risk of Infant Mortality*	
	Black	White	Black	White
Low Birthweight (<2,500 grams)	14.6	8.0	20.9	17.9
Preterm Birth (<37 weeks gestation)	15.6	11.6	17.6	12.8
Multiple Birth	3.6	3.1	4.6	5.1
Teenage Mother (<18 years)	7.9	3.5	1.0 [†]	1.6
Older Mother (35+ years)	7.3	10.3	1.1 [†]	1.0 [†]
Not Married	73.7	28.3	1.3	1.7
Previous Child Death	2.7	1.4	3.4	3.9
High School or Lower Education	65.8	53.6	1.3	1.9
Smoked During Pregnancy	9.1	20.6	1.6	2.2
No Prenatal Care	3.9	1.2	4.1	4.3
Intermediate/Inadequate Prenatal Care	38.2	23.1	0.9 [†]	1.3

* Relative risks are not adjusted for other risk factors

[†] Relative risk is not statistically significant

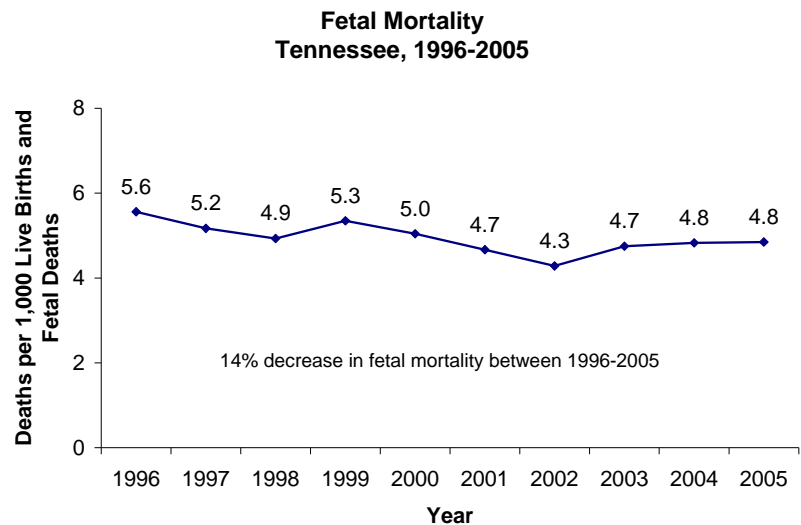
- The association between infant mortality and low birthweight and preterm birth was stronger among infants born to black mothers than among those born to white mothers. This was due in part to the higher prevalence of extremely and very low birthweight and preterm infants born to black mothers.
- The association between infant mortality and each of the following risk factors was stronger among white infants than among black infants: teenage mother, unmarried mother, mother with high school or lower education, mother who smoked during pregnancy, and intermediate or inadequate prenatal care. Although the strength of association was greater among whites, the prevalence of each risk factor (with the exception of smoking) was higher among blacks.
- The strength of association between infant mortality and each of the following risk factors was similar among infants born to black and to white mothers: multiple birth, older mother, mother with a previous child death, and no prenatal care.

Fetal Mortality

Fetal deaths, often referred to as spontaneous abortions or miscarriages, do not involve a live birth. Thus, they are not the same as infant deaths and are not included in infant mortality statistics (see Technical Notes for definitions of infant and fetal death). Nonetheless, fetal and infant deaths share many of the same risk factors and together are indicators of overall maternal and child health.

Overall Fetal Mortality

- Tennessee requires the reporting of fetal deaths weighing 500 grams or more (or in the absence of weight, 22 or more weeks of gestation). On average, approximately 390 fetal deaths are reported in the state each year.
- Between 1996 and 2005, the annual fetal mortality rate in Tennessee averaged 4.9 deaths per 1,000 live births and fetal deaths.
- During this time period, the fetal mortality rate decreased by 14%, from 5.6/1,000 to 4.8/1,000.

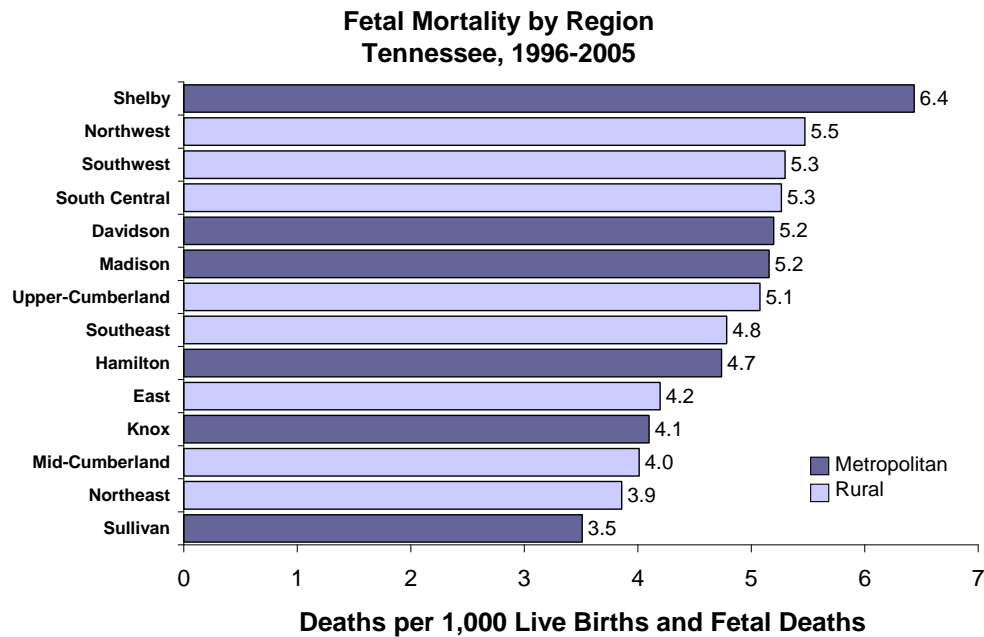


Fetal Mortality by Location

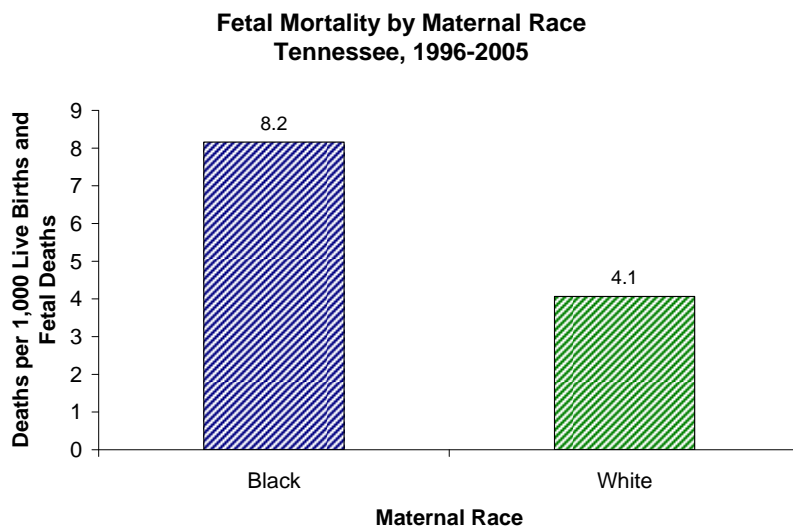
- Unlike Tennessee, most states require the reporting of fetal deaths at 20 or more weeks of gestation (roughly equivalent to 350+ grams). Because of this difference in reporting requirements, it is not possible to directly compare the overall fetal mortality rate in Tennessee to that of other states or to the overall U.S. rate.
- In order to address this and other reporting differences among states, the National Center for Health Statistics compared 2002-2004 fetal mortality rates for fetal deaths at 24 weeks or more of gestation. The U.S. fetal mortality rate for this time period was 4.1 deaths per 1,000 live births and fetal deaths. Among individual states, the fetal mortality rate ranged from 2.6/1,000 in New Mexico to 6.1/1,000 in Mississippi. Tennessee's fetal mortality rate was similar to the U.S. average at 4.1/1,000.⁷

Fetal Mortality by Location *cont.*

- Between 1996 and 2005, the average, annual fetal mortality rate in individual Tennessee Health Department regions ranged from 3.5 deaths per 1,000 live births and fetal deaths in Sullivan to 6.4/1,000 in Shelby.
- Both the highest and lowest fetal mortality rates occurred in metropolitan regions.



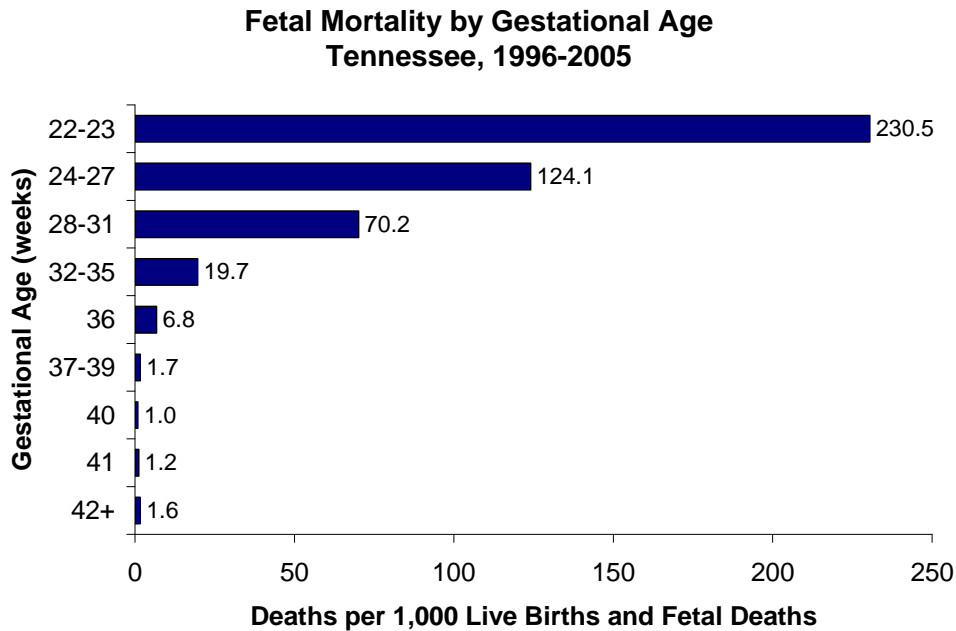
Fetal Mortality by Race



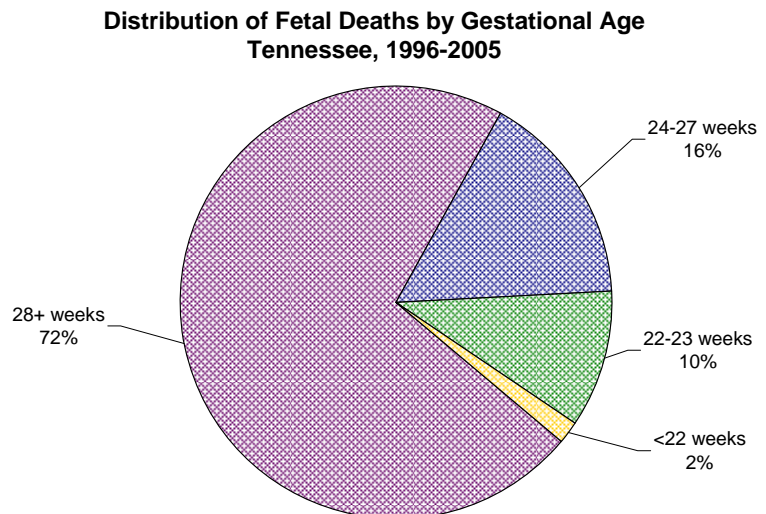
- Between 1996 and 2005, the annual fetal mortality rate among blacks averaged 8.2 deaths per 1,000 live births and fetal deaths. This was twice the fetal mortality rate among whites (4.1/1,000).
- There was no statistically significant trend in the fetal mortality rate among either blacks or whites over the period 1996 to 2005.

Fetal Mortality by Gestational Age

- Fetal mortality increased exponentially with decreasing gestational age.
- Between 1996 and 2005, the fetal mortality rate in Tennessee was highest at 22-23 weeks gestation (230.5/1,000). At gestational ages greater than 36 weeks, there were fewer than two fetal deaths per 1,000 live births and fetal deaths.

