Table 18. Number of Maternal Deaths and Maternal Mortality Rates for Selected Causes, by Race, Oklahoma, 1999-2006

	Number			Rate		
Cause of death (based on ICD-10)	**All Races**	**White**	**Black**	**All Races**	**White**	**Black**
Maternal causes (A34,O00-O95,O98-O99)	79	56	14	19.4	17.8	37.2
Pregnancy with abortive outcome (O00-O07)	3	2	-	0.7	*	*
Ectopic pregnancy (O00)	1	1	-	*	*	*
Spontaneous abortion (O03)	-	-	-	*	*	*
Medical abortion (O04)	-	-	-	*	*	*
Other abortion (O05)	-	-	-	*	*	*
Other and unspecified pregnancy with abortive outcome (O01-O02,O06-O07)	2	1	-	*	*	*
Other direct obstetric causes (A34,O10-O92)	43	30	9	10.6	9.5	23.9
Eclampsia and pre-eclampsia (O11,O13-O16)	4	4	-	1.0	1.3	*
Hemorrhage of pregnancy and childbirth and placenta previa (O20,O44-O46,O67,O72)	4	3	-	1.0	1.0	*
Complications predominately related to the puerperium (A34,O85-O92)	12	7	3	3.0	2.2	8.0
Obstetrical tetanus (A34)	-	-	-	*	*	*
Obstetric embolism (O88)	8	5	2	2.0	1.6	*
Other complications predominately related to the puerperium (O85-O87,O89-O92)	4	2	1	1.0	*	*
All other direct obstetric causes (O10,O12,O21-O43,O47-O66,O68-O71,O73-O75)	21	15	6	5.2	4.8	16.0
Obstetric death of unspecified cause (O95)	5	4	-	1.2	1.3	*
Indirect obstetric causes (O98-O99)	25	17	5	6.2	5.4	13.3
Maternal causes more than 42 days after delivery or termination of pregnancy (O96-O97)	3	3	-	0.7	1.0	*
Death from any obstetric cause occurring more than 42 days but less than one year after delivery (O96)	3	3	-	0.7	1.0	*
Death from sequelae of direct obstetric causes (O97)	-	-	-	*	*	*

Rates are maternal deaths per 100,000 live births
* Rates are suppressed when numerator is less than 3.
- Quantity zero.

After several years of inactivity, in 2009, MCH re-established the state level Maternal Mortality Review (MMR) Committee. The MMR Committee is comprised of individuals from varied organizations and occupations. The MMR Committee has met twice and has reviewed eight cases. Although pertinent and important data are being compiled with each review, it will likely take several years of data collection to get a more realistic picture of pregnancy related death issues in Oklahoma.

3. Infants

Access to Care

The statewide implementation in July 2010 of an electronic application for SoonerCare (eNB1) will add a newborn to its mother's existing SoonerCare case. This change will facilitate the newborn having full Medicaid eligibility before being discharged from the hospital. In SFY

2009, 33,228 infants born in Oklahoma had their deliveries paid through SoonerCare/Medicaid. This is an increase of 2.4% from SFY 2008. Medicaid deliveries represent approximately 61% of all deliveries in the state.

The American Academy of Pediatrics (AAP) recommends well child visits for all infants at or before one week of life, a visit at about two to four weeks of age and at two, four, six, nine, and twelve months of age (American Academy of Pediatrics , 2010). Information about who does and does not receive well child care in the first week of life, as well as during the two to four month period is available from PRAMS.

OK PRAMS data for 2006-2007, showed that 19.8% of infants with a hospital stay 48 hours or less were not seen by a health professional at one-week post delivery. For those who had not had a doctor visit at the one-week mark, 61.7% had a mother whose prenatal or delivery care was paid for by SoonerCare. One in four American Indian/Alaska Native mothers reported not receiving a one-week well visit, compared to one in five for white mothers and one in seven for African American/Black mothers. Among infants who were breastfed, even for a short amount of time, 18% did not receive a well baby visit by one week. The AAP recommends that all breastfeeding infants should be seen by a pediatrician or other health care professional at three to five days of age for examination and evaluation of breastfeeding. This early visit is critical to identify possible breastfeeding problems that may require more intensive evaluation of breastfeeding and possible intervention to correct problems and improve milk production and transfer (American Academy of Pediatrics , 2010).

According to OK PRAMS 2006-2007 data, 97.9% of infants have had a well child visit at two to six months of age. Only 2.1% of mothers reported no well baby visits at two to six months postpartum, and mothers who received assistance during pregnancy from SoonerCare were among those most likely to report no care (3.2% vs. 0.9%). Information on content of those visits or the quality of provider-patient-parent interaction is not readily available from any state sources.

- **Newborn Screening**

All newborns born in Oklahoma are screened through the Newborn Screening Program (NSP) for the disorders of phenylketonuria (PKU) and other amino acid disorders, congenital hypothyroidism, galactosemia, sickle cell disease, hemoglobinopathies, cystic fibrosis (CF), congenital adrenal hyperplasia (CAH), medium chain acyl-CoA dehydrogenase deficiency (MCAD) and other fatty acid disorders, and organic acid disorders. The number of disorders identified in calendar year (CY) 2009 included: PKU (2) and Hyperphe (2); Congenital Hypothyroidism (18); Classic Galactosemia (3); Sickle cell disease (5); hemoglobin disease, including SC disease, Sickle Beta Thalassemia, Sickle Beta Zero Thalassemia, CC disease (10); CF (14); CAH (3); Fatty acid disorders MCAD (9); Short-chain acyl-coenzyme A (CoA) dehydrogenase deficiency (SCAD) (3); Amino acid disorders (3); Organic Acid Disorders (5); hemoglobin C trait (111); and sickle cell trait (431). One hundred percent of newborns received short-term follow-up (STFU) services for diagnosis and 100% of affected newborns were referred to long-term follow-up (LTFU) for care coordination services. All cases of confirmed diagnosis for newborn screening disorders received genetic counseling.

For CY 2009, 542 of the sickle cell traits and hemoglobin C traits were referred for counseling and 53 families received counseling from a board certified genetic counselor. All newborns identified with an out-of-range CF screen were referred for genetic counseling (102 of the 110 received counseling).

Currently Oklahoma screening includes 53 of the 54 core disorders. The only disorder on the American College of Medical Genetics (ACMG) panel that is pending is Biotinidase.

- **Newborn Hearing**

Of the 54,753 Oklahoma births in calendar year (CY) 2008, 52,980 infants (96.8%) had a hearing screen prior to hospital discharge, while only 755 (1.4%) were not screened at any time. Of the infants screened, 2,607 (4.8%) were referred for diagnostic assessment for failing the hospital screen and 94 had confirmed hearing loss. Sixty (64%) of those infants that failed the screening were diagnosed with hearing loss and amplified by the first month of life. Due to the presence of hearing "risk indicators," 2,607 infants who passed screening at birth were later referred for additional hearing screening when they reached six months of age. At least 80 of the infants born in 2008 and diagnosed with a hearing loss were enrolled in one of Oklahoma's 0-3 early intervention programs such as SoonerStart.

Breastfeeding

Breastfeeding at six months has the potential to prevent and reduce risk for many childhood and chronic illnesses, such as ear infections, respiratory illnesses, rotaviruses, asthma, and some childhood cancers. In Oklahoma, the number of new mothers attempting breastfeeding increased to 74.2% in 2007 from 68.7% in 2000. The Healthy People 2010 objective for breastfeeding initiation is 75%, a goal Oklahoma has now exceeded as of 2008 (79%). However, duration rates for Oklahoma mothers have not changed since 2000, indicating an issue in the support and continuation of breastfeeding for mothers in the state.

The Healthy People 2010 goal for breastfeeding at six months is 50%. In Oklahoma, TOTS 2007 data shows that 31.5% of infants are breastfed for six months, and it is unknown how many of those were exclusively breastfed to that point. Many of the mothers in Oklahoma who begin breastfeeding stop in the first four to eight weeks postpartum.

