TENNESSEE Birth Defects 2005-2009

TENNESSEE DEPARTMENT OF HEALTH
DIVISION OF POLICY, PLANNING AND ASSESSMENT

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Executive Summary

"Birth defects, also called congenital anomalies, are physical abnormalities that occur before a baby is born. They are usually obvious at birth or by 1 year of age." [1]

Birth Defects (BD) continue to be one of the leading causes of death in infants less than one year old nationally and in Tennessee, with 645 deaths in Tennessee between 2005-2009 related to birth defects. Although not all birth defects result in death, according to the Center for Disease Control (CDC), an infant is born every four and half minutes with a birth defect with hospital costs that may exceed 2.5 billion dollars.

This BD report is a statewide population-based report produced by the Tennessee Birth Defects Registry (TBDR) detailing the birth prevalence of 45 major birth defects and fetal alcohol syndrome for Tennessee infants born in the years 2005 through 2009. Sections in this report detail counts and rates presented by infant gender, race/ethnicity, perinatal region, age of mother, education of mother, maternal county of residence, and maternal diabetes. The two most common reported birth defects overall were members of the cardiovascular group: 1) atrial septal defect ((ASD), a hole or opening in the upper chambers of the heart)) and 2) patent ductus arteriosus ((PDA), an opening that failed to close from fetal circulation)).

- Prevention is the best option for minimizing the occurrence of birth defects. This report concludes with a section on birth defects prevention. Some examples include:
    - Intake of folic acid (a B-vitamin) supplements by women of childbearing age has been shown to reduce neural tube defects (like spina bifida) by at least 50 percent. *Pediatrics Vol. 104 No. 2 August 1, 1999 pp. 325 -327*
    - Making healthy living choices remain the most effective way to reduce the risk of birth defects. These choices include all women who may become or

[1] Accessed on December 23, 2013 2010-2013 Merck Sharp & Dohme Corp., a subsidiary of Merck & Co., Inc., Whitehouse Station, N.J., U.S.A
http://www.merckmanuals.com/home/childrens_health_issues/birth_defects/overview_of_birth_defects.html

want to become pregnant should have contact with a trusted medical professional who will assist in monitoring their health status and provide preconception care. They should be current on their immunizations and take precautions to avoid common infections. For those with type 1 or type 2 diabetes it is critical to maintain normal blood sugar levels.

  - Fetal alcohol spectrum disorders (FASD) are 100% preventable. http://www.cdc.gov/NCBDDD/fasd/alcohol-use.html. Women who do not drink while pregnant do not have babies with FASD.
  - Avoidance of even seemingly benign, everyday exposures can reduce the risk for birth defects—for example, pregnant women who are exposed to cat feces during the process of changing a litter box can develop an infection called toxoplasmosis, and their infants may be born with vision problems or seizures.

- The three-year backward moving averages of the overall annual birth defects rates (Figure 2) show an increasing trend from 2002 through 2009 with only one year's average, 2008, showing decline. While there is no one clear reason for the increase in birth defects rates, several possibilities exist: there may be a true increase in birth defects rates related to familial, maternal or environmental risk factors; there may be improved birth defects surveillance; or the increase may have resulted from changes in clinical practice and awareness in coding of birth defects diagnoses or other neonatal diagnoses in hospitals. It is probable that the increase is a result of a combination of these factors.

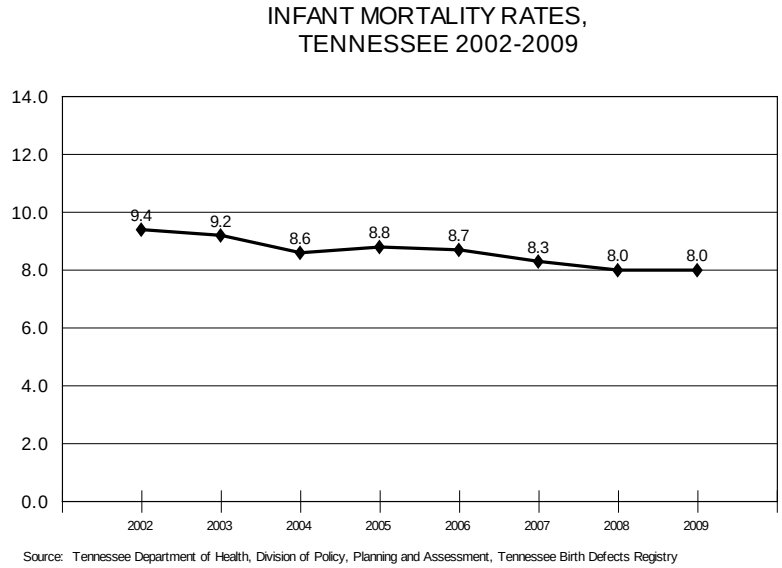
- Birth defects in general were more common among males and babies born to mothers aged 35 and older; however, this is not the case for all birth defects as several categories for women under age 20 had the highest rates. While the number of birth defects was highest for white infants, the rate for black infants was greater than the white rate for 2005-2009.

- Birth defect rates vary by perinatal region with the highest rates in the Northeast, East, and West perinatal regions and lower rates in the Southeast and Middle regions. The TBDR is working to evaluate factors that may affect regional

differences as well as the racial/ethnic and gender differences in birth defects rates. The department is closely reviewing data cases to evaluate the coding variation of the years to determine differences and identify population characteristics, if any. A limitation of the data collection methodology is the timeliness of the data availability. The lag in the birth defect registry data is more apparent in this example as it is difficult to tell whether the cases have been more appropriately reclassified or these are now additional cases affecting our infant population.

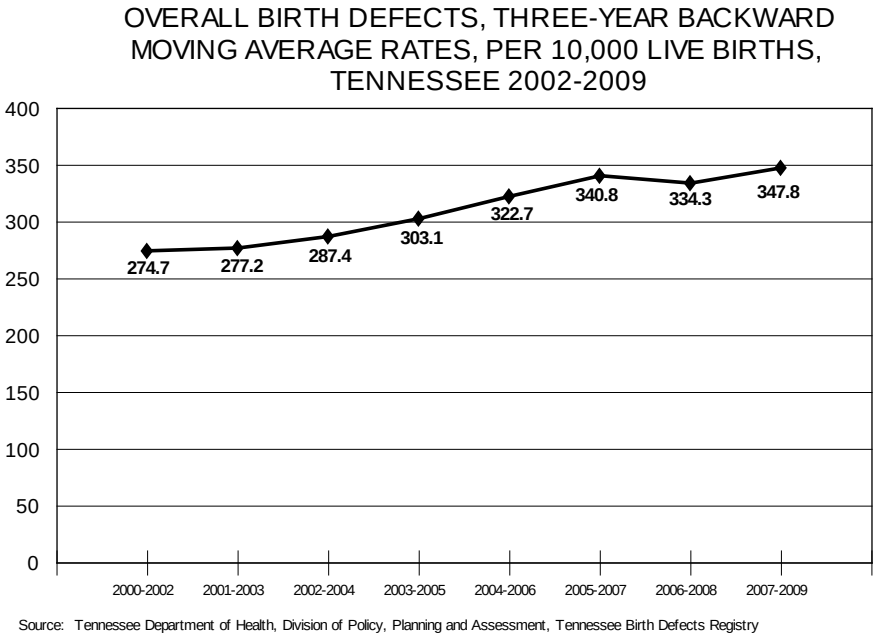
- The Tennessee Department of Health has a number of statewide maternal and infant programs and tracking areas that assist in identifying at risk populations; such programs include the Pregnancy Risk Assessment Monitoring System (PRAMS) and the Newborn Screening and Follow-Up program, which includes a new screening (implemented in 2013) for critical congenital heart disease. These programs and the collaboration of others across the state have assisted in the **improvement of Tennessee's infant mortality rate by 14.9% over the last several years**—from 9.4 in 2002 to 8.7 in 2006 and most recently to 8.0 per 1,000 live births in 2008 and 2009. While alarming that the rate of birth defects has increased, the overall infant mortality rate has decreased, perhaps programs leading to early diagnosis and interventions have positively impacted the severity of the defects.

Figure 1



Source: Tennessee Department of Health, Division of Policy, Planning and Assessment, Tennessee Birth Defects Registry

Figure 2



Source: Tennessee Department of Health, Division of Policy, Planning and Assessment, Tennessee Birth Defects Registry

Birth Defects Overview

Birth defects occur during the first three months of pregnancy with most originating in the first six weeks and can affect almost any part of the body. Nationally nearly one out of every 33 babies is born with a birth defect[2]. Some defects are obvious at birth while others may not be apparent until adulthood. Some defects can result in life-long debilitating illnesses or death. Surgery and medical interventions may correct others, but not without cost.

Unfortunately, the underlying causes of individual birth defects are largely unknown; with a high percentage of infant birth defects having no known cause. This leaves many questions about the causes and patterns of birth defects unanswered. Information obtained through monitoring diseases and the surveillance of births defects can assist with the task of addressing these questions. While the direct causes of birth defects are not fully understood, there are known risk factors that affect birth defects prevalence. For example: drinking alcohol during pregnancy, smoking during pregnancy, low blood

[2] Accessed on December 23, 2013. http://www.cdc.gov/ncbddd/birthdefects/index.html

folate levels, poorly controlled blood sugar levels in diabetic mothers, and maternal infections are all associated with increased risk of having a baby born with a birth defect.

The primary use of data collected by TBDR is to observe patterns and detect changes in the patterns of leading birth defects. The data provides the basis for research studies into the causes of birth defects and provides information to evaluate the effectiveness of birth defects prevention efforts. It also serves as an historic baseline used to evaluate the existence of suspected birth defects clusters.

Tennessee Birth Defects Registry

The Tennessee Birth Defects Registry (TBDR) was established in law (TCA 68-5-506) by the Tennessee State Legislature in June 2000. The TBDR was established with the mission of: 1) providing annual information on birth defects prevalence and trends; 2) to provide information on the possible association of environmental hazards and other potential causes of birth defects; 3) to evaluate current birth defects prevention initiatives, providing guidance and strategies for improving those initiatives; and 4) to provide families of children with birth defects information on public services available to children with birth defects. Since 2003, the program has expanded to provide population-based birth defects surveillance for the entire state of Tennessee. Currently, the registry is undergoing a complete review in order to evaluate its effectiveness and ability to meet the requirements of its intent.

Birth Defect Definition

The tracking of birth defects is recommended by the Centers of Disease Control and Prevention (CDC) and the National Birth Defects Prevention Network (NBDPN). The department does not receive federal funding for participation in the network. Currently, 41 states maintain a birth defects registry or report its data to the CDC. Unfortunately, rates across states should not be compared as collection methodology, years collected, and individual definitions vary widely. This report details the birth prevalence of 45 major

birth defects for Tennessee infants who were born to resident mothers during the period 2005 through 2009.

Tennessee's Birth defects are classified as major birth defects when they require medical or surgical treatment, have serious adverse effects on health and development, or have a significant cosmetic impact. Additionally, the 45 birth defects can be organized within eight diagnostic categories corresponding to eight major organ systems: 1) Central Nervous System; 2) Eye and Ear; 3) Cardiovascular; 4) Orofacial; 5) Gastrointestinal; 6) Genitourinary; 7) Musculoskeletal; and 8) Chromosomal.

Birth defect counts include: 1) live-born infants diagnosed with a birth defect during the first year of life; and 2) diagnosed fetal-death cases that were at least 500 grams in weight or in the absence of weight at least 22 weeks gestation. As of July 1, 2010, the Department of Health's fetal death definition changed to include cases of at least 350 grams or 20 weeks completed gestation. However, the fetal death cases included in this report were not covered by the new definition with the last year of data being 2009. The denominators used for calculating birth defects rates include only live births and are reported per 10,000 live births.

Data Sources

Currently, the primary data sources for the TBDR are the Hospital Discharge Data System (HDDS) and the Birth, Death, and Fetal Death Statistical Data Systems, which are compiled, processed and stored by the Office of Vital Records and the Office of Health Statistics in the Division of Policy, Planning, and Assessment (PPA). The Tennessee Birth Defects Registry (TBDR), which produces this report, is also housed within PPA. The HDDS contains admission-level records for all patients treated in Tennessee licensed hospitals and their outpatient treatment and rehabilitation centers. The TBDR uses these records to track the 45 major birth defects. Infants' HDDS records containing diagnostic codes corresponding to the tracked birth defects are extracted, compiled, and linked with their birth certificate records. The linkages provide validity checks and add information such as maternal risk factors, demographics, and

street-level geography that are not available in the HDDS. Diagnostic data are also obtained from the fetal death and death certificate data systems. For the fetal death certificate identified cases; demographic, geographic, and risk factor information are obtained from the fetal death certificate system. For the death certificate identified cases; demographic, geographic, and risk factor information are obtained from the death certificate data system. Together they provide statewide population-based birth defects surveillance for Tennessee.

Data Limitations

The current methodology inhibits timeliness of the data availability and evaluation. The department is evaluating alternative methods that would permit at least the prior year's data available. This report's data only captures those infants born through 2009 as the HDDS data is always one year behind the birth year. Additional limitations of administrative data systems such as these for birth defects surveillance include coding errors. Some of the diagnostic codes used in the HDDS correspond to both the major and minor variants of a given birth defect. Thus, the coding system used in the HDDS, The International Classification of Diseases Revision 9 Clinical Modification (ICD-9-CM), prevents distinguishing these differences for certain birth defects. This may have the effect of elevating rates for some of the more common birth defects, such as atrial septal defects, which are congenital heart defects, and hypospadias, a common genitourinary defect. Less systematically, there are simple coding errors that result in both non-cases being miscoded as having a birth defect and valid cases not being recorded as having a birth defect. However, the new ICD-10 system should assist in correct coding.

Some options to assist with the current data limitations include required provider reporting similar to newborn screening and neonatal abstinence syndrome (NAS); active surveillance which is very resource and time intensive, and changing administrative collection methodology; each of these options may present new challenges such as poor response rates with provider reporting, prohibitive resourcing needs for active

surveillance and others that the department and Advisory Committee will need to consider as it moves forward in its evaluation.

Data Tables

Individual birth defect counts and rates are presented in tabular form for the state overall and presented by infant sex; race/ethnicity; age of mother; education of mother; maternal county of residence; maternal diabetes; and the five perinatal regions that are served by Tennessee's five designated Regional Perinatal Center Hospitals (Tables 1-8). Within the tables, counts and rates are organized by the affected organ system: 1) central nervous system; 2) eye and ear; 3) cardiovascular, 4) orofacial; 5) gastrointestinal; 6) genitourinary; 7) musculoskeletal; 8) chromosomal; and 9) fetal alcohol syndrome. Definitions and brief descriptions for each of the reported birth defects are provided in the glossary at the end of the report.

All of the tables provide 95 percent confidence intervals for each of the rates. A 95 percent confidence interval is the interval that contains the true prevalence, which can only be estimated, 95 percent of the time. Prevalence is all cases with a diagnosis; it includes both old and new cases. Narrower confidence intervals support greater certainty regarding an estimated rate, whereas wider confidence intervals support less certainty. In this report, confidence intervals for 100 cases or less are exact Poisson. Otherwise confidence intervals are based on the normal approximation. The width of a confidence interval is primarily dependent upon the number of birth defects (exact Poisson) or the size of the population used to compute the rate (normal approximation). Thus, confidence intervals become increasingly wider progressing through tables for the entire population to smaller subgroups and from more common to more rare birth defects. Accordingly, rate estimates for rarer birth defects and small populations should be interpreted with caution. Confidence intervals are effective for determining the likely range for birth defects rate estimates affected by random error. Confidence intervals are less effective for determining the likely range of birth defects rate estimates that are affected by systematic error, such as limitations in the ICD-9-CM disease classification coding system and nonstandard coding practices in hospitals.

Birth defects may occur alone or in conjunction with other birth defects. Therefore, birth defects counts and rates are presented in two ways: 1) the number of birth defect diagnoses (i.e., birth defects rate); and 2) the number of patients, or cases, affected by birth defects (i.e., case rate). For example, when an infant or case has multiple birth defect diagnoses, we count and report each diagnosis separately. The totals for each of the eight birth defects categories, however, represent the number of cases (or patients) with one or more diagnoses in that category. Since it is also possible for a case to have diagnoses in multiple categories, the category totals cannot be added to obtain the total number of Tennessee cases. Of the 14,983 cases diagnosed with a birth defect between 2005 and 2009, 3,336 (22.3 percent) had more than one birth defect. Thus, while each represents at least a single case within a diagnostic category, some are counted as cases in more than one diagnostic category and some may have multiple diagnoses within a category.

Overall Tennessee Birth Defects Rates 2005-2009

Table 1 contains the overall birth defect counts, rates and 95% confidence intervals for each of the 45 major birth defects diagnoses organized within their respective organ systems. The central nervous system category contains five birth defects, three of which, anencephalus, spina bifida, and encephalocele are classified as neural tube defects (NTDs). NTDs occur when there is a failure of the neural tube to close during the first month of pregnancy. Over the five year period 2005-2009, there were 56 anencephalus cases, 181 spina bifida cases, and 56 encephalocele cases. Babies affected by anencephalus are born missing parts of their skull and the cerebral hemispheres. Anencephalus is almost always fatal soon after birth[3]. Spina bifida is the incomplete closure of the vertebral spine with the spinal cord and meninges that cover the spinal cord herniating through the opening. Though not fatal, spina bifida generally requires multiple surgeries with disabilities such as lower limb paralysis, curvature of the spine, and lack of bowel and bladder control

[3] Division of Birth Defects and Developmental Disabilities, NCBDDD, Centers for Disease Control and Prevention accessed on December 23, 2013. http://www.cdc.gov/ncbddd/birthdefects/anencephaly.html

persisting post-surgery. In spite of these obstacles, many of the babies born with spina bifida live full, productive and, rewarding lives

Although the causes of neural tube defects are not fully understood, research has shown that women who take 400 micrograms of a B vitamin known as folic acid significantly reduce the likelihood of conceiving a baby with an NTD. The American College of Obstetrics and Gynecology and the United States Preventative Task Force recommend that all who may become pregnant take a multivitamin containing 400 micrograms of folic acid every day[4]. Taking a daily multivitamin before pregnancy is especially important because most birth defects including NTDs are thought to originate in the period before a woman knows she is pregnant.

The cardiovascular category contains counts and rates for thirteen congenital heart defects. Six of the defects are labeled as CCHD, for critical congenital heart defect. Undiagnosed and untreated newborns affected by CCHDs are at risk of serious morbidity and mortality. In January 2013, Tennessee hospitals began a critical congenital heart defect screening program, using pulse oximetry testing to assess newborn blood oxygen levels. Newborns with blood oxygenation below a critical level will receive follow-up screening, diagnosis, treatment, and care as necessary for those with confirmed CCHD diagnoses. For newborns with one of these CCHD diagnoses, the care may be life-saving. In the past, many newborns with CCHD may have been sent home undiagnosed and experience complications leading to death or lifelong disability. The CCHD screening program has become part of a nationwide effort initiated to identify and begin treatment of CCHD affected newborns immediately after birth.

[4] U.S. Preventive Services Task Force. *Folic Acid for the Prevention of Neural Tube Defects: U.S. Preventive Services Task Force Recommendation Statement*. AHRQ Publication No. 09-05132-EF-2, May 2009. http://www.uspreventiveservicestaskforce.org/uspstf09/folicacid/folicacidrs.htm Accessed December 23, 2013.

The six CCHD diagnoses in Table 1 are common truncus (CT), also known as truncus arteriosus (TA); transposition of great arteries (TGA); tetralogy of fallot (TOF); pulmonary valve atresia (PVA); tricuspid valve atresia (TVA); and hypoplastic left heart syndrome (HLHS). The seventh CCHD diagnosis, total anomalous pulmonary venous return (TAPVR), will also be screened for in the pulse oximetry screening program. TAPVR will be added to the standard TBDR data system in upcoming TBDR reports. Ebstein's anomaly, which is currently tracked by TBDR is also considered a CCHD, but will not be screened for in the CCHD screening program as it is not likely to be detected via the pulse oximetry methodology. As such, it was not labeled as a CCHD diagnosis in Table 1. The Tennessee CCHD pulse oximetry screening program follow-up will include diagnosis by a cardiologist, which is entered in the Neometrics Newborn Screening Database.