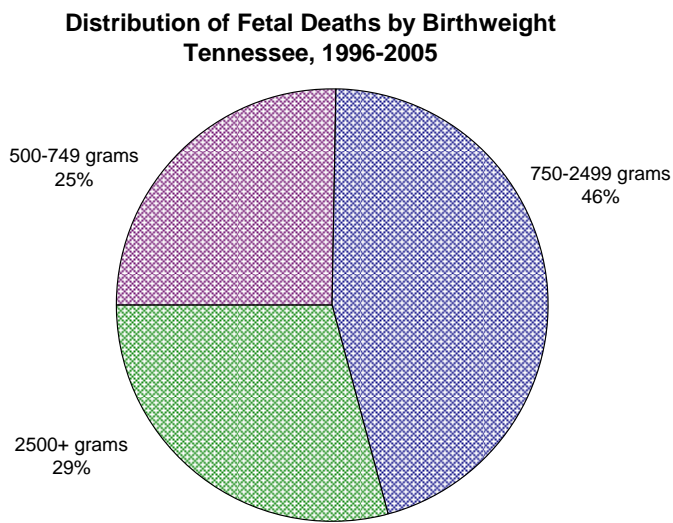
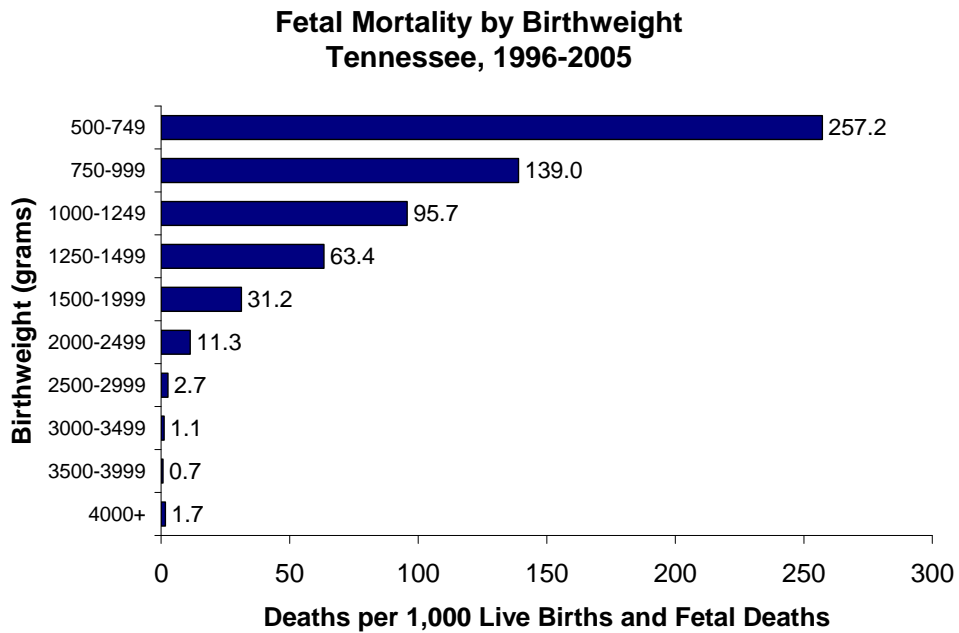


- Between 1996 and 2005, 28% of fetal deaths in Tennessee occurred at less than 28 weeks gestation.
- There is evidence that underreporting of fetal deaths is likely to occur in the earlier part of a state's required reporting period.⁷ For states reporting fetal deaths at 20+ weeks (roughly 350+ grams), 49% of fetal deaths occur at 20-27 weeks gestation, whereas for states reporting fetal deaths of 500+ grams (such as Tennessee), only 26% of fetal deaths occur at 20-27 weeks.⁷



Fetal Mortality by Birthweight

- Fetal mortality increased exponentially with decreasing birthweight.
- Between 1996 and 2005, the fetal mortality rate in Tennessee was highest at birthweights of 500-749 grams (257.2/1,000). At birthweights of 2,500 grams or more, there were fewer than three fetal deaths per 1,000 live births and fetal deaths.



- Nationally, approximately one half of fetal deaths weigh less than 750 grams.⁷
- Because of Tennessee's reporting requirements, there were no fetal deaths at birthweights of less than 500 grams between 1996 and 2005, and only 25% of fetal deaths weighed less than 750 grams.

Summary

Infant mortality rates in Tennessee have remained unchanged in recent years and have been consistently higher than national rates. Racial disparities have also persisted, with black babies two-and-a-half times as likely as white babies to die during their first year of life. Short gestation (i.e. preterm birth) and low birthweight were the leading cause of death overall and among black infants, and the second leading cause among white infants. Congenital defects, sudden infant death syndrome (SIDS) and accidents were also among the leading causes of death. Although the infant mortality rate for SIDS decreased between 1997 and 2006, mortality due to short gestation and low birthweight and to accidents increased, while mortality due to congenital defects remained unchanged. The prevalence of both low birthweight and preterm birth has increased since 1997. This is concerning given the fact that these are the two strongest predictors of infant mortality – low birthweight infants are 20 times as likely as normal weight infants to die during their first year of life and preterm infants are 15 times as likely as term infants to die. The prevalence of multiple births, older maternal age and unmarried mothers has also increased. With the exception of older maternal age and smoking during pregnancy, all risk factors examined in this report were more prevalent among infants born to black mothers than among those born to white mothers.

In order to decrease infant mortality in Tennessee, these risk factors will need to be addressed. However, as was noted in the introduction, this report is limited to data collected on birth and death certificates and to a large extent the risk factors examined occur *during* pregnancy. While this information is vital to understanding and reducing the burden of infant mortality in the state, it doesn't address risk factors that occur prior to or after pregnancy, or those for which information is not collected by vital records. It has been suggested that a woman's reproductive health and the health of her infant are shaped by her early life experiences and by exposure to risk and protective factors throughout her life.⁸ In simplistic terms, healthy women have healthy babies. Improving infant mortality and eliminating disparities requires an integrated approach that considers not just preconception and prenatal care, but the biological, behavioral, psychological and social determinants of women's health (i.e. a life-course perspective).⁸ Studies to date have suggested that past socioeconomic status (not just SES during pregnancy), chronic stressors (relationship, economic, housing, discrimination, etc.), and vulnerability to infection are some of the factors that may play a roll in poor birth outcomes.⁸ Long term investments in women's health, in community health and in improving social conditions are ultimately needed to improve the health of infants and children in Tennessee.

Appendix A – Perinatal Periods of Risk

Perinatal periods of risk (PPOR) is a planning tool that was developed to help communities better understand and address fetal and infant mortality.* The PPOR approach consists of six major stages:

Perinatal Periods of Risk 6 Major Stages	
1.	Assure analytic and community readiness
2.	Conduct analytic phases of PPOR
3.	Develop prevention strategies
4.	Strengthen existing and/or launch new prevention initiatives
5.	Monitor and evaluate prevention initiatives
6.	Sustain stakeholder investment and political will

The focus of this report is stage two, which consists of two analytic phases. Phase I identifies populations and perinatal periods with the largest excess mortality. Phase II tries to explain why these excess deaths occurred.

In phase I, fetal and infant deaths are mapped onto a 6-cell grid based on birthweight and age at death:

		Age at Death		
		Fetal (24+ weeks)	Neonatal	Postneonatal
Birthweight	500-1,499 grams	1	2	3
	1,500+ grams	4	5	6

Fetal deaths are limited to those that occur at 24 or more weeks gestation. Both fetal *and* infant deaths are limited to those with birthweights of 500 or more grams. These limitations were put in place due to reporting discrepancies for events below these two cutoffs. It should be noted, however, that in some populations the number of deaths excluded from the analysis may be large and may even outnumber the deaths included in the 6-cell grid. In such cases, PPOR may not identify the greatest opportunities for prevention of fetal and infant deaths.

The six cells in the grid are then clustered together into four periods of risk based on risk factors and causes of death, and given labels that suggest the primary preventive direction for deaths in that group:

		Age at Death		
		Fetal (24+ weeks)	Neonatal	Postneonatal
Birthweight	500-1,499 grams	Maternal Health/Prematurity		
	1,500+ grams	Maternal Care	Newborn Care	Infant Health

* All background information regarding PPOR was obtained at http://www.citymatch.org/ppor_index.php

The following table provides some examples of possible focus areas for prevention activities for each perinatal period of risk:

<i>Period of Risk:</i>	<i>Possible Areas for Prevention Activities:</i>
Maternal Health/Prematurity	<ul style="list-style-type: none"> • Well-woman and preconception care • Diagnosis and treatment of genitourinary tract infections • Family planning • Smoking cessation and substance abuse treatment • Supplemental nutrition programs inc. folic acid awareness • High quality prenatal care
Maternal Care	<ul style="list-style-type: none"> • Proper ID of women at high-risk for poor birth outcomes • Referral of high risk pregnancies • Medical management of diabetes, seizures, etc. • Smoking cessation and substance abuse treatment • High quality prenatal care
Newborn Care	<ul style="list-style-type: none"> • Referral systems for high-risk women in labor • Availability and quality of advanced neonatal care • Follow-up care for at-risk infants
Infant Health	<ul style="list-style-type: none"> • Well-baby care • SIDS prevention (sleeping position, breast feeding) • Injury prevention • Childhood vaccinations • Clean and safe food, milk and drinking water • Smoking, substance abuse and mental health services for parents

Once fetal and infant deaths have been assigned to the appropriate cells, mortality rates for each period of risk can be calculated. This is accomplished by dividing the number of deaths in each period of risk by the total number of fetal deaths and live births meeting the age and birthweight cutoffs described earlier. These mortality rates can then be compared to an appropriate reference group to calculate both excess mortality rates and the number of excess (i.e. preventable) deaths for each risk period, and to determine which risk period(s) account for the greatest excess risk.

Once this determination has been made, further analyses are conducted in order to explain the reasons behind this excess risk. These phase II analyses may involve assessments of community health and health systems, in depth review of data collected on birth and death certificates, or additional epidemiologic studies. The results of phase II allow prevention efforts to be efficiently and effectively targeted at specific components or populations within a community.

Comprehensive state- and regional-level PPOR analyses are beyond the scope of this report. However, phase I results for Tennessee, both overall and by maternal race, and for each Tennessee Health Department region (see Appendix B) are presented, along with preliminary state-level phase II results. These analyses compliment and support the data presented earlier in this report and serve as an introduction to the PPOR process for interested individuals and communities.

Perinatal Periods of Risk for Tennessee

- Between 2001 and 2005, there were 1,586 fetal deaths and 2,623 infant deaths in Tennessee that met PPOR age and weight limitations. During this same time period a total of 394,878 live births met the PPOR age and weight limitations.

- The overall feto-infant mortality rate was therefore 10.6 deaths per 1,000 live births and fetal deaths.

Number of Feto-Infant Deaths – Tennessee, 2001-2005

	Fetal	Neonatal	Postneonatal
500-1,499 grams	1,686		
1,500+ grams	908	637	978

- Among the four perinatal periods of risk, maternal health/prematurity had the highest mortality rate (4.3/1,000) followed by infant health (2.5/1,000), maternal care (2.3/1,000) and newborn care (1.6/1,000).

Feto-Infant Mortality Rates (per 1,000) – Tennessee, 2001-2005

	Fetal	Neonatal	Postneonatal
500-1,499 grams	4.3		
1,500+ grams	2.3	1.6	2.5

These mortality rates were compared to a reference group that consisted of infants born to white non-Hispanic mothers aged 20 years or more and with 13 or more years of education. This is a standard reference group considered to have optimal pregnancy outcomes.

Excess Feto-Infant Mortality Rates and Deaths – Tennessee, 2001-2005*

Perinatal Period of Risk	Feto-Infant Mortality Rates		Excess Mortality Rate	Excess Deaths
	Tennessee	Reference Group		
Maternal Health/ Prematurity	4.3	2.2	2.1	813
Maternal Care	2.3	1.2	1.1	422
Newborn Care	1.6	1.1	0.5	218
Infant Health	2.5	1.1	1.4	553
Total	10.6	5.6	5.0	2,006

* Values for the four risk periods may not sum exactly to the total due to rounding.

- Between 2001 and 2005, the excess feto-infant mortality rate in Tennessee was 5.0 deaths per 1,000 live births and fetal deaths. This translates into 2,006 excess (i.e. preventable) fetal and infant deaths in the state during this time period.
- Most of these excess deaths (41%) occurred during the maternal health/prematurity period, followed by infant health (28%), maternal care (21%) and newborn care (11%).

Perinatal Periods of Risk by Race

- Between 2001 and 2005, there were 1,419 fetal and infant deaths among black mothers and 2,706 among white mothers.
- The overall feto-infant mortality rate among black mothers was 17.4 deaths per 1,000 live births and fetal deaths, compared to 8.9/1,000 among white mothers.

- Among black mothers, the highest mortality rate was observed during the maternal health/prematurity period (8.0/1,000) followed by maternal care (3.8/1,000), infant health (3.4/1,000) and newborn care (2.2/1,000).

**Feto-Infant Deaths and Mortality Rates, Black Maternal Race
Tennessee, 2001-2005**

	Fetal	Neonatal	Postneonatal
500-1,499 grams	n=653 8.0		
1,500+ grams	n=313 3.8	n=175 2.2	n=278 3.4

**Feto-Infant Deaths and Mortality Rates, White Maternal Race
Tennessee, 2001-2005**

	Fetal	Neonatal	Postneonatal
500-1,499 grams	n=1,010 3.3		
1,500+ grams	n=564 1.8	n=451 1.5	n=681 2.2

- Among white mothers, the highest mortality rate was also observed during the maternal health/prematurity period (3.3/1,000) followed by infant health (2.2/1,000), maternal care (1.8/1,000) and newborn care (1.5/1,000).

- The mortality rate in each perinatal period of risk was higher among black mothers than among white mothers, with the greatest difference in the maternal health/prematurity period.
- As was noted earlier, fetal and infant deaths with birthweights of less than 500 grams are excluded from PPOR analyses. Between 2001 and 2005, 15% of infant deaths among white mothers and 34% among black mothers had birthweights of less than 500 grams.

Perinatal Periods of Risk by Race *cont.*

Feto-infant mortality rates among black and white mothers were each compared to the same reference group described above (i.e. white non-Hispanic mothers aged 20 years or more and with 13 or more years of education), and excess mortality rates and number of deaths were calculated for each group.

Excess Feto-Infant Mortality Rates by Maternal Race Tennessee, 2001-2005*

Perinatal Period of Risk	Overall	Black	White
Maternal Health/ Prematurity	2.1	5.8	1.1
Maternal Care	1.1	2.6	0.6
Newborn Care	0.5	1.1	0.4
Infant Health	1.4	2.3	1.2
Total	5.0	11.9	3.3

Excess Feto-Infant Deaths by Maternal Race Tennessee, 2001-2005[†]

Perinatal Period of Risk	Overall	Black	White
Maternal Health/ Prematurity	813	474	337
Maternal Care	422	213	189
Newborn Care	218	89	128
Infant Health	553	191	354
Total	2,006	967	1,009

- Excess mortality rates for all perinatal periods were higher among blacks than among whites.
- Although black mothers accounted for only 21% of births, they experienced 48% of excess fetal and infant deaths.
- Among black mothers, the largest opportunity for preventing deaths was in the maternal health/prematurity period. Approximately one-half of feto-infant deaths among black mothers occurred during this period.
- Among white mothers, the largest opportunities for preventing deaths were in the maternal health/prematurity and infant health periods. Approximately one-third of feto-infant deaths among white mothers occurred during each of these periods.