According to 2007 OK PRAMS data, only 55.2% of mothers nursed their infants at four weeks postpartum, and by eight weeks the number dropped to 44%, falling short of the six month goal by four months. Mothers most likely to breastfeed for at least four weeks were white, Hispanic, 25 years or older, had some high school education, and/or were married. The top three reasons for stopping, as reported by mothers who attempted breastfeeding, were: not producing enough milk for baby (45.3%), breastmilk alone did not satisfy baby (38.2%), and the baby had difficulty nursing (31.2%). The categories were not exclusive; mothers could check more than one.

Table 19. Multivariate Logistic Regression Adjusted Odds Ratio for Exclusive Breastfeeding for Six Weeks or Longer, OK PRAMS, 2005-2007

Predictors	Adjusted Odds Ratio	95% Confidence Interval
Doctor or other health professional gave advice		
No	1.33	1.05, 1.69
Yes (reference)	1.00	1.00, 1.00
Friend or family member gave advice		
No (reference)	1.00	1.00, 1.00
Yes	1.69	1.31, 2.17
Lactation consultant gave advice		
No (reference)	1.00	1.00, 1.00
Yes	1.48	1.15, 1.90
Enrolled in WIC during pregnancy		
No	1.28	0.99, 1.66
Yes (reference)	1.00	1.00, 1.00
Mother's age group		
<19 (reference)	1.00	1.00, 1.00
20-24	1.10	0.71, 1.73
25-29	2.42	1.52, 3.85
30-34	2.29	1.37, 3.81
35+	1.93	1.08, 3.43
Mother's education		
< High school (reference)	1.00	1.00, 1.00
>= High school	1.52	1.10, 2.10
Postpartum Smoking		
No	2.14	1.63, 2.80
Yes (reference)	1.00	1.00, 1.00

The issue of exclusive breastfeeding is also important. Exclusive breastfeeding in PRAMS is defined as feeding only breastmilk to an infant (no water, formula, sugar water, juice or baby food). The American Academy of Pediatrics recommends that all infants be exclusively breastfed for the first six months of life. In a recent study of OK PRAMS 2005-2007 data examining exclusive breastfeeding at six weeks postpartum, the following groups of mothers were least likely to breastfeed exclusively for six weeks or more: mothers who smoked postpartum, mothers 24 years of age and younger, and mothers with less than a high school education. Mothers or females who were enrolled in WIC were marginally less likely to exclusively breastfeed (Table 19). Mothers who did not breastfeed or did not breastfeed exclusively, even for a short time, were excluded from the study. The study found that advice or help with breastfeeding was most beneficial when received from a friend, a family member, or a lactation consultant. Help or advice from doctors or other health professionals was not associated with exclusive breastfeeding beyond six weeks in this study.

Secondhand Smoke

Secondhand smoke exposure has severe public health consequences. For infants, an increased risk of Sudden Infant Death Syndrome (SIDS), ear infections, bronchitis, and childhood asthma are all associated with exposure to secondhand smoke (U.S. Department of Health and Human Services, 2006). In Oklahoma, smoking rates continue to exceed the national averages, putting Oklahoma's children at further risk. Healthy People 2010 set the target for the proportion of children regularly exposed to tobacco smoke in the home to ten percent or less.

According to OK PRAMS data from 2006-2007, 10.66% of infants are exposed to secondhand smoke on an average day (Table 20). Those infants most likely to be exposed to secondhand smoke had mothers who were white or American Indian/Alaska Native, non-Hispanic, less than 24 years of age, had less than a high school education, were unmarried, and/or had SoonerCare coverage for their prenatal or delivery care. The amount of exposure measured varies from 1-3 hours (8.28%) to more than 7 hours per day (1.73%).

Table 20. Infant Secondhand Smoke Exposure Levels by Maternal Demographics, OK PRAMS, 2006-2007

	Exposure Levels to Tobacco Smoke							
Maternal Characteristic	Never Exposed		Exposed 1-3 Hours per Day		Exposed 4-6 Hours per Day		Exposed 7 or More Hours per Day	
	Prevalence (%)	95%CI	Prevalence (%)	95%CI	Prevalence (%)	95%CI	Prevalence (%)	95%CI
Overall	89.34	87.49, 90.94	8.28	6.86, 9.95	0.66	0.34, 1.28	1.73	1.13, 2.65
Race								
White	88.90	86.75, 90.74	8.20	6.63, 10.11	0.82	0.41, 1.63	2.07	1.33, 3.23
African American/ Black	94.46	89.15, 97.25	5.19	2.47, 10.61	0.11	0.02, 0.63	0.24	0.09, 0.66
American Indian/Alaska Native	85.92	78.85, 90.90	13.13	8.31, 20.13	0.05	0.01, 0.28	0.90	0.17, 4.58
Other	99.52	97.79, 99.90	0.09	0.03, 0.29	0.40	0.06, 2.43	0.00	
Ethnicity								
Non-Hispanic	88.15	86.09, 89.94	9.47	7.86, 11.37	0.66	0.32, 1.33	1.72	1.10, 2.70
Hispanic	97.39	92.89, 99.07	0.16	0.06, 0.41	0.67	0.10, 4.57	1.77	0.47, 6.45

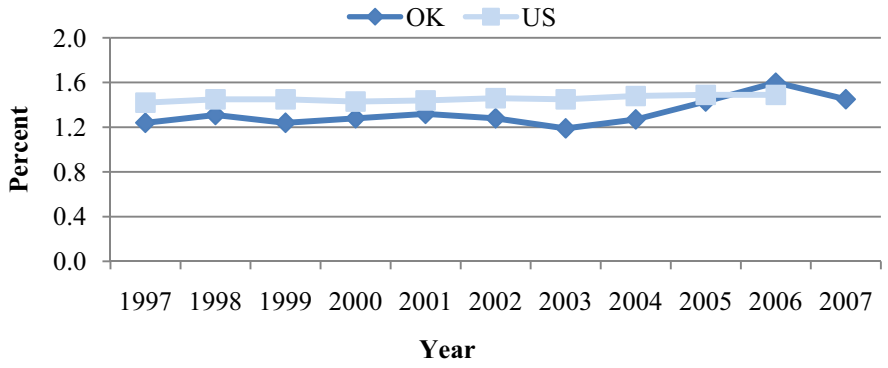
Table 20. (Cont'd) Infant Secondhand Smoke Exposure Levels by Maternal Demographics, OK PRAMS, 2006-2007								
	Exposure Levels to Tobacco Smoke							
Maternal Characteristic	Never Exposed		Exposed 1-3 Hours per Day		Exposed 4-6 Hours per Day		Exposed 7 or More Hours per Day	
	Prevalence (%)	95%CI	Prevalence (%)	95%CI	Prevalence (%)	95%CI	Prevalence (%)	95%CI
Age								
<20	82.17	74.88, 87.70	12.80	8.13, 19.58	1.54	0.46, 5.03	3.48	1.42, 8.26
20-24	87.02	83.32, 89.99	9.93	7.34, 13.29	0.69	0.20, 2.30	2.37	1.25, 4.47
25-29	91.16	87.89, 93.61	7.20	5.02, 10.22	0.54	0.14, 2.01	1.11	0.41, 2.97
30-34	93.56	89.71, 96.03	5.33	3.09, 9.05	0.46	0.08, 2.47	0.65	0.17, 2.43
35+	94.38	88.69, 97.29	4.70	2.09, 10.23	0.01	0.00, 0.04	0.91	0.16, 5.06
Education								
<High School	96.87	89.58, 99.11	2.49	0.53, 10.92	0.00		0.65	0.21, 2.02
High School	81.04	73.24, 86.96	12.97	8.13, 20.06	0.71	0.12, 3.99	5.28	2.46, 11.01
>High School	90.69	88.77, 92.30	7.44	6.00, 9.20	0.70	0.34, 1.47	1.17	0.67, 2.02
Marital Status								
Married	92.47	90.47, 94.08	5.78	4.39, 7.57	0.39	0.14, 1.11	1.36	0.75, 2.47
Other	84.57	80.94, 87.62	12.08	9.37, 15.43	1.06	0.45, 2.49	2.29	1.24, 4.18
SoonerCare								
Yes	85.06	82.24, 87.50	11.51	9.34, 14.09	1.11	0.57, 2.15	2.32	1.44, 3.74
No	95.61	93.60, 97.01	3.49	2.29, 5.29	0.01	0.00, 0.01	0.90	0.35, 2.28