The two most common reported birth defects overall were members of the cardiovascular group: atrial septal defect (ASD) and patent ductus arteriosus (PDA). An ASD is a hole in the atrial septum, which is the anatomical wall separating the two upper chambers of the heart[5]. In order for an ASD to be coded the hole should be at least 4mm in diameter. If smaller than 4mm, the defect is classified as patent foramen ovale (PFO). Patent foramen ovale is an artifact of the fetal circulation system and unlike an ASD, which will likely require surgery, a PFO will likely close on its own, or remaining, may have little impact on health[6]. According to the American Heart Association, PFO prevalence in the current United States adult population is 27 percent. Both ASD and PFO share the same ICD-9-CM code, they

[5] Parker SE, Mai CT, Canfield MA, et al; for the National Birth Defects Prevention Network. Updated national birth prevalence estimates for selected birth defects in the United States, 2004-2006. Birth Defects Res A Clin Mol Teratol. 2010;88:1008-16. Accessed December 23, 2013. http://www.cdc.gov/ncbddd/heartdefects/atrialseptaldefect.html

[6] Webb GD, Smallhorn JF, Therrien J, Redington AN. Congenital heart disease. In: Bonow RO, Mann DL, Zipes DP, Libby P, eds. *Braunwald's Heart Disease: A Textbook of Cardiovascular Medicine*. 9th ed. Philadelphia, Pa: Saunders Elsevier; 2011:chap 65. Updated by: Kurt R. Schumacher, MD, Pediatric Cardiology, University of Michigan Congenital Heart Center, Ann Arbor, MI. Review provided by VeriMed Healthcare Network. Also reviewed by David Zieve, MD, MHA, Medical Director, A.D.A.M., Inc. accessed December 23, 2013.

are indistinguishable in the HDDS data system and therefore properly coded PFO cases are counted as ASD.

Like PFO, patent ductus arteriosus (PDA) is a remnant of the fetal circulation system. The ductus arteriosus is a blood vessel that allows blood to bypass the fetus' lungs while in the womb. Normally, the ductus arteriosus closes within days of birth. In the case of PDA the ductus arteriosus fails to close. In some cases, PDA may actually be a benefit, such as when a newborn has both PDA and HLHS. In that case, the open ductus provides a temporary open circulatory pathway that may save the newborn's life until surgery can be performed to resolve the HLHS. Under normal conditions however, PDA results in low oxygenation of the blood and puts the infant at risk. If the PDA does not close on its own, it will be treated with catheterization or surgery. Overall, three of the five most prevalent birth defects in Tennessee during the period 2005-2009 (Table 1) were cardiovascular defects: 1) atrial septal defect (3921); 2) patent ductus arteriosus (2,529), and 3) ventricular septal defect (1,937). The two remaining top five birth defects were a genitourinary defect, hypospadias (2,282) and a gastrointestinal defect, pyloric stenosis (1,829).

Orofacial birth defects monitored are cleft palate without cleft lip, cleft lip with and without cleft palate, and choanal atresia. Cleft lip is a defect resulting from the incomplete fusion of the parts of the lip. Cleft lip may be central, unilateral or bilateral. Cleft palate results from the incomplete fusion of the palate, may be central, unilateral, and bilateral, and may include hard palate, soft palate or both. Clefts require surgical repair and the initial surgery generally takes place in six to twelve weeks following delivery. Choanal atresia involves a membrane blocking the nasal passages and preventing nasal breathing. Choanal atresia is treated with the surgical removal of the membrane.

Among the gastrointestinal birth defects in Table 1 biliary atresia (BA) is the least common, but most deadly. In (BA) bile flow from the liver to the gallbladder is blocked,

damaging the liver and leading to cirrhosis. A surgical procedure known as the Kasai procedure that allows bile to drain into the small intestine performed is crucial for survival of affected newborns. Esophageal atresia (EA) is a blockage of the esophagus, where the upper esophagus does not connect to the lower esophagus. EA is usually diagnosed early due to the newborn's inability to feed either normally or through a feeding tube and is then surgically corrected.

Among the genitourinary birth defects in Table 1 hypospadias was most common, accounting for 2,282 cases. Its counterpart, epispadias, accounted for only 56 cases. Hypospadias and epispadias both involve a displacement of the urethral opening on the penile shaft rather than at the tip of the glans. In hypospadias the displacement of the urethra is ventral, on the underside of the penis, whereas epispadias is dorsal on the top of the penis. Surgical repair of hypospadias and epispadias is generally performed within the first year. Obstructive genitourinary defect (OGD) affected 1,186 newborns. OGD is a partial or complete obstruction of the flow of urine at any level of the genitourinary system from the kidney to the urethra. As such, it includes a large number of more specific less common birth defects. Renal agenesis, which is the failure of the kidney or kidneys to develop, affected 214 newborns. Renal agenesis may be unilateral or bilateral[7]. As long as the remaining kidney remains healthy, unilateral agenesis does not a have significant impact on health.

Looking at the musculoskeletal defects in Table 1, reduction deformities of the upper limbs may involve the complete or partial absence of the upper arm, lower arm, wrist hand or fingers. Reduction deformities of the lower limb involve the complete or partial absence of the upper leg, lower leg or foot or toes. Upper and lower limb deformities affected 91 and 88 newborns, respectively. Gastroschisis and omphalocele are both defects of the abdominal wall. Gastroschisis results from the

[7] Genital and urinary tract defects. (February 2013). *March of Dimes*. Retrieved June 6, 2013, from 2013http://www.marchofdimes.com/baby/birth- accessed December 29, 2013 http://www.healthline.com/health/renal-agenesis

failure of the abdominal wall to fuse completely, allowing the small intestines and other digestive organs to protrude out of the abdominal cavity. The opening is lateral to, and usually to the right of the umbilicus. An infant born with gastroschisis[8] requires surgery within days of birth. During the time the baby is waiting for surgery the protruding organs are suspended in a plastic pouch or silo above the baby and slowly lowered into the abdominal cavity over a period of days. The process allows for the cavity to expand in order to receive the organs. Once completed the abdomen is closed by the surgeon. Gastroschisis is more common among young mothers and some studies have shown relationships to tobacco and drug use[9]. In the case of omphalocele the small intestine, part of the large intestine and sometimes the liver and spleen herniate into the umbilical cord covered by a nearly transparent membranous sac. The surgical repair of omphalocele is similar to the gastroschisis repair and in serious cases may take several weeks for the organs to be fully positioned within the abdominal cavity.

Down syndrome or trisomy 21 was the most common chromosomal anomaly, accounting for 605 cases or 14.4 per 10,000 live births (Table 1). Down syndrome occurs when a baby is born with an extra copy of chromosome 21. Though the majority of Down syndrome babies are born to younger mothers, mothers thirty-five years and older are at greater risk of having babies with Down syndrome. Most children affected by Down syndrome have mild to moderate intellectual deficits. Down syndrome children are at elevated risk for a number of health problems affecting different systems including: congenital heart disease, hearing deficits, intestinal disorders, eye, thyroid, and skeletal problems[10]. Today many Down

[8] Neil K. Kaneshiro, MD, MHA, Clinical Assistant Professor of Pediatrics, University of Washington School of Medicine. Also reviewed by David Zieve, MD, MHA, Medical Director, A.D.A.M., Inc. accessed December 30, 2013 http://www.nlm.nih.gov/medlineplus/ency/article/000992.htm

[9] Division of Birth Defects and Developmental Disabilities, NCBDDD, Centers for Disease Control and Prevention. http://www.cdc.gov/ncbddd/birthdefects/gastroschisis.html accessed December 30, 2013

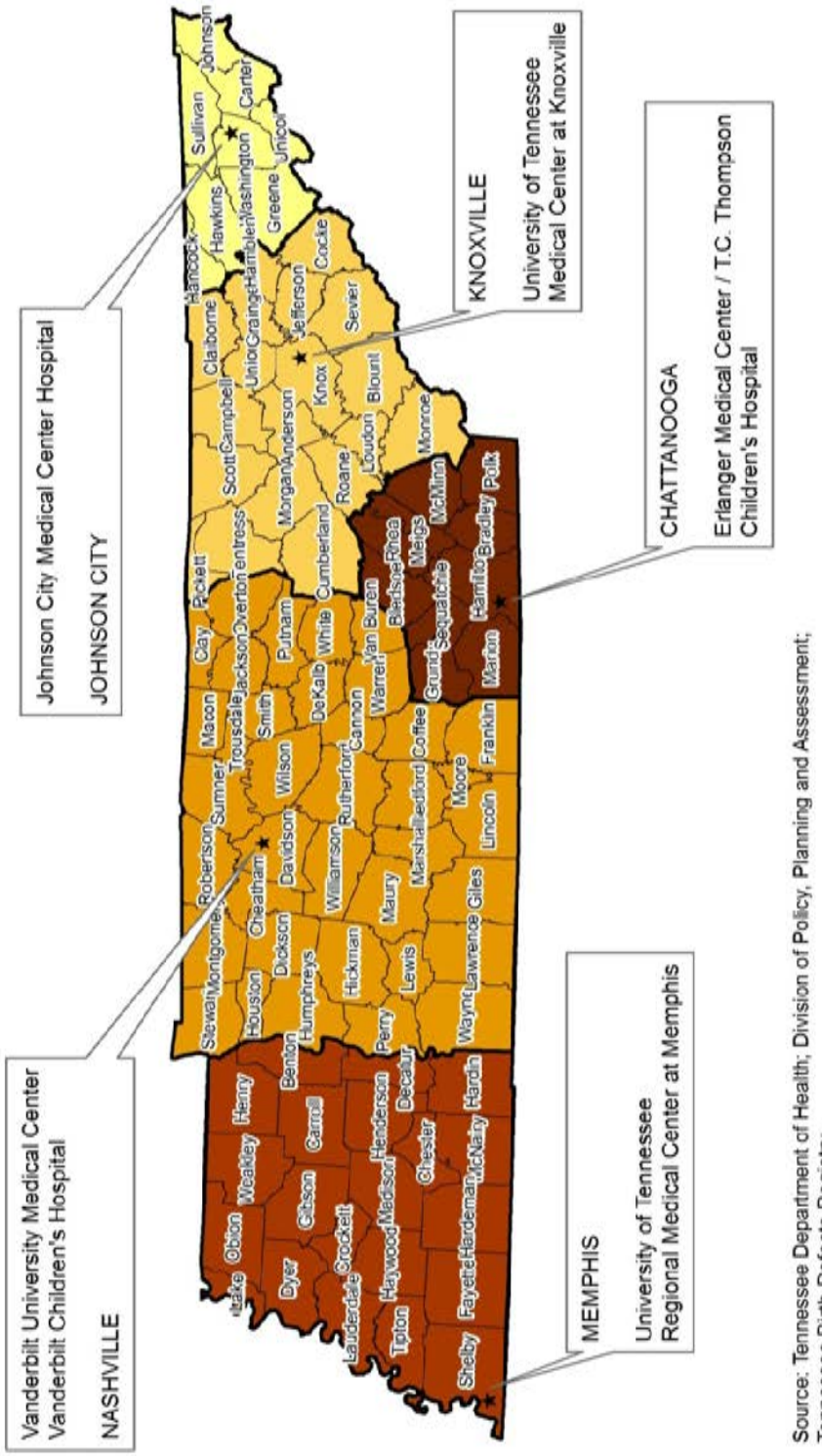
- [10] Division of Birth Defects and Developmental Disabilities, NCBDDD, Centers for Disease Control and Prevention accessed December 30, 2013 http://www.cdc.gov/ncbddd/birthdefects/downsyndrome.html

syndrome children are integrated into regular school classrooms. Much rarer than Down syndrome, there were only 34 trisomy 13 births, or 0.8 per 10,000 live births. Trisomy 13, also known as Patau syndrome, occurs when a baby is born with an extra copy of chromosome 13. Most infants with trisomy 13 have congenital heart disease and 80 percent die within the first year. Trisomy 18 occurs when a baby is born with an extra copy of chromosome 18. Half of those born with trisomy 18 fail to survive the first week. Though some may live to their teens, it is rare. In all there were 68 births affected by trisomy 18, accounting for 1.6 cases per 10,000 live births.

Figure 3 (Page 16) shows the five perinatal regions and the locations of the five regional perinatal center hospitals in Johnson City, Knoxville, Chattanooga, Nashville, and Memphis.

Figure 4 (Page 17) illustrates the overall birth defects rates by county for 2005-2009 given in Table 7 (Page 47).

Figure 3. Tennessee Perinatal Regions and Perinatal Center Hospitals



Source: Tennessee Department of Health; Division of Policy, Planning and Assessment; Tennessee Birth Defects Registry

Figure 4. Birth Defects by Maternal Resident County, Tennessee 2005-2009

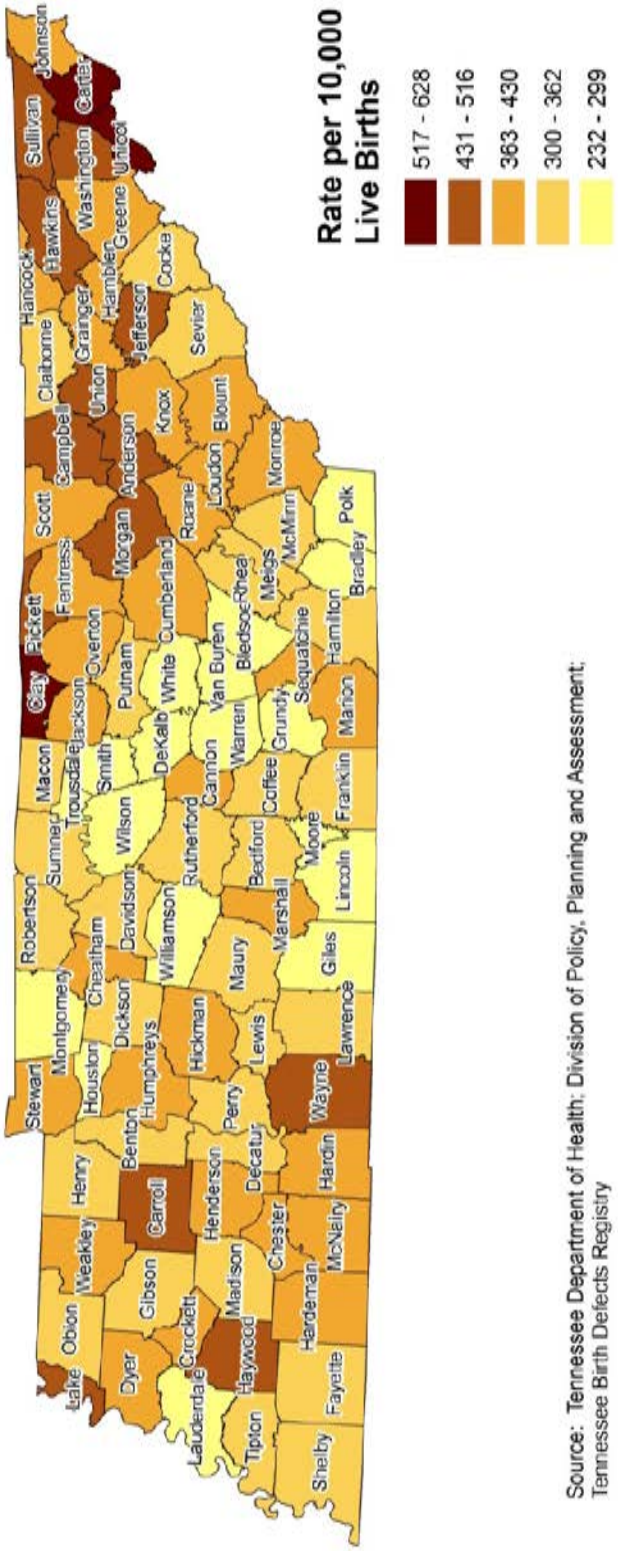


Table 1. Overall Tennessee Birth Defects Rates by Organ System, 2005-2009

Birth Defect	*Count*[1]	*Rate*[2]	*95%CI*[3]
Central Nervous System	**1,031**	**24.5**	**23.1-26.1**
Anencephalus	56	1.3	1.0-1.7
Spina bifida without anencephalus	181	4.3	3.7-5.0
Hydrocephalus without spina bifida	303	7.2	6.4-8.1
Encephalocele	56	1.3	1.0-1.7
Microcephalus	477	11.3	10.4-12.4
Ear and Eye	**170**	**4.0**	**3.5-4.7**
Aniridia	7	0.2	0.1-0.3
Anophthalmia/microphthalmia	41	1.0	0.7-1.3
Congenital cataract	103	2.5	2.0-3.0
Anotia/microtia	28	0.7	0.4-1.0
Cardiovascular	**6,984**	**166.2**	**162.3-170.1**
Common truncus(CCHD)	44	1.0	0.8-1.4
Transposition of great arteries	265	6.3	5.6-7.1
Transposition of great arteries(CCHD)	97	2.3	1.9-2.8
Tetralogy of fallot(CCHD)	253	6.0	5.3-6.8
Ventricular septal defect	1,937	46.1	44.1-48.2
Atrial septal defect	3,921	93.3	90.4-96.3
Atrioventricular septal defect	168	4.0	3.4-4.6
Pulmonary valve atresia and stenosis	447	10.6	9.7-11.7
Pulmonary valve atresia and stenosis(CCHD)	70	1.7	1.3-2.1
Tricuspid valve atresia and stenosis(CCHD)	49	1.2	0.9-1.5
Ebstein's anomaly	36	0.9	0.6-1.2
Aortic valve stenosis	85	2.0	1.6-2.5
Hypoplastic left heart syndrome(CCHD)	138	3.3	2.8-3.9
Patent ductus arteriosus	2,529	60.2	57.9-62.6
Coarctation of aorta	277	6.6	5.8-7.4
Orofacial	**837**	**19.9**	**18.6-21.3**
Cleft palate without cleft lip	320	7.6	6.8-8.5
Cleft lip with and without cleft palate	473	11.3	10.3-12.3
Choanal atresia	74	1.8	1.4-2.2
Gastrointestinal	**2,321**	**55.2**	**53.0-57.5**
Esophageal atresia/tracheoesophageal fistula	103	2.5	2.0-3.0

Table 1. Overall Tennessee Birth Defects Rates by Organ System, 2005-2009

Birth Defect	*Count*[1]	*Rate*[2]	*95%CI*[3]
Rectal and large intestinal atresia/stenosis	247	5.9	5.2-6.7
Pyloric stenosis	1,829	43.5	41.5-45.6
Hirshsprung's disease (congenital megacolon)	131	3.1	2.6-3.7
Biliary atresia	31	0.7	0.5-1.0
Genitourinary	**3,677**	**87.5**	**84.7-90.4**
Bladder exstrophy	22	0.5	0.3-0.8
Hypospadias	2,282	106.3	101.9-110.7
Epispadias	56	1.3	1.0-1.7
Obstructive genitourinary defect	1,186	28.2	26.6-29.9
Renal agensis/hypoplasia	214	5.1	4.4-5.8
Musculoskeletal	**962**	**22.9**	**21.5-24.4**
Reduction deformity, upper limbs	91	2.2	1.7-2.7
Reduction deformity, lower limbs	88	2.1	1.7-2.6
Gastroschisis	224	5.3	4.7-6.1
Omphalocele	127	3.0	2.5-3.6
Diaphragmatic hernia	153	3.6	3.1-4.3
Congenital hip dislocation	315	7.5	6.7-8.4
Chromosomal	**703**	**16.7**	**15.5-18.0**
Trisomy 13	34	0.8	0.6-1.1
Down syndrome	605	14.4	13.3-15.6
Trisomy 18	68	1.6	1.3-2.1
Fetus or newborn affected by maternal alcohol use	**88**	**2.1**	**1.7-2.6**
	.	.	
Total Cases	**14,983**	**356.5**	**350.8-362.3**
Total Live Births	**420,278**		

Source: Tennessee Department of Health, Division of Policy, Planning and Assessment, Tennessee Birth Defects Registry 2005-2009

[1]Counts include cases resulting from live births and fetal deaths.
[2]Rates were computed per 10,000 live births except for Hypospadias per 10,000 live male births.
[3]Confidence intervals for 100 or less cases are exact Poisson; otherwise confidence intervals are based on the normal approximation.