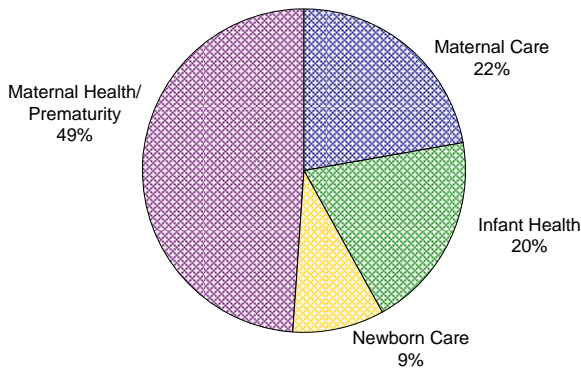
* Values for the four risk periods may not sum exactly to the total due to rounding.

† Overall deaths may be greater than the sum of black and white deaths due to missing race data and inclusion of 'other' race in the overall group.

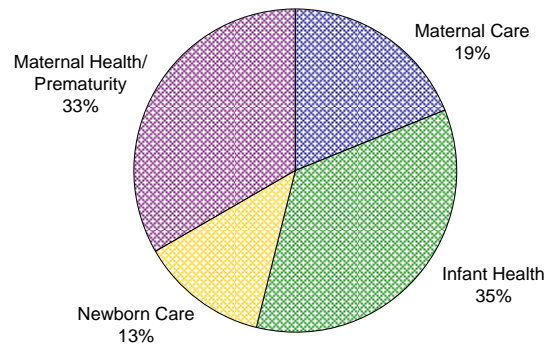
Perinatal Periods of Risk by Race *cont.*

Approximately half of all excess fetο-infant deaths among black mothers occurred during the maternal health/prematurity period, while among white mothers approximately one-third of excess fetο-infant deaths occurred during this period of risk.

**Excess Fetο-Infant Deaths by Perinatal Period of Risk
Black Maternal Race, Tennessee, 2001-2005**

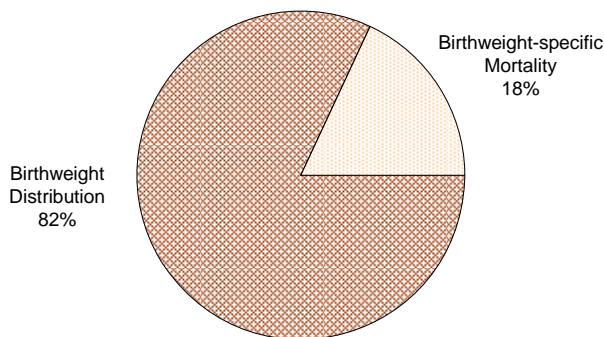


**Excess Fetο-Infant Deaths by Perinatal Period of Risk
White Maternal Race, Tennessee, 2001-2005**

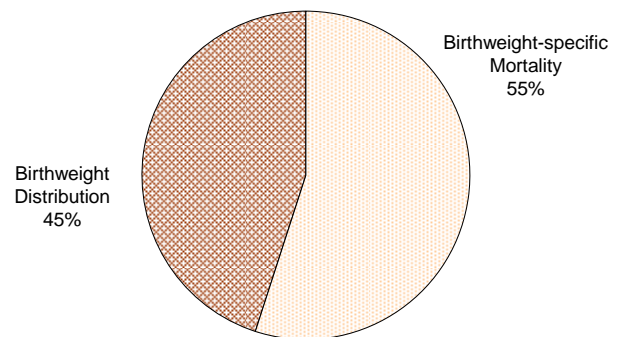


Excess deaths during the maternal health/prematurity period of risk may be due to either birthweight distribution (i.e. higher proportion of infants born at very low birthweights) or to birthweight-specific mortality (i.e. higher mortality rates among infants born at those birthweights). The difference is important because the causes, risk factors and interventions are different for each. Very low birthweight and premature births generally relate to behavioral, social, health and economic factors, whereas elevated mortality among these small infants generally relates to perinatal or medical care provided to the mother and infant prior to, during or after birth. It is therefore important to determine the contribution of each pathway to excess deaths in the maternal health/prematurity period. This is accomplished using Kitagawa Analysis, which estimates the percentage of excess mortality due to birthweight distribution and the percentage of excess due to birthweight-specific mortality rates.*

**Excess Mortality in the Maternal Health/Prematurity Period
Black Maternal Race, Tennessee, 2001-2005**



**Excess Mortality in the Maternal Health/Prematurity Period
White Maternal Race, Tennessee, 2001-2005**



* A modifiable spreadsheet for conducting the Kitagawa Analysis was obtained at http://www.citymatch.org/ppor_index.php

Perinatal Periods of Risk by Race *cont.*

Among white mothers, excess fetο-infant mortality in the maternal health/prematurity period of risk was due almost equally to birthweight distribution (45%) and birthweight-specific mortality (55%). However, among black mothers, the majority of excess mortality in this period (82%) was due to birthweight distribution, compared to just 18% due to birthweight-specific mortality. This is perhaps not surprising given data presented earlier in this report. As was noted on page 31, racial disparities in birthweight-specific mortality among the smallest and earliest infants were much less pronounced than were the disparities in the prevalence of low birthweight and prematurity.

Given the above observations, as well as the large and persistent racial disparities in infant mortality in Tennessee, a more detailed phase II analysis of very low birthweight infants (less than 1,500 grams) born to black mothers was conducted. The purpose of this analysis was to look more closely at risk factors contributing to such high levels of prematurity and low birthweight (and hence excess mortality) in this group of infants. Although beyond the scope of the current report, a more in-depth phase II PPOR analysis might also include examination of birthweight distribution and birthweight-specific mortality among both black and white mothers, as well as mortality in other periods of risk.

The first step in examining the risk factors for very low birthweight and prematurity was to determine if there were differences in the prevalence of these risk factors among black mothers compared to the reference group. Since all infants are at risk of being born very low birthweight, prevalence rates were examined among all live births. This portion of the analysis was restricted to risk factors that could be evaluated using vital statistics data. It is important to note, however, that there are additional factors that impact very low birthweight and prematurity (e.g. bacterial vaginosis, unintended pregnancies, domestic violence, and alcohol/drug abuse) for which information is not collected on birth certificates. Future analyses may be able to incorporate estimates from the recently implemented Pregnancy Risk Assessment Monitoring System (PRAMS) which collects data on risk factors experienced before, during and after pregnancy, including those mentioned above.

Perinatal Periods of Risk – Black Maternal Race

There was a statistically significant, higher prevalence of the following risk factors among black mothers compared to reference group mothers: preterm birth, low pregnancy weight gain, high blood pressure, infections during pregnancy, previous poor birth outcome, high parity, no prenatal care and enrollment in TennCare. Risk factors with a higher prevalence among black mothers may have contributed to the excess mortality in the maternal health/prematurity period observed in this group.

Prevalence of Maternal Risk Factor for Very Low Birthweight Tennessee, 2004-2006

Risk Factor	Prevalence (% of All Live Births)	
	Black Maternal Race	Reference Group
Preterm Birth (<37 weeks)	16.0*	11.6
Multiple Birth (twins, triplets, etc.)	3.8	3.9
Pregnancy Weight Gain <15 lbs.	19.5*	10.5
Diabetes ^a	5.0	6.0
High Blood Pressure ^b	8.1*	7.7
Infection during Pregnancy ^c	9.7*	2.8
Infertility Treatment	0.1	1.8
Previous Poor Birth Outcome ^d	5.8*	4.7
High Parity for Age ^e	23.5*	10.2
No Prenatal Care	5.5*	1.2
Smoking during Pregnancy	10.0	10.7
TennCare	72.4*	19.5
Less than 13 years Education ^f	62.4	--
Maternal Age less than 20 years ^f	20.0	--

^a Prepregnancy or gestational

^b Prepregnancy, gestational or eclampsia

^c Gonorrhea, Chlamydia, Syphilis, Hepatitis B and/or Hepatitis C present or treated during pregnancy

^d Includes preterm birth, perinatal death, and small-for-gestational age

^e See technical notes for definition of high parity for age

^f The reference group was defined by education ≥ 13 years and age ≥ 20 years therefore younger women and those with less education are by definition excluded from this analysis

* Statistically significant higher prevalence among black mothers compared to the reference group

The next step in assessing these risk factors was to examine their impact on very low birthweight among black mothers. Very low birthweight infants were compared to those with normal birthweight, and each risk factor was examined individually (simple logistic regression models) and in conjunction with other risk factors (multiple logistic regression main effects model). The results of the multiple regression analysis are summarized in the following table. The odds ratio for each individual risk factor has been adjusted (i.e. controlled) for all of the other risk factors listed in the table. Because the vast majority (over 98%) of very low birthweight infants were born preterm (this was true among both black mothers and among mothers in the reference group), preterm birth was not included as a variable in the multiple regression analysis. However, the higher prevalence of preterm birth among black mothers likely contributed to the excess deaths observed in this group.

Perinatal Periods of Risk – Black Maternal Race cont.

Eight of the twelve risk factors examined were positively associated with very low birthweight among infants born to black mothers, with odds ratios that remained statistically significant after adjustment. The strongest association (i.e. largest odds ratio) was for multiple births. However, the prevalence of multiple births was actually higher among the reference group, and therefore unlikely to account for the excess mortality observed among infants of black mothers. Likewise, smoking during pregnancy was also more prevalent among the reference group.

There were six risk factors that were both positively associated with very low birthweight and more prevalent among infants of black mothers (previous poor birth outcome, low pregnancy weight gain, high blood pressure, no prenatal care, teenage mother, and TennCare). Not surprisingly, many of these risk factors are related to maternal health and care. Very low birthweight infants were approximately four times as likely as normal birthweight infants to have been born to a mother with a previous poor birth outcome, low pregnancy weight gain, high blood pressure or no prenatal care. They were 40% more likely to have been born to a mother less than 20 years of age and 30% more likely to have been born to a mother enrolled in TennCare than normal birthweight infants.

Multiple Logistic Regression Analysis of Maternal Risk Factors for Very Low Birthweight Black Maternal Race, Tennessee, 2004-2006

Risk Factor	Adjusted Odds Ratio	95% Confidence Interval
Multiple Birth (twins, triplets, etc.)	21.3	17.4-26.0
Previous Poor Birth Outcome ^a	4.4	3.6-5.2
Pregnancy Weight Gain <15 lbs.	4.1	3.6-4.7
High Blood Pressure ^b	3.8	3.2-4.5
No Prenatal Care	3.5	2.8-4.2
Infertility Treatment	2.2	0.7-7.6
Smoking during Pregnancy	1.4	1.1-1.6
Maternal Age less than 20 years	1.4	1.1-1.6
TennCare	1.3	1.1-1.8
Diabetes ^c	1.0	0.8-1.3
High Parity for Age ^d	1.0	0.9-1.2
Less than 13 years Education	1.0	0.9-1.2
Infection during Pregnancy ^e	0.8	0.7-1.1

^a Includes preterm birth, perinatal death, and small-for-gestational age

^b Prepregnancy, gestational or eclampsia

^c Prepregnancy or gestational

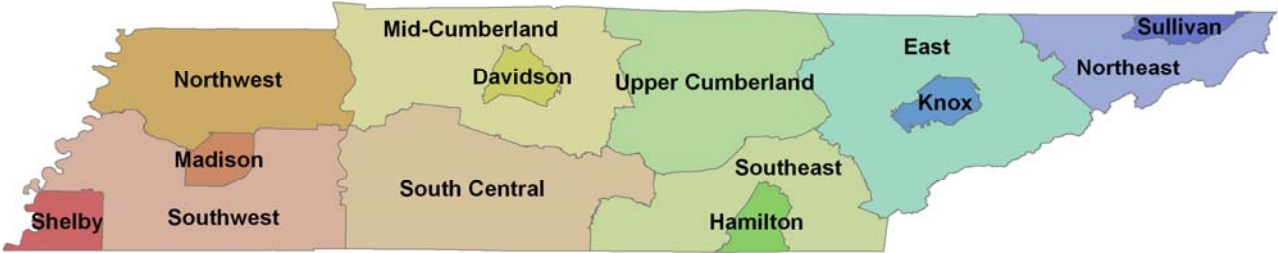
^d See technical notes for definition of high parity for age

^e Gonorrhea, Chlamydia, Syphilis, Hepatitis B and/or Hepatitis C present or treated during pregnancy

It is important to note that although multiple births and smoking were less prevalent among black mothers, and therefore unlikely to account for the observed excess deaths, both were still positively associated with very low birthweight. Addressing these issues, especially smoking, which is a modifiable risk factor, is still important for reducing very low birthweight among all infants.

Appendix B – Regional Infant Mortality Profiles

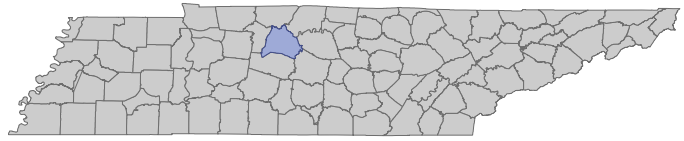
The following pages contain individual infant mortality profiles for each Tennessee Health Department region. These include six metropolitan regions/counties (Davidson, Hamilton, Knox, Madison, Shelby and Sullivan) and eight rural regions (East, Mid-Cumberland, Northeast, Northwest, South Central, Southeast, Southwest and Upper-Cumberland).



Each profile includes infant mortality rates (overall and by race), fetal mortality rates, leading causes of death, risk factor prevalence and the relative risk of infant mortality for each risk factor, and phase I perinatal periods of risk analysis. Rural region profiles also include overall infant mortality rates for each county in the region.

Region/County	Pages
Davidson.....	50-51
East.....	52-53
Hamilton.....	54-55
Knox.....	56-57
Madison.....	58-59
Mid-Cumberland.....	60-61
Northeast.....	62-63
Northwest.....	64-65
Shelby.....	66-67
South Central.....	68-69
Southeast.....	70-71
Southwest.....	72-73
Sullivan.....	74-75
Upper-Cumberland.....	76-77

DAVIDSON COUNTY



- On average, approximately 77 infants die each year in Davidson County.
- Between 1997 and 2006, the annual infant mortality rate in the county averaged 8.7 deaths per 1,000 live births. There was not a statistically significant upward or downward trend in infant mortality over this time period.
- Davidson County had the 7th highest infant mortality rate among the state’s 14 health department regions, and the 35th highest among the state’s 95 counties.
- The average, annual mortality rate among black infants (14.8/1,000) was more than double that of white infants (6.1/1,000). Fifty-two percent of infant deaths in the county occurred among black infants, although only 32% of infants were born to black mothers.
- Between 1996 and 2005, the annual fetal mortality rate in Davidson County averaged 5.2 deaths per 1,000 live births and fetal deaths.