Morbidity

- **Very Low Birth Weight (VLBW)**

A VLBW infant is an infant weighing less than 1500 grams at birth. Reducing the number of births that are VLBW is an important step in reducing the infant mortality rate, as VLBW infants have a greater risk of not surviving their first year of life compared to low birth weight (LBW) or normal birth weight infants. The percentage of VLBW infants in Oklahoma and the U.S. changed minimally over the past decade; however, there was a slight uptick in VLBW births in Oklahoma in 2005, 2006, and 2007 (Figure 56). In 2007, 3.5% of births to African American/Black mothers were VLBW making them more than twice as likely as mothers of any race to have a VLBW infant. Asian/Pacific Island mothers had the lowest percent of VLBW births at 0.98%.

Figure 56. Percent of Very Low Birth Weight Infants (<1500 grams) Among All Live Births, Oklahoma, 1997-2007, and U.S., 1997-2006

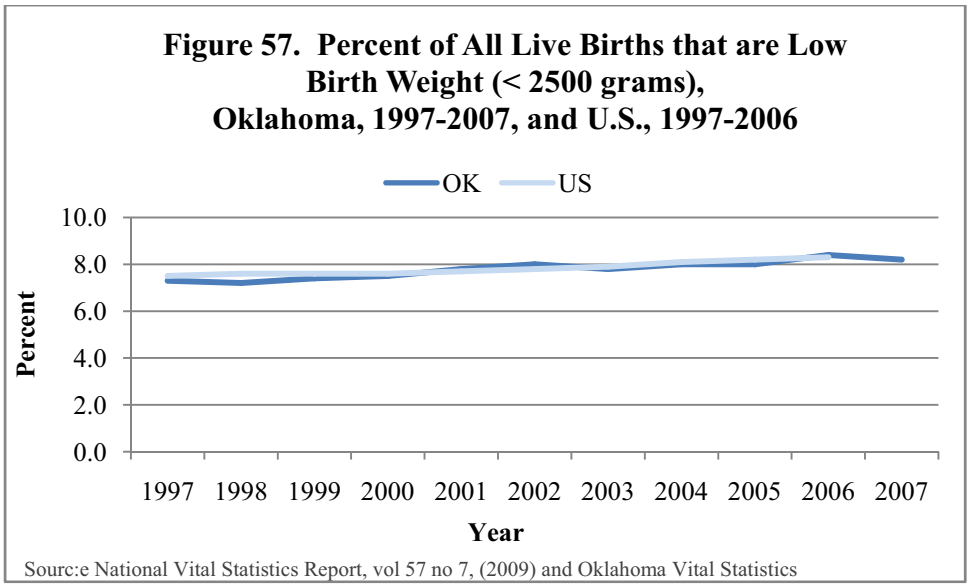


Source: National Vital Statistics Report, vol 57 no 7 (2009) and Oklahoma Vital Statistics

- **Low Birth Weight (LBW)**

Infants born weighing less than 2500 grams are considered LBW. LBW infants are at a higher risk than normal weight babies for experiencing health and developmental problems. LBW infants are born either preterm (less than 37 completed weeks of gestation) or small for gestational age (SGA - less than 10th percentile for gestational age), or both. Some risk factors for low birth weight are late entry into prenatal care, limited access to prenatal care, race, ethnicity, smoking, and age. Improvements in medical care have increased the survivability of very low birth weight infants that would previously have been fetal losses, but it is difficult to assess this overall contribution to low birth weight live births.

Over the last 15 years both Oklahoma and the U.S. have experienced an increase in LBW rates (Figure 57). Oklahoma increased 25% from 6.7% in 1992 to 8.4% in 2006. The U.S. increased 16.9% from 7.1% in 1992 to 8.3% in 2006. Part of the increase is due to the rising number of multiple births each year as more than half of multiple birth infants are delivered at a low birth weight. However, when LBW rates are examined among singleton births only, a significant increase is still observed for this time frame, rising from 5.6% in 1992 to 6.6% in 2006, a 17.9% increase (data not shown).



From 1998 to 2007, all racial/ethnic groups, except for Asian/Pacific Islanders and those of Hispanic origin, have seen an increase in the percentage of low birth weight deliveries (Table 21). Mothers of Hispanic origin have basically remained unchanged in their low birth weight rates. In 2007, African American/Blacks were almost twice (1.8 times) as likely as mothers of any other racial group to have a low birth weight infant.

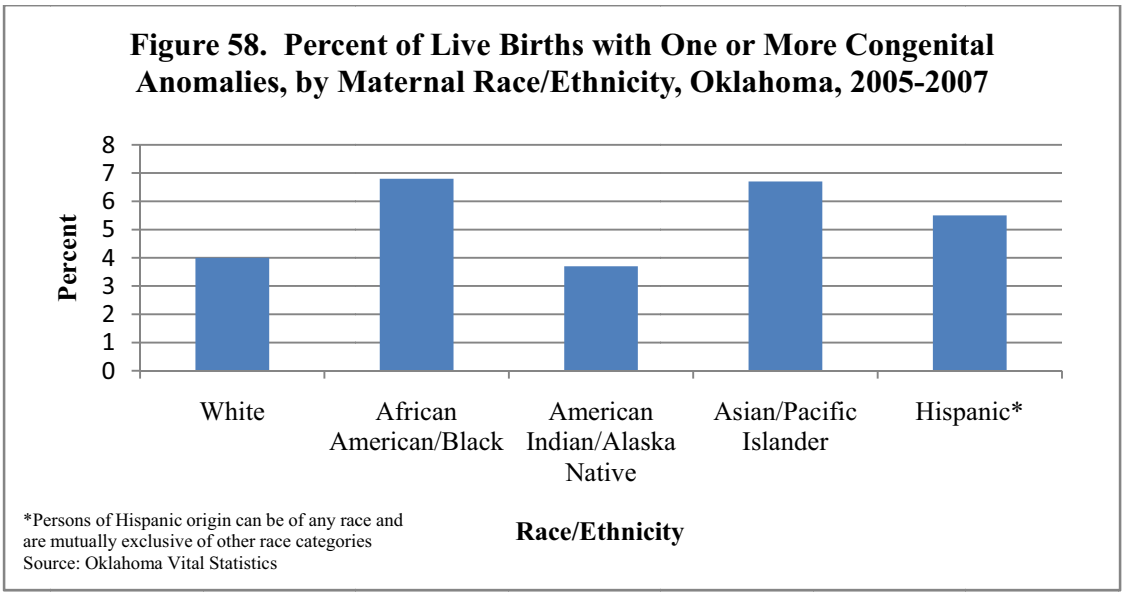
Table 21. Percent of Live Births that are Low Birth Weight (<2500 grams), by Race/Ethnicity, Oklahoma, 1998-2007

	Percent by Year									
Race/Ethnicity	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
White	6.7	7.2	7	7.4	7.5	7.5	7.8	7.6	7.9	7.9
Black or African American	12.5	11.9	13.2	13.7	13.9	13.7	13	14.2	15.4	14.7
American Indian/ Alaska Native	6.4	6.1	6.2	6.7	6.6	6.3	6.8	7	7.2	7.4
Asian/Pacific Islander	6.8	5.7	7.2	8.5	8	6.5	7	7.2	8.3	6.1
Hispanic*	6.1	5.9	6.3	5.9	7	5.9	6.6	6.7	6.6	6.1