Diagnostic data were derived from the Tennessee Hospital Discharge Data System (2005-2010), the Tennessee Death Statistical System (2005-2009) and the Tennessee Fetal Death Statistical System (2005-2009).
Total live births were derived from the Tennessee Birth Statistical System (2005-2009).

Table 2. Birth Defects by Infant Gender 2005-2009

- The 2005-2009 birth defects counts, rates, and confidence intervals by infant gender for the 45 major birth defects are presented in Table 2.
- There were 9,522 male infant birth defects cases, corresponding to a rate of 443.4 per 10,000 live births and 5,457 female infant birth defects cases, corresponding to a rate of 265.5 per 10,000 live births for 2005-2009.

Table 3. Birth Defects by Infant Race/Ethnicity 2005-2009

- Table 3 shows the birth defects counts, rates, and confidence intervals by infant race/ethnicity for the 45 major birth defects for the years 2005-2009.
- There were 10,416 white infant birth defects cases, corresponding to a rate of 366.9 per 10,000 live births.
- The number of black infant birth defects cases was 3,209 with a rate of 369.0. The black rate per 10,000 live births was slightly higher than the white rate for 2005-2009.
- The number of cases for other races was 247 with a corresponding rate of 228.3 per 10,000 live births.
- The ethnic population group of Hispanic had 1,111 infant birth defects cases with a rate of 287.7 per 10,000 live births for 2005-2009.

Table 4. Birth Defects by Perinatal Region 2005-2009

- The birth defects counts, rates, and confidence intervals by perinatal region for the 45 major birth defects for the years 2005-2009 are presented in Table 4. The regions were evaluated in comparison to the Middle Tennessee Perinatal Region.
- The Middle and Southeast regions had approximately the same overall birth defects rates of 324.9 and 322.4 per 10,000 live births, respectively. The Middle region was chosen as the standard due to its larger birth population.
- The Northeast Perinatal Region birth defects rate (491.3) was the highest regional rate for 2005-2009.

Table 5. Birth Defects by Age of Mother 2005-2009

- Table 5 gives the birth defects counts, rates, and confidence intervals by maternal age group for the 45 major birth defects for the years 2005-2009.
- The maternal age groups 40 years and older overall had the highest rates for infant birth defects.
- Mothers less than 20 years of age and ages 35-39 years also had high birth defects rates.

Table 6. Birth Defects by Maternal Education 2005-2009

- Birth defects counts, rates, and confidence intervals by maternal education for the 45 major birth defects for the years 2005-2009 are presented in Table 6.
- The total birth defects rate was lowest for mothers with some college or a Bachelor Degree followed by mothers with a Graduate Degree.

Table 7. Birth Defects by Maternal County of Residence 2005-2009

- Table 7 gives the birth defects counts, rates, and confidence intervals by maternal county of residence for 2005-2009.
- Within each county the counts and rates are organized by the eight organ systems: 1) central nervous system; 2) eye and ear; 3) cardiovascular, 4) orofacial; 5) gastrointestinal; 6) genitourinary; 7) musculoskeletal; and 8) chromosomal.

Table 8. Birth Defects by Maternal Diabetes 2005-2009

- The 2005-2009 birth defects counts, rates, and confidence intervals by maternal diabetes for the 45 major birth defects are presented in Table 8. Babies born to mothers with diabetes are at increased risk for birth defects.
- The birth defects rate for maternal diabetes was 919.6 per 10,000 live births for 2005-2009.

Table 2. Tennessee Birth Defects Counts and Rates by Gender, 2005-2009

Birth Defect	*Male*	*Female*
Central Nervous System **	**477**	**552**
Rate	**22.2**	**26.9**
95% confidence interval	**20.3-24.3**	**24.7-29.2**
Anencephalus	27	29
Rate	1.3	1.4
95% confidence interval	0.8-1.8	0.9-2.0
Spina bifida without anencephalus	86	93
Rate	4.0	4.5
95% confidence interval	3.2-4.9	3.7-5.5
Hydrocephalus without spina bifida	159	144
Rate	7.4	7.0
95% confidence interval	6.3-8.6	5.9-8.2
Encephalocele	25	31
Rate	1.2	1.5
95% confidence interval	0.8-1.7	1.0-2.1
Microcephalus ***	202	274
Rate	9.4	13.3
95% confidence interval	8.2-10.8	11.8-15.0
Ear and Eye	**88**	**82**
Rate	**4.1**	**4.0**
95% confidence interval	**3.3-5.0**	**3.2-5.0**
Aniridia	3	4
Rate	0.1	0.2
95% confidence interval	0.0-0.4	0.1-0.5
Anophthalmia/microphthalmia	20	21
Rate	0.9	1.0
95% confidence interval	0.6-1.4	0.6-1.6
Congenital cataract	53	50
Rate	2.5	2.4
95% confidence interval	1.8-3.2	1.8-3.2
Anotia/microtia	15	13
Rate	0.7	0.6
95% confidence interval	0.4-1.2	0.3-1.1
Cardiovascular *	**3,663**	**3,321**
Rate	**170.6**	**161.6**
95% confidence interval	**165.1-176.2**	**156.1-167.2**

Table 2. Tennessee Birth Defects Counts and Rates by Gender, 2005-2009

Birth Defect	*Male*	*Female*
Common truncus(CCHD)	23	21
Rate	1.1	1.0
95% confidence interval	0.7-1.6	0.6-1.6
Transposition of great arteries **	157	108
Rate	7.3	5.3
95% confidence interval	6.2-8.5	4.3-6.3
Transposition of great arteries(CCHD) **	63	34
Rate	2.9	1.7
95% confidence interval	2.3-3.8	1.1-2.3
Tetralogy of fallot(CCHD)	129	124
Rate	6.0	6.0
95% confidence interval	5.0-7.1	5.0-7.2
Ventricular septal defect	959	978
Rate	44.7	47.6
95% confidence interval	41.9-47.6	44.7-50.7
Atrial septal defect **	2,093	1,828
Rate	97.5	88.9
95% confidence interval	93.3-101.7	84.9-93.1
Atrioventricular septal defect	76	92
Rate	3.5	4.5
95% confidence interval	2.8-4.4	3.6-5.5
Pulmonary valve atresia and stenosis	236	211
Rate	11.0	10.3
95% confidence interval	9.6-12.5	8.9-11.7
Pulmonary valve atresia and stenosis(CCHD)	35	35
Rate	1.6	1.7
95% confidence interval	1.1-2.3	1.2-2.4
Tricuspid valve atresia and stenosis(CCHD)	30	19
Rate	1.4	0.9
95% confidence interval	0.9-2.0	0.6-1.4
Ebstein's anomaly	14	22
Rate	0.7	1.1
95% confidence interval	0.4-1.1	0.7-1.6
Aortic valve stenosis *	55	30
Rate	2.6	1.5
95% confidence interval	1.9-3.3	1.0-2.1

Table 2. Tennessee Birth Defects Counts and Rates by Gender, 2005-2009

Birth Defect	Male	Female
Hypoplastic left heart syndrome(CCHD) ***	93	45
Rate	4.3	2.2
95% confidence interval	3.5-5.3	1.6-2.9
Patent ductus arteriosus **	1,359	1,170
Rate	63.3	56.9
95% confidence interval	60.0-66.7	53.7-60.3
Coarctation of aorta *	161	116
Rate	7.5	5.6
95% confidence interval	6.4-8.7	4.7-6.8
Orofacial * **	**480**	**357**
Rate	**22.4**	**17.4**
95% confidence interval	**20.4-24.4**	**15.6-19.3**
Cleft palate without cleft lip	150	170
Rate	7.0	8.3
95% confidence interval	5.9-8.2	7.1-9.6
Cleft lip with and without cleft palate ***	305	168
Rate	14.2	8.2
95% confidence interval	12.7-15.9	7.0-9.5
Choanal atresia	43	31
Rate	2.0	1.5
95% confidence interval	1.4-2.7	1.0-2.1
Gastrointestinal * **	**1,770**	**549**
Rate	**82.4**	**26.7**
95% confidence interval	**78.6-86.4**	**24.5-29.0**
Esophageal atresia/tracheoesophageal fistula	57	46
Rate	2.7	2.2
95% confidence interval	2.0-3.4	1.6-3.0
Rectal and large intestinal atresia/stenosis *	143	102
Rate	6.7	5.0
95% confidence interval	5.6-7.8	4.0-6.0
Pyloric stenosis ***	1,482	347
Rate	69.0	16.9
95% confidence interval	65.5-72.6	15.2-18.8
Hirshsprung's disease (congenital megacolon) ***	90	41
Rate	4.2	2.0
95% confidence interval	3.4-5.2	1.4-2.7

Table 2. Tennessee Birth Defects Counts and Rates by Gender, 2005-2009

Birth Defect	*Male*	*Female*
Biliary atresia	11	20
Rate	0.5	1.0
95% confidence interval	0.3-0.9	0.6-1.5
Genitourinary * **	**3,234**	**440**
Rate	**150.6**	**21.4**
95% confidence interval	**145.4-155.9**	**19.5-23.5**
Bladder exstrophy	10	11
Rate	0.5	0.5
95% confidence interval	0.2-0.9	0.3-1.0
Hypospadias ***	2,282	0
Rate	106.3	0.0
95% confidence interval	101.9-110.7	0.0-0.2
Epispadias ***	56	0
Rate	2.6	0.0
95% confidence interval	2.0-3.4	0.0-0.2
Obstructive genitourinary defect ***	822	364
Rate	38.3	17.7
95% confidence interval	35.7-41.0	15.9-19.6
Renal agensis/hypoplasia ***	137	75
Rate	6.4	3.6
95% confidence interval	5.4-7.5	2.9-4.6
**Musculoskeletal ** **	**445**	**517**
Rate	**20.7**	**25.2**
95% confidence interval	**18.8-22.7**	**23.0-27.4**
Reduction deformity, upper limbs	50	41
Rate	2.3	2.0
95% confidence interval	1.7-3.1	1.4-2.7
Reduction deformity, lower limbs	51	37
Rate	2.4	1.8
95% confidence interval	1.8-3.1	1.3-2.5
Gastroschisis	116	108
Rate	5.4	5.3
95% confidence interval	4.5-6.5	4.3-6.3
Omphalocele	69	58
Rate	3.2	2.8
95% confidence interval	2.5-4.1	2.1-3.6

Table 2. Tennessee Birth Defects Counts and Rates by Gender, 2005-2009

Birth Defect	*Male*	*Female*
Diaphragmatic hernia	89	64
Rate	4.1	3.1
95% confidence interval	3.3-5.1	2.4-4.0
Congenital hip dislocation ***	91	224
Rate	4.2	10.9
95% confidence interval	3.4-5.2	9.5-12.4
Chromosomal	**363**	**340**
Rate	**16.9**	**16.5**
95% confidence interval	**15.2-18.7**	**14.8-18.4**
Trisomy 13	18	16
Rate	0.8	0.8
95% confidence interval	0.5-1.3	0.4-1.3
Down syndrome	324	281
Rate	15.1	13.7
95% confidence interval	13.5-16.8	12.1-15.4
Trisomy 18 ***	21	47
Rate	1.0	2.3
95% confidence interval	0.6-1.5	1.7-3.0
Fetus or newborn affected by maternal alcohol use	**47**	**41**
Rate	**2.2**	**2.0**
95% confidence interval	**1.6-2.9**	**1.4-2.7**
Total Cases ***	**9,522**	**5,457**
Rate	**443.4**	**265.5**
95% confidence interval	**434.5-452.4**	**258.5-272.7**
Total Live Births	**214,749**	**205,513**

Source: Tennessee Department of Health, Division of Policy, Planning and Assessment Tennessee Birth Defects Registry 2005-2009.

Note:
[1]Counts include cases resulting from live births and fetal deaths.
[2]Rates were computed per 10,000 live births.
[3]Statistical significance was determined by Poisson regression with statistical probabilities indicated as: p < 0.001***, P < 0.01** , p < 0.05*.
[4]95 percent confidence intervals for 100 or less cases are exact Poisson; otherwise confidence intervals are based on the normal approximation.
[5]Diagnostic data were derived from the Tennessee Hospital Discharge Data System (2005-2010), the Tennessee Death Statistical System (2005-2009) and the Tennessee Fetal Death Statistical System (2005-2009).There were 4 unknown sex cases.
[6]Total live births were derived from the Tennessee Birth Statistical system (2005-2009).

Table 3. Tennessee Birth Defects Counts and Rates by Race/Ethnicity, 2005-2009

Birth Defect	*White*	*Black*	*Hispanic*	*Other*
Central Nervous System * **	**648**	**246**	**120**	**17**
Rate	**22.8**	**28.3**	**31.1**	**15.7**
95% confidence interval	**21.1-24.7**	**24.9-32.1**	**25.8-37.2**	**9.2-25.2**
Anencephalus	35	11	8	2
Rate	1.2	1.3	2.1	1.8
95% confidence interval	0.9-1.7	0.6-2.3	0.9-4.1	0.2-6.7
Spina bifida without anencephalus **	121	29	29	2
Rate	4.3	3.3	7.5	1.8
95% confidence interval	3.5-5.1	2.2-4.8	5.0-10.8	0.2-6.7
Hydrocephalus without spina bifida **	176	85	37	5
Rate	6.2	9.8	9.6	4.6
95% confidence interval	5.3-7.2	7.8-12.1	6.7-13.2	1.5-10.8
Encephalocele *	35	10	11	0
Rate	1.2	1.1	2.8	0.0
95% confidence interval	0.9-1.7	0.6-2.1	1.4-5.1	0.0-3.4
Microcephalus	308	117	44	8
Rate	10.8	13.5	11.4	7.4
95% confidence interval	9.7-12.1	11.1-16.1	8.3-15.3	3.2-14.6
Ear and Eye	**112**	**37**	**13**	**8**
Rate	**3.9**	**4.3**	**3.4**	**7.4**
95% confidence interval	**3.2-4.7**	**3.0-5.9**	**1.8-5.8**	**3.2-14.6**
Aniridia	7	0	0	0
Rate	0.2	0.0	0.0	0.0
95% confidence interval	0.1-0.5	0.0-0.4	0.0-1.0	0.0-3.4
Anophthalmia/microphthalmia *	20	16	3	2
Rate	0.7	1.8	0.8	1.8
95% confidence interval	0.4-1.1	1.1-3.0	0.2-2.3	0.2-6.7
Congenital cataract	74	20	4	5
Rate	2.6	2.3	1.0	4.6
95% confidence interval	2.0-3.3	1.4-3.6	0.3-2.7	1.5-10.8
Anotia/microtia *	18	2	7	1
Rate	0.6	0.2	1.8	0.9
95% confidence interval	0.4-1.0	0.0-0.8	0.7-3.7	0.0-5.1
Cardiovascular * **	**4,515**	**1,817**	**539**	**113**
Rate	**159.0**	**208.9**	**139.6**	**104.4**
95% confidence interval	**154.4-163.8**	**199.4-218.8**	**128.0-151.9**	**86.1-125.6**

Table 3. Tennessee Birth Defects Counts and Rates by Race/Ethnicity, 2005-2009

Birth Defect	*White*	*Black*	*Hispanic*	*Other*
Common truncus(CCHD)	37	3	3	1
Rate	1.3	0.3	0.8	0.9
95% confidence interval	0.9-1.8	0.1-1.0	0.2-2.3	0.0-5.1
Transposition of great arteries	182	54	24	5
Rate	6.4	6.2	6.2	4.6
95% confidence interval	5.5-7.4	4.7-8.1	4.0-9.2	1.5-10.8
Transposition of great arteries(CCHD)	67	19	8	3
Rate	2.4	2.2	2.1	2.8
95% confidence interval	1.8-3.0	1.3-3.4	0.9-4.1	0.6-8.1
Tetralogy of fallot(CCHD)	177	52	19	5
Rate	6.2	6.0	4.9	4.6
95% confidence interval	5.4-7.2	4.5-7.8	3.0-7.7	1.5-10.8
Ventricular septal defect **	1,341	386	182	28
Rate	47.2	44.4	47.1	25.9
95% confidence interval	44.7-49.8	40.1-49.0	40.5-54.5	17.2-37.4
Atrial septal defect ***	2,450	1,133	274	64
Rate	86.3	130.3	71.0	59.1
95% confidence interval	82.9-89.8	122.8-138.1	62.8-79.9	45.5-75.5
Atrioventricular septal defect	123	34	10	1
Rate	4.3	3.9	2.6	0.9
95% confidence interval	3.6-5.2	2.7-5.5	1.2-4.8	0.0-5.1
Pulmonary valve atresia and stenosis	307	103	29	8
Rate	10.8	11.8	7.5	7.4
95% confidence interval	9.6-12.1	9.7-14.4	5.0-10.8	3.2-14.6
Pulmonary valve atresia and stenosis(CCHD)	44	17	8	1
Rate	1.5	2.0	2.1	0.9
95% confidence interval	1.1-2.1	1.1-3.1	0.9-4.1	0.0-5.1
Tricuspid valve atresia and stenosis(CCHD)	40	7	1	1
Rate	1.4	0.8	0.3	0.9
95% confidence interval	1.0-1.9	0.3-1.7	0.0-1.4	0.0-5.1
Ebstein's anomaly	24	7	4	1
Rate	0.8	0.8	1.0	0.9
95% confidence interval	0.5-1.3	0.3-1.7	0.3-2.7	0.0-5.1
Aortic valve stenosis ***	71	5	8	1
Rate	2.5	0.6	2.1	0.9
95% confidence interval	2.0-3.2	0.2-1.3	0.9-4.1	0.0-5.1

Table 3. Tennessee Birth Defects Counts and Rates by Race/Ethnicity, 2005-2009

Birth Defect	*White*	*Black*	*Hispanic*	*Other*
Hypoplastic left heart syndrome(CCHD) *	91	34	13	0
Rate	3.2	3.9	3.4	0.0
95% confidence interval	2.6-3.9	2.7-5.5	1.8-5.8	0.0-3.4
Patent ductus arteriosus ***	1,582	693	214	40
Rate	55.7	79.7	55.4	37.0
95% confidence interval	53.0-58.5	73.9-85.8	48.2-63.4	26.4-50.3
Coarctation of aorta *	200	49	27	1
Rate	7.0	5.6	7.0	0.9
95% confidence interval	6.1-8.1	4.2-7.4	4.6-10.2	0.0-5.1
Orofacial * **	**651**	**113**	**57**	**16**
Rate	**22.9**	**13.0**	**14.8**	**14.8**
95% confidence interval	**21.2-24.8**	**10.7-15.6**	**11.2-19.1**	**8.5-24.0**
Cleft palate without cleft lip **	244	46	20	10
Rate	8.6	5.3	5.2	9.2
95% confidence interval	7.6-9.7	3.9-7.1	3.2-8.0	4.4-17.0
Cleft lip with and without cleft palate ***	372	60	35	6
Rate	13.1	6.9	9.1	5.5
95% confidence interval	11.8-14.5	5.3-8.9	6.3-12.6	2.0-12.1
Choanal atresia	59	11	3	1
Rate	2.1	1.3	0.8	0.9
95% confidence interval	1.6-2.7	0.6-2.3	0.2-2.3	0.0-5.1
Gastrointestinal * **	**1,737**	**336**	**224**	**24**
Rate	**61.2**	**38.6**	**58.0**	**22.2**
95% confidence interval	**58.3-64.1**	**34.6-43.0**	**50.7-66.1**	**14.2-33.0**
Esophageal atresia/tracheoesophageal fistula *	81	13	9	0
Rate	2.9	1.5	2.3	0.0
95% confidence interval	2.3-3.5	0.8-2.6	1.1-4.4	0.0-3.4
Rectal and large intestinal atresia/stenosis	171	47	24	5
Rate	6.0	5.4	6.2	4.6
95% confidence interval	5.2-7.0	4.0-7.2	4.0-9.2	1.5-10.8
Pyloric stenosis ***	1,401	230	183	15
Rate	49.4	26.4	47.4	13.9
95% confidence interval	46.8-52.0	23.1-30.1	40.8-54.8	7.8-22.9
Hirshsprung's disease (congenital megacolon) **	79	43	8	1
Rate	2.8	4.9	2.1	0.9
95% confidence interval	2.2-3.5	3.6-6.7	0.9-4.1	0.0-5.1