**Leading Causes of Infant Mortality
Davidson County, 1997-2006**

Cause of Death (ICD-10 codes)	Number of Deaths	Percent of Deaths
<i>All Causes</i>	773	100
Congenital defects (Q00-Q99)	159	20.6
Short gestation and low birthweight (P07)	145	18.8
Sudden infant death syndrome (R95)	64	8.3
Maternal complications of pregnancy (P01)	32	4.1
Complications of placenta, cord and membranes (P02)	31	4.0
Respiratory distress (P22)	27	3.5
Accidents (V01-X59)	27	3.5
Diseases of the circulatory system (I00-I99)	18	2.3
Influenza and pneumonia (J10-J11)	17	2.2
Bacterial sepsis of newborn (P36)	17	2.2
All other causes	236	30.5

- Congenital defects were the leading cause of infant mortality in the county (20.6% of deaths), followed closely by short gestation and low birthweight (18.8%).
- Sudden infant death syndrome (8.3%) was the third leading cause of death and accidents (3.5%, tied with respiratory distress) the sixth leading cause.

DAVIDSON COUNTY *cont.*

- The most common infant mortality risk factors in Davidson County were a mother with high school or lower education (51.8%), an unmarried mother (42.0%), and a mother who received TennCare (41.8%).
- The least common risk factors were multiple birth (3.1%), no prenatal care (2.6%), and a mother with a previous child death (1.2%).
- The highest relative risks of infant mortality were associated with low birthweight and with preterm birth.

**Infant Mortality Risk Factors
Davidson County, 2001-2005**

Risk Factor	Prevalence (% Live Births)	Relative Risk of Infant Mortality*
High School or Lower Education	51.8	1.8
Not Married	42.0	2.0
TennCare [†]	41.8	1.6
Intermediate/Inadequate Prenatal Care	23.6	1.1 [‡]
Preterm Birth (<37 weeks gestation)	11.4	17.2
Smoked During Pregnancy	11.2	1.9
Low Birthweight (<2,500 grams)	9.3	20.9
Teenage Mother (<18 years)	3.7	1.3
Multiple Birth	3.1	6.4
No Prenatal Care	2.6	4.2
Previous Child Death	1.2	6.4

*Unadjusted
[†]Data are for 2004-2005 only
[‡]Not statistically significant

Results of perinatal periods of risk (PPOR) analysis for Davidson County are summarized below. For a detailed description and explanation of PPOR (including a list of possible prevention focus areas for each of the four periods of risk), please refer to Appendix A.

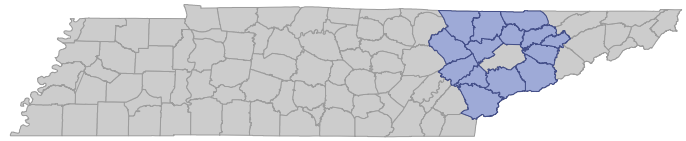
- Between 2001 and 2005, the overall feto-infant mortality rate in the county was 10.5/1,000 live births and fetal deaths. This does not include 72 infant deaths that occurred among infants with birthweights less than 500 grams (approximately 20% of all infant deaths).

**Feto-Infant Mortality Rates and Excess Deaths
Davidson County, 2001-2005**

	Fetal	Neonatal	Postneonatal
500-1,499 grams	Maternal Health/Prematurity 4.4/1,000 97		
1,500+ grams	Maternal Care 2.4/1,000 51	Newborn Care 1.6/1,000 25	Infant Health 2.2/1,000 50

- There were a total of 223 excess (i.e. preventable) feto-infant deaths. The highest proportion of deaths (43%) occurred in the maternal health/prematurity period of risk. Approximately 22-23% of excess deaths occurred in both the maternal care and infant health periods of risk.

EAST REGION



- On average, approximately 53 infants die each year in the East Region.
- Between 1997 and 2006, the annual infant mortality rate in the region averaged 6.5 deaths per 1,000 live births. There was not a statistically significant upward or downward trend in infant mortality over this time period.
- The East Region had the 3rd lowest infant mortality rate among the state's 14 health department regions.
- The average, annual mortality rate among black infants (15.7/1,000) was approximately two-and-a-half times that of white infants (6.4/1,000). Five percent of infant deaths in the region occurred among black infants, although only 2% of infants were born to black mothers.
- Between 1996 and 2005, the annual fetal mortality rate in the East Region averaged 4.2 deaths per 1,000 live births and fetal deaths.

**Infant Mortality by County
East Region, 1997-2006**

County	Number of Deaths	Deaths per 1,000 Live Births
Anderson	53	6.5
Blount	81	6.4
Campbell	34	7.0
Claiborne	20	5.6
Cocke	30	7.2
Grainger	16	6.3
Hamblen	40	4.9
Jefferson	28	5.3
Loudon	34	7.0
Monroe	48	9.1
Morgan	21	9.6
Roane	29	5.2
Scott	26	8.2
Sevier	59	6.3
Union	13	5.6

**Leading Causes of Infant Mortality
East Region, 1997-2006**

Cause of Death (ICD-10 codes)	Number of Deaths	Percent of Deaths
<i>All Causes</i>	532	100
Congenital defects (Q00-Q99)	123	23.1
Accidents (V01-X59)	61	11.5
Sudden infant death syndrome (R95)	46	8.6
Short gestation and low birthweight (P07)	31	5.8
Bacterial sepsis of newborn (P36)	22	4.1
Diseases of the circulatory system (I00-I99)	16	3.0
Maternal complications of pregnancy (P01)	16	3.0
Respiratory distress (P22)	16	3.0
Intrauterine hypoxia and birth asphyxia (P20-P21)	12	2.3
Complications of placenta, cord and membranes (P02)	10	1.9
All other causes	179	33.6

- Congenital defects were the leading cause of infant mortality in the region (23.1% of deaths), followed by accidents (11.5%) and sudden infant death syndrome (8.6%).
- Short gestation and low birthweight (5.8%) were the fourth leading cause of death.

EAST REGION *cont.*

- The most common infant mortality risk factors in the East Region were a mother with high school or lower education (64.2%), a mother who received TennCare (53.7%), and an unmarried mother (31.0%).
- The least common risk factors were multiple birth (2.9%), a mother with a previous child death (1.4%) and no prenatal care (0.6%).
- The highest relative risks of infant mortality were associated with low birthweight and with preterm birth.

**Infant Mortality Risk Factors
East Region, 2001-2005**

Risk Factor	Prevalence (% of Live Births)	Relative Risk of Infant Mortality*
High School or Lower Education	64.2	1.7
TennCare [†]	53.7	2.8
Not Married	31.0	1.5
Smoked During Pregnancy	27.4	2.3
Intermediate/Inadequate Prenatal Care	22.3	1.5
Preterm Birth (<37 weeks gestation)	12.3	9.2
Low Birthweight (<2,500 grams)	8.6	14.6
Teenage Mother (<18 years)	4.4	1.7
Multiple Birth	2.9	7.3
Previous Child Death	1.4	2.6
No Prenatal Care	0.6	5.1

*Unadjusted

[†]Data are for 2004-2005 only

Results of perinatal periods of risk (PPOR) analysis for the East Region are summarized below. For a detailed description and explanation of PPOR (including a list of possible prevention focus areas for each of the four periods of risk), please refer to Appendix A.

- Between 2001 and 2005, the overall feto-infant mortality rate in the region was 9.0/1,000 live births and fetal deaths. This does not include 32 infant deaths that occurred among infants with birthweights less than 500 grams (approximately 12% of all infant deaths).

**Feto-Infant Mortality Rates and Excess Deaths
East Region, 2001-2005**

	Fetal	Neonatal	Postneonatal
500-1,499 grams	Maternal Health/Prematurity 3.1/1,000 39		
1,500+ grams	Maternal Care 1.8/1,000 25	Newborn Care 1.4/1,000 16	Infant Health 2.6/1,000 65

- There were a total of 145 excess (i.e. preventable) feto-infant deaths. The majority of these deaths occurred in the infant health (45%) and maternal health/prematurity (27%) periods of risk.

HAMILTON COUNTY



- On average, approximately 37 infants die each year in Hamilton County.
- Between 1997 and 2006, the annual infant mortality rate in the county averaged 9.4 deaths per 1,000 live births. There was not a statistically significant upward or downward trend in infant mortality over this time period.
- Hamilton County had the 5th highest infant mortality rate among the state’s 14 health department regions, and the 17th highest among the state’s 95 counties.
- The average, annual mortality rate among black infants (17.4/1,000) was almost three times that of white infants (6.4/1,000). Forty-seven percent of infant deaths in the county occurred among black infants, although only 26% of infants were born to black mothers.
- Between 1996 and 2005, the annual fetal mortality rate in Hamilton County averaged 4.7 deaths per 1,000 live births and fetal deaths.

**Leading Causes of Infant Mortality
Hamilton County, 1997-2006**

Cause of Death (ICD-10 codes)	Number of Deaths	Percent of Deaths
<i>All Causes</i>	372	100
Congenital defects (Q00-Q99)	57	15.3
Short gestation and low birthweight (P07)	55	14.8
Sudden infant death syndrome (R95)	42	11.3
Bacterial sepsis of newborn (P36)	15	4.0
Necrotizing enterocolitis (P77)	12	3.2
Maternal complications of pregnancy (P01)	11	3.0
Respiratory distress (P22)	11	3.0
Atelectasis (P28.0-P28.1)	11	3.0
Complications of placenta, cord and membranes (P02)	10	2.7
Intrauterine hypoxia and birth asphyxia (P20-P21)	10	2.7
All other causes	138	37.1

- Congenital defects were the leading cause of infant mortality in the county (15.3% of deaths), followed closely by short gestation and low birthweight (14.8%).
- Sudden infant death syndrome (11.3%) was the third leading cause of death.
- Accidents (2.4%) were not among the ten leading causes of death.

HAMILTON COUNTY *cont.*

- The most common infant mortality risk factors in Hamilton County were a mother with high school or lower education (50.4%), a mother who received TennCare (48.1%), and an unmarried mother (39.7%).
- The least common risk factors were multiple birth (3.6%), no prenatal care (1.4%), and a mother with a previous child death (1.3%).
- The highest relative risks of infant mortality were associated with low birthweight and with preterm birth.

**Infant Mortality Risk Factors
Hamilton County, 2001-2005**

Risk Factor	Prevalence (% Live Births)	Relative Risk of Infant Mortality*
High School or Lower Education	50.4	2.1
TennCare [†]	48.1	1.9
Not Married	39.7	1.8
Intermediate/Inadequate Prenatal Care	25.6	1.5
Preterm Birth (<37 weeks gestation)	16.3	13.9
Smoked During Pregnancy	13.8	2.0
Low Birthweight (<2,500 grams)	11.5	18.5
Teenage Mother (<18 years)	5.0	0.9 [‡]
Multiple Birth	3.6	3.9
No Prenatal Care	1.4	5.1
Previous Child Death	1.3	5.8

*Unadjusted
[†]Data are for 2004-2005 only
[‡]Not statistically significant

Results of perinatal periods of risk (PPOR) analysis for Hamilton County are summarized below. For a detailed description and explanation of PPOR (including a list of possible prevention focus areas for each of the four periods of risk), please refer to Appendix A.

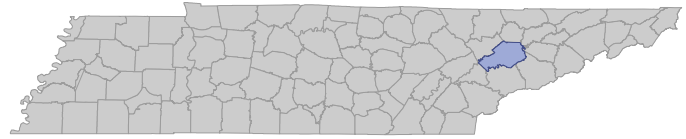
- Between 2001 and 2005, the overall feto-infant mortality rate in the county was 9.8/1,000 live births and fetal deaths. This does not include 48 infant deaths that occurred among infants with birthweights less than 500 grams (approximately 27% of all infant deaths).

**Feto-Infant Mortality Rates and Excess Deaths
Hamilton County, 2001-2005**

	Fetal	Neonatal	Postneonatal
500-1,499 grams	Maternal Health/Prematurity 4.7/1,000 50		
1,500+ grams	Maternal Care 1.5/1,000 6	Newborn Care 1.2/1,000 2	Infant Health 2.4/1,000 27

- There were a total of 85 excess (i.e. preventable) feto-infant deaths. The highest proportion of deaths occurred in the maternal health/prematurity (59%) and infant health (32%) periods of risk.

KNOX COUNTY



- On average, approximately 30 infants die each year in Knox County.
- Between 1997 and 2006, the annual infant mortality rate in the county averaged 6.0 deaths per 1,000 live births. There was not a statistically significant upward or downward trend in infant mortality over this time period.
- Knox County had the lowest infant mortality rate among the state’s 14 health department regions, and the 24th lowest among the state’s 95 counties.
- The average, annual mortality rate among black infants (12.0/1,000) was over two times that of white infants (5.3/1,000). Twenty-one percent of infant deaths in the county occurred among black infants, although only 11% of infants were born to black mothers.
- Between 1996 and 2005, the annual fetal mortality rate in Knox County averaged 4.1 deaths per 1,000 live births and fetal deaths.

**Leading Causes of Infant Mortality
Knox County, 1997-2006**

Cause of Death (ICD-10 codes)	Number of Deaths	Percent of Deaths
<i>All Causes</i>	296	100
Congenital defects (Q00-Q99)	70	23.6
Short gestation and low birthweight (P07)	28	9.5
Sudden infant death syndrome (R95)	26	8.8
Accidents (V01-X59)	15	5.1
Intrauterine hypoxia and birth asphyxia (P20-P21)	10	3.4
Necrotizing enterocolitis (P77)	10	3.4
Respiratory distress (P22)	9	3.0
Complications of placenta, cord and membranes (P02)	8	2.7
Maternal complications of pregnancy (P01)	7	2.4
Bacterial sepsis of newborn (P36)	7	2.4
All other causes	106	35.8

- Congenital defects were the leading cause of infant mortality in the county (23.6% of deaths).
- Short gestation and low birthweight (9.5%) were the second leading cause, followed by sudden infant death syndrome (8.8%) and accidents (5.1%).