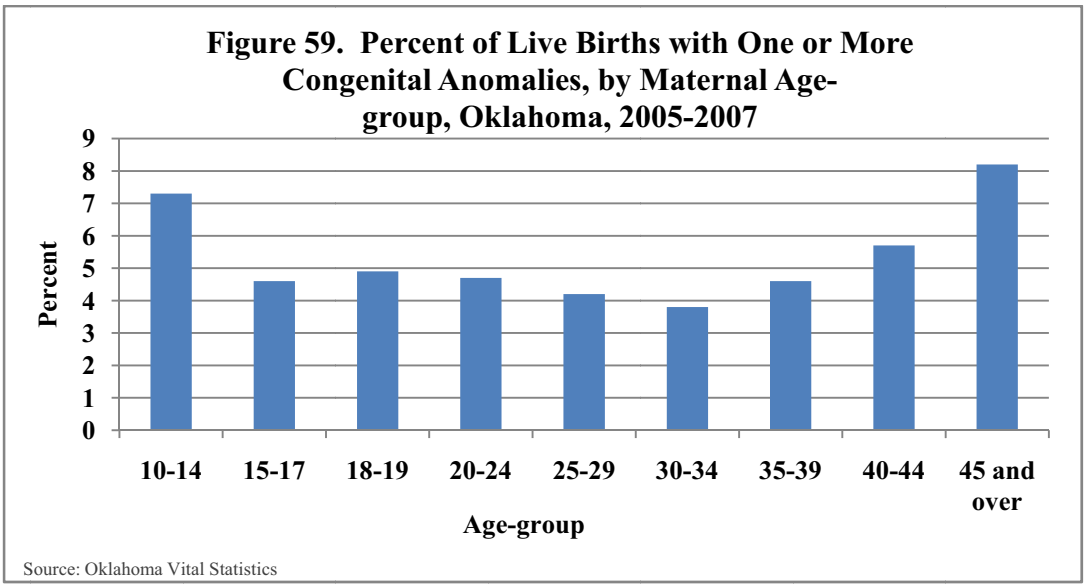
*Persons of Hispanic origin can be of any race and are mutually exclusive of other race categories
Source: Oklahoma Vital Statistics

- **Congenital Anomalies (Birth defects)**

A congenital anomaly indicates that a health problem is present in the infant at birth. While some anomalies have been linked with environmental and genetic factors, the cause of most congenital anomalies remains largely unknown. Racial and ethnic disparities exist in Oklahoma for the presence of congenital anomalies (Figure 58). From 2005-2007, African American/Blacks had the highest rate of births with at least one congenital anomaly present at 6.8%, followed by Asian/Pacific Islanders at 6.7%, and Hispanics at 5.5%. Whites and American Indian/Alaska Natives were only slightly lower at 4.0% and 3.7%, respectively.

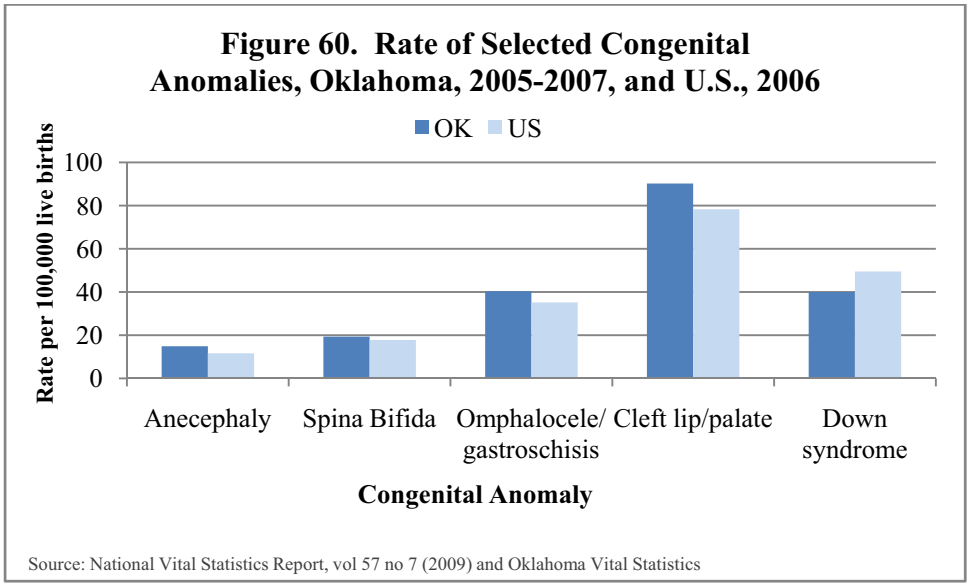


Disparities also exist among maternal age-groups for the presence of at least one congenital anomaly (Figure 59). The following frequency distribution reflects a well curve, a bimodal distribution that is a probability distribution with two distinct peaks, or modes, instead of a bell curve. This well curve indicates increased risks of congenital anomalies for the youngest mothers and the oldest mothers. Mothers aged 30-34 had the lowest percent of births with an anomaly at 3.8%, followed by 25-29 year olds at 4.2%. Mothers aged 45 and over and aged 10-14 had at least one congenital anomaly in 8.2% and 7.3% of births, respectively, nearly twice that of all other maternal age-groups.



There are five congenital anomalies that are reported on both the revised and unrevised U.S. Standard Certificate of Live Birth and are therefore comparable from year to year and between

populations. These five congenital anomalies are anencephaly, meningomyelocele/spina bifida, cleft lip/palate, Down Syndrome, and omphalocele/gastroschisis. Oklahoma is lower in only one category, Down Syndrome, at a rate of 40.0 per 100,000 live births compared with 49.5 for the U.S. average (Figure 60). Oklahoma has a higher rate than the U.S. for the four remaining categories. Other anomalies with a substantially high rate are "other congenital anomalies" at 352.8 per 100,000 live births; "other musculoskeletal" at 138.1; "other urogenital" at 104.5; and polydactyly, club foot, and heart malformations at 65.9, 64.1, and, 55.4 per 100,000 live births, respectively.



Mortality

- **Infant Mortality**

Infant mortality is considered a principle measure of health for a population. Due to Oklahoma's high infant mortality rate, the OSDH Commissioner's Action Team on Reduction of Infant Mortality was convened May 2007 with the overarching goal of reducing infant mortality in Oklahoma. This effort has expanded over the past couple of years to a statewide initiative engaging partners at the state, regional, and community levels.

Studies have shown that placing infants in the supine (back) position for sleep can reduce the risk of SIDS. SIDS is the third leading cause of infant death among Oklahoma's infants (congenital malformations, deformations, and abnormalities are the leading cause and disorders related to short gestation and low birth weight are the second leading cause). The percentage of infants being placed on their back for most sleep episodes, has increased from 2000-2007, increasing from 55.7% to 62.7% (Figure 61). The Healthy People 2010 Objective is 70%.

Mothers in Oklahoma least likely to place their infants on their backs for sleep were African American/Black mothers and mothers with more than one child. Mothers, who were older, had more education or were married, were among those most likely to place their infants on their backs for sleep most of the time (PRAMS Working Group, 2007).