Table 3. Tennessee Birth Defects Counts and Rates by Race/Ethnicity, 2005-2009

Birth Defect	*White*	*Black*	*Hispanic*	*Other*
Biliary atresia	18	7	3	3
Rate	0.6	0.8	0.8	2.8
95% confidence interval	0.4-1.0	0.3-1.7	0.2-2.3	0.6-8.1
Genitourinary * **	**2,726**	**717**	**171**	**63**
Rate	**96.0**	**82.4**	**44.3**	**58.2**
95% confidence interval	**92.5-99.7**	**76.5-88.7**	**37.9-51.4**	**44.7-74.5**
Bladder exstrophy	18	4	0	0
Rate	0.6	0.5	0.0	0.0
95% confidence interval	0.4-1.0	0.1-1.2	0.0-1.0	0.0-3.4
Hypospadias ***	1,694	490	66	32
Rate	116.5	110.8	33.6	58.4
95% confidence interval	111.0-122.2	101.2-121.1	26.0-42.7	39.9-82.4
Epispadias	44	10	2	0
Rate	1.5	1.1	0.5	0.0
95% confidence interval	1.1-2.1	0.6-2.1	0.1-1.9	0.0-3.4
Obstructive genitourinary defect ***	896	176	87	27
Rate	31.6	20.2	22.5	25.0
95% confidence interval	29.5-33.7	17.4-23.5	18.0-27.8	16.4-36.3
Renal agensis/hypoplasia	140	51	19	4
Rate	4.9	5.9	4.9	3.7
95% confidence interval	4.1-5.8	4.4-7.7	3.0-7.7	1.0-9.5
**Musculoskeletal ** **	**693**	**165**	**87**	**17**
Rate	**24.4**	**19.0**	**22.5**	**15.7**
95% confidence interval	**22.6-26.3**	**16.2-22.1**	**18.0-27.8**	**9.2-25.2**
Reduction deformity, upper limbs	56	20	12	3
Rate	2.0	2.3	3.1	2.8
95% confidence interval	1.5-2.6	1.4-3.6	1.6-5.4	0.6-8.1
Reduction deformity, lower limbs	53	25	7	3
Rate	1.9	2.9	1.8	2.8
95% confidence interval	1.4-2.4	1.9-4.2	0.7-3.7	0.6-8.1
Gastroschisis ***	178	23	19	4
Rate	6.3	2.6	4.9	3.7
95% confidence interval	5.4-7.3	1.7-4.0	3.0-7.7	1.0-9.5
Omphalocele *	79	37	11	0
Rate	2.8	4.3	2.8	0.0
95% confidence interval	2.2-3.5	3.0-5.9	1.4-5.1	0.0-3.4

Table 3. Tennessee Birth Defects Counts and Rates by Race/Ethnicity, 2005-2009

Birth Defect	*White*	*Black*	*Hispanic*	*Other*
Diaphragmatic hernia	106	29	14	4
Rate	3.7	3.3	3.6	3.7
95% confidence interval	3.1-4.5	2.2-4.8	2.0-6.1	1.0-9.5
Congenital hip dislocation ***	246	39	27	3
Rate	8.7	4.5	7.0	2.8
95% confidence interval	7.6-9.8	3.2-6.1	4.6-10.2	0.6-8.1
Chromosomal	**479**	**138**	**72**	**14**
Rate	**16.9**	**15.9**	**18.6**	**12.9**
95% confidence interval	**15.4-18.5**	**13.3-18.7**	**14.6-23.5**	**7.1-21.7**
Trisomy 13	17	13	3	1
Rate	0.6	1.5	0.8	0.9
95% confidence interval	0.3-1.0	0.8-2.6	0.2-2.3	0.0-5.1
Down syndrome	420	112	60	13
Rate	14.8	12.9	15.5	12.0
95% confidence interval	13.4-16.3	10.6-15.5	11.9-20.0	6.4-20.5
Trisomy 18	46	13	9	0
Rate	1.6	1.5	2.3	0.0
95% confidence interval	1.2-2.2	0.8-2.6	1.1-4.4	0.0-3.4
Fetus or newborn affected by maternal alcohol use * **	**55**	**33**	**0**	**0**
Rate	**1.9**	**3.8**	**0.0**	**0.0**
95% confidence interval	**1.5-2.5**	**2.6-5.3**	**0.0-1.0**	**0.0-3.4**
Total Cases * **	**10,416**	**3,209**	**1,111**	**247**
Rate	**366.9**	**369.0**	**287.7**	**228.3**
95% confidence interval	**359.9-374.0**	**356.3-382.0**	**271.0-305.1**	**200.7-258.6**
Total Live Births	**283,873**	**86,969**	**38,615**	**10,821**

Source: Tennessee Department of Health, Division of Policy, Planning and Assessment, Tennessee Birth Defects Registry 2005-2009.

Note:
[1]Counts include cases resulting from live births and fetal deaths.
[2]Rates were computed per 10,000 live births except for Hypospadias per 10,000 live male births.
[3]Statistical significance was determined by Poisson regression with statistical probabilities indicated as: p < 0.001***, P < 0.01** , p < 0.05*.
[4]95 percent confidence intervals for 100 or less cases are exact Poisson; otherwise confidence intervals are based on the normal approximation.
[5]Diagnostic data were derived from the Tennessee Hospital Discharge Data System (2005-2010), the Tennessee Death Statistical System (2005-2009) and the Tennessee Fetal Death Statistical System (2005-2009).
[6]Total live births were derived from the Tennessee Birth Statistical system (2005-2009).

Table 4. Tennessee Birth Defects Counts and Rates by Perinatal Region, 2005-2009

Birth Defect	*Northeast*	*East*	*Southeast*	*Middle*	*West*
Central Nervous System ***	**76**	**197**	**107**	**331**	**320**
Rate	**28.0**	**26.7**	**28.2**	**19.8**	**28.0**
95% confidence interval	**22.1-35.0**	**23.1-30.7**	**23.1-34.1**	**17.7-22.1**	**25.0-31.3**
Anencephalus	3	3	4	26	20
Rate	1.1	0.4	1.1	1.6	1.8
95% confidence interval	0.2-3.2	0.1-1.2	0.3-2.7	1.0-2.3	1.1-2.7
Spina bifida without anencephalus	8	35	14	76	48
Rate	2.9	4.7	3.7	4.5	4.2
95% confidence interval	1.3-5.8	3.3-6.6	2.0-6.2	3.6-5.7	3.1-5.6
Hydrocephalus without spina bifida	23	46	31	103	100
Rate	8.5	6.2	8.2	6.2	8.8
95% confidence interval	5.4-12.7	4.6-8.3	5.6-11.6	5.0-7.5	7.1-10.6
Encephalocele	2	9	5	21	19
Rate	0.7	1.2	1.3	1.3	1.7
95% confidence interval	0.1-2.7	0.6-2.3	0.4-3.1	0.8-1.9	1.0-2.6
Microcephalus ***	41	109	59	118	150
Rate	15.1	14.8	15.6	7.1	13.1
95% confidence interval	10.8-20.5	12.1-17.8	11.8-20.1	5.8-8.5	11.1-15.4
Ear and Eye *	**18**	**30**	**14**	**50**	**58**
Rate	**6.6**	**4.1**	**3.7**	**3.0**	**5.1**
95% confidence interval	**3.9-10.5**	**2.7-5.8**	**2.0-6.2**	**2.2-3.9**	**3.9-6.6**
Aniridia	1	1	0	4	1
Rate	0.4	0.1	0.0	0.2	0.1
95% confidence interval	0.0-2.1	0.0-0.8	0.0-1.0	0.1-0.6	0.0-0.5
Anophthalmia/microphthalmia	4	6	3	9	19
Rate	1.5	0.8	0.8	0.5	1.7
95% confidence interval	0.4-3.8	0.3-1.8	0.2-2.3	0.2-1.0	1.0-2.6
Congenital cataract	10	20	8	33	32
Rate	3.7	2.7	2.1	2.0	2.8
95% confidence interval	1.8-6.8	1.7-4.2	0.9-4.2	1.4-2.8	1.9-4.0
Anotia/microtia	5	6	4	6	7
Rate	1.8	0.8	1.1	0.4	0.6
95% confidence interval	0.6-4.3	0.3-1.8	0.3-2.7	0.1-0.8	0.2-1.3
Cardiovascular ***	**759**	**1,250**	**484**	**2,277**	**2,214**
Rate	**279.5**	**169.2**	**127.6**	**136.3**	**193.8**
95% confidence interval	**260.0-300.2**	**159.9-178.8**	**116.5-139.5**	**130.8-142.0**	**185.8-202.0**

Table 4. Tennessee Birth Defects Counts and Rates by Perinatal Region, 2005-2009

Birth Defect	*Northeast*	*East*	*Southeast*	*Middle*	*West*
Common truncus(CCHD)	2	11	5	21	5
Rate	0.7	1.5	1.3	1.3	0.4
95% confidence interval	0.1-2.7	0.7-2.7	0.4-3.1	0.8-1.9	0.1-1.0
Transposition of great arteries	17	48	29	101	70
Rate	6.3	6.5	7.6	6.0	6.1
95% confidence interval	3.6-10.0	4.8-8.6	5.1-11.0	4.9-7.3	4.8-7.7
Transposition of great arteries(CCHD) **	6	24	9	21	37
Rate	2.2	3.2	2.4	1.3	3.2
95% confidence interval	0.8-4.8	2.1-4.8	1.1-4.5	0.8-1.9	2.3-4.5
Tetralogy of fallot(CCHD)	14	52	21	90	76
Rate	5.2	7.0	5.5	5.4	6.7
95% confidence interval	2.8-8.7	5.3-9.2	3.4-8.5	4.3-6.6	5.2-8.3
Ventricular septal defect	145	352	170	745	525
Rate	53.4	47.6	44.8	44.6	46.0
95% confidence interval	45.1-62.8	42.8-52.9	38.3-52.1	41.4-47.9	42.1-50.1
Atrial septal defect ***	492	682	246	1,121	1,380
Rate	181.2	92.3	64.8	67.1	120.8
95% confidence interval	165.5-198.0	85.5-99.5	57.0-73.5	63.2-71.1	114.5-127.3
Atrioventricular septal defect	6	35	22	57	48
Rate	2.2	4.7	5.8	3.4	4.2
95% confidence interval	0.8-4.8	3.3-6.6	3.6-8.8	2.6-4.4	3.1-5.6
Pulmonary valve atresia and stenosis ***	53	68	36	183	107
Rate	19.5	9.2	9.5	11.0	9.4
95% confidence interval	14.6-25.5	7.1-11.7	6.6-13.1	9.4-12.7	7.7-11.3
Pulmonary valve atresia and stenosis(CCHD) *	5	4	5	31	25
Rate	1.8	0.5	1.3	1.9	2.2
95% confidence interval	0.6-4.3	0.1-1.4	0.4-3.1	1.3-2.6	1.4-3.2
Tricuspid valve atresia and stenosis(CCHD)	3	11	8	16	11
Rate	1.1	1.5	2.1	1.0	1.0
95% confidence interval	0.2-3.2	0.7-2.7	0.9-4.2	0.5-1.6	0.5-1.7
Ebstein's anomaly	2	10	4	15	5
Rate	0.7	1.4	1.1	0.9	0.4
95% confidence interval	0.1-2.7	0.6-2.5	0.3-2.7	0.5-1.5	0.1-1.0
Aortic valve stenosis	3	17	9	43	13
Rate	1.1	2.3	2.4	2.6	1.1
95% confidence interval	0.2-3.2	1.3-3.7	1.1-4.5	1.9-3.5	0.6-1.9

Table 4. Tennessee Birth Defects Counts and Rates by Perinatal Region, 2005-2009

Birth Defect	*Northeast*	*East*	*Southeast*	*Middle*	*West*
Hypoplastic left heart syndrome(CCHD)	7	30	13	51	37
Rate	2.6	4.1	3.4	3.1	3.2
95% confidence interval	1.0-5.3	2.7-5.8	1.8-5.9	2.3-4.0	2.3-4.5
Patent ductus arteriosus ***	294	373	156	813	893
Rate	108.3	50.5	41.1	48.7	78.2
95% confidence interval	96.3-121.4	45.5-55.9	34.9-48.1	45.4-52.1	73.1-83.5
Coarctation of aorta	12	46	29	123	67
Rate	4.4	6.2	7.6	7.4	5.9
95% confidence interval	2.3-7.7	4.6-8.3	5.1-11.0	6.1-8.8	4.5-7.4
Orofacial * **	**69**	**180**	**81**	**339**	**168**
Rate	**25.4**	**24.4**	**21.4**	**20.3**	**14.7**
95% confidence interval	**19.8-32.2**	**20.9-28.2**	**17.0-26.5**	**18.2-22.6**	**12.6-17.1**
Cleft palate without cleft lip **	33	62	31	131	63
Rate	12.2	8.4	8.2	7.8	5.5
95% confidence interval	8.4-17.1	6.4-10.8	5.6-11.6	6.6-9.3	4.2-7.1
Cleft lip with and without cleft palate ***	37	103	46	197	90
Rate	13.6	13.9	12.1	11.8	7.9
95% confidence interval	9.6-18.8	11.4-16.9	8.9-16.2	10.2-13.6	6.3-9.7
Choanal atresia	2	18	7	30	17
Rate	0.7	2.4	1.8	1.8	1.5
95% confidence interval	0.1-2.7	1.4-3.9	0.7-3.8	1.2-2.6	0.9-2.4
Gastrointestinal * **	**202**	**483**	**220**	**854**	**562**
Rate	**74.4**	**65.4**	**58.0**	**51.1**	**49.2**
95% confidence interval	**64.5-85.4**	**59.7-71.5**	**50.6-66.2**	**47.7-54.7**	**45.2-53.4**
Esophageal atresia/tracheoesophageal fistula	5	16	10	47	25
Rate	1.8	2.2	2.6	2.8	2.2
95% confidence interval	0.6-4.3	1.2-3.5	1.3-4.8	2.1-3.7	1.4-3.2
Rectal and large intestinal atresia/stenosis	16	52	26	95	58
Rate	5.9	7.0	6.9	5.7	5.1
95% confidence interval	3.4-9.6	5.3-9.2	4.5-10.0	4.6-7.0	3.9-6.6
Pyloric stenosis ***	172	395	170	646	446
Rate	63.3	53.5	44.8	38.7	39.0
95% confidence interval	54.2-73.6	48.3-59.0	38.3-52.1	35.7-41.8	35.5-42.8
Hirshsprung's disease (congenital megacolon)	12	17	10	55	37
Rate	4.4	2.3	2.6	3.3	3.2
95% confidence interval	2.3-7.7	1.3-3.7	1.3-4.8	2.5-4.3	2.3-4.5

Table 4. Tennessee Birth Defects Counts and Rates by Perinatal Region, 2005-2009

Birth Defect	*Northeast*	*East*	*Southeast*	*Middle*	*West*
Biliary atresia	0	4	4	18	5
Rate	0.0	0.5	1.1	1.1	0.4
95% confidence interval	0.0-1.4	0.1-1.4	0.3-2.7	0.6-1.7	0.1-1.0
Genitourinary * **	**230**	**764**	**287**	**1,564**	**832**
Rate	**84.7**	**103.4**	**75.7**	**93.6**	**72.8**
95% confidence interval	**74.1-96.4**	**96.2-111.0**	**67.2-84.9**	**89.0-98.4**	**68.0-77.9**
Bladder exstrophy	2	6	2	9	3
Rate	0.7	0.8	0.5	0.5	0.3
95% confidence interval	0.1-2.7	0.3-1.8	0.1-1.9	0.2-1.0	0.1-0.8
Hypospadias ***	108	418	172	1,038	546
Rate	77.8	110.4	88.4	121.6	93.9
95% confidence interval	63.8-93.9	100.1-121.5	75.7-102.7	114.3-129.2	86.2-102.1
Epispadias	1	17	6	19	13
Rate	0.4	2.3	1.6	1.1	1.1
95% confidence interval	0.0-2.1	1.3-3.7	0.6-3.4	0.7-1.8	0.6-1.9
Obstructive genitourinary defect ***	123	293	95	443	232
Rate	45.3	39.7	25.0	26.5	20.3
95% confidence interval	37.6-54.1	35.2-44.5	20.3-30.6	24.1-29.1	17.8-23.1
Renal agensis/hypoplasia	11	45	19	85	54
Rate	4.1	6.1	5.0	5.1	4.7
95% confidence interval	2.0-7.2	4.4-8.1	3.0-7.8	4.1-6.3	3.6-6.2
Musculoskeletal	**63**	**184**	**105**	**376**	**234**
Rate	**23.2**	**24.9**	**27.7**	**22.5**	**20.5**
95% confidence interval	**17.8-29.7**	**21.4-28.8**	**22.6-33.5**	**20.3-24.9**	**17.9-23.3**
Reduction deformity, upper limbs	6	21	12	31	21
Rate	2.2	2.8	3.2	1.9	1.8
95% confidence interval	0.8-4.8	1.8-4.3	1.6-5.5	1.3-2.6	1.1-2.8
Reduction deformity, lower limbs	3	12	12	31	30
Rate	1.1	1.6	3.2	1.9	2.6
95% confidence interval	0.2-3.2	0.8-2.8	1.6-5.5	1.3-2.6	1.8-3.7
Gastroschisis	13	47	17	93	54
Rate	4.8	6.4	4.5	5.6	4.7
95% confidence interval	2.5-8.2	4.7-8.5	2.6-7.2	4.5-6.8	3.6-6.2
Omphalocele	4	29	11	55	28
Rate	1.5	3.9	2.9	3.3	2.5
95% confidence interval	0.4-3.8	2.6-5.6	1.4-5.2	2.5-4.3	1.6-3.5

Table 4. Tennessee Birth Defects Counts and Rates by Perinatal Region, 2005-2009

Birth Defect	*Northeast*	*East*	*Southeast*	*Middle*	*West*
Diaphragmatic hernia	19	26	9	60	39
Rate	7.0	3.5	2.4	3.6	3.4
95% confidence interval	4.2-10.9	2.3-5.2	1.1-4.5	2.7-4.6	2.4-4.7
Congenital hip dislocation **	20	55	48	125	67
Rate	7.4	7.4	12.7	7.5	5.9
95% confidence interval	4.5-11.4	5.6-9.7	9.3-16.8	6.2-8.9	4.5-7.4
Chromosomal	**40**	**125**	**59**	**296**	**183**
Rate	**14.7**	**16.9**	**15.6**	**17.7**	**16.0**
95% confidence interval	**10.5-20.1**	**14.1-20.2**	**11.8-20.1**	**15.8-19.9**	**13.8-18.5**
Trisomy 13 *	3	5	0	10	16
Rate	1.1	0.7	0.0	0.6	1.4
95% confidence interval	0.2-3.2	0.2-1.6	0.0-1.0	0.3-1.1	0.8-2.3
Down syndrome	34	109	50	260	152
Rate	12.5	14.8	13.2	15.6	13.3
95% confidence interval	8.7-17.5	12.1-17.8	9.8-17.4	13.7-17.6	11.3-15.6
Trisomy 18	3	12	9	27	17
Rate	1.1	1.6	2.4	1.6	1.5
95% confidence interval	0.2-3.2	0.8-2.8	1.1-4.5	1.1-2.4	0.9-2.4
**Fetus or newborn affected by maternal alcohol use ** **	**11**	**23**	**11**	**21**	**22**
Rate	**4.1**	**3.1**	**2.9**	**1.3**	**1.9**
95% confidence interval	**2.0-7.2**	**2.0-4.7**	**1.4-5.2**	**0.8-1.9**	**1.2-2.9**
Total Cases * **	**1,334**	**2,871**	**1,223**	**5,428**	**4,127**
Rate	**491.3**	**388.6**	**322.4**	**324.9**	**361.2**
95% confidence interval	**465.3-518.4**	**374.5-403.1**	**304.6-341.0**	**316.3-333.7**	**350.3-372.4**
Total Live Births	**27,151**	**73,882**	**37,937**	**167,060**	**114,243**

Source: Tennessee Department of Health, Division of Policy, Planning and Assessment, Tennessee Birth Defects Registry 2005-2009.