KNOX COUNTY *cont.*

- The most common infant mortality risk factors in Knox County were a mother with high school or lower education (45.3%), a mother who received TennCare (39.4%), and an unmarried mother (29.6%).
- The least common risk factors were a teenage mother (3.6%), a mother with a previous child death (1.2%) and no prenatal care (0.8%).
- The highest relative risks of infant mortality were associated with low birthweight and with preterm birth.

**Infant Mortality Risk Factors
Knox County, 2001-2005**

Risk Factor	Prevalence (% Live Births)	Relative Risk of Infant Mortality*
High School or Lower Education	45.3	2.0
TennCare [†]	39.4	1.6 [‡]
Not Married	29.6	1.9
Intermediate/Inadequate Prenatal Care	19.4	1.6
Smoked During Pregnancy	18.1	3.1
Preterm Birth (<37 weeks gestation)	12.4	12.7
Low Birthweight (<2,500 grams)	8.9	19.8
Multiple Birth	3.7	3.2
Teenage Mother (<18 years)	3.6	1.2 [‡]
Previous Child Death	1.2	4.1
No Prenatal Care	0.8	5.2

*Unadjusted
[†]Data are for 2004-2005 only
[‡]Not statistically significant

Results of perinatal periods of risk (PPOR) analysis for Knox County are summarized below. For a detailed description and explanation of PPOR (including a list of possible prevention focus areas for each of the four periods of risk), please refer to Appendix A.

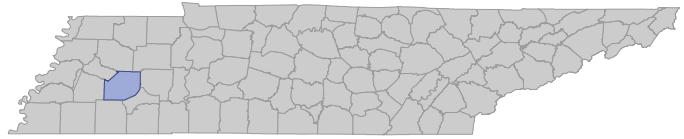
- Between 2001 and 2005, the overall feto-infant mortality rate in the county was 7.9/1,000 live births and fetal deaths. This does not include 29 infant deaths that occurred among infants with birthweights less than 500 grams (approximately 20% of all infant deaths).

**Feto-Infant Mortality Rates and Excess Deaths
Knox County, 2001-2005**

	Fetal	Neonatal	Postneonatal
500-1,499 grams	Maternal Health/Prematurity 2.7/1,000 12		
1,500+ grams	Maternal Care 2.0/1,000 19	Newborn Care 1.5/1,000 10	Infant Health 1.8/1,000 19

- There were a total of 59 excess (i.e. preventable) feto-infant deaths. The majority of these deaths occurred in the maternal care and infant health periods of risk (32% each).

MADISON COUNTY



- On average, approximately 15 infants die each year in Madison County.
- Between 1997 and 2006, the annual infant mortality rate in the county averaged 11.5 deaths per 1,000 live births. There was not a statistically significant upward or downward trend in infant mortality over this time period.
- Madison County had the 2nd highest infant mortality rate among the state’s 14 health department regions, and the 10th highest among the state’s 95 counties.
- The average, annual mortality rate among black infants (17.0/1,000) was over two times that of white infants (7.9/1,000). Fifty-nine percent of infant deaths in the county occurred among black infants, although only 40% of infants were born to black mothers.
- Between 1996 and 2005, the annual fetal mortality rate in Madison County averaged 5.2 deaths per 1,000 live births and fetal deaths.

**Leading Causes of Infant Mortality
Madison County, 1997-2006**

Cause of Death (ICD-10 codes)	Number of Deaths	Percent of Deaths
<i>All Causes</i>	152	100
Short gestation and low birthweight (P07)	29	19.1
Congenital defects (Q00-Q99)	23	15.1
Sudden infant death syndrome (R95)	18	11.8
Maternal complications of pregnancy (P01)	11	7.2
Respiratory distress (P22)	7	4.6
Bacterial sepsis of newborn (P36)	7	4.6
Complications of placenta, cord and membranes (P02)	6	3.9
Accidents (V01-X59)	6	3.9
Diseases of the circulatory system (I00-I99)	4	2.6
Influenza and pneumonia (J10-J11)	4	2.6
Neonatal hemorrhage (P50-P52)	4	2.6
Necrotizing enterocolitis (P77)	4	2.6
All other causes	29	19.1

- Short gestation and low birthweight were the leading cause of infant mortality in the region (19.1% of deaths), followed by congenital defects (15.1%) and sudden infant death syndrome (11.8%).
- Accidents (3.9%, tied with complications of placenta, cord and membranes) were the seventh leading cause of death.

MADISON COUNTY *cont.*

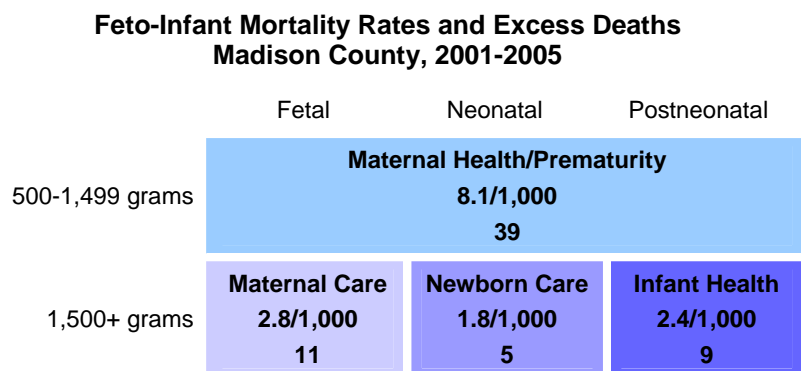
- The most common infant mortality risk factors in Madison County were a mother who received TennCare (50.9%), a mother with high school or lower education (50.2%), and an unmarried mother (45.4%).
- The least common risk factors were multiple birth (3.3%), a mother with a previous child death (1.3%) and no prenatal care (1.2%).
- The highest relative risks of infant mortality were associated with low birthweight and with preterm birth.

Risk Factor	Prevalence (% Live Births)	Relative Risk of Infant Mortality*
TennCare [†]	50.9	7.0
High School or Lower Education	50.2	1.7
Not Married	45.4	2.3
Intermediate/Inadequate Prenatal Care	29.6	1.5
Smoked During Pregnancy	14.6	1.9
Preterm Birth (<37 weeks gestation)	12.9	39.3
Low Birthweight (<2,500 grams)	10.6	40.6
Teenage Mother (<18 years)	4.7	1.0 [‡]
Multiple Birth	3.3	6.5
Previous Child Death	1.3	4.6
No Prenatal Care	1.2	8.2

*Unadjusted
[†]Data are for 2004-2005 only
[‡]Not statistically significant

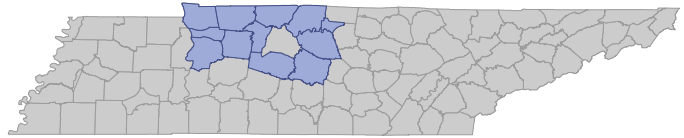
Results of perinatal periods of risk (PPOR) analysis for Madison County are summarized below. For a detailed description and explanation of PPOR (including a list of possible prevention focus areas for each of the four periods of risk), please refer to Appendix A.

- Between 2001 and 2005, the overall feto-infant mortality rate in the county was 15.1/1,000 live births and fetal deaths. This does not include 19 infant deaths that occurred among infants with birthweights less than 500 grams (approximately 22% of all infant deaths).



- There were a total of 64 excess (i.e. preventable) feto-infant deaths. The majority of these deaths (61%) occurred in the maternal health/ prematurity period of risk.

MID-CUMBERLAND REGION



- On average, approximately 79 infants die each year in the Mid-Cumberland Region.
- Between 1997 and 2006, the annual infant mortality rate in the region averaged 6.2 deaths per 1,000 live births. There was not a statistically significant upward or downward trend in infant mortality over this time period.
- The Mid-Cumberland Region had the 2nd lowest infant mortality rate among the state's 14 health department regions.
- The average, annual mortality rate among black infants (12.6/1,000) was over two times that of white infants (5.5/1,000). Twenty percent of infant deaths in the region occurred among black infants, although only 10% of infants were born to black mothers.
- Between 1996 and 2005, the annual fetal mortality rate in the Mid-Cumberland Region averaged 4.0 deaths per 1,000 live births and fetal deaths.

**Infant Mortality by County
Mid-Cumberland Region, 1997-2006**

County	Number of Deaths	Deaths per 1,000 Live Births
Cheatham	34	7.0
Dickson	38	6.0
Houston	6	5.8
Humphreys	16	7.4
Montgomery	200	8.1
Robertson	51	5.8
Rutherford	187	6.2
Stewart	20	13.9
Sumner	101	5.6
Trousdale	1	1.1
Williamson	70	3.9
Wilson	69	5.5

**Leading Causes of Infant Mortality
Mid-Cumberland Region, 1997-2006**

Cause of Death (ICD-10 codes)	Number of Deaths	Percent of Deaths
<i>All Causes</i>	793	100
Congenital defects (Q00-Q99)	198	25.0
Short gestation and low birthweight (P07)	111	14.0
Sudden infant death syndrome (R95)	109	13.7
Complications of placenta, cord and membranes (P02)	32	4.0
Accidents (V01-X59)	23	2.9
Influenza and pneumonia (J10-J11)	21	2.6
Respiratory distress (P22)	21	2.6
Maternal complications of pregnancy (P01)	20	2.5
Neonatal hemorrhage (P50-P52)	19	2.4
Atelectasis (P28.0-P28.1)	18	2.3
All other causes	221	27.9

- Congenital defects were the leading cause of infant mortality in the region (25.0% of deaths), followed by short gestation and low birthweight (14.0%) and sudden infant death syndrome (13.7%).
- Accidents (2.9%) were the fifth leading cause of death.

MID-CUMBERLAND REGION *cont.*

- The most common infant mortality risk factors in the Mid-Cumberland Region were a mother with high school or lower education (47.1%), a mother who received TennCare (33.0%), and an unmarried mother (27.6%).
- The least common risk factors were a teenage mother (2.8%), a mother with a previous child death (1.3%) and no prenatal care (0.8%).
- The highest relative risks of infant mortality were associated with low birthweight and with preterm birth.

**Infant Mortality Risk Factors
Mid-Cumberland Region, 2001-2005**

Risk Factor	Prevalence (% of Live Births)	Relative Risk of Infant Mortality*
High School or Lower Education	47.1	1.7
TennCare [†]	33.0	2.4
Not Married	27.6	1.9
Intermediate/Inadequate Prenatal Care	23.6	1.2 [‡]
Smoked During Pregnancy	16.5	2.2
Preterm Birth (<37 weeks gestation)	11.4	13.4
Low Birthweight (<2,500 grams)	8.1	16.2
Multiple Birth	3.3	3.1
Teenage Mother (<18 years)	2.8	1.8
Previous Child Death	1.3	4.1
No Prenatal Care	0.8	6.4

*Unadjusted
[†]Data are for 2004-2005 only
[‡]Not statistically significant

Results of perinatal periods of risk (PPOR) analysis for the Mid-Cumberland Region are summarized below. For a detailed description and explanation of PPOR (including a list of possible prevention focus areas for each of the four periods of risk), please refer to Appendix A.

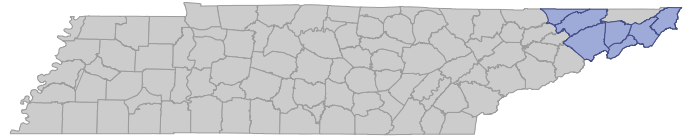
- Between 2001 and 2005, the overall feto-infant mortality rate in the region was 8.5/1,000 live births and fetal deaths. This does not include 70 infant deaths that occurred among infants with birthweights less than 500 grams (approximately 17% of all infant deaths).

**Feto-Infant Mortality Rates and Excess Deaths
Mid-Cumberland Region, 2001-2005**

	Fetal	Neonatal	Postneonatal
500-1,499 grams	Maternal Health/Prematurity 3.1/1,000 56		
1,500+ grams	Maternal Care 1.7/1,000 34	Newborn Care 1.7/1,000 45	Infant Health 2.0/1,000 59

- There were a total of 194 excess (i.e. preventable) feto-infant deaths. The majority of these deaths occurred in the infant health (30%) and maternal health/prematurity (29%) periods of risk.

NORTHEAST REGION



- On average, approximately 31 infants die each year in the Northeast Region.
- Between 1997 and 2006, the annual infant mortality rate in the region averaged 8.3 deaths per 1,000 live births. There was not a statistically significant upward or downward trend in infant mortality over this time period.
- The Northeast Region had the 7th lowest infant mortality rate among the state's 14 health department regions.
- The average, annual mortality rate among black infants (19.4/1,000) was almost two-and-a-half times that of white infants (8.1/1,000). Five percent of infant deaths in the region occurred among black infants, although only 2% of infants were born to black mothers.
- Between 1996 and 2005, the annual fetal mortality rate in the Northeast Region averaged 3.9 deaths per 1,000 live births and fetal deaths.

**Infant Mortality by County
Northeast Region, 1997-2006**

County	Number of Deaths	Deaths per 1,000 Live Births
Carter	54	9.1
Greene	56	7.6
Hancock	4	5.3
Hawkins	45	7.1
Johnson	19	11.6
Unicoi	15	8.0
Washington	113	8.6

**Leading Causes of Infant Mortality
Northeast Region, 1997-2006**

Cause of Death (ICD-10 codes)	Number of Deaths	Percent of Deaths
<i>All Causes</i>	306	100
Congenital defects (Q00-Q99)	60	19.6
Sudden infant death syndrome (R95)	32	10.5
Short gestation and low birthweight (P07)	30	9.8
Respiratory distress (P22)	21	6.9
Accidents (V01-X59)	17	5.6
Maternal complications of pregnancy (P01)	11	3.6
Complications of placenta, cord and membranes (P02)	9	2.9
Intrauterine hypoxia and birth asphyxia (P20-P21)	9	2.9
Neonatal hemorrhage (P50-P52)	9	2.9
Diseases of the circulatory system (I00-I99)	8	2.6
All other causes	100	32.7

- Congenital defects were the leading cause of infant mortality in the region (19.6% of deaths), followed by sudden infant death syndrome (10.5%) and short gestation and low birthweight (9.8%).
- Accidents (5.6%) were the fifth leading cause of death.