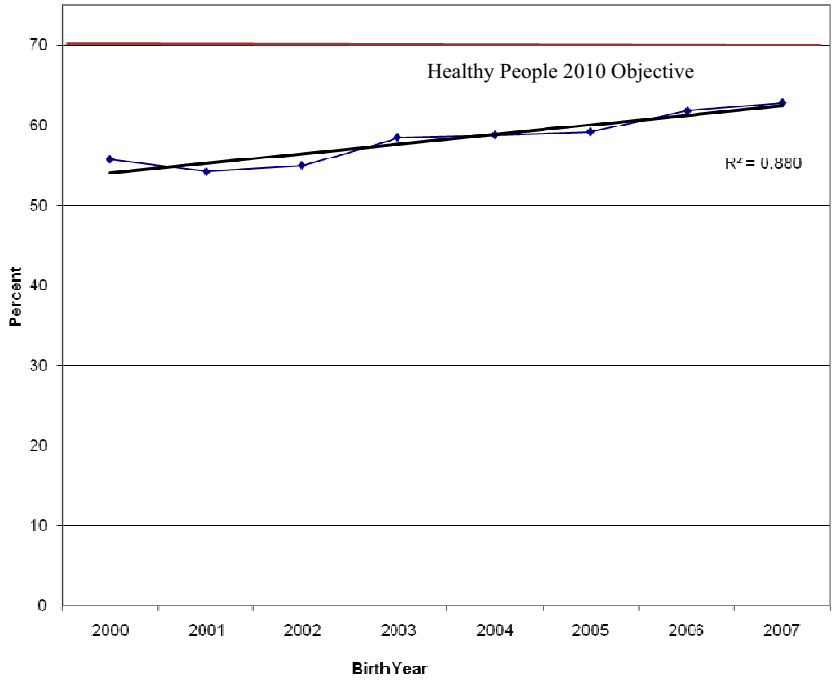
Other factors should also be considered when reviewing safe sleep practices: exposure to second hand (and possibly third hand) tobacco smoke; the condition, location, and composition of the sleep environment (firmness of mattress, place in the house, presence of pillows, blankets, temperature, etc.); as well as family co-sleeping and bed sharing practices. Currently no state data are systematically collected on these topics. Data from infant death scene investigations, the Child Death Review Board, and information collected by the two Fetal and Infant Mortality Review projects (Tulsa County and Oklahoma County) provide insight into infant deaths related to sleep. According to the Oklahoma County Fetal and Infant Mortality Review (FIMR) annual report, the issue of safe sleep is far reaching and extends beyond the risk for SIDS. Unsafe sleep circumstances and conditions for infants who have died "appear to outnumber SIDS cases by at least 50%" (Oklahoma Child Death Review Board, 2009).

According to The Oklahoma Child Death Review Board 2008 Annual Report, a total of 78 deaths were reviewed related to unsafe sleeping practices. Of the 78 deaths reviewed, 57 were ruled unknown manner of death, with the pathologist stating unsafe sleep conditions might have contributed to the death, 15 deaths were classified as SIDS, and six were ruled "accidental." Although 39 infants had an unknown sleeping position, 15 were sleeping on their stomachs, three on their sides, and 10 on their backs.

Over half of the sleep related deaths were white (56.4%), one in five were American Indian (20.5%); 14.1% were African American/Black, and 9% were multi-race. Three-fourths of the deaths reviewed occurred by four months of age.

OK PRAMS VI, the newest version of the survey (beginning with 2009 births) does ask two new and related questions, one on safe sleep advice during prenatal care and the other on frequency of bed-sharing (sharing any sleep surface with another child or adult). This is an attempt to better outline risk for all Oklahoma infants.

Figure 61. Percent of Infants Placed on Backs to Sleep, for Most Sleep Episodes, OK PRAMS, 2000-2007



- **Infant Mortality Rates**

An infant mortality rate (IMR) is defined as the number of infant deaths during the first year of life per 1,000 live births. The U.S.'s IMR has declined significantly throughout the 20th century, from approximately 100 infant deaths per 1,000 live births in 1900 to 29.2 in 1950 then to 12.6 in 1980, which represented an 87% decrease overall. However, since 1980 the decline in infant mortality has been more modest and now stands at 6.7 deaths per 1,000 live births in 2006 (Figure 62). Oklahoma has experienced similar declines in infant mortality; however, Oklahoma's 2006 infant mortality rate of 8.0 was 19% higher than the national average. Oklahoma saw a relative decrease of 1.2% from the 2005 IMR of 8.1 deaths per 1,000 live births to 8.0 deaths per 1,000 live births in 2006.

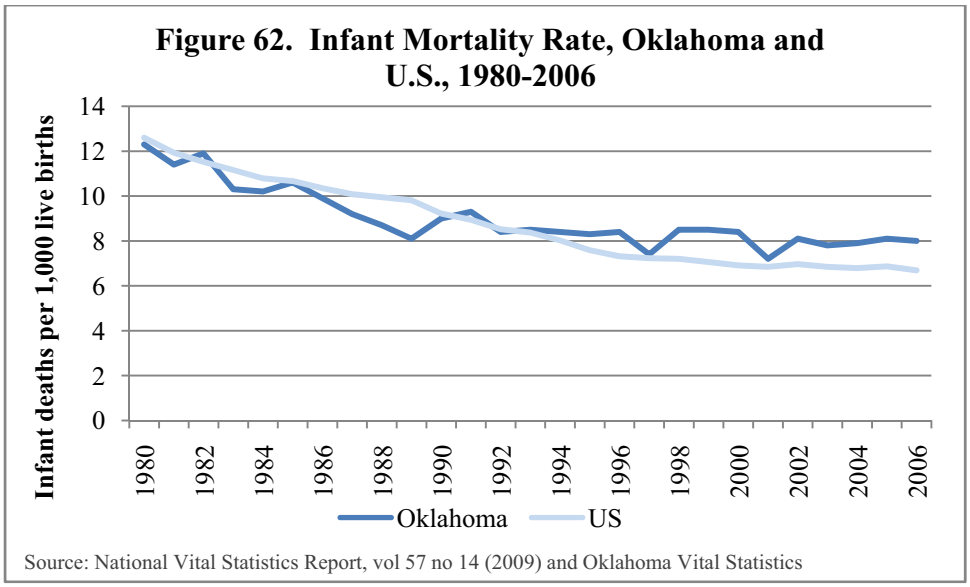
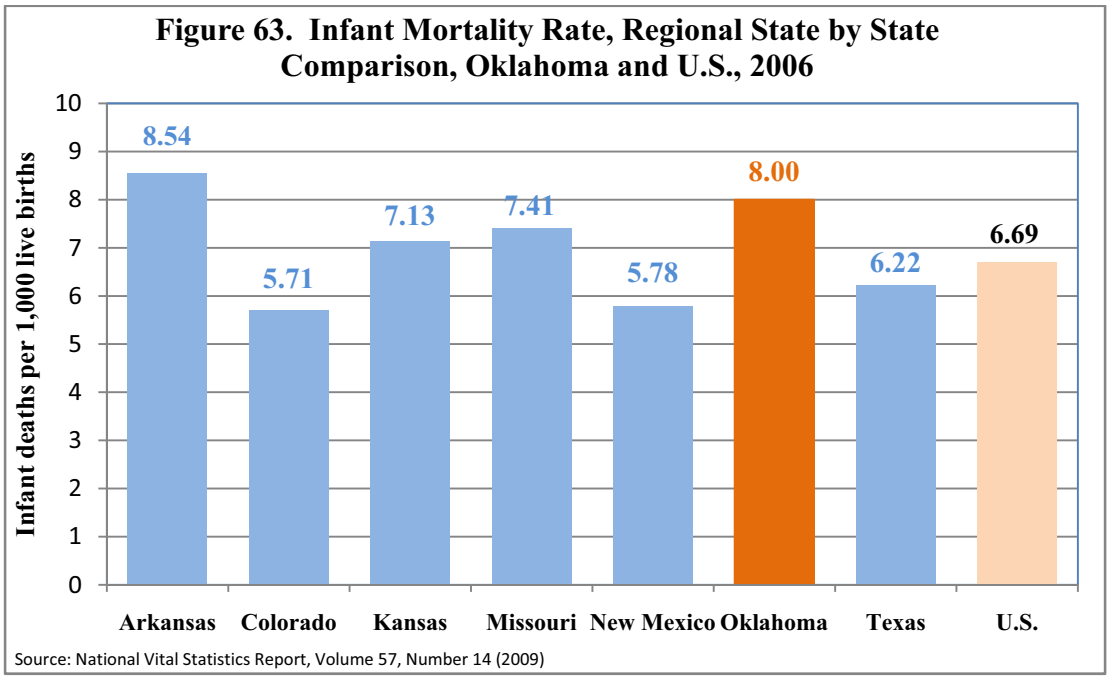


Figure 63, Oklahoma highlighted in orange, shows a regional state by state comparison of infant mortality rates for 2006. Of our neighboring states: Colorado, New Mexico, Texas, and Kansas all have lower rates than Oklahoma, while Arkansas has a higher rate. Oklahoma's 2006 IMR of 8.0 gave it a ranking of 41st in the U.S.. Washington state is ranked first, Mississippi is ranked 50th, and the District of Columbia is ranked 51st (data not shown).