Note:
[1]Counts include cases resulting from live births and fetal deaths.
[2]Rates were computed per 10,000 live births except for Hypospadias per 10,000 live male births.
[3]Statistical significance was determined by Poisson regression with statistical probabilities indicated as: p < 0.001***, P < 0.01** , p < 0.05*.
[4]95 percent confidence intervals for 100 or less cases are exact Poisson; otherwise confidence intervals are based on the normal approximation.
[5]Diagnostic data were derived from the Tennessee Hospital Discharge Data System (2005-2010), the Tennessee Death Statistical System (2005-2009) and the Tennessee Fetal Death Statistical System (2005-2009).
[6]Total live births were derived from the Tennessee Birth Statistical system (2005-2009).

Table 5. Tennessee Birth Defects Counts and Rates by Age of Mother, 2005-2009

Birth Defect	*<20*	*20-24*	*25-29*	*30-34*	*35-39*	*>=40*
Central Nervous System	**161**	**312**	**284**	**166**	**95**	**13**
Rate	**29.2**	**24.9**	**24.1**	**21.0**	**26.7**	**18.2**
95% confidence interval	**24.9-34.1**	**22.2-27.8**	**21.4-27.1**	**17.9-24.5**	**21.6-32.7**	**9.7-31.1**
Anencephalus	9	18	18	8	3	0
Rate	1.6	1.4	1.5	1.0	0.8	0.0
95% confidence interval	0.7-3.1	0.9-2.3	0.9-2.4	0.4-2.0	0.2-2.5	0.0-5.2
Spina bifida without anencephalus	25	43	62	29	19	3
Rate	4.5	3.4	5.3	3.7	5.3	4.2
95% confidence interval	2.9-6.7	2.5-4.6	4.0-6.7	2.5-5.3	3.2-8.4	0.9-12.3
Hydrocephalus without spina bifida	42	101	75	57	24	4
Rate	7.6	8.1	6.4	7.2	6.8	5.6
95% confidence interval	5.5-10.3	6.6-9.8	5.0-8.0	5.5-9.3	4.3-10.1	1.5-14.3
Encephalocele	5	14	18	14	5	0
Rate	0.9	1.1	1.5	1.8	1.4	0.0
95% confidence interval	0.3-2.1	0.6-1.9	0.9-2.4	1.0-3.0	0.5-3.3	0.0-5.2
Microcephalus **	85	151	122	66	46	7
Rate	15.4	12.0	10.3	8.4	12.9	9.8
95% confidence interval	12.3-19.1	10.2-14.1	8.6-12.4	6.5-10.6	9.5-17.3	3.9-20.2
Ear and Eye *	**34**	**55**	**40**	**21**	**17**	**3**
Rate	**6.2**	**4.4**	**3.4**	**2.7**	**4.8**	**4.2**
95% confidence interval	**4.3-8.6**	**3.3-5.7**	**2.4-4.6**	**1.6-4.1**	**2.8-7.7**	**0.9-12.3**
Aniridia	1	1	3	2	0	0
Rate	0.2	0.1	0.3	0.3	0.0	0.0
95% confidence interval	0.0-1.0	0.0-0.4	0.1-0.7	0.0-0.9	0.0-1.0	0.0-5.2
Anophthalmia/microphthalmia	10	15	8	3	4	1
Rate	1.8	1.2	0.7	0.4	1.1	1.4
95% confidence interval	0.9-3.3	0.7-2.0	0.3-1.3	0.1-1.1	0.3-2.9	0.0-7.8
Congenital cataract	19	33	26	14	9	2
Rate	3.4	2.6	2.2	1.8	2.5	2.8
95% confidence interval	2.1-5.4	1.8-3.7	1.4-3.2	1.0-3.0	1.2-4.8	0.3-10.1
Anotia/microtia	8	7	5	3	5	0
Rate	1.5	0.6	0.4	0.4	1.4	0.0
95% confidence interval	0.6-2.9	0.2-1.2	0.1-1.0	0.1-1.1	0.5-3.3	0.0-5.2
Cardiovascular * **	**947**	**1,993**	**1,847**	**1,249**	**759**	**186**
Rate	**171.9**	**158.9**	**156.6**	**158.1**	**213.6**	**260.6**
95% confidence interval	**161.1-183.2**	**152.0-166.1**	**149.6-163.9**	**149.5-167.1**	**198.7-229.4**	**224.5-300.8**

Table 5. Tennessee Birth Defects Counts and Rates by Age of Mother, 2005-2009

Birth Defect	*<20*	*20-24*	*25-29*	*30-34*	*35-39*	*>=40*
Common truncus(CCHD)	10	12	12	4	4	2
Rate	1.8	1.0	1.0	0.5	1.1	2.8
95% confidence interval	0.9-3.3	0.5-1.7	0.5-1.8	0.1-1.3	0.3-2.9	0.3-10.1
Transposition of great arteries	37	76	63	55	30	4
Rate	6.7	6.1	5.3	7.0	8.4	5.6
95% confidence interval	4.7-9.3	4.8-7.6	4.1-6.8	5.2-9.1	5.7-12.1	1.5-14.3
Transposition of great arteries(CCHD)	11	29	26	20	8	3
Rate	2.0	2.3	2.2	2.5	2.3	4.2
95% confidence interval	1.0-3.6	1.5-3.3	1.4-3.2	1.5-3.9	1.0-4.4	0.9-12.3
Tetralogy of fallot(CCHD) *	29	80	66	35	36	7
Rate	5.3	6.4	5.6	4.4	10.1	9.8
95% confidence interval	3.5-7.6	5.1-7.9	4.3-7.1	3.1-6.2	7.1-14.0	3.9-20.2
Ventricular septal defect ***	247	497	530	347	249	67
Rate	44.8	39.6	44.9	43.9	70.1	93.9
95% confidence interval	39.4-50.8	36.2-43.3	41.2-48.9	39.4-48.8	61.6-79.3	72.7-119.2
Atrial septal defect ***	567	1,166	1,039	654	397	96
Rate	102.9	93.0	88.1	82.8	111.7	134.5
95% confidence interval	94.6-111.8	87.7-98.5	82.8-93.6	76.6-89.4	101.0-123.3	108.9-164.2
Atrioventricular septal defect ***	29	41	31	19	29	19
Rate	5.3	3.3	2.6	2.4	8.2	26.6
95% confidence interval	3.5-7.6	2.3-4.4	1.8-3.7	1.4-3.8	5.5-11.7	16.0-41.6
Pulmonary valve atresia and stenosis	52	143	118	70	51	12
Rate	9.4	11.4	10.0	8.9	14.4	16.8
95% confidence interval	7.0-12.4	9.6-13.4	8.3-12.0	6.9-11.2	10.7-18.9	8.7-29.4
Pulmonary valve atresia and stenosis(CCHD)	12	18	19	11	7	3
Rate	2.2	1.4	1.6	1.4	2.0	4.2
95% confidence interval	1.1-3.8	0.9-2.3	1.0-2.5	0.7-2.5	0.8-4.1	0.9-12.3
Tricuspid valve atresia and stenosis(CCHD)	5	11	16	9	6	2
Rate	0.9	0.9	1.4	1.1	1.7	2.8
95% confidence interval	0.3-2.1	0.4-1.6	0.8-2.2	0.5-2.2	0.6-3.7	0.3-10.1
Ebstein's anomaly *	3	18	5	9	1	0
Rate	0.5	1.4	0.4	1.1	0.3	0.0
95% confidence interval	0.1-1.6	0.9-2.3	0.1-1.0	0.5-2.2	0.0-1.6	0.0-5.2
Aortic valve stenosis	10	25	30	11	9	0
Rate	1.8	2.0	2.5	1.4	2.5	0.0
95% confidence interval	0.9-3.3	1.3-2.9	1.7-3.6	0.7-2.5	1.2-4.8	0.0-5.2

Table 5. Tennessee Birth Defects Counts and Rates by Age of Mother, 2005-2009

Birth Defect	*<20*	*20-24*	*25-29*	*30-34*	*35-39*	*>=40*
Hypoplastic left heart syndrome(CCHD)	21	42	32	31	12	0
Rate	3.8	3.3	2.7	3.9	3.4	0.0
95% confidence interval	2.4-5.8	2.4-4.5	1.9-3.8	2.7-5.6	1.7-5.9	0.0-5.2
Patent ductus arteriosus ***	335	651	667	509	296	70
Rate	60.8	51.9	56.6	64.4	83.3	98.1
95% confidence interval	54.5-67.7	48.0-56.1	52.3-61.0	59.0-70.3	74.1-93.4	76.4-123.9
Coarctation of aorta ***	54	57	76	45	32	13
Rate	9.8	4.5	6.4	5.7	9.0	18.2
95% confidence interval	7.4-12.8	3.4-5.9	5.1-8.1	4.2-7.6	6.2-12.7	9.7-31.1
Orofacial *	**96**	**268**	**217**	**145**	**91**	**20**
Rate	**17.4**	**21.4**	**18.4**	**18.4**	**25.6**	**28.0**
95% confidence interval	**14.1-21.3**	**18.9-24.1**	**16.0-21.0**	**15.5-21.6**	**20.6-31.4**	**17.1-43.3**
Cleft palate without cleft lip *	33	98	79	60	39	11
Rate	6.0	7.8	6.7	7.6	11.0	15.4
95% confidence interval	4.1-8.4	6.3-9.5	5.3-8.3	5.8-9.8	7.8-15.0	7.7-27.6
Cleft lip with and without cleft palate	57	159	125	79	45	8
Rate	10.3	12.7	10.6	10.0	12.7	11.2
95% confidence interval	7.8-13.4	10.8-14.8	8.8-12.6	7.9-12.5	9.2-16.9	4.8-22.1
Choanal atresia	7	23	19	13	10	2
Rate	1.3	1.8	1.6	1.6	2.8	2.8
95% confidence interval	0.5-2.6	1.2-2.8	1.0-2.5	0.9-2.8	1.3-5.2	0.3-10.1
Gastrointestinal * **	**428**	**794**	**586**	**328**	**158**	**26**
Rate	**77.7**	**63.3**	**49.7**	**41.5**	**44.5**	**36.4**
95% confidence interval	**70.5-85.4**	**59.0-67.9**	**45.7-53.9**	**37.2-46.3**	**37.8-52.0**	**23.8-53.4**
Esophageal atresia/tracheoesophageal fistula *	15	24	30	13	15	6
Rate	2.7	1.9	2.5	1.6	4.2	8.4
95% confidence interval	1.5-4.5	1.2-2.8	1.7-3.6	0.9-2.8	2.4-7.0	3.1-18.3
Rectal and large intestinal atresia/stenosis	39	83	61	39	23	2
Rate	7.1	6.6	5.2	4.9	6.5	2.8
95% confidence interval	5.0-9.7	5.3-8.2	4.0-6.6	3.5-6.7	4.1-9.7	0.3-10.1
Pyloric stenosis ***	359	638	459	253	105	14
Rate	65.2	50.9	38.9	32.0	29.6	19.6
95% confidence interval	58.6-72.3	47.0-55.0	35.4-42.7	28.2-36.2	24.2-35.8	10.7-32.9
Hirshsprung's disease (congenital megacolon)	18	43	34	21	11	4
Rate	3.3	3.4	2.9	2.7	3.1	5.6
95% confidence interval	1.9-5.2	2.5-4.6	2.0-4.0	1.6-4.1	1.5-5.5	1.5-14.3

Table 5. Tennessee Birth Defects Counts and Rates by Age of Mother, 2005-2009

Birth Defect	*<20*	*20-24*	*25-29*	*30-34*	*35-39*	*>=40*
Biliary atresia	3	10	9	3	6	0
Rate	0.5	0.8	0.8	0.4	1.7	0.0
95% confidence interval	0.1-1.6	0.4-1.5	0.3-1.4	0.1-1.1	0.6-3.7	0.0-5.2
Genitourinary	**458**	**1,039**	**1,037**	**735**	**335**	**73**
Rate	**83.1**	**82.9**	**87.9**	**93.1**	**94.3**	**102.3**
95% confidence interval	**75.7-91.1**	**77.9-88.1**	**82.7-93.5**	**86.4-100.0**	**84.5-104.9**	**80.2-128.6**
Bladder exstrophy	4	9	4	2	2	1
Rate	0.7	0.7	0.3	0.3	0.6	1.4
95% confidence interval	0.2-1.9	0.3-1.4	0.1-0.9	0.0-0.9	0.1-2.0	0.0-7.8
Hypospadias	284	653	654	452	193	46
Rate	100.5	102.3	108.2	111.9	106.9	126.7
95% confidence interval	89.2-112.9	94.6-110.5	100.1-116.8	101.8-122.7	92.3-123.0	92.8-169.0
Epispadias	9	18	14	12	3	0
Rate	1.6	1.4	1.2	1.5	0.8	0.0
95% confidence interval	0.7-3.1	0.9-2.3	0.6-2.0	0.8-2.7	0.2-2.5	0.0-5.2
Obstructive genitourinary defect	148	326	329	238	123	22
Rate	26.9	26.0	27.9	30.1	34.6	30.8
95% confidence interval	22.7-31.6	23.3-29.0	25.0-31.1	26.4-34.2	28.8-41.3	19.3-46.7
Renal agensis/hypoplasia	21	61	64	45	17	6
Rate	3.8	4.9	5.4	5.7	4.8	8.4
95% confidence interval	2.4-5.8	3.7-6.2	4.2-6.9	4.2-7.6	2.8-7.7	3.1-18.3
Musculoskeletal ***	**176**	**329**	**232**	**154**	**58**	**13**
Rate	**31.9**	**26.2**	**19.7**	**19.5**	**16.3**	**18.2**
95% confidence interval	**27.4-37.0**	**23.5-29.2**	**17.2-22.4**	**16.5-22.8**	**12.4-21.1**	**9.7-31.1**
Reduction deformity, upper limbs	12	32	27	15	5	0
Rate	2.2	2.6	2.3	1.9	1.4	0.0
95% confidence interval	1.1-3.8	1.7-3.6	1.5-3.3	1.1-3.1	0.5-3.3	0.0-5.2
Reduction deformity, lower limbs	14	28	24	17	5	0
Rate	2.5	2.2	2.0	2.2	1.4	0.0
95% confidence interval	1.4-4.3	1.5-3.2	1.3-3.0	1.3-3.4	0.5-3.3	0.0-5.2
Gastroschisis ***	82	95	34	13	0	0
Rate	14.9	7.6	2.9	1.6	0.0	0.0
95% confidence interval	11.8-18.5	6.1-9.3	2.0-4.0	0.9-2.8	0.0-1.0	0.0-5.2
Omphalocele	19	44	32	21	8	3
Rate	3.4	3.5	2.7	2.7	2.3	4.2
95% confidence interval	2.1-5.4	2.5-4.7	1.9-3.8	1.6-4.1	1.0-4.4	0.9-12.3

Table 5. Tennessee Birth Defects Counts and Rates by Age of Mother, 2005-2009

Birth Defect	*<20*	*20-24*	*25-29*	*30-34*	*35-39*	*>=40*
Diaphragmatic hernia	18	48	46	29	9	3
Rate	3.3	3.8	3.9	3.7	2.5	4.2
95% confidence interval	1.9-5.2	2.8-5.1	2.9-5.2	2.5-5.3	1.2-4.8	0.9-12.3
Congenital hip dislocation	37	93	79	66	33	7
Rate	6.7	7.4	6.7	8.4	9.3	9.8
95% confidence interval	4.7-9.3	6.0-9.1	5.3-8.3	6.5-10.6	6.4-13.0	3.9-20.2
Chromosomal * **	**55**	**121**	**136**	**111**	**169**	**111**
Rate	**10.0**	**9.6**	**11.5**	**14.1**	**47.6**	**155.5**
95% confidence interval	**7.5-13.0**	**8.0-11.5**	**9.7-13.6**	**11.6-16.9**	**40.7-55.3**	**127.9-187.3**
Trisomy 13	3	8	10	4	7	2
Rate	0.5	0.6	0.8	0.5	2.0	2.8
95% confidence interval	0.1-1.6	0.3-1.3	0.4-1.6	0.1-1.3	0.8-4.1	0.3-10.1
Down syndrome ***	43	96	113	103	149	101
Rate	7.8	7.7	9.6	13.0	41.9	141.5
95% confidence interval	5.6-10.5	6.2-9.3	7.9-11.5	10.6-15.8	35.5-49.2	115.2-171.9
Trisomy 18 ***	9	17	15	5	13	9
Rate	1.6	1.4	1.3	0.6	3.7	12.6
95% confidence interval	0.7-3.1	0.8-2.2	0.7-2.1	0.2-1.5	1.9-6.3	5.8-23.9
Fetus or newborn affected by maternal alcohol use * **	**7**	**21**	**22**	**12**	**21**	**5**
Rate	**1.3**	**1.7**	**1.9**	**1.5**	**5.9**	**7.0**
95% confidence interval	**0.5-2.6**	**1.0-2.6**	**1.2-2.8**	**0.8-2.7**	**3.7-9.0**	**2.3-16.3**
Total Cases * **	**2,123**	**4,431**	**4,006**	**2,630**	**1,442**	**347**
Rate	**385.4**	**353.4**	**339.7**	**333.0**	**405.9**	**486.1**
95% confidence interval	**369.2-402.1**	**343.0-363.9**	**329.3-350.4**	**320.4-345.9**	**385.2-427.4**	**436.3-540.1**
Total Live Births	**55,087**	**125,390**	**117,930**	**78,986**	**35,530**	**7,138**

Source: Tennessee Department of Health, Division of Policy, Planning and Assessment, Tennessee Birth Defects Registry 2005-2009.

Note:
[1]Counts include cases resulting from live births and fetal deaths.
[2]Rates were computed per 10,000 live births except for Hypospadias per 10,000 live male births.
[3]Statistical significance was determined by Poisson regression with statistical probabilities indicated as: p < 0.001***, P < 0.01** , p < 0.05*.
[4]95 percent confidence intervals for 100 or less cases are exact Poisson; otherwise confidence intervals are based on the normal approximation.
[5]Diagnostic data were derived from the Tennessee Hospital Discharge Data System (2005-2010), the Tennessee Death Statistical System (2005-2009) and the Tennessee Fetal Death Statistical System (2005-2009).
[6]Total live births were derived from the Tennessee Birth Statistical system (2005-2009).