NORTHEAST REGION *cont.*

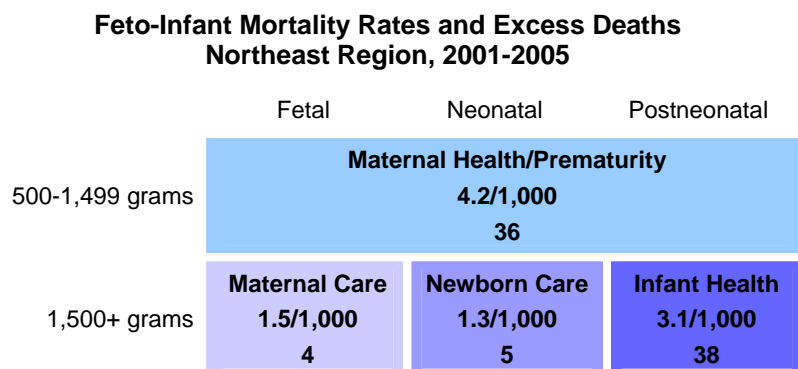
- The most common infant mortality risk factors in the Northeast Region were a mother with high school or lower education (58.8%), a mother who received TennCare (56.8%), and an unmarried mother (30.9%).
- The least common risk factors were multiple birth (2.8%), a mother with a previous child death (1.4%) and no prenatal care (0.5%).
- The highest relative risks of infant mortality were associated with low birthweight and with preterm birth.

Risk Factor	Prevalence (% of Live Births)	Relative Risk of Infant Mortality*
High School or Lower Education	58.8	1.9
TennCare [†]	56.8	2.2
Not Married	30.9	2.1
Smoked During Pregnancy	28.3	2.1
Intermediate/Inadequate Prenatal Care	22.7	1.3 [‡]
Preterm Birth (<37 weeks gestation)	10.9	15.0
Low Birthweight (<2,500 grams)	9.0	18.4
Teenage Mother (<18 years)	4.0	1.9
Multiple Birth	2.8	5.7
Previous Child Death	1.4	5.2
No Prenatal Care	0.5	6.8

*Unadjusted
[†]Data are for 2004-2005 only
[‡]Not statistically significant

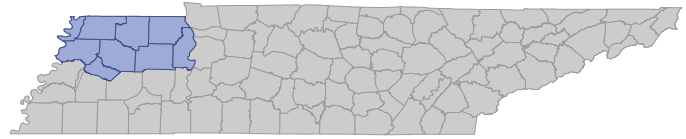
Results of perinatal periods of risk (PPOR) analysis for the Northeast Region are summarized below. For a detailed description and explanation of PPOR (including a list of possible prevention focus areas for each of the four periods of risk), please refer to Appendix A.

- Between 2001 and 2005, the overall feto-infant mortality rate in the region was 10.1/1,000 live births and fetal deaths. This does not include 38 infant deaths that occurred among infants with birthweights less than 500 grams (approximately 22% of all infant deaths).



- There were a total of 84 excess (i.e. preventable) feto-infant deaths. The majority of these deaths occurred in the infant health (45%) and maternal health/prematurity (43%) periods of risk.

NORTHWEST REGION



- On average, approximately 30 infants die each year in the Northwest Region.
- Between 1997 and 2006, the annual infant mortality rate in the region averaged 9.9 deaths per 1,000 live births. There was not a statistically significant upward or downward trend in infant mortality over this time period.
- The Northwest Region had the 4th highest infant mortality rate among the state's 14 health department regions.
- The average, annual mortality rate among black infants (18.2/1,000) was over two times that of white infants (8.5/1,000). Twenty-seven percent of infant deaths in the region occurred among black infants, although only 15% of infants were born to black mothers.
- Between 1996 and 2005, the annual fetal mortality rate in the Northwest Region averaged 5.5 deaths per 1,000 live births and fetal deaths.

**Infant Mortality by County
Northwest Region, 1997-2006**

County	Number of Deaths	Deaths per 1,000 Live Births
Benton	15	9.0
Carroll	41	11.4
Crockett	12	6.5
Dyer	47	9.4
Gibson	66	10.9
Henry	34	9.3
Lake	9	11.7
Obion	42	10.5
Weakley	33	8.9

**Leading Causes of Infant Mortality
Northwest Region, 1997-2006**

Cause of Death (ICD-10 codes)	Number of Deaths	Percent of Deaths
<i>All Causes</i>	299	100
Short gestation and low birthweight (P07)	47	15.7
Congenital defects (Q00-Q99)	47	15.7
Sudden infant death syndrome (R95)	43	14.4
Bacterial sepsis of newborn (P36)	15	5.0
Complications of placenta, cord and membranes (P02)	10	3.3
Respiratory distress (P22)	10	3.3
Necrotizing enterocolitis (P77)	10	3.3
Diseases of the circulatory system (I00-I99)	8	2.7
Intrauterine hypoxia and birth asphyxia (P20-P21)	8	2.7
Neonatal hemorrhage (P50-P52)	8	2.7
All other causes	93	31.1

- Congenital defects and short gestation and low birthweight were the leading causes of infant mortality in the region (15.7% of deaths each), followed closely by sudden infant death syndrome (14.4%).
- Accidents (1.3%) were not among the ten leading causes of death.

NORTHWEST REGION *cont.*

- The most common infant mortality risk factors in the Northwest Region were a mother with high school or lower education (64.8%), a mother who received TennCare (60.1%), and an unmarried mother (39.6%).
- The least common risk factors were multiple birth (2.8%), a mother with a previous child death (1.7%) and no prenatal care (1.0%).
- The highest relative risks of infant mortality were associated with low birthweight and with preterm birth.

**Infant Mortality Risk Factors
Northwest Region, 2001-2005**

Risk Factor	Prevalence (% of Live Births)	Relative Risk of Infant Mortality*
High School or Lower Education	64.8	2.2
TennCare [†]	60.1	2.8
Not Married	39.6	1.4
Intermediate/Inadequate Prenatal Care	27.7	1.8
Smoked During Pregnancy	26.3	2.1
Preterm Birth (<37 weeks gestation)	12.3	16.0
Low Birthweight (<2,500 grams)	9.5	21.5
Teenage Mother (<18 years)	5.3	1.9 [‡]
Multiple Birth	2.8	4.9
Previous Child Death	1.7	2.7
No Prenatal Care	1.0	9.5

*Unadjusted
[†]Data are for 2004-2005 only
[‡]Not statistically significant

Results of perinatal periods of risk (PPOR) analysis for the Northwest Region are summarized below. For a detailed description and explanation of PPOR (including a list of possible prevention focus areas for each of the four periods of risk), please refer to Appendix A.

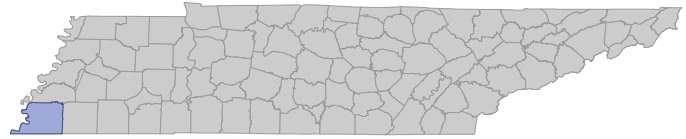
- Between 2001 and 2005, the overall feto-infant mortality rate in the region was 13.0/1,000 live births and fetal deaths. This does not include 19 infant deaths that occurred among infants with birthweights less than 500 grams (approximately 13% of all infant deaths).

**Feto-Infant Mortality Rates and Excess Deaths
Northwest Region, 2001-2005**

	Fetal	Neonatal	Postneonatal
500-1,499 grams	Maternal Health/Prematurity 6.0/1,000 58		
1,500+ grams	Maternal Care 2.5/1,000 19	Newborn Care 2.0/1,000 15	Infant Health 2.4/1,000 20

- There were a total of 112 excess (i.e. preventable) feto-infant deaths. The majority of these deaths (52%) occurred in the maternal health/ prematurity period of risk.

SHELBY COUNTY



- On average, approximately 192 infants die each year in Shelby County.
- Between 1997 and 2006, the annual infant mortality rate in the county averaged 13.1 deaths per 1,000 live births. There was not a statistically significant upward or downward trend in infant mortality over this time period.
- Shelby County had the highest infant mortality rate among the state’s 14 health department regions, and the 5th highest among the state’s 95 counties.
- The average, annual mortality rate among black infants (17.9/1,000) was almost three times that of white infants (6.3/1,000). Seventy-nine percent of infant deaths in the county occurred among black infants, although only 59% of infants were born to black mothers.
- Between 1996 and 2005, the annual fetal mortality rate in Shelby County averaged 6.4 deaths per 1,000 live births and fetal deaths.

**Leading Causes of Infant Mortality
Shelby County, 1997-2006**

Cause of Death (ICD-10 codes)	Number of Deaths	Percent of Deaths
<i>All Causes</i>	1915	100
Short gestation and low birthweight (P07)	515	26.9
Congenital defects (Q00-Q99)	259	13.5
Sudden infant death syndrome (R95)	215	11.2
Respiratory distress (P22)	77	4.0
Accidents (V01-X59)	67	3.5
Bacterial sepsis of newborn (P36)	55	2.9
Maternal complications of pregnancy (P01)	41	2.1
Diseases of the circulatory system (I00-I99)	40	2.1
Complications of placenta, cord and membranes (P02)	40	2.1
Neonatal hemorrhage (P50-P52)	35	1.8
All other causes	571	29.8

- Short gestation and low birthweight were the leading cause of infant mortality in the county (26.9% of deaths), followed by congenital defects (13.5%) and sudden infant death syndrome (11.2%).
- Accidents (3.5%) were the fifth leading cause of death.

SHELBY COUNTY *cont.*

- The most common infant mortality risk factors in Shelby County were a mother with high school or lower education (55.3%), a mother who received TennCare (54.6%), and an unmarried mother (54.0%).
- The least common risk factors were no prenatal care (5.2%), multiple birth (3.5%), and a mother with a previous child death (2.9%).
- The highest relative risks of infant mortality were associated with low birthweight and with preterm birth.

**Infant Mortality Risk Factors
Shelby County, 2001-2005**

Risk Factor	Prevalence (% Live Births)	Relative Risk of Infant Mortality*
High School or Lower Education	55.3	1.8
TennCare [†]	54.6	2.0
Not Married	54.0	2.0
Intermediate/Inadequate Prenatal Care	34.3	1.1 [‡]
Preterm Birth (<37 weeks gestation)	13.2	20.8
Low Birthweight (<2,500 grams)	11.2	26.8
Smoked During Pregnancy	7.1	1.5
Teenage Mother (<18 years)	5.9	1.1 [‡]
No Prenatal Care	5.2	4.0
Multiple Birth	3.5	5.3
Previous Child Death	2.9	3.6

*Unadjusted
[†]Data are for 2004-2005 only
[‡]Not statistically significant

Results of perinatal periods of risk (PPOR) analysis for Shelby County are summarized below. For a detailed description and explanation of PPOR (including a list of possible prevention focus areas for each of the four periods of risk), please refer to Appendix A.

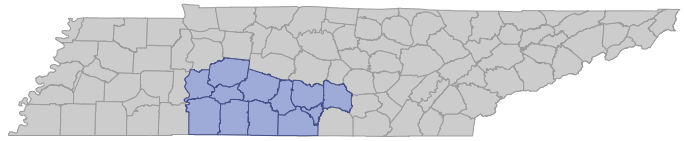
- Between 2001 and 2005, the overall feto-infant mortality rate in the county was 14.0/1,000 live births and fetal deaths. This does not include 327 infant deaths that occurred among infants with birthweights less than 500 grams (approximately 35% of all infant deaths).

**Feto-Infant Mortality Rates and Excess Deaths
Shelby County, 2001-2005**

	Fetal	Neonatal	Postneonatal
500-1,499 grams	Maternal Health/Prematurity 6.1/1,000 277		
1,500+ grams	Maternal Care 3.5/1,000 163	Newborn Care 1.6/1,000 40	Infant Health 2.8/1,000 124

- There were a total of 605 excess (i.e. preventable) feto-infant deaths. The highest proportion of deaths (46%) occurred in the maternal health/prematurity period of risk.

SOUTH CENTRAL REGION



- On average, approximately 37 infants die each year in the South Central Region.
- Between 1997 and 2006, the annual infant mortality rate in the region averaged 7.8 deaths per 1,000 live births. There was not a statistically significant upward or downward trend in infant mortality over this time period.
- The South Central Region had the 6th lowest infant mortality rate among the state's 14 health department regions.
- The average, annual mortality rate among black infants (18.1/1,000) was over two times that of white infants (7.0/1,000). Sixteen percent of infant deaths in the region occurred among black infants, although only 7% of infants were born to black mothers.
- Between 1996 and 2005, the annual fetal mortality rate in the South Central Region averaged 5.3 deaths per 1,000 live births and fetal deaths.

**Infant Mortality by County
South Central Region, 1997-2006**

County	Number of Deaths	Deaths per 1,000 Live Births
Bedford	57	9.4
Coffee	59	8.8
Giles	25	7.2
Hickman	22	7.9
Lawrence	41	7.2
Lewis	8	5.6
Lincoln	34	8.7
Marshall	32	8.8
Maury	71	7.1
Moore	0	--
Perry	6	6.3
Wayne	10	6.0

**Leading Causes of Infant Mortality
South Central Region, 1997-2006**

Cause of Death (ICD-10 codes)	Number of Deaths	Percent of Deaths
<i>All Causes</i>	365	100
Congenital defects (Q00-Q99)	86	23.6
Short gestation and low birthweight (P07)	50	13.7
Sudden infant death syndrome (R95)	47	12.9
Accidents (V01-X59)	17	4.7
Influenza and pneumonia (J10-J11)	13	3.6
Complications of placenta, cord and membranes (P02)	12	3.3
Bacterial sepsis of newborn (P36)	10	2.7
Diseases of the circulatory system (I00-I99)	8	2.2
Intrauterine hypoxia and birth asphyxia (P20-P21)	8	2.2
Respiratory distress (P22)	8	2.2
Neonatal hemorrhage (P50-P52)	8	2.2
All other causes	98	26.8

- Congenital defects were the leading cause of infant mortality in the region (23.6% of deaths), followed by short gestation and low birthweight (13.7%) and sudden infant death syndrome (12.9%).
- Accidents (4.7%) were the fourth leading cause of death.