Like the U.S., the top three rankable causes of infant death in Oklahoma are congenital malformations, deformations, and abnormalities; disorders related to short gestation and low birth weight; and SIDS (Table 22). However, compared to the U.S., Oklahoma has an excess mortality rate of 40.7 deaths per 100,000 live births for congenital malformations and 4.8 for

SIDS. Conversely, Oklahoma's mortality rate of 106.4 infant deaths per 100,000 live births for short gestation and low birth rate is 7.1 less than the U.S. rate of 113.5. Bacterial sepsis of the newborn, respiratory distress of the newborn, and diseases of the circulatory system occur more frequently than the national average, while accidents, maternal complications of pregnancy, and complications of placenta, cord, and membranes occur less frequently. Since this table only shows rankable causes of death, one important category is not shown and that is "other symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified (ICD 10 codes: R00-R53, R55-R94, and R96-R99)". The Oklahoma mortality rate for this category was significantly higher than the U.S. rate at 73.9 and 22.2 infant deaths per 100,000 live births, respectively (National Center for Health Statistics, 2009). Oklahoma has observed a significant drop in the number of deaths attributed to SIDS with a corresponding increase to the remainder of the R group of deaths of the ICD 10 codes. The primary reason for this shift may be reluctance of the State Medical Examiner's Office to classify unknown deaths to SIDS. The R group includes "…abnormal results of clinical or other investigative procedures", and it is used by many pediatricians and medical examiners because of their reluctance to classify deaths as SIDS.

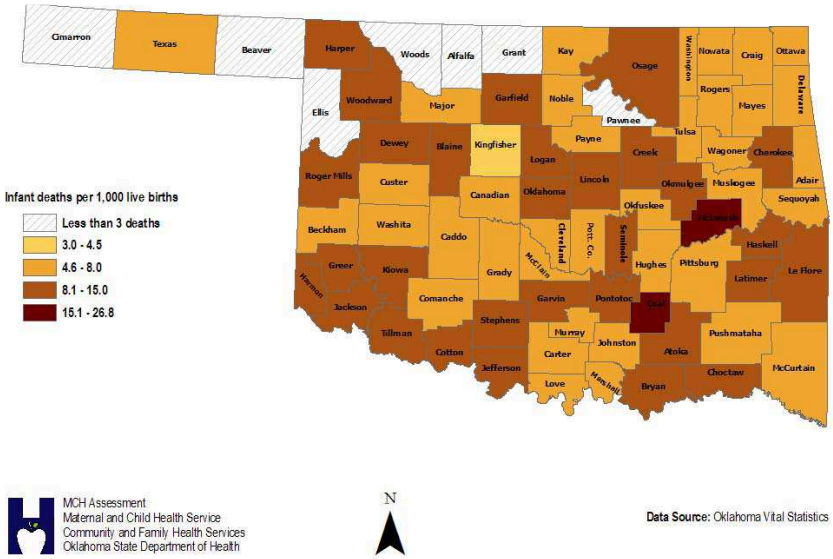
Table 22. Top 10 Rankable Causes of Infant Death Based on the International Classification of Diseases, Tenth Revision (ICD-10), Oklahoma, 2004-2006, and U.S., 2006

	Oklahoma		U.S.		Oklahoma Excess
Cause of death	**Rank**	**Rate**	**Rank**	**Rate**	**Rate**
Congenital malformations (Q00-Q99)	1	177.1	1	136.4	40.7
Disorders related to short gestation and low birth weight (P07)	2	106.4	2	113.5	-7.1
Sudden infant death syndrome(R95)	3	59.3	3	54.5	4.8
Bacterial sepsis of newborn(P36)	4	37.6	8	18.9	18.7
Respiratory distress of newborn(P22)	5	31.9	7	19.3	12.6
Accidents (unintentional injuries)(V01-X59)	6	29.3	5	26.9	2.4
Newborn affected by maternal complications of pregnancy(P01)	7	20.4	4	39.5	-19.1
Diseases of the circulatory system(I00-I99)	8	19.8	10	12.7	7.1
Newborn affected by complications of placenta, cord and membranes(P02)	9	17.2	6	26.7	-9.5
Necrotizing enterocolitis of newborn(P77)	10	13.4	9	12.4	1.0

Rates are infant deaths per 100,000 live births
Source: National Vital Statistics Report, vol 57 no 14 (2009) and Oklahoma Vital Statistics

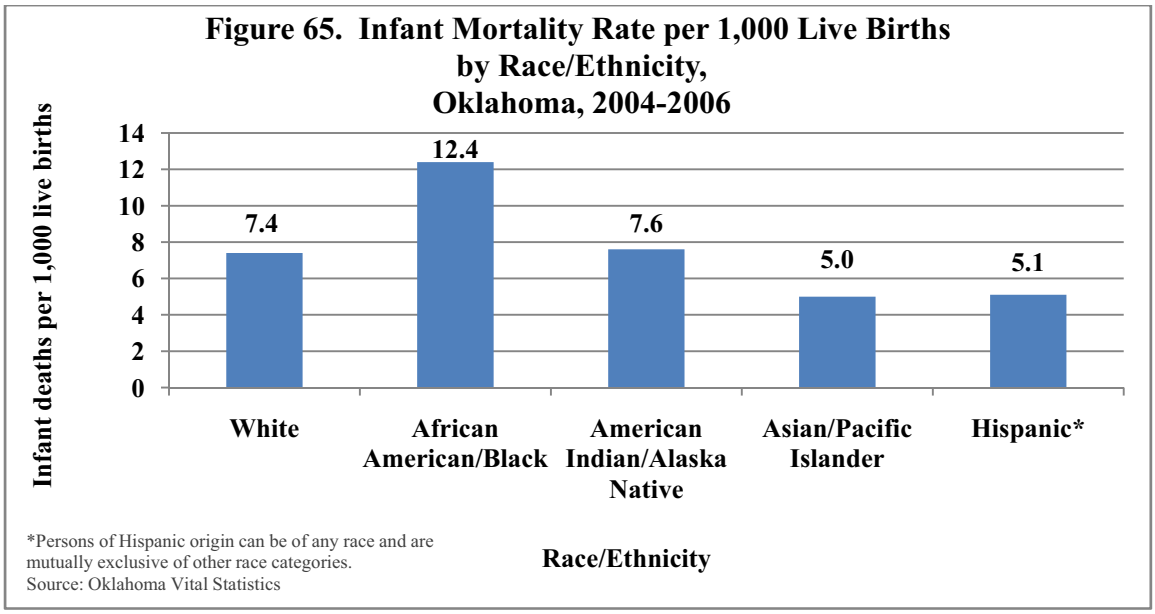
Figure 64 shows infant mortality rates by county using five years of data, 2002-2006. The ranges used were based on the Healthy People 2010 goal of 4.5 and the 2006 IMR for Oklahoma of 8.0. While several counties had an average IMR below the state IMR of 8.0 in 2006, fewer had a lower rate than the national average of 6.7 and only one county, Kingfisher, had a rate lower than the Healthy People 2010 goal of 4.5. While the southeastern region of the state historically has had higher infant mortality rates, all regions of the state have at least one county with an IMR at or above the state average. The two largest metropolitan areas, Oklahoma County and Tulsa County, had a five-year average rate of 8.9 and 8.0 infant deaths per 1,000 live births respectively.