Table 6. Tennessee Birth Defects Counts and Rates by Maternal Education, 2005-2009

Birth Defect	*No High School Diploma*	*Diploma or GED*	*Some College or Bachelor*	*Graduate Degree*
Central Nervous System * **	**336**	**303**	**338**	**44**
Rate	**35.9**	**24.5**	**19.4**	**16.1**
95% confidence interval	**32.2-40.0**	**21.8-27.4**	**17.4-21.6**	**11.7-21.6**
Anencephalus	14	21	17	3
Rate	1.5	1.7	1.0	1.1
95% confidence interval	0.8-2.5	1.0-2.6	0.6-1.6	0.2-3.2
Spina bifida without anencephalus	55	45	70	9
Rate	5.9	3.6	4.0	3.3
95% confidence interval	4.4-7.7	2.6-4.9	3.1-5.1	1.5-6.2
Hydrocephalus without spina bifida ***	101	98	91	10
Rate	10.8	7.9	5.2	3.6
95% confidence interval	8.8-13.1	6.4-9.6	4.2-6.4	1.8-6.7
Encephalocele	15	17	20	4
Rate	1.6	1.4	1.1	1.5
95% confidence interval	0.9-2.6	0.8-2.2	0.7-1.8	0.4-3.7
Microcephalus ***	163	136	154	19
Rate	17.4	11.0	8.9	6.9
95% confidence interval	14.9-20.3	9.2-13.0	7.5-10.4	4.2-10.8
Ear and Eye	**44**	**52**	**62**	**12**
Rate	**4.7**	**4.2**	**3.6**	**4.4**
95% confidence interval	**3.4-6.3**	**3.1-5.5**	**2.7-4.6**	**2.3-7.6**
Aniridia	1	2	3	1
Rate	0.1	0.2	0.2	0.4
95% confidence interval	0.0-0.6	0.0-0.6	0.0-0.5	0.0-2.0
Anophthalmia/microphthalmia	8	14	18	1
Rate	0.9	1.1	1.0	0.4
95% confidence interval	0.4-1.7	0.6-1.9	0.6-1.6	0.0-2.0
Congenital cataract	26	34	35	8
Rate	2.8	2.7	2.0	2.9
95% confidence interval	1.8-4.1	1.9-3.8	1.4-2.8	1.3-5.8
Anotia/microtia	10	7	9	2
Rate	1.1	0.6	0.5	0.7
95% confidence interval	0.5-2.0	0.2-1.2	0.2-1.0	0.1-2.6
Cardiovascular * **	**1,742**	**2,208**	**2,616**	**397**
Rate	**186.3**	**178.2**	**150.4**	**144.9**
95% confidence interval	**177.7-195.3**	**170.9-185.8**	**144.6-156.2**	**131.0-159.9**

Table 6. Tennessee Birth Defects Counts and Rates by Maternal Education, 2005-2009

Birth Defect	*No High School Diploma*	*Diploma or GED*	*Some College or Bachelor*	*Graduate Degree*
Common truncus(CCHD)	9	19	15	1
Rate	1.0	1.5	0.9	0.4
95% confidence interval	0.4-1.8	0.9-2.4	0.5-1.4	0.0-2.0
Transposition of great arteries	63	79	111	12
Rate	6.7	6.4	6.4	4.4
95% confidence interval	5.2-8.6	5.0-7.9	5.2-7.7	2.3-7.6
Transposition of great arteries(CCHD)	21	24	47	5
Rate	2.2	1.9	2.7	1.8
95% confidence interval	1.4-3.4	1.2-2.9	2.0-3.6	0.6-4.3
Tetralogy of fallot(CCHD)	59	83	92	19
Rate	6.3	6.7	5.3	6.9
95% confidence interval	4.8-8.1	5.3-8.3	4.3-6.5	4.2-10.8
Ventricular septal defect	474	575	754	126
Rate	50.7	46.4	43.3	46.0
95% confidence interval	46.2-55.5	42.7-50.4	40.3-46.5	38.3-54.7
Atrial septal defect ***	1,036	1,278	1,399	195
Rate	110.8	103.2	80.4	71.2
95% confidence interval	104.2-117.8	97.6-109.0	76.2-84.7	61.5-81.9
Atrioventricular septal defect	31	55	69	13
Rate	3.3	4.4	4.0	4.7
95% confidence interval	2.3-4.7	3.3-5.8	3.1-5.0	2.5-8.1
Pulmonary valve atresia and stenosis	113	130	177	26
Rate	12.1	10.5	10.2	9.5
95% confidence interval	10.0-14.5	8.8-12.5	8.7-11.8	6.2-13.9
Pulmonary valve atresia and stenosis(CCHD)	17	17	31	3
Rate	1.8	1.4	1.8	1.1
95% confidence interval	1.1-2.9	0.8-2.2	1.2-2.5	0.2-3.2
Tricuspid valve atresia and stenosis(CCHD)	10	18	18	2
Rate	1.1	1.5	1.0	0.7
95% confidence interval	0.5-2.0	0.9-2.3	0.6-1.6	0.1-2.6
Ebstein's anomaly	9	8	19	0
Rate	1.0	0.6	1.1	0.0
95% confidence interval	0.4-1.8	0.3-1.3	0.7-1.7	0.0-1.3
Aortic valve stenosis	16	27	39	3
Rate	1.7	2.2	2.2	1.1
95% confidence interval	1.0-2.8	1.4-3.2	1.6-3.1	0.2-3.2

Table 6. Tennessee Birth Defects Counts and Rates by Maternal Education, 2005-2009

Birth Defect	*No High School Diploma*	*Diploma or GED*	*Some College or Bachelor*	*Graduate Degree*
Hypoplastic left heart syndrome(CCHD)	38	46	43	11
Rate	4.1	3.7	2.5	4.0
95% confidence interval	2.9-5.6	2.7-5.0	1.8-3.3	2.0-7.2
Patent ductus arteriosus	582	789	1,001	151
Rate	62.3	63.7	57.5	55.1
95% confidence interval	57.3-67.5	59.3-68.3	54.0-61.2	46.7-64.6
Coarctation of aorta	75	88	96	17
Rate	8.0	7.1	5.5	6.2
95% confidence interval	6.3-10.1	5.7-8.8	4.5-6.7	3.6-9.9
Orofacial	**179**	**279**	**326**	**50**
Rate	**19.1**	**22.5**	**18.7**	**18.2**
95% confidence interval	**16.4-22.2**	**20.0-25.3**	**16.8-20.9**	**13.5-24.1**
Cleft palate without cleft lip	69	94	129	26
Rate	7.4	7.6	7.4	9.5
95% confidence interval	5.7-9.3	6.1-9.3	6.2-8.8	6.2-13.9
Cleft lip with and without cleft palate *	100	167	182	24
Rate	10.7	13.5	10.5	8.8
95% confidence interval	8.7-13.0	11.5-15.7	9.0-12.1	5.6-13.0
Choanal atresia	14	25	31	3
Rate	1.5	2.0	1.8	1.1
95% confidence interval	0.8-2.5	1.3-3.0	1.2-2.5	0.2-3.2
Gastrointestinal * **	**651**	**829**	**747**	**86**
Rate	**69.6**	**66.9**	**42.9**	**31.4**
95% confidence interval	**64.4-75.2**	**62.4-71.6**	**39.9-46.1**	**25.1-38.8**
Esophageal atresia/tracheoesophageal fistula	24	30	38	10
Rate	2.6	2.4	2.2	3.6
95% confidence interval	1.6-3.8	1.6-3.5	1.5-3.0	1.8-6.7
Rectal and large intestinal atresia/stenosis	56	87	90	14
Rate	6.0	7.0	5.2	5.1
95% confidence interval	4.5-7.8	5.6-8.7	4.2-6.4	2.8-8.6
Pyloric stenosis ***	534	660	569	59
Rate	57.1	53.3	32.7	21.5
95% confidence interval	52.4-62.2	49.3-57.5	30.1-35.5	16.4-27.8
Hirshsprung's disease (congenital megacolon) *	36	48	43	4
Rate	3.9	3.9	2.5	1.5
95% confidence interval	2.7-5.3	2.9-5.1	1.8-3.3	0.4-3.7

Table 6. Tennessee Birth Defects Counts and Rates by Maternal Education, 2005-2009

Birth Defect	*No High School Diploma*	*Diploma or GED*	*Some College or Bachelor*	*Graduate Degree*
Biliary atresia	7	10	13	1
Rate	0.7	0.8	0.7	0.4
95% confidence interval	0.3-1.5	0.4-1.5	0.4-1.3	0.0-2.0
Genitourinary * **	**719**	**1,071**	**1,582**	**300**
Rate	**76.9**	**86.4**	**90.9**	**109.5**
95% confidence interval	**71.4-82.7**	**81.3-91.8**	**86.5-95.5**	**97.4-122.6**
Bladder exstrophy	5	9	8	0
Rate	0.5	0.7	0.5	0.0
95% confidence interval	0.2-1.2	0.3-1.4	0.2-0.9	0.0-1.3
Hypospadias ***	407	664	1,015	191
Rate	84.8	105.2	114.3	135.7
95% confidence interval	76.8-93.5	97.4-113.6	107.4-121.5	117.1-156.4
Epispadias	13	17	22	4
Rate	1.4	1.4	1.3	1.5
95% confidence interval	0.7-2.4	0.8-2.2	0.8-1.9	0.4-3.7
Obstructive genitourinary defect	259	341	488	98
Rate	27.7	27.5	28.0	35.8
95% confidence interval	24.4-31.3	24.7-30.6	25.6-30.7	29.0-43.6
Renal agensis/hypoplasia	59	64	83	8
Rate	6.3	5.2	4.8	2.9
95% confidence interval	4.8-8.1	4.0-6.6	3.8-5.9	1.3-5.8
Musculoskeletal *	**245**	**303**	**360**	**52**
Rate	**26.2**	**24.5**	**20.7**	**19.0**
95% confidence interval	**23.0-29.7**	**21.8-27.4**	**18.6-22.9**	**14.2-24.9**
Reduction deformity, upper limbs	24	33	32	2
Rate	2.6	2.7	1.8	0.7
95% confidence interval	1.6-3.8	1.8-3.7	1.3-2.6	0.1-2.6
Reduction deformity, lower limbs	24	31	31	2
Rate	2.6	2.5	1.8	0.7
95% confidence interval	1.6-3.8	1.7-3.6	1.2-2.5	0.1-2.6
Gastroschisis ***	67	81	72	4
Rate	7.2	6.5	4.1	1.5
95% confidence interval	5.6-9.1	5.2-8.1	3.2-5.2	0.4-3.7
Omphalocele	35	36	52	4
Rate	3.7	2.9	3.0	1.5
95% confidence interval	2.6-5.2	2.0-4.0	2.2-3.9	0.4-3.7

Table 6. Tennessee Birth Defects Counts and Rates by Maternal Education, 2005-2009

Birth Defect	*No High School Diploma*	*Diploma or GED*	*Some College or Bachelor*	*Graduate Degree*
Diaphragmatic hernia	38	53	56	6
Rate	4.1	4.3	3.2	2.2
95% confidence interval	2.9-5.6	3.2-5.6	2.4-4.2	0.8-4.8
Congenital hip dislocation *	65	83	130	35
Rate	7.0	6.7	7.5	12.8
95% confidence interval	5.4-8.9	5.3-8.3	6.2-8.9	8.9-17.8
Chromosomal * **	**142**	**174**	**312**	**71**
Rate	**15.2**	**14.0**	**17.9**	**25.9**
95% confidence interval	**12.8-17.9**	**12.0-16.3**	**16.0-20.0**	**20.2-32.7**
Trisomy 13	8	8	16	2
Rate	0.9	0.6	0.9	0.7
95% confidence interval	0.4-1.7	0.3-1.3	0.5-1.5	0.1-2.6
Down syndrome ***	120	145	270	66
Rate	12.8	11.7	15.5	24.1
95% confidence interval	10.6-15.3	9.9-13.8	13.7-17.5	18.6-30.6
Trisomy 18	14	21	30	3
Rate	1.5	1.7	1.7	1.1
95% confidence interval	0.8-2.5	1.0-2.6	1.2-2.5	0.2-3.2
Fetus or newborn affected by maternal alcohol use * **	**41**	**33**	**12**	**1**
Rate	**4.4**	**2.7**	**0.7**	**0.4**
95% confidence interval	**3.1-5.9**	**1.8-3.7**	**0.4-1.2**	**0.0-2.0**
Total Cases * **	**3,636**	**4,712**	**5,678**	**908**
Rate	**389.0**	**380.3**	**326.3**	**331.4**
95% confidence interval	**376.4-401.8**	**369.5-391.3**	**317.9-334.9**	**310.2-353.6**
Total Live Births	**93,482**	**123,893**	**173,987**	**27,402**

Source: Tennessee Department of Health, Division of Policy, Planning and Assessment, Tennessee Birth Defects Registry 2005-2009.

Note:
[1]Counts include cases resulting from live births and fetal deaths.
[2]Rates were computed per 10,000 live births except for Hypospadias per 10,000 live male births.
[3]Statistical significance was determined by Poisson regression with statistical probabilities indicated as: p < 0.001***, P < 0.01** , p < 0.05*.
[4]95 percent confidence intervals for 100 or less cases are exact Poisson; otherwise confidence intervals are based on the normal approximation.
[5]Diagnostic data were derived from the Tennessee Hospital Discharge Data System (2005-2010), the Tennessee Death Statistical System (2005-2009) and the Tennessee Fetal Death Statistical System (2005-2009).
[6]Total live births were derived from the Tennessee Birth Statistical system (2005-2009).

Table 7. Tennessee Birth Defects Counts and Rates by Maternal Resident County, 2005-2009

County	*Birth Defect*	*Count*	*Rate*	*95%CI*
Anderson	**Total Cases**	**192**	**445.7**	**384.9-513.4**
	Central Nervous System	14	32.5	17.8-54.5
	Ear and Eye	2	4.6	0.6-16.8
	Cardiovascular	78	181.1	143.1-226.0
	Orofacial	10	23.2	11.1-42.7
	Gastrointestinal	27	62.7	41.3-91.2
	Genitourinary	64	148.6	114.4-189.7
	Musculoskeletal	17	39.5	23.0-63.2
	Chromosomal	7	16.2	6.5-33.5
Bedford	**Total Cases**	**116**	**331.6**	**274.0-397.7**
	Central Nervous System	11	31.4	15.7-56.3
	Ear and Eye	0	0.0	0.0-10.5
	Cardiovascular	43	122.9	89.0-165.6
	Orofacial	7	20.0	8.0-41.2
	Gastrointestinal	23	65.8	41.7-98.7
	Genitourinary	27	77.2	50.9-112.3
	Musculoskeletal	12	34.3	17.7-59.9
	Chromosomal	5	14.3	4.6-33.4
Benton	**Total Cases**	**30**	**348.8**	**235.4-498.0**
	Central Nervous System	2	23.3	2.8-84.0
	Ear and Eye	1	11.6	0.3-64.8
	Cardiovascular	10	116.3	55.8-213.8
	Orofacial	3	34.9	7.2-101.9
	Gastrointestinal	4	46.5	12.7-119.1
	Genitourinary	8	93.0	40.2-183.3
	Musculoskeletal	2	23.3	2.8-84.0
	Chromosomal	2	23.3	2.8-84.0
Bledsoe	**Total Cases**	**15**	**231.8**	**129.8-382.4**
	Central Nervous System	0	0.0	0.0-57.0
	Ear and Eye	1	15.5	0.4-86.1
	Cardiovascular	5	77.3	25.1-180.3
	Orofacial	2	30.9	3.7-111.7
	Gastrointestinal	6	92.7	34.0-201.8
	Genitourinary	1	15.5	0.4-86.1
	Musculoskeletal	2	30.9	3.7-111.7
	Chromosomal	1	15.5	0.4-86.1

Table 7. Tennessee Birth Defects Counts and Rates by Maternal Resident County, 2005-2009

County	*Birth Defect*	*Count*	*Rate*	*95%CI*
Blount	**Total Cases**	**264**	**394.5**	**348.3-445.1**
	Central Nervous System	19	28.4	17.1-44.3
	Ear and Eye	4	6.0	1.6-15.3
	Cardiovascular	120	179.3	148.7-214.4
	Orofacial	19	28.4	17.1-44.3
	Gastrointestinal	41	61.3	44.0-83.1
	Genitourinary	72	107.6	84.2-135.5
	Musculoskeletal	11	16.4	8.2-29.4
	Chromosomal	9	13.4	6.1-25.5
Bradley	**Total Cases**	**171**	**282.2**	**241.5-327.8**
	Central Nervous System	12	19.8	10.2-34.6
	Ear and Eye	3	5.0	1.0-14.5
	Cardiovascular	59	97.4	74.1-125.6
	Orofacial	18	29.7	17.6-46.9
	Gastrointestinal	33	54.5	37.5-76.5
	Genitourinary	35	57.8	40.2-80.3
	Musculoskeletal	17	28.1	16.3-44.9
	Chromosomal	5	8.3	2.7-19.3
Campbell	**Total Cases**	**111**	**464.8**	**382.4-559.8**
	Central Nervous System	9	37.7	17.2-71.5
	Ear and Eye	0	0.0	0.0-15.4
	Cardiovascular	49	205.2	151.8-271.3
	Orofacial	3	12.6	2.6-36.7
	Gastrointestinal	17	71.2	41.5-114.0
	Genitourinary	35	146.6	102.1-203.8
	Musculoskeletal	3	12.6	2.6-36.7
	Chromosomal	4	16.8	4.6-42.9
Cannon	**Total Cases**	**31**	**395.9**	**269.0-562.0**
	Central Nervous System	4	51.1	13.9-130.8
	Ear and Eye	1	12.8	0.3-71.2
	Cardiovascular	10	127.7	61.2-234.9
	Orofacial	1	12.8	0.3-71.2
	Gastrointestinal	5	63.9	20.7-149.0
	Genitourinary	9	114.9	52.6-218.2
	Musculoskeletal	2	25.5	3.1-92.3
	Chromosomal	2	25.5	3.1-92.3

Table 7. Tennessee Birth Defects Counts and Rates by Maternal Resident County, 2005-2009

County	*Birth Defect*	*Count*	*Rate*	*95%CI*
Carroll	**Total Cases**	**83**	**467.3**	**372.2-579.3**
	Central Nervous System	4	22.5	6.1-57.7
	Ear and Eye	3	16.9	3.5-49.4
	Cardiovascular	27	152.0	100.2-221.2
	Orofacial	4	22.5	6.1-57.7
	Gastrointestinal	15	84.5	47.3-139.3
	Genitourinary	24	135.1	86.6-201.1
	Musculoskeletal	7	39.4	15.8-81.2
	Chromosomal	1	5.6	0.1-31.4
Carter	**Total Cases**	**186**	**619.2**	**533.4-714.8**
	Central Nervous System	5	16.6	5.4-38.8
	Ear and Eye	2	6.7	0.8-24.1
	Cardiovascular	111	369.5	304.0-445.0
	Orofacial	8	26.6	11.5-52.5
	Gastrointestinal	30	99.9	67.4-142.6
	Genitourinary	34	113.2	78.4-158.2
	Musculoskeletal	8	26.6	11.5-52.5
	Chromosomal	2	6.7	0.8-24.1
Cheatham	**Total Cases**	**90**	**367.6**	**295.6-451.9**
	Central Nervous System	5	20.4	6.6-47.7
	Ear and Eye	1	4.1	0.1-22.8
	Cardiovascular	34	138.9	96.2-194.1
	Orofacial	9	36.8	16.8-69.8
	Gastrointestinal	13	53.1	28.3-90.8
	Genitourinary	29	118.5	79.3-170.1
	Musculoskeletal	6	24.5	9.0-53.3
	Chromosomal	2	8.2	1.0-29.5
Chester	**Total Cases**	**34**	**371.6**	**257.3-519.3**
	Central Nervous System	2	21.9	2.6-79.0
	Ear and Eye	0	0.0	0.0-40.3
	Cardiovascular	21	229.5	142.1-350.8
	Orofacial	1	10.9	0.3-60.9
	Gastrointestinal	4	43.7	11.9-111.9
	Genitourinary	6	65.6	24.1-142.7
	Musculoskeletal	4	43.7	11.9-111.9
	Chromosomal	0	0.0	0.0-40.3

Table 7. Tennessee Birth Defects Counts and Rates by Maternal Resident County, 2005-2009