SOUTH CENTRAL REGION *cont.*

- The most common infant mortality risk factors in the South Central Region were a mother with high school or lower education (64.1%), a mother who received TennCare (51.3%), and an unmarried mother (35.7%).
- The least common risk factors were multiple birth (2.8%), a mother with a previous child death (1.6%) and no prenatal care (1.1%).
- The highest relative risks of infant mortality were associated with low birthweight and with preterm birth.

**Infant Mortality Risk Factors
South Central Region, 2001-2005**

Risk Factor	Prevalence (% of Live Births)	Relative Risk of Infant Mortality*
High School or Lower Education	64.1	1.9
TennCare [†]	51.3	1.7
Not Married	35.7	1.6
Intermediate/Inadequate Prenatal Care	27.1	1.0 [‡]
Smoked During Pregnancy	22.7	2.0
Preterm Birth (<37 weeks gestation)	10.9	11.6
Low Birthweight (<2,500 grams)	8.3	17.1
Teenage Mother (<18 years)	4.1	1.7 [‡]
Multiple Birth	2.8	4.1
Previous Child Death	1.6	3.5
No Prenatal Care	1.1	6.3

*Unadjusted
[†]Data are for 2004-2005 only
[‡]Not statistically significant

Results of perinatal periods of risk (PPOR) analysis for the South Central Region are summarized below. For a detailed description and explanation of PPOR (including a list of possible prevention focus areas for each of the four periods of risk), please refer to Appendix A.

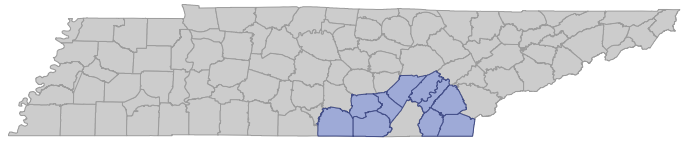
- Between 2001 and 2005, the overall feto-infant mortality rate in the region was 10.1/1,000 live births and fetal deaths. This does not include 23 infant deaths that occurred among infants with birthweights less than 500 grams (approximately 14% of all infant deaths).

**Feto-Infant Mortality Rates and Excess Deaths
South Central Region, 2001-2005**

	Fetal	Neonatal	Postneonatal
500-1,499 grams	Maternal Health/Prematurity 3.7/1,000 35		
1,500+ grams	Maternal Care 2.2/1,000 24	Newborn Care 1.4/1,000 9	Infant Health 2.7/1,000 39

- There were a total of 107 excess (i.e. preventable) feto-infant deaths. The majority of these deaths occurred in the infant health (36%) and maternal health/prematurity (33%) periods of risk.

SOUTHEAST REGION



- On average, approximately 26 infants die each year in the Southeast Region.
- Between 1997 and 2006, the annual infant mortality rate in the region averaged 6.9 deaths per 1,000 live births. There was not a statistically significant upward or downward trend in infant mortality over this time period.
- The Southeast Region had the 4th lowest infant mortality rate among the state's 14 health department regions.
- The average, annual mortality rate among black infants (10.7/1,000) was over one-and-a-half times that of white infants (6.7/1,000). Five percent of infant deaths in the region occurred among black infants, although only 3% of infants were born to black mothers.
- Between 1996 and 2005, the annual fetal mortality rate in the Southeast Region averaged 4.8 deaths per 1,000 live births and fetal deaths.

**Infant Mortality by County
Southeast Region, 1997-2006**

County	Number of Deaths	Deaths per 1,000 Live Births
Bledsoe	7	5.5
Bradley	87	7.4
Franklin	22	4.9
Grundy	11	5.7
McMinn	32	5.3
Marion	25	7.3
Meigs	12	8.8
Polk	23	11.8
Rhea	34	8.5
Sequatchie	9	5.9

**Leading Causes of Infant Mortality
Southeast Region, 1997-2006**

Cause of Death (ICD-10 codes)	Number of Deaths	Percent of Deaths
<i>All Causes</i>	262	100
Congenital defects (Q00-Q99)	48	18.3
Sudden infant death syndrome (R95)	40	15.3
Short gestation and low birthweight (P07)	31	11.8
Respiratory distress (P22)	18	6.9
Influenza and pneumonia (J10-J11)	12	4.6
Complications of placenta, cord and membranes (P02)	12	4.6
Bacterial sepsis of newborn (P36)	7	2.7
Accidents (V01-X59)	6	2.3
Maternal complications of pregnancy (P01)	5	1.9
Atelectasis (P28.0-P28.1)	5	1.9
Homicide (E960-E969)	5	1.9
All other causes	73	27.9

- Congenital defects were the leading cause of infant mortality in the region (18.3% of deaths), followed by sudden infant death syndrome (15.3%) and short gestation and low birthweight (11.8%).
- Accidents (2.3%) were the eighth leading cause of death.

SOUTHEAST REGION *cont.*

- The most common infant mortality risk factors in the Southeast Region were a mother with high school or lower education (63.6%), a mother who received TennCare (54.3%), and an unmarried mother (32.3%).
- The least common risk factors were multiple birth (3.0%), a mother with a previous child death (1.2%) and no prenatal care (0.7%).
- The highest relative risks of infant mortality were associated with low birthweight and with preterm birth.

**Infant Mortality Risk Factors
Southeast Region, 2001-2005**

Risk Factor	Prevalence (% of Live Births)	Relative Risk of Infant Mortality*
High School or Lower Education	63.6	2.0
TennCare [†]	54.3	2.6
Not Married	32.3	1.6
Intermediate/Inadequate Prenatal Care	29.5	1.4 [‡]
Smoked During Pregnancy	25.7	1.7
Preterm Birth (<37 weeks gestation)	13.3	9.9
Low Birthweight (<2,500 grams)	9.0	14.0
Teenage Mother (<18 years)	4.5	2.0
Multiple Birth	3.0	6.3
Previous Child Death	1.2	3.6
No Prenatal Care	0.7	4.8

*Unadjusted
[†]Data are for 2004-2005 only
[‡]Not statistically significant

Results of perinatal periods of risk (PPOR) analysis for the Southeast Region are summarized below. For a detailed description and explanation of PPOR (including a list of possible prevention focus areas for each of the four periods of risk), please refer to Appendix A.

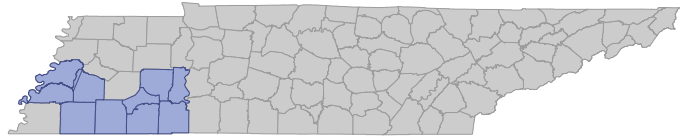
- Between 2001 and 2005, the overall feto-infant mortality rate in the region was 10.2/1,000 live births and fetal deaths. This does not include 28 infant deaths that occurred among infants with birthweights less than 500 grams (approximately 19% of all infant deaths).

**Feto-Infant Mortality Rates and Excess Deaths
Southeast Region, 2001-2005**

	Fetal	Neonatal	Postneonatal
500-1,499 grams	Maternal Health/Prematurity 3.4/1,000 22		
1,500+ grams	Maternal Care 2.3/1,000 21	Newborn Care 1.7/1,000 13	Infant Health 2.8/1,000 33

- There were a total of 88 excess (i.e. preventable) feto-infant deaths. The highest proportion of deaths (38%) occurred in the infant health period of risk. Approximately 24-25% of excess deaths occurred in both the maternal health/prematurity and maternal care periods of risk.

SOUTHWEST REGION



- On average, approximately 37 infants die each year in the Southwest Region.
- Between 1997 and 2006, the annual infant mortality rate in the region averaged 10.9 deaths per 1,000 live births. There was not a statistically significant upward or downward trend in infant mortality over this time period.
- The Southwest Region had the 3rd highest infant mortality rate among the state's 14 health department regions.
- The average, annual mortality rate among black infants (16.6/1,000) was almost two times that of white infants (9.0/1,000). Forty percent of infant deaths in the region occurred among black infants, although only 25% of infants were born to black mothers.
- Between 1996 and 2005, the annual fetal mortality rate in the Southwest Region averaged 5.3 deaths per 1,000 live births and fetal deaths.

**Infant Mortality by County
Southwest Region, 1997-2006**

County	Number of Deaths	Deaths per 1,000 Live Births
Chester	20	10.8
Decatur	11	8.4
Fayette	28	6.8
Hardeman	54	15.9
Hardin	26	9.2
Haywood	39	13.7
Henderson	33	9.3
Lauderdale	52	13.3
McNairy	27	8.4
Tipton	84	11.6

**Leading Causes of Infant Mortality
Southwest Region, 1997-2006**

Cause of Death (ICD-10 codes)	Number of Deaths	Percent of Deaths
<i>All Causes</i>	374	100
Congenital defects (Q00-Q99)	68	18.2
Short gestation and low birthweight (P07)	61	16.3
Sudden infant death syndrome (R95)	57	15.2
Bacterial sepsis of newborn (P36)	18	4.8
Respiratory distress (P22)	15	4.0
Diseases of the circulatory system (I00-I99)	13	3.5
Maternal complications of pregnancy (P01)	13	3.5
Complications of placenta, cord and membranes (P02)	10	2.7
Accidents (V01-X59)	10	2.7
Influenza and pneumonia (J10-J11)	5	1.3
Intrauterine hypoxia and birth asphyxia (P20-P21)	5	1.3
Atelectasis (P28.0-P28.1)	5	1.3
Neonatal hemorrhage (P50-P52)	5	1.3
All other causes	89	23.8

- Congenital defects were the leading cause of infant mortality in the region (18.3% of deaths), followed by short gestation and low birthweight (16.3%) and sudden infant death syndrome (15.2%).
- Accidents (2.7%, tied with complications of placenta, cord and membranes) were the eighth leading cause of death.

SOUTHWEST REGION *cont.*

- The most common infant mortality risk factors in the Southwest Region were a mother with high school or lower education (64.8%), a mother who received TennCare (57.2%), and an unmarried mother (41.4%).
- The least common risk factors were multiple birth (3.2%), a mother with a previous child death (2.1%) and no prenatal care (1.2%).
- The highest relative risks of infant mortality were associated with low birthweight and with preterm birth.

**Infant Mortality Risk Factors
Southwest Region, 2001-2005**

Risk Factor	Prevalence (% of Live Births)	Relative Risk of Infant Mortality*
High School or Lower Education	64.8	1.9
TennCare [†]	57.2	2.4
Not Married	41.4	2.5
Intermediate/Inadequate Prenatal Care	30.5	1.4 [‡]
Smoked During Pregnancy	20.6	1.7
Preterm Birth (<37 weeks gestation)	13.4	11.0
Low Birthweight (<2,500 grams)	10.2	18.5
Teenage Mother (<18 years)	5.3	1.7
Multiple Birth	3.2	3.0
Previous Child Death	2.1	3.7
No Prenatal Care	1.2	11.1

*Unadjusted
[†]Data are for 2004-2005 only
[‡]Not statistically significant

Results of perinatal periods of risk (PPOR) analysis for the Southwest Region are summarized below. For a detailed description and explanation of PPOR (including a list of possible prevention focus areas for each of the four periods of risk), please refer to Appendix A.

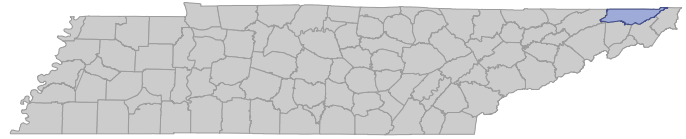
- Between 2001 and 2005, the overall feto-infant mortality rate in the region was 13.3/1,000 live births and fetal deaths. This does not include 44 infant deaths that occurred among infants with birthweights less than 500 grams (approximately 23% of all infant deaths).

**Feto-Infant Mortality Rates and Excess Deaths
Southwest Region, 2001-2005**

	Fetal	Neonatal	Postneonatal
500-1,499 grams	Maternal Health/Prematurity 5.2/1,000 51		
1,500+ grams	Maternal Care 2.5/1,000 22	Newborn Care 2.2/1,000 20	Infant Health 3.3/1,000 39

- There were a total of 132 excess (i.e. preventable) feto-infant deaths. The majority of these deaths occurred in the maternal health/prematurity (39%) and infant health (30%) periods of risk.

SULLIVAN COUNTY



- On average, approximately 15 infants die each year in Sullivan County.
- Between 1997 and 2006, the annual infant mortality rate in the county averaged 8.9 deaths per 1,000 live births. There was not a statistically significant upward or downward trend in infant mortality over this time period.
- Sullivan County had the 6th highest infant mortality rate among the state's 14 health department regions, and the 27th highest among the state's 95 counties.
- The average, annual mortality rate among black infants (22.4/1,000) was over two-and-a-half times that of white infants (8.5/1,000). Six percent of infant deaths in the county occurred among black infants, although only 3% of infants were born to black mothers.
- Between 1996 and 2005, the annual fetal mortality rate in Sullivan County averaged 3.5 deaths per 1,000 live births and fetal deaths.

**Leading Causes of Infant Mortality
Sullivan County, 1997-2006**

Cause of Death (ICD-10 codes)	Number of Deaths	Percent of Deaths
<i>All Causes</i>	149	100
Congenital defects (Q00-Q99)	22	14.8
Respiratory distress (P22)	18	12.1
Short gestation and low birthweight (P07)	17	11.4
Sudden infant death syndrome (R95)	15	10.1
Maternal complications of pregnancy (P01)	7	4.7
Complications of placenta, cord and membranes (P02)	7	4.7
Gastrointestinal inflammation (K29, K50-K55)	4	2.7
Intrauterine hypoxia and birth asphyxia (P20-P21)	4	2.7
Hydrops fetalis (P83.2)	4	2.7
Diseases of the circulatory system (I00-I99)	3	2.0
Pulmonary hemorrhage (P26)	3	2.0
Neonatal hemorrhage (P50-P52)	3	2.0
Accidents (V01-X59)	3	2.0
All other causes	39	26.2

- Congenital defects were the leading cause of infant mortality in the county (14.8% of deaths), followed by respiratory distress (12.1%) and short gestation and low birthweight (11.4%).
- Sudden infant death syndrome (10.1%) was the fourth leading cause of death.
- Accidents (2.0%, tied with diseases of the circulatory system, pulmonary hemorrhage and neonatal hemorrhage) were the tenth leading cause of death.