Figure 64. Infant Mortality Rate by County, Oklahoma, 2002-2006



Using linked birth and death records allows for the use of many additional variables and therefore provides the opportunity for more detailed analyses. The linked file is particularly helpful when calculating mortality rates by race because the race of the mother is used in both the numerator and the denominator thus providing a more accurate representation of infant mortality by race. In addition, studies have shown that using the mother's race from the birth certificate is more reliable than using the infant's race on the death certificate since this field is completed by a funeral director or medical examiner based on information from an informant or personal observation.

Despite significant declines in infant mortality over the last several decades, there continue to be significant disparities among Oklahoma's minority population. Although African American/Blacks experienced similar rates of decline over the last several decades, they have historically had higher rates than other racial groups in the state and that disparity continues today. Figure 65 shows infant mortality rates in Oklahoma by race and ethnicity for 2004-2006. Asian/Pacific Islanders had the lowest infant mortality rate during this period at 5.0 infant deaths per 1,000 live births, followed by Hispanics, whites, American Indian/Alaska Natives, and African American/Blacks at 5.1, 7.4, 7.6, and 12.4, respectively. Although the rate for African American/Blacks using the linked file was lower than when calculating rates from the death file only, the African American/Black rate was still nearly twice that of all other racial/ethnic groups.



The following table shows infant mortality rates by gestational period and the mother's race/ethnicity (Table 23). The infant mortality rate for very preterm (less than 32 weeks completed gestation) births was significantly high for each racial/ethnic group. However, the African American/Black infant mortality rate at 212.0 deaths per 1,000 live births was 30% higher than the next group which was 162.9 infant deaths per 1,000 live births for whites. All other racial/ethnic groups were significantly lower than African American/Blacks in this category. Although disparities exist, what is apparent is that all racial/ethnic groups' infant mortality rates decrease as the number of completed weeks of gestation increases.

Table 23. Infant Mortality Rates by Completed Weeks of Gestation and Race/Ethnicity, Oklahoma, 2002-2006

Gestation in Weeks	White	African American/ Black	American Indian/ Alaska Native	Asian/ Pacific Islander	Hispanic
< 32 (very preterm)	162.9	212.0	138.1	131.6	137.1
33-34 (moderate preterm)	23.3	23.1	15.0	25.3	10.6
34-36 (late preterm)	8.8	8.3	12.2	9.9	8.2
37+ (term plus)	3.8	4.1	4.4	2.2	2.5

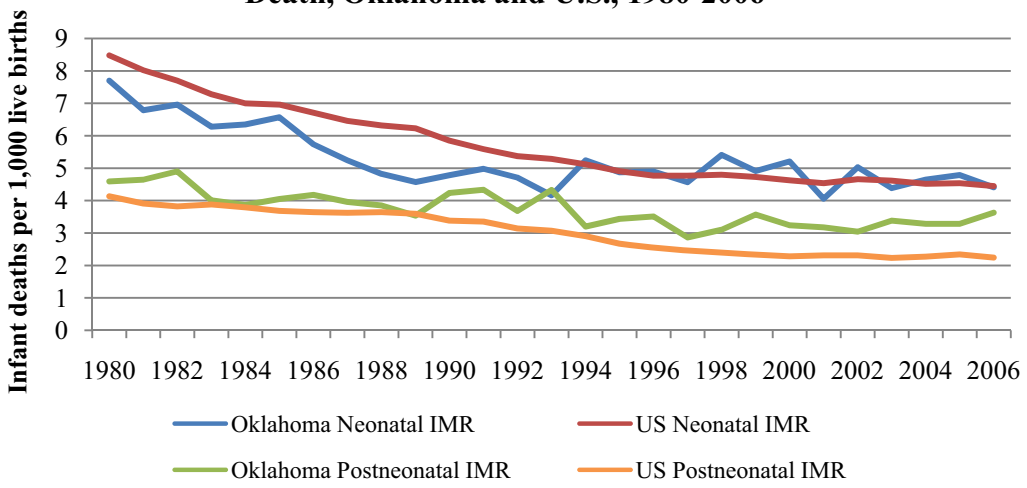
Rates are infant deaths per 1,000 live births
Source: Oklahoma Vital Statistics

- **Neonatal and Postneonatal Mortality**

Infant deaths are typically classified as neonatal and postneonatal. Neonatal deaths are death of infants who die before 28 complete days of life; postneonatal deaths are defined as deaths of infants that are least 28 days of age but less than 365 complete days of age. Causes of neonatal deaths are primarily associated with conditions arising during pregnancy, the health of the mother before and during pregnancy, and conditions arising during delivery; many of the postneonatal deaths are due to conditions occurring to the infant after it is born. The following

graph (Figure 66) shows neonatal and postneonatal mortality trends from 1980-2006 for Oklahoma and the U.S. The neonatal mortality rates (neonatal deaths per 1,000 live births) in Oklahoma, have been lower than the national average for several years and for 2006 were 4.40 and 4.45, respectively. For postneonatal mortality rates, Oklahoma was very close to the national average for several years, but over the last 15 years has been losing ground to the U.S. average and appears to be on an upward trend. The postneonatal mortality rate for Oklahoma was 3.6 postneonatal deaths per 1,000 live births in 2006, compared to 2.2 for the U.S..

Figure 66. Infant Mortality Rates by Period of Death, Oklahoma and U.S., 1980-2006



Source: National Vital Statistics Report, vol 57 no 14 (2009) and Oklahoma Vital Statistics

When analyzing by maternal age and period of death, the youngest and oldest mothers have the greatest risk of infant mortality. Teen mothers 17 years of age and younger have nearly twice the rate of neonatal deaths as mothers aged 25-34 (Table 24). As the maternal age increases the mortality rate for both neonates and postneonates decreases; however, rates begin to increase again for mothers aged 35 and over.

Table 24. Neonatal, Postneonatal, and Infants, Infant Mortality Rates by Maternal Age-group, Oklahoma, 2002-2006

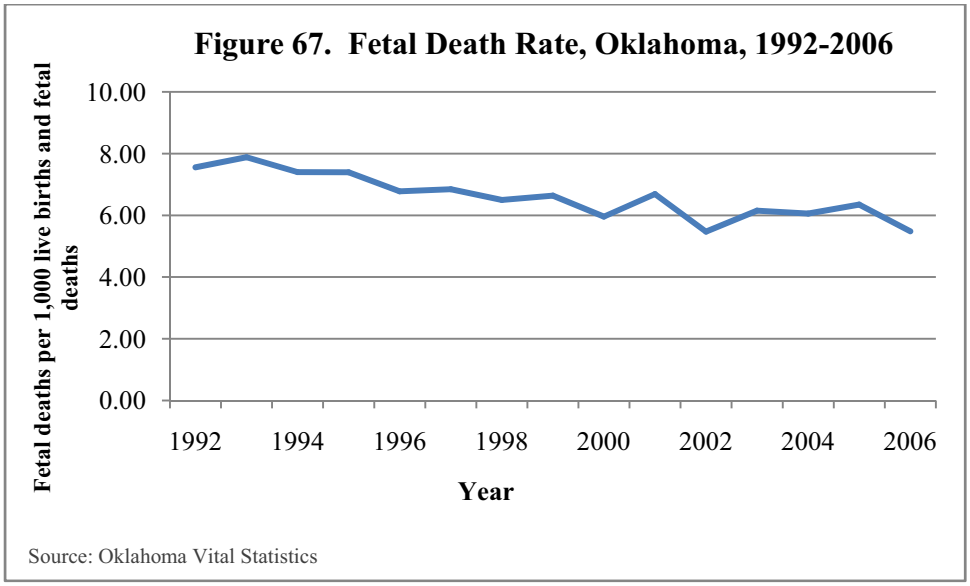
		Neonates		Postneonates		Infants	
Maternal Age (Years)	Live Births	(Under 28 days) Deaths	Rate	(28 days-11 months) Deaths	Rate	(under 1 year of age) Deaths	Rate
Under 18	11320	79	6.98	54	4.77	133	11.75
18-19	24287	116	4.78	106	4.36	222	9.14
20-24	86831	378	4.35	352	4.05	730	8.41
25-29	71282	289	4.05	168	2.36	457	6.41
30-34	43805	174	3.97	97	2.21	271	6.19
35-39	17383	82	4.72	38	2.19	120	6.90
40 +	3711	39	10.51	11	2.96	50	13.47

Rates are deaths per 1,000 live births
Source: Oklahoma Vital Statistics

- **Fetal Mortality**

A fetal death is defined by the World Health Organization as "*a 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, such as beating of the heart, pulsation of the umbilical cord, or definite movement of voluntary muscles.*" (Definition adopted by the World Health Organization in 1950.)