County	*Birth Defect*	*Count*	*Rate*	*95%CI*
Claiborne	**Total Cases**	**57**	**319.9**	**242.3-414.4**
	Central Nervous System	3	16.8	3.5-49.2
	Ear and Eye	1	5.6	0.1-31.3
	Cardiovascular	25	140.3	90.8-207.1
	Orofacial	4	22.4	6.1-57.5
	Gastrointestinal	13	73.0	38.8-124.7
	Genitourinary	14	78.6	43.0-131.8
	Musculoskeletal	2	11.2	1.4-40.5
	Chromosomal	3	16.8	3.5-49.2
Clay	**Total Cases**	**28**	**592.0**	**393.4-855.6**
	Central Nervous System	0	0.0	0.0-78.0
	Ear and Eye	0	0.0	0.0-78.0
	Cardiovascular	11	232.6	116.1-416.1
	Orofacial	3	63.4	13.1-185.4
	Gastrointestinal	12	253.7	131.1-443.2
	Genitourinary	3	63.4	13.1-185.4
	Musculoskeletal	1	21.1	0.5-117.8
	Chromosomal	1	21.1	0.5-117.8
Cocke	**Total Cases**	**77**	**359.8**	**284.0-449.7**
	Central Nervous System	5	23.4	7.6-54.5
	Ear and Eye	1	4.7	0.1-26.0
	Cardiovascular	34	158.9	110.0-222.0
	Orofacial	6	28.0	10.3-61.0
	Gastrointestinal	19	88.8	53.5-138.6
	Genitourinary	16	74.8	42.7-121.4
	Musculoskeletal	2	9.3	1.1-33.8
	Chromosomal	2	9.3	1.1-33.8
Coffee	**Total Cases**	**122**	**340.7**	**282.9-406.8**
	Central Nervous System	8	22.3	9.6-44.0
	Ear and Eye	1	2.8	0.1-15.6
	Cardiovascular	41	114.5	82.2-155.3
	Orofacial	9	25.1	11.5-47.7
	Gastrointestinal	33	92.2	63.4-129.4
	Genitourinary	25	69.8	45.2-103.1
	Musculoskeletal	8	22.3	9.6-44.0
	Chromosomal	6	16.8	6.1-36.5

Table 7. Tennessee Birth Defects Counts and Rates by Maternal Resident County, 2005-2009

County	*Birth Defect*	*Count*	*Rate*	*95%CI*
Crockett	**Total Cases**	**41**	**417.9**	**299.9-567.0**
	Central Nervous System	5	51.0	16.5-118.9
	Ear and Eye	2	20.4	2.5-73.6
	Cardiovascular	19	193.7	116.6-302.5
	Orofacial	1	10.2	0.3-56.8
	Gastrointestinal	10	101.9	48.9-187.5
	Genitourinary	3	30.6	6.3-89.4
	Musculoskeletal	5	51.0	16.5-118.9
	Chromosomal	1	10.2	0.3-56.8
Cumberland	**Total Cases**	**106**	**385.9**	**315.9-466.7**
	Central Nervous System	6	21.8	8.0-47.5
	Ear and Eye	0	0.0	0.0-13.4
	Cardiovascular	46	167.5	122.6-223.4
	Orofacial	12	43.7	22.6-76.3
	Gastrointestinal	28	101.9	67.7-147.3
	Genitourinary	22	80.1	50.2-121.3
	Musculoskeletal	4	14.6	4.0-37.3
	Chromosomal	2	7.3	0.9-26.3
Davidson	**Total Cases**	**1677**	**340.6**	**324.5-357.3**
	Central Nervous System	94	19.1	15.4-23.4
	Ear and Eye	20	4.1	2.5-6.3
	Cardiovascular	741	150.5	139.8-161.7
	Orofacial	99	20.1	16.3-24.5
	Gastrointestinal	204	41.4	35.9-47.5
	Genitourinary	527	107.0	98.1-116.6
	Musculoskeletal	101	20.5	16.7-24.9
	Chromosomal	97	19.7	16.0-24.0
Decatur	**Total Cases**	**22**	**326.4**	**204.6-494.2**
	Central Nervous System	4	59.3	16.2-152.0
	Ear and Eye	0	0.0	0.0-54.7
	Cardiovascular	3	44.5	9.2-130.1
	Orofacial	1	14.8	0.4-82.7
	Gastrointestinal	5	74.2	24.1-173.1
	Genitourinary	10	148.4	71.1-272.9
	Musculoskeletal	0	0.0	0.0-54.7
	Chromosomal	1	14.8	0.4-82.7

Table 7. Tennessee Birth Defects Counts and Rates by Maternal Resident County, 2005-2009

County	*Birth Defect*	*Count*	*Rate*	*95%CI*
Dekalb	**Total Cases**	**35**	**280.9**	**195.7-390.7**
	Central Nervous System	2	16.1	1.9-58.0
	Ear and Eye	0	0.0	0.0-29.6
	Cardiovascular	14	112.4	61.4-188.5
	Orofacial	6	48.2	17.7-104.8
	Gastrointestinal	7	56.2	22.6-115.8
	Genitourinary	8	64.2	27.7-126.5
	Musculoskeletal	4	32.1	8.7-82.2
	Chromosomal	3	24.1	5.0-70.4
Dickson	**Total Cases**	**121**	**361.1**	**299.6-431.5**
	Central Nervous System	5	14.9	4.8-34.8
	Ear and Eye	0	0.0	0.0-11.0
	Cardiovascular	51	152.2	113.3-200.1
	Orofacial	5	14.9	4.8-34.8
	Gastrointestinal	18	53.7	31.8-84.9
	Genitourinary	46	137.3	100.5-183.1
	Musculoskeletal	9	26.9	12.3-51.0
	Chromosomal	4	11.9	3.3-30.6
Dyer	**Total Cases**	**103**	**396.8**	**323.8-481.2**
	Central Nervous System	5	19.3	6.3-44.9
	Ear and Eye	1	3.9	0.1-21.5
	Cardiovascular	43	165.6	119.9-223.1
	Orofacial	4	15.4	4.2-39.5
	Gastrointestinal	20	77.0	47.1-119.0
	Genitourinary	17	65.5	38.1-104.8
	Musculoskeletal	12	46.2	23.9-80.7
	Chromosomal	2	7.7	0.9-27.8
Fayette	**Total Cases**	**82**	**328.1**	**261.0-407.3**
	Central Nervous System	8	32.0	13.8-63.1
	Ear and Eye	0	0.0	0.0-14.8
	Cardiovascular	42	168.1	121.1-227.2
	Orofacial	4	16.0	4.4-41.0
	Gastrointestinal	14	56.0	30.6-94.0
	Genitourinary	19	76.0	45.8-118.7
	Musculoskeletal	3	12.0	2.5-35.1
	Chromosomal	6	24.0	8.8-52.3

Table 7. Tennessee Birth Defects Counts and Rates by Maternal Resident County, 2005-2009

County	*Birth Defect*	*Count*	*Rate*	*95%CI*
Fentress	**Total Cases**	**41**	**399.2**	**286.5-541.6**
	Central Nervous System	5	48.7	15.8-113.6
	Ear and Eye	1	9.7	0.2-54.3
	Cardiovascular	18	175.3	103.9-277.0
	Orofacial	1	9.7	0.2-54.3
	Gastrointestinal	8	77.9	33.6-153.5
	Genitourinary	11	107.1	53.5-191.6
	Musculoskeletal	2	19.5	2.4-70.3
	Chromosomal	1	9.7	0.2-54.3
Franklin	**Total Cases**	**76**	**357.5**	**281.7-447.4**
	Central Nervous System	1	4.7	0.1-26.2
	Ear and Eye	1	4.7	0.1-26.2
	Cardiovascular	41	192.9	138.4-261.6
	Orofacial	2	9.4	1.1-34.0
	Gastrointestinal	10	47.0	22.6-86.5
	Genitourinary	17	80.0	46.6-128.0
	Musculoskeletal	8	37.6	16.2-74.1
	Chromosomal	1	4.7	0.1-26.2
Gibson	**Total Cases**	**108**	**344.5**	**282.6-415.9**
	Central Nervous System	8	25.5	11.0-50.3
	Ear and Eye	1	3.2	0.1-17.8
	Cardiovascular	55	175.4	132.2-228.4
	Orofacial	9	28.7	13.1-54.5
	Gastrointestinal	21	67.0	41.5-102.4
	Genitourinary	23	73.4	46.5-110.1
	Musculoskeletal	3	9.6	2.0-28.0
	Chromosomal	2	6.4	0.8-23.0
Giles	**Total Cases**	**45**	**260.1**	**189.7-348.1**
	Central Nervous System	2	11.6	1.4-41.8
	Ear and Eye	2	11.6	1.4-41.8
	Cardiovascular	19	109.8	66.1-171.5
	Orofacial	1	5.8	0.1-32.2
	Gastrointestinal	12	69.4	35.8-121.2
	Genitourinary	10	57.8	27.7-106.3
	Musculoskeletal	0	0.0	0.0-21.3
	Chromosomal	5	28.9	9.4-67.4

Table 7. Tennessee Birth Defects Counts and Rates by Maternal Resident County, 2005-2009

County	*Birth Defect*	*Count*	*Rate*	*95%CI*
Grainger	**Total Cases**	**54**	**403.6**	**303.2-526.6**
	Central Nervous System	6	44.8	16.5-97.6
	Ear and Eye	0	0.0	0.0-27.6
	Cardiovascular	27	201.8	133.0-293.6
	Orofacial	3	22.4	4.6-65.5
	Gastrointestinal	7	52.3	21.0-107.8
	Genitourinary	11	82.2	41.0-147.1
	Musculoskeletal	3	22.4	4.6-65.5
	Chromosomal	3	22.4	4.6-65.5
Greene	**Total Cases**	**153**	**420.1**	**356.2-492.2**
	Central Nervous System	10	27.5	13.2-50.5
	Ear and Eye	2	5.5	0.7-19.8
	Cardiovascular	89	244.4	196.3-300.7
	Orofacial	13	35.7	19.0-61.0
	Gastrointestinal	17	46.7	27.2-74.7
	Genitourinary	27	74.1	48.9-107.9
	Musculoskeletal	11	30.2	15.1-54.0
	Chromosomal	5	13.7	4.5-32.0
Grundy	**Total Cases**	**24**	**270.3**	**173.2-402.1**
	Central Nervous System	0	0.0	0.0-41.5
	Ear and Eye	0	0.0	0.0-41.5
	Cardiovascular	11	123.9	61.8-221.6
	Orofacial	1	11.3	0.3-62.7
	Gastrointestinal	5	56.3	18.3-131.4
	Genitourinary	7	78.8	31.7-162.4
	Musculoskeletal	3	33.8	7.0-98.7
	Chromosomal	2	22.5	2.7-81.4
Hamblen	**Total Cases**	**167**	**385.0**	**328.8-448.0**
	Central Nervous System	6	13.8	5.1-30.1
	Ear and Eye	0	0.0	0.0-8.5
	Cardiovascular	70	161.4	125.8-203.9
	Orofacial	12	27.7	14.3-48.3
	Gastrointestinal	32	73.8	50.5-104.1
	Genitourinary	32	73.8	50.5-104.1
	Musculoskeletal	17	39.2	22.8-62.7
	Chromosomal	10	23.1	11.1-42.4

Table 7. Tennessee Birth Defects Counts and Rates by Maternal Resident County, 2005-2009

County	*Birth Defect*	*Count*	*Rate*	*95%CI*
Hamilton	**Total Cases**	**684**	**324.4**	**300.5-349.6**
	Central Nervous System	62	29.4	22.5-37.7
	Ear and Eye	7	3.3	1.3-6.8
	Cardiovascular	285	135.1	119.9-151.8
	Orofacial	44	20.9	15.2-28.0
	Gastrointestinal	96	45.5	36.9-55.6
	Genitourinary	175	83.0	71.1-96.2
	Musculoskeletal	55	26.1	19.6-33.9
	Chromosomal	38	18.0	12.8-24.7
Hancock	**Total Cases**	**15**	**365.9**	**204.8-603.4**
	Central Nervous System	2	48.8	5.9-176.2
	Ear and Eye	0	0.0	0.0-90.0
	Cardiovascular	7	170.7	68.6-351.8
	Orofacial	2	48.8	5.9-176.2
	Gastrointestinal	2	48.8	5.9-176.2
	Genitourinary	2	48.8	5.9-176.2
	Musculoskeletal	1	24.4	0.6-135.9
	Chromosomal	1	24.4	0.6-135.9
Hardeman	**Total Cases**	**61**	**368.6**	**281.9-473.5**
	Central Nervous System	4	24.2	6.6-61.9
	Ear and Eye	0	0.0	0.0-22.3
	Cardiovascular	35	211.5	147.3-294.1
	Orofacial	2	12.1	1.5-43.7
	Gastrointestinal	3	18.1	3.7-53.0
	Genitourinary	12	72.5	37.5-126.7
	Musculoskeletal	6	36.3	13.3-78.9
	Chromosomal	3	18.1	3.7-53.0
Hardin	**Total Cases**	**62**	**425.5**	**326.3-545.5**
	Central Nervous System	7	48.0	19.3-99.0
	Ear and Eye	0	0.0	0.0-25.3
	Cardiovascular	28	192.2	127.7-277.7
	Orofacial	2	13.7	1.7-49.6
	Gastrointestinal	18	123.5	73.2-195.2
	Genitourinary	7	48.0	19.3-99.0
	Musculoskeletal	4	27.5	7.5-70.3
	Chromosomal	3	20.6	4.2-60.2

Table 7. Tennessee Birth Defects Counts and Rates by Maternal Resident County, 2005-2009

County	*Birth Defect*	*Count*	*Rate*	*95%CI*
Hawkins	**Total Cases**	**156**	**501.6**	**426.0-586.8**
	Central Nervous System	12	38.6	19.9-67.4
	Ear and Eye	5	16.1	5.2-37.5
	Cardiovascular	98	315.1	255.8-384.0
	Orofacial	9	28.9	13.2-54.9
	Gastrointestinal	18	57.9	34.3-91.5
	Genitourinary	16	51.4	29.4-83.5
	Musculoskeletal	6	19.3	7.1-42.0
	Chromosomal	6	19.3	7.1-42.0
Haywood	**Total Cases**	**59**	**463.5**	**352.8-597.8**
	Central Nervous System	4	31.4	8.6-80.5
	Ear and Eye	0	0.0	0.0-29.0
	Cardiovascular	31	243.5	165.5-345.7
	Orofacial	7	55.0	22.1-113.3
	Gastrointestinal	8	62.8	27.1-123.8
	Genitourinary	13	102.1	54.4-174.6
	Musculoskeletal	0	0.0	0.0-29.0
	Chromosomal	1	7.9	0.2-43.8
Henderson	**Total Cases**	**68**	**366.2**	**284.4-464.2**
	Central Nervous System	5	26.9	8.7-62.8
	Ear and Eye	3	16.2	3.3-47.2
	Cardiovascular	32	172.3	117.9-243.3
	Orofacial	4	21.5	5.9-55.2
	Gastrointestinal	12	64.6	33.4-112.9
	Genitourinary	14	75.4	41.2-126.5
	Musculoskeletal	2	10.8	1.3-38.9
	Chromosomal	1	5.4	0.1-30.0
Henry	**Total Cases**	**60**	**317.1**	**242.0-408.2**
	Central Nervous System	6	31.7	11.6-69.0
	Ear and Eye	2	10.6	1.3-38.2
	Cardiovascular	20	105.7	64.6-163.3
	Orofacial	2	10.6	1.3-38.2
	Gastrointestinal	13	68.7	36.6-117.5
	Genitourinary	17	89.9	52.3-143.9
	Musculoskeletal	1	5.3	0.1-29.4
	Chromosomal	3	15.9	3.3-46.3

Table 7. Tennessee Birth Defects Counts and Rates by Maternal Resident County, 2005-2009

County	*Birth Defect*	*Count*	*Rate*	*95%CI*
Hickman	**Total Cases**	**52**	**381.8**	**285.1-500.7**
	Central Nervous System	2	14.7	1.8-53.0
	Ear and Eye	1	7.3	0.2-40.9
	Cardiovascular	15	110.1	61.6-181.6
	Orofacial	0	0.0	0.0-27.1
	Gastrointestinal	18	132.2	78.3-208.9
	Genitourinary	14	102.8	56.2-172.5
	Musculoskeletal	5	36.7	11.9-85.7
	Chromosomal	3	22.0	4.5-64.4
Houston	**Total Cases**	**13**	**256.4**	**136.5-438.5**
	Central Nervous System	0	0.0	0.0-72.8
	Ear and Eye	0	0.0	0.0-72.8
	Cardiovascular	7	138.1	55.5-284.5
	Orofacial	0	0.0	0.0-72.8
	Gastrointestinal	3	59.2	12.2-172.9
	Genitourinary	2	39.4	4.8-142.5
	Musculoskeletal	0	0.0	0.0-72.8
	Chromosomal	0	0.0	0.0-72.8
Humphreys	**Total Cases**	**43**	**408.7**	**295.8-550.6**
	Central Nervous System	5	47.5	15.4-110.9
	Ear and Eye	0	0.0	0.0-35.1
	Cardiovascular	14	133.1	72.8-223.3
	Orofacial	2	19.0	2.3-68.7
	Gastrointestinal	3	28.5	5.9-83.3
	Genitourinary	16	152.1	86.9-247.0
	Musculoskeletal	4	38.0	10.4-97.4
	Chromosomal	1	9.5	0.2-53.0
Jackson	**Total Cases**	**21**	**405.4**	**251.0-619.7**
	Central Nervous System	0	0.0	0.0-71.2
	Ear and Eye	0	0.0	0.0-71.2
	Cardiovascular	10	193.1	92.6-355.0
	Orofacial	2	38.6	4.7-139.5
	Gastrointestinal	5	96.5	31.3-225.3
	Genitourinary	2	38.6	4.7-139.5
	Musculoskeletal	3	57.9	11.9-169.3
	Chromosomal	1	19.3	0.5-107.6

Table 7. Tennessee Birth Defects Counts and Rates by Maternal Resident County, 2005-2009

County	*Birth Defect*	*Count*	*Rate*	*95%CI*
Jefferson	**Total Cases**	**128**	**437.8**	**365.2-520.5**
	Central Nervous System	11	37.6	18.8-67.3
	Ear and Eye	2	6.8	0.8-24.7
	Cardiovascular	57	194.9	147.6-252.6
	Orofacial	8	27.4	11.8-53.9
	Gastrointestinal	29	99.2	66.4-142.4
	Genitourinary	25	85.5	55.3-126.2
	Musculoskeletal	11	37.6	18.8-67.3
	Chromosomal	4	13.7	3.7-35.0
Johnson	**Total Cases**	**36**	**409.6**	**286.8-567.0**
	Central Nervous System	0	0.0	0.0-42.0
	Ear and Eye	0	0.0	0.0-42.0
	Cardiovascular	23	261.7	165.9-392.6
	Orofacial	2	22.8	2.8-82.2
	Gastrointestinal	7	79.6	32.0-164.1
	Genitourinary	6	68.3	25.0-148.6
	Musculoskeletal	0	0.0	0.0-42.0
	Chromosomal	1	11.4	0.3-63.4
Knox	**Total Cases**	**982**	**369.6**	**346.9-393.5**
	Central Nervous System	65	24.5	18.9-31.2
	Ear and Eye	10	3.8	1.8-6.9
	Cardiovascular	454	170.9	155.5-187.4
	Orofacial	52	19.6	14.6-25.7
	Gastrointestinal	117	44.0	36.4-52.8
	Genitourinary	285	107.3	95.2-120.5
	Musculoskeletal	63	23.7	18.2-30.3
	Chromosomal	44	16.6	12.0-22.2
Lake	**Total Cases**	**16**	**453.3**	**259.1-736.1**
	Central Nervous System	0	0.0	0.0-104.5
	Ear and Eye	0	0.0	0.0-104.5
	Cardiovascular	7	198.3	79.7-408.6
	Orofacial	1	28.3	0.7-157.8
	Gastrointestinal	4	113.3	30.9-290.1
	Genitourinary	3	85.0	17.5-248.4
	Musculoskeletal	2	56.7	6.9-204.7
	Chromosomal	1	28.3	0.7-157.8

Table 7. Tennessee Birth Defects Counts and Rates by Maternal Resident County, 2005-2009