SULLIVAN COUNTY *cont.*

- The most common infant mortality risk factors in Sullivan County were a mother who received TennCare (60.9%), a mother with high school or lower education (56.0%), and an unmarried mother (30.0%).
- The least common risk factors were multiple birth (3.1%), a mother with a previous child death (1.1%) and no prenatal care (0.5%).
- The highest relative risks of infant mortality were associated with low birthweight and with preterm birth.

**Infant Mortality Risk Factors
Sullivan County, 2001-2005**

Risk Factor	Prevalence (% Live Births)	Relative Risk of Infant Mortality*
TennCare [†]	60.9	1.9 [‡]
High School or Lower Education	56.0	2.1
Not Married	30.0	2.0
Intermediate/Inadequate Prenatal Care	27.8	1.4 [‡]
Smoked During Pregnancy	26.1	2.2
Preterm Birth (<37 weeks gestation)	11.8	25.9
Low Birthweight (<2,500 grams)	9.2	26.9
Teenage Mother (<18 years)	4.0	1.1 [‡]
Multiple Birth	3.1	6.1
Previous Child Death	1.1	2.9 [‡]
No Prenatal Care	0.5	8.2

*Unadjusted
[†]Data are for 2004-2005 only
[‡]Not statistically significant

Results of perinatal periods of risk (PPOR) analysis for Sullivan County are summarized below. For a detailed description and explanation of PPOR (including a list of possible prevention focus areas for each of the four periods of risk), please refer to Appendix A.

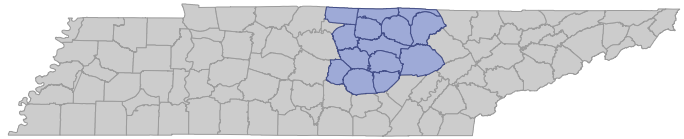
- Between 2001 and 2005, the overall feto-infant mortality rate in the county was 9.5/1,000 live births and fetal deaths. This does not include 12 infant deaths that occurred among infants with birthweights less than 500 grams (approximately 18% of all infant deaths).

**Feto-Infant Mortality Rates and Excess Deaths
Sullivan County, 2001-2005**

	Fetal	Neonatal	Postneonatal
500-1,499 grams	Maternal Health/Prematurity 4.1/1,000 15		
1,500+ grams	Maternal Care 2.1/1,000 7	Newborn Care 1.8/1,000 6	Infant Health 1.5/1,000 3

- There were a total of 32 excess (i.e. preventable) feto-infant deaths. The highest proportion of deaths (47%) occurred in the maternal health/prematurity period of risk.

UPPER-CUMBERLAND REGION



- On average, approximately 27 infants die each year in the Upper-Cumberland Region.
- Between 1997 and 2006, the annual infant mortality rate in the region averaged 7.0 deaths per 1,000 live births. There was not a statistically significant upward or downward trend in infant mortality over this time period.
- The Upper-Cumberland Region had the 5th lowest infant mortality rate among the state's 14 health department regions.
- The average, annual mortality rate among black infants (16.6/1,000) was almost two-and-a-half times that of white infants (6.9/1,000). Three percent of infant deaths in the region occurred among black infants, although only 1% of infants were born to black mothers.
- Between 1996 and 2005, the annual fetal mortality rate in the Upper-Cumberland Region averaged 5.1 deaths per 1,000 live births and fetal deaths.

**Infant Mortality by County
Upper-Cumberland Region, 1997-2006**

County	Number of Deaths	Deaths per 1,000 Live Births
Cannon	13	8.8
Clay	6	6.9
Cumberland	29	5.7
Dekalb	17	7.5
Fentress	20	9.7
Jackson	5	4.7
Macon	24	8.9
Overton	17	7.1
Pickett	4	6.9
Putnam	59	6.8
Smith	14	6.3
Van Buren	5	8.8
Warren	36	6.7
White	20	6.8

**Leading Causes of Infant Mortality
Upper-Cumberland Region, 1997-2006**

Cause of Death (ICD-10 codes)	Number of Deaths	Percent of Deaths
<i>All Causes</i>	269	100
Congenital defects (Q00-Q99)	72	26.8
Sudden infant death syndrome (R95)	35	13.0
Short gestation and low birthweight (P07)	32	11.9
Respiratory distress (P22)	9	3.3
Accidents (V01-X59)	9	3.3
Diseases of the circulatory system (I00-I99)	7	2.6
Influenza and pneumonia (J10-J11)	7	2.6
Intrauterine hypoxia and birth asphyxia (P20-P21)	6	2.2
Maternal complications of pregnancy (P01)	5	1.9
Complications of placenta, cord and membranes (P02)	4	1.5
Atelectasis (P28.0-P28.1)	4	1.5
Neonatal hemorrhage (P50-P52)	4	1.5
Necrotizing enterocolitis (P77)	4	1.5
All other causes	71	26.4

- Congenital defects were the leading cause of infant mortality in the region (26.8% of deaths), followed by sudden infant death syndrome (13.0%) and short gestation and low birthweight (11.9%).
- Accidents (3.3%, tied with respiratory distress) were the fourth leading cause of death.

UPPER-CUMBERLAND REGION *cont.*

- The most common infant mortality risk factors in the Upper-Cumberland Region were a mother with high school or lower education (65.8%), a mother who received TennCare (57.8%), and an unmarried mother (31.1%).
- The least common risk factors were multiple birth (3.0%), a mother with a previous child death (1.7%) and no prenatal care (0.8%).
- The highest relative risks of infant mortality were associated with low birthweight and with preterm birth.

**Infant Mortality Risk Factors
Upper-Cumberland Region, 2001-2005**

Risk Factor	Prevalence (% of Live Births)	Relative Risk of Infant Mortality*
High School or Lower Education	65.8	1.6
TennCare [†]	57.8	1.7 [‡]
Not Married	31.1	1.4
Smoked During Pregnancy	27.3	2.1
Intermediate/Inadequate Prenatal Care	25.7	1.3 [‡]
Preterm Birth (<37 weeks gestation)	11.6	11.3
Low Birthweight (<2,500 grams)	8.5	13.7
Teenage Mother (<18 years)	4.2	1.9 [‡]
Multiple Birth	3.0	5.5
Previous Child Death	1.7	3.8
No Prenatal Care	0.8	4.4

*Unadjusted
[†]Data are for 2004-2005 only
[‡]Not statistically significant

Results of perinatal periods of risk (PPOR) analysis for the Upper-Cumberland Region are summarized below. For a detailed description and explanation of PPOR (including a list of possible prevention focus areas for each of the four periods of risk), please refer to Appendix A.

- Between 2001 and 2005, the overall feto-infant mortality rate in the region was 9.5/1,000 live births and fetal deaths. This does not include 14 infant deaths that occurred among infants with birthweights less than 500 grams (approximately 11% of all infant deaths).

**Feto-Infant Mortality Rates and Excess Deaths
Upper-Cumberland Region, 2001-2005**

	Fetal	Neonatal	Postneonatal
500-1,499 grams	Maternal Health/Prematurity 3.5/1,000 25		
1,500+ grams	Maternal Care 2.1/1,000 16	Newborn Care 1.3/1,000 6	Infant Health 2.6/1,000 29

- There were a total of 77 excess (i.e. preventable) feto-infant deaths. The majority of these deaths occurred in the infant health (38%) and maternal health/prematurity (32%) periods of risk.

Technical Notes

DATA SOURCES

Death Statistical System (DSS): The DSS is an annual state-based compilation of mortality data. Infant mortality rates were calculated by dividing the number of infant deaths in a calendar year(s) by the number of live births registered for the same period of time. An infant death is defined as one that occurs before one year of age. Analyses were limited to the records of Tennessee residents. The DSS was used to calculate overall infant mortality rates, as well as infant mortality rates by county/region, age at death and infant race/ethnicity, and to determine leading causes of death. Procedures used for ranking causes of death were the same as used by the National Center for Health Statistics. Causes of death were ranked according to the number of deaths assigned to the 71 rankable causes selected by the NCHS from the ICD-10 "List of 130 Selected Causes of Infant Death."⁹ Unless otherwise noted, the terms "white" and "black" refer to infants of any ethnicity, and the terms "Hispanic" and "non-Hispanic" refer to infants of any race. Time trends were analyzed using linear regression. Two-way comparisons of mortality rates (e.g. blacks vs. whites) were tested for significance using chi-square tests. Unless otherwise indicated, trends and differences noted in the text were statistically significant (p -value < 0.05). At the time of this report, the most recently available DSS data were for 2006.

Birth Statistical System (BSS): The BSS is an annual state-based compilation of birth data. All data included in this report are for resident births that occurred both in and out of state. Data were collected on the 1989 revision of the Tennessee version of the U.S. Standard Certificate of Live Birth for 2003 and earlier. Beginning in 2004, data were collected on the 2003 revision of the Tennessee version of the U.S. Standard Certificate of Live Birth. The BSS was used to determine the denominator for infant mortality rates based on the DSS (see above discussion), as well as to determine the prevalence of infant mortality risk factors. The BSS was also used to examine very low birthweight risk factors as part of phase II perinatal periods of risk (PPOR) analyses. Gestational age was based on estimated/clinical gestational age. If estimated gestational age was missing or invalid (<17wks or >49wks), generated gestational age (based on last menstrual period) was substituted. Adequacy of prenatal care was determined using the Kessner Adequacy of Prenatal Care Index.¹⁰ Race was determined using mother's self-reported race and the terms "white" and "black" refer to women of any ethnicity. High parity for age (used in PPOR) was defined as follows (definition obtained at http://www.citymatch.org/ppor_index.php):

Age (years)	Total Birth Order*
<15 or 35+	1
<20 or 40+	2 or 3
<25 or 40+	4
<30 or 35+	5
All ages	6 or more

**Sum of live births and other terminations including the present birth*

The questions used to obtain mother's highest level of education, prenatal care, and smoking status in 2004 and later were modified from questions used to gather the same information in previous years. The questions used to obtain annual household income and payment source were newly added to the 2004 birth certificate. When examining time trends in risk factor prevalence, data are presented through 2006 (most recent year for which BSS data were available). Trends were analyzed using linear regression and were considered statistically significant (p -value < 0.05) unless otherwise indicated in the text. For variables that changed with the 2004 birth certificate, time trends were only

Technical Notes *cont.*

examined for 1997-2003. When examining average prevalence rates, data are presented for 2001-2005 in order to correspond with infant mortality rates based on linked birth/death data files (see below discussion). Average prevalence rates were calculated for all risk factors regardless of birth certificate changes. Racial differences in risk factor prevalence were analyzed using chi-square tests and were considered statistically significant (p -value < 0.05) unless otherwise indicated in the text.

Linked Birth and Death Statistical System: The BSS and DSS are linked based on birth cohort to create the Linked Birth and Death Statistical System. For a given year the data file consists of all Tennessee resident, in-state births for that year (i.e. the denominator for infant mortality calculations). The numerator is all infant deaths among these babies, regardless of the year death occurred. The linked system was used to determine infant mortality rates for infants with and without specific risk factors (e.g. low birthweight, preterm birth, maternal cigarette smoking) for which information is collected on the birth but not the death certificate, and to calculate the relative risk of infant mortality associated with these risk factors. In addition, the linked system was used to calculate feto-infant mortality rates for phase I PPOR analyses. Risk factor variables were defined as described above for the BSS. Relative risks for infant mortality were considered statistically significant (95% confidence interval did not include 1) unless otherwise indicated in the text. Racial differences in relative risk for infant mortality were tested for statistical significance using Gart's likelihood score method.¹¹ Relative risk is a measure of the strength of the association between a risk factor and an outcome. For example, a relative risk of 1.3 means that the risk of death among infants with a certain risk factor is 30% higher than among infants without that same risk factor. At the time of this report, the most recently available linked data were for the 2005 birth year.

Fetal Death Statistical System (FDSS): The FDSS is an annual state-based compilation of fetal mortality data. A fetal death is defined as death prior to the complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of pregnancy; the death is indicated by the fact that after such separation, the fetus does not breathe or show any other evidence of life. Tennessee requires the reporting of fetal deaths weighing 500 grams or more, or, in the absence of weight, at 22 or more completed weeks of gestation. Induced abortions are excluded from fetal death counts. Fetal mortality rates were calculated by dividing the number of fetal deaths in a calendar year(s) by the number of live births and fetal deaths registered for the same time period. Analyses were limited to state residents. The FDSS was used to calculate overall fetal mortality rates, as well as fetal mortality rates by region, maternal race, gestational age and birthweight. In addition, the FDSS was used to calculate feto-infant mortality rates for phase I PPOR analyses. Gestational age was based on estimated/clinical gestational age. If estimated gestational age was missing, generated gestational age (based on last menstrual period) was substituted. Overall fetal mortality rates, as well as those by region and maternal race, include all fetal deaths as reported, regardless of birthweight or gestational age. Birthweight- and gestational age-specific fetal mortality rates are only reported for birthweights of 500 or more grams and 22 or more completed weeks of gestation. Although some fetal deaths in the FDSS had birthweights and/or gestational ages below these cutoffs, they are not required to be reported and there were actually very few reported (less than 1% of all fetal deaths for 1996-2005). Time trends were analyzed using linear regression and two-way comparisons of mortality rates by maternal race were tested for significance using a chi-square test. Unless otherwise indicated, trends and differences noted in the text were statistically significant (p -value < 0.05). At the time of this report, the most recently available FDSS data were for 2005.

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