Oklahoma requires that any fetal death of 20 weeks or more gestation be reported to the OSDH. A fetal death rate is the number of fetal deaths divided by the number of live births plus the number of fetal deaths. Over the last 15 years the fetal death rate in Oklahoma has decreased 27.6% from 7.6 fetal deaths per 1,000 live births and fetal deaths in 1992, to 5.5 fetal deaths per 1,000 live births and fetal deaths in 2006 (Figure 67). While there has been some fluctuation in the fetal death rate over the past few years this decrease is statistically significant. The 2005 rate of 6.35 for Oklahoma was not significantly different than the U.S. rate of 6.22 for the same year.

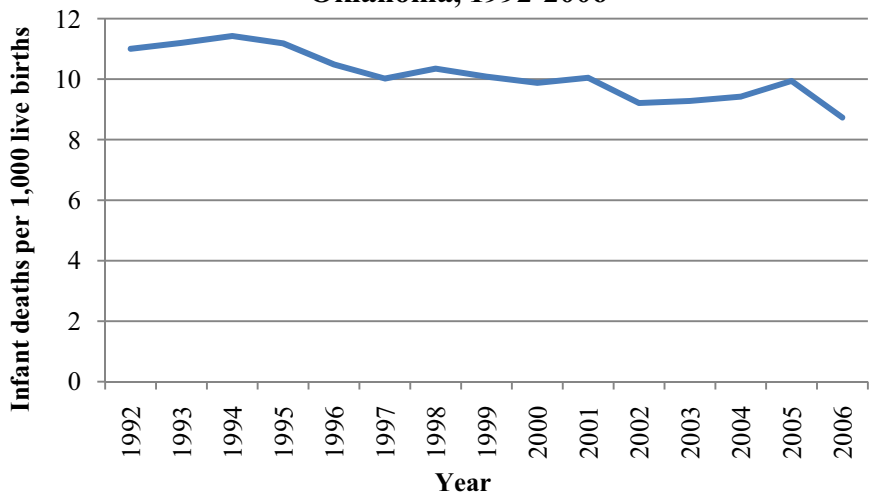


- **Perinatal Mortality**

Early neonatal deaths, those infants who die in the first week of life, and fetal deaths have been shown to have common causes. Combining early neonatal deaths and fetal deaths produces a perinatal mortality rate. Data from the Perinatal Periods of Risk (PPOR) model as well as other studies have shown that perinatal deaths are an important indicator of maternal health and maternal care. Like other outcomes previously discussed in this document it is apparent that while access to care and entry into prenatal care play an important role in birth outcomes, socioeconomic status as well as maternal health behaviors have a significant association as well.

A perinatal mortality rate is the number of fetal deaths plus the number of early neonatal deaths divided by the number of fetal deaths plus the number of live births. The perinatal mortality rate in Oklahoma has decreased from 1992 to 2006 (Figure 68) from 11.0 per 1,000 live births to 8.7 per 1,000 live births.

Figure 68. Perinatal Mortality Rate, Oklahoma, 1992-2006



Perinatal deaths are those infants who die in the first week of life combined with fetal deaths.
Source: Oklahoma Vital Statistics

In addition to the standard approach for assessing the burden of infant mortality, data were utilized from the PPOR model. The PPOR model is based on two factors: age at death and birth weight. Together, these two factors form the basis for the "feto-infant mortality map" and can provide direction for specific prevention strategies. The final PPOR model contains four major categories: Maternal Health/Prematurity, Maternal Care, Newborn Care, and Infant Health. Each group is named based on the area to which prevention efforts would be most logically concentrated. The following PPOR Map is based on Oklahoma fetal and infant deaths from 2002-2006 (Table 25). Due to the anticipation of limited resources two specific areas from the PPOR results have been chosen for intervention based on their high mortality rates and contribution to the burden of infant mortality in Oklahoma: Maternal Health/Prematurity with a rate of 3.3 fetal and infant deaths per 1,000 live births and fetal deaths, and Infant Health with a rate of 2.6 fetal and infant deaths per 1,000 live births and fetal deaths. While the underlying cause of death is useful for investigating deaths in the Infant Health category, the causes of death among VLBW births and fetal deaths in the Maternal Health/Prematurity category can be complex, resulting in inconsistent reporting.

Table 25. PPOR Map of Fetal and Infant Deaths, Oklahoma, 2002-2006				
	Fetal Death	**Neonatal**	**Post-Neonatal**	
500-1499 grams	3.4 fetal-infant deaths per 1,000 fetal deaths and live births **Maternal Health & Prematurity**			1393 Fetal-Infant Deaths
1500+ grams	1.9 fetal deaths per 1,000 fetal deaths and live births **Maternal Care**	1.5 neonatal deaths per 1,000 fetal deaths and live births **Newborn Care**	2.6 post-neonatal deaths per 1,000 fetal deaths and live births **Infant Health**	152,120 live births and fetal deaths
"9.2 overall feto-infant mortality rate"				
Overall feto-infant mortality rate is number of fetal and infant deaths per 1,000 fetal deaths and live births Source: Oklahoma Vital Statistics				

To estimate the contribution of deaths that are attributed to birth weight in the Maternal Health/Prematurity group, the Kitagawa Formula was used (Kitagawa, 1955). This formula can provide an estimation for excess deaths due to having more than the expected proportion of infants being born low weight or of having infants born low weight but not surviving at the expected rates. The results showed that while African American/Black VLBW infants survive better than white VLBW infants, the larger than expected proportion of African American/Black infants born too small contributes greatly to the racial disparities seen in infant mortality rates and further emphasizes the need for preventing prematurity among this group (data not shown). Decreasing infant mortality for whites will require both preventing prematurity and reducing mortality for the smallest infants.

For the Maternal Health/Prematurity category, Oklahoma prevention efforts are focused on maternal behaviors before and during pregnancy such as preconception/interconception care and education, maternal infections (sexually transmitted infections), postpartum depression, and tobacco use. Infant Health efforts focus on infant safe sleep including sleep position and bed sharing, breastfeeding, tobacco exposure, and infant injury prevention.

B. Children

Access to Care

A lack of access to health care is correlated with low socio-economic status and presents families with a multitude of problems. While enrollment in social programs does increase a caretakers' ability to provide needed services for their children, it is indicative of the elevated poverty levels in the state. Throughout counties in Oklahoma, child poverty levels range from 11.3% to 41.3%, with almost half of the counties with rates of 25% or higher. Overall, a lack of health care access and insurance coverage is associated with a decrease in the use of preventive health services, a delay in seeking medical attention, and poor health status, which translates into more school absenteeism for children.

According to the Kaiser Family Foundation, 13.3% of Oklahoma children 18 years and under were uninsured compared to 11.3% nationally (data not shown) (Kaiser Family Foundation, 2007). Additionally, data provided by the OHCA show that 509,354 children and adolescents