County	*Birth Defect*	*Count*	*Rate*	*95%CI*
Lauderdale	**Total Cases**	**54**	**288.2**	**216.5-376.0**
	Central Nervous System	4	21.3	5.8-54.7
	Ear and Eye	1	5.3	0.1-29.7
	Cardiovascular	29	154.7	103.6-222.2
	Orofacial	2	10.7	1.3-38.6
	Gastrointestinal	9	48.0	22.0-91.2
	Genitourinary	13	69.4	36.9-118.6
	Musculoskeletal	1	5.3	0.1-29.7
	Chromosomal	2	10.7	1.3-38.6
Lawrence	**Total Cases**	**101**	**350.3**	**285.3-425.7**
	Central Nervous System	6	20.8	7.6-45.3
	Ear and Eye	0	0.0	0.0-12.8
	Cardiovascular	33	114.5	78.8-160.8
	Orofacial	8	27.7	12.0-54.7
	Gastrointestinal	23	79.8	50.6-119.7
	Genitourinary	31	107.5	73.1-152.6
	Musculoskeletal	6	20.8	7.6-45.3
	Chromosomal	7	24.3	9.8-50.0
Lewis	**Total Cases**	**23**	**312.5**	**198.1-468.9**
	Central Nervous System	0	0.0	0.0-50.1
	Ear and Eye	0	0.0	0.0-50.1
	Cardiovascular	7	95.1	38.2-196.0
	Orofacial	3	40.8	8.4-119.1
	Gastrointestinal	5	67.9	22.1-158.5
	Genitourinary	5	67.9	22.1-158.5
	Musculoskeletal	3	40.8	8.4-119.1
	Chromosomal	2	27.2	3.3-98.2
Lincoln	**Total Cases**	**50**	**237.2**	**176.0-312.7**
	Central Nervous System	7	33.2	13.4-68.4
	Ear and Eye	1	4.7	0.1-26.4
	Cardiovascular	22	104.4	65.4-158.0
	Orofacial	7	33.2	13.4-68.4
	Gastrointestinal	7	33.2	13.4-68.4
	Genitourinary	12	56.9	29.4-99.4
	Musculoskeletal	4	19.0	5.2-48.6
	Chromosomal	1	4.7	0.1-26.4

Table 7. Tennessee Birth Defects Counts and Rates by Maternal Resident County, 2005-2009

County	*Birth Defect*	*Count*	*Rate*	*95%CI*
Loudon	**Total Cases**	**105**	**397.6**	**325.2-481.3**
	Central Nervous System	4	15.1	4.1-38.8
	Ear and Eye	1	3.8	0.1-21.1
	Cardiovascular	44	166.6	121.1-223.7
	Orofacial	10	37.9	18.2-69.6
	Gastrointestinal	19	71.9	43.3-112.3
	Genitourinary	28	106.0	70.4-153.2
	Musculoskeletal	8	30.3	13.1-59.7
	Chromosomal	8	30.3	13.1-59.7
McMinn	**Total Cases**	**108**	**355.6**	**291.7-429.4**
	Central Nervous System	13	42.8	22.8-73.2
	Ear and Eye	1	3.3	0.1-18.3
	Cardiovascular	38	125.1	88.5-171.7
	Orofacial	6	19.8	7.3-43.0
	Gastrointestinal	28	92.2	61.3-133.2
	Genitourinary	16	52.7	30.1-85.6
	Musculoskeletal	11	36.2	18.1-64.8
	Chromosomal	3	9.9	2.0-28.9
McNairy	**Total Cases**	**56**	**371.4**	**280.5-482.2**
	Central Nervous System	2	13.3	1.6-47.9
	Ear and Eye	1	6.6	0.2-36.9
	Cardiovascular	25	165.8	107.3-244.7
	Orofacial	4	26.5	7.2-67.9
	Gastrointestinal	10	66.3	31.8-122.0
	Genitourinary	11	72.9	36.4-130.5
	Musculoskeletal	5	33.2	10.8-77.4
	Chromosomal	4	26.5	7.2-67.9
Macon	**Total Cases**	**46**	**306.7**	**224.5-409.1**
	Central Nervous System	4	26.7	7.3-68.3
	Ear and Eye	1	6.7	0.2-37.1
	Cardiovascular	18	120.0	71.1-189.7
	Orofacial	3	20.0	4.1-58.4
	Gastrointestinal	11	73.3	36.6-131.2
	Genitourinary	10	66.7	32.0-122.6
	Musculoskeletal	0	0.0	0.0-24.6
	Chromosomal	5	33.3	10.8-77.8

Table 7. Tennessee Birth Defects Counts and Rates by Maternal Resident County, 2005-2009

County	*Birth Defect*	*Count*	*Rate*	*95%CI*
Madison	**Total Cases**	**253**	**362.0**	**318.8-409.5**
	Central Nervous System	14	20.0	11.0-33.6
	Ear and Eye	3	4.3	0.9-12.5
	Cardiovascular	147	210.4	177.7-247.2
	Orofacial	10	14.3	6.9-26.3
	Gastrointestinal	30	42.9	29.0-61.3
	Genitourinary	54	77.3	58.1-100.8
	Musculoskeletal	13	18.6	9.9-31.8
	Chromosomal	15	21.5	12.0-35.4
Marion	**Total Cases**	**63**	**372.8**	**286.5-476.9**
	Central Nervous System	6	35.5	13.0-77.3
	Ear and Eye	1	5.9	0.1-33.0
	Cardiovascular	28	165.7	110.1-239.5
	Orofacial	4	23.7	6.4-60.6
	Gastrointestinal	11	65.1	32.5-116.5
	Genitourinary	19	112.4	67.7-175.6
	Musculoskeletal	4	23.7	6.4-60.6
	Chromosomal	5	29.6	9.6-69.0
Marshall	**Total Cases**	**73**	**372.4**	**291.9-468.3**
	Central Nervous System	8	40.8	17.6-80.4
	Ear and Eye	0	0.0	0.0-18.8
	Cardiovascular	22	112.2	70.3-169.9
	Orofacial	3	15.3	3.2-44.7
	Gastrointestinal	13	66.3	35.3-113.4
	Genitourinary	22	112.2	70.3-169.9
	Musculoskeletal	7	35.7	14.4-73.6
	Chromosomal	4	20.4	5.6-52.3
Maury	**Total Cases**	**190**	**335.6**	**289.6-386.9**
	Central Nervous System	17	30.0	17.5-48.1
	Ear and Eye	0	0.0	0.0-6.5
	Cardiovascular	65	114.8	88.6-146.3
	Orofacial	10	17.7	8.5-32.5
	Gastrointestinal	42	74.2	53.5-100.3
	Genitourinary	62	109.5	84.0-140.4
	Musculoskeletal	17	30.0	17.5-48.1
	Chromosomal	4	7.1	1.9-18.1

Table 7. Tennessee Birth Defects Counts and Rates by Maternal Resident County, 2005-2009

County	*Birth Defect*	*Count*	*Rate*	*95%CI*
Meigs	**Total Cases**	**21**	**321.6**	**199.1-491.6**
	Central Nervous System	4	61.3	16.7-156.8
	Ear and Eye	0	0.0	0.0-56.5
	Cardiovascular	6	91.9	33.7-200.0
	Orofacial	0	0.0	0.0-56.5
	Gastrointestinal	6	91.9	33.7-200.0
	Genitourinary	4	61.3	16.7-156.8
	Musculoskeletal	0	0.0	0.0-56.5
	Chromosomal	1	15.3	0.4-85.3
Monroe	**Total Cases**	**100**	**370.5**	**301.5-450.6**
	Central Nervous System	9	33.3	15.2-63.3
	Ear and Eye	1	3.7	0.1-20.6
	Cardiovascular	41	151.9	109.0-206.1
	Orofacial	6	22.2	8.2-48.4
	Gastrointestinal	18	66.7	39.5-105.4
	Genitourinary	25	92.6	59.9-136.7
	Musculoskeletal	8	29.6	12.8-58.4
	Chromosomal	5	18.5	6.0-43.2
Montgomery	**Total Cases**	**431**	**298.8**	**271.2-328.3**
	Central Nervous System	25	17.3	11.2-25.6
	Ear and Eye	4	2.8	0.8-7.1
	Cardiovascular	204	141.4	122.7-162.2
	Orofacial	20	13.9	8.5-21.4
	Gastrointestinal	72	49.9	39.1-62.9
	Genitourinary	104	72.1	58.9-87.4
	Musculoskeletal	33	22.9	15.7-32.1
	Chromosomal	27	18.7	12.3-27.2
Moore	**Total Cases**	**8**	**298.5**	**128.9-588.2**
	Central Nervous System	0	0.0	0.0-137.6
	Ear and Eye	0	0.0	0.0-137.6
	Cardiovascular	3	111.9	23.1-327.1
	Orofacial	1	37.3	0.9-207.9
	Gastrointestinal	1	37.3	0.9-207.9
	Genitourinary	3	111.9	23.1-327.1
	Musculoskeletal	0	0.0	0.0-137.6
	Chromosomal	2	74.6	9.0-269.6

Table 7. Tennessee Birth Defects Counts and Rates by Maternal Resident County, 2005-2009

County	*Birth Defect*	*Count*	*Rate*	*95%CI*
Morgan	**Total Cases**	**54**	**488.7**	**367.1-637.6**
	Central Nervous System	4	36.2	9.9-92.7
	Ear and Eye	2	18.1	2.2-65.4
	Cardiovascular	17	153.8	89.6-246.3
	Orofacial	5	45.2	14.7-105.6
	Gastrointestinal	12	108.6	56.1-189.7
	Genitourinary	19	171.9	103.5-268.5
	Musculoskeletal	4	36.2	9.9-92.7
	Chromosomal	1	9.0	0.2-50.4
Obion	**Total Cases**	**62**	**331.6**	**254.2-425.0**
	Central Nervous System	4	21.4	5.8-54.8
	Ear and Eye	0	0.0	0.0-19.7
	Cardiovascular	31	165.8	112.6-235.3
	Orofacial	2	10.7	1.3-38.6
	Gastrointestinal	9	48.1	22.0-91.4
	Genitourinary	13	69.5	37.0-118.9
	Musculoskeletal	8	42.8	18.5-84.3
	Chromosomal	1	5.3	0.1-29.8
Overton	**Total Cases**	**49**	**395.5**	**292.6-522.8**
	Central Nervous System	6	48.4	17.8-105.4
	Ear and Eye	0	0.0	0.0-29.8
	Cardiovascular	16	129.1	73.8-209.7
	Orofacial	5	40.4	13.1-94.2
	Gastrointestinal	8	64.6	27.9-127.2
	Genitourinary	13	104.9	55.9-179.4
	Musculoskeletal	4	32.3	8.8-82.7
	Chromosomal	2	16.1	2.0-58.3
Perry	**Total Cases**	**16**	**336.8**	**192.5-547.0**
	Central Nervous System	2	42.1	5.1-152.1
	Ear and Eye	1	21.1	0.5-117.3
	Cardiovascular	4	84.2	22.9-215.6
	Orofacial	0	0.0	0.0-77.7
	Gastrointestinal	3	63.2	13.0-184.6
	Genitourinary	4	84.2	22.9-215.6
	Musculoskeletal	2	42.1	5.1-152.1
	Chromosomal	1	21.1	0.5-117.3

Table 7. Tennessee Birth Defects Counts and Rates by Maternal Resident County, 2005-2009

County	*Birth Defect*	*Count*	*Rate*	*95%CI*
Pickett	**Total Cases**	**13**	**515.9**	**274.7-882.2**
	Central Nervous System	1	39.7	1.0-221.1
	Ear and Eye	0	0.0	0.0-146.4
	Cardiovascular	3	119.0	24.6-347.9
	Orofacial	1	39.7	1.0-221.1
	Gastrointestinal	6	238.1	87.4-518.2
	Genitourinary	4	158.7	43.2-406.4
	Musculoskeletal	2	79.4	9.6-286.7
	Chromosomal	0	0.0	0.0-146.4
Polk	**Total Cases**	**27**	**298.7**	**196.8-434.6**
	Central Nervous System	4	44.2	12.1-113.3
	Ear and Eye	0	0.0	0.0-40.8
	Cardiovascular	6	66.4	24.4-144.5
	Orofacial	1	11.1	0.3-61.6
	Gastrointestinal	9	99.6	45.5-189.0
	Genitourinary	5	55.3	18.0-129.1
	Musculoskeletal	3	33.2	6.8-97.0
	Chromosomal	0	0.0	0.0-40.8
Putnam	**Total Cases**	**160**	**337.6**	**287.3-394.2**
	Central Nervous System	16	33.8	19.3-54.8
	Ear and Eye	2	4.2	0.5-15.2
	Cardiovascular	58	122.4	92.9-158.2
	Orofacial	10	21.1	10.1-38.8
	Gastrointestinal	39	82.3	58.5-112.5
	Genitourinary	34	71.7	49.7-100.3
	Musculoskeletal	9	19.0	8.7-36.1
	Chromosomal	7	14.8	5.9-30.4
Rhea	**Total Cases**	**75**	**358.7**	**282.1-449.6**
	Central Nervous System	4	19.1	5.2-49.0
	Ear and Eye	0	0.0	0.0-17.6
	Cardiovascular	32	153.0	104.7-216.0
	Orofacial	4	19.1	5.2-49.0
	Gastrointestinal	20	95.6	58.4-147.7
	Genitourinary	14	67.0	36.6-112.3
	Musculoskeletal	6	28.7	10.5-62.5
	Chromosomal	3	14.3	3.0-41.9

Table 7. Tennessee Birth Defects Counts and Rates by Maternal Resident County, 2005-2009

County	*Birth Defect*	*Count*	*Rate*	*95%CI*
Roane	**Total Cases**	**115**	**430.1**	**355.1-516.2**
	Central Nervous System	9	33.7	15.4-63.9
	Ear and Eye	2	7.5	0.9-27.0
	Cardiovascular	44	164.5	119.6-220.9
	Orofacial	6	22.4	8.2-48.8
	Gastrointestinal	22	82.3	51.6-124.6
	Genitourinary	29	108.5	72.6-155.8
	Musculoskeletal	11	41.1	20.5-73.6
	Chromosomal	8	29.9	12.9-58.9
Robertson	**Total Cases**	**161**	**309.6**	**263.6-361.3**
	Central Nervous System	7	13.5	5.4-27.7
	Ear and Eye	1	1.9	0.0-10.7
	Cardiovascular	74	142.3	111.7-178.7
	Orofacial	17	32.7	19.0-52.3
	Gastrointestinal	22	42.3	26.5-64.1
	Genitourinary	39	75.0	53.3-102.5
	Musculoskeletal	11	21.2	10.6-37.9
	Chromosomal	8	15.4	6.6-30.3
Rutherford	**Total Cases**	**587**	**310.9**	**286.3-337.1**
	Central Nervous System	36	19.1	13.4-26.4
	Ear and Eye	6	3.2	1.2-6.9
	Cardiovascular	244	129.2	113.5-146.5
	Orofacial	36	19.1	13.4-26.4
	Gastrointestinal	71	37.6	29.4-47.4
	Genitourinary	195	103.3	89.3-118.8
	Musculoskeletal	41	21.7	15.6-29.5
	Chromosomal	32	16.9	11.6-23.9
Scott	**Total Cases**	**58**	**383.3**	**291.1-495.6**
	Central Nervous System	2	13.2	1.6-47.8
	Ear and Eye	0	0.0	0.0-24.4
	Cardiovascular	21	138.8	85.9-212.2
	Orofacial	5	33.0	10.7-77.1
	Gastrointestinal	13	85.9	45.7-146.9
	Genitourinary	18	119.0	70.5-188.0
	Musculoskeletal	7	46.3	18.6-95.3
	Chromosomal	4	26.4	7.2-67.7

Table 7. Tennessee Birth Defects Counts and Rates by Maternal Resident County, 2005-2009

County	*Birth Defect*	*Count*	*Rate*	*95%CI*
Sequatchie	**Total Cases**	**35**	**398.2**	**277.3-553.8**
	Central Nervous System	2	22.8	2.8-82.2
	Ear and Eye	1	11.4	0.3-63.4
	Cardiovascular	14	159.3	87.1-267.2
	Orofacial	1	11.4	0.3-63.4
	Gastrointestinal	6	68.3	25.0-148.6
	Genitourinary	11	125.1	62.5-223.9
	Musculoskeletal	4	45.5	12.4-116.5
	Chromosomal	1	11.4	0.3-63.4
Sevier	**Total Cases**	**186**	**337.4**	**290.7-389.6**
	Central Nervous System	15	27.2	15.2-44.9
	Ear and Eye	2	3.6	0.4-13.1
	Cardiovascular	72	130.6	102.2-164.5
	Orofacial	11	20.0	10.0-35.7
	Gastrointestinal	45	81.6	59.5-109.2
	Genitourinary	43	78.0	56.5-105.1
	Musculoskeletal	9	16.3	7.5-31.0
	Chromosomal	8	14.5	6.3-28.6
Shelby	**Total Cases**	**2674**	**359.7**	**346.2-373.6**
	Central Nervous System	224	30.1	26.3-34.3
	Ear and Eye	38	5.1	3.6-7.0
	Cardiovascular	1509	203.0	192.9-213.5
	Orofacial	100	13.5	10.9-16.4
	Gastrointestinal	317	42.6	38.1-47.6
	Genitourinary	520	70.0	64.1-76.2
	Musculoskeletal	145	19.5	16.5-23.0
	Chromosomal	125	16.8	14.0-20.0
Smith	**Total Cases**	**29**	**252.4**	**169.0-362.5**
	Central Nervous System	2	17.4	2.1-62.9
	Ear and Eye	0	0.0	0.0-32.1
	Cardiovascular	13	113.1	60.2-193.5
	Orofacial	1	8.7	0.2-48.5
	Gastrointestinal	9	78.3	35.8-148.7
	Genitourinary	5	43.5	14.1-101.6
	Musculoskeletal	0	0.0	0.0-32.1
	Chromosomal	1	8.7	0.2-48.5

Table 7. Tennessee Birth Defects Counts and Rates by Maternal Resident County, 2005-2009

County	*Birth Defect*	*Count*	*Rate*	*95%CI*
Stewart	**Total Cases**	**28**	**417.9**	**277.7-604.0**
	Central Nervous System	1	14.9	0.4-83.2
	Ear and Eye	0	0.0	0.0-55.1
	Cardiovascular	14	209.0	114.2-350.6
	Orofacial	1	14.9	0.4-83.2
	Gastrointestinal	3	44.8	9.2-130.9
	Genitourinary	8	119.4	51.5-235.3
	Musculoskeletal	1	14.9	0.4-83.2
	Chromosomal	1	14.9	0.4-83.2
Sullivan	**Total Cases**	**426**	**508.1**	**461.0-558.7**
	Central Nervous System	30	35.8	24.1-51.1
	Ear and Eye	6	7.2	2.6-15.6
	Cardiovascular	237	282.7	247.8-321.1
	Orofacial	19	22.7	13.6-35.4
	Gastrointestinal	62	74.0	56.7-94.8
	Genitourinary	75	89.5	70.4-112.1
	Musculoskeletal	21	25.0	15.5-38.3
	Chromosomal	16	19.1	10.9-31.0
Sumner	**Total Cases**	**332**	**326.8**	**292.6-363.9**
	Central Nervous System	20	19.7	12.0-30.4
	Ear and Eye	1	1.0	0.0-5.5
	Cardiovascular	149	146.7	124.1-172.2
	Orofacial	23	22.6	14.4-34.0
	Gastrointestinal	64	63.0	48.5-80.4
	Genitourinary	79	77.8	61.6-96.9
	Musculoskeletal	25	24.6	15.9-36.3
	Chromosomal	15	14.8	8.3-24.4
Tipton	**Total Cases**	**131**	**332.4**	**277.9-394.4**
	Central Nervous System	7	17.8	7.1-36.6
	Ear and Eye	1	2.5	0.1-14.1
	Cardiovascular	70	177.6	138.5-224.4
	Orofacial	2	5.1	0.6-18.3
	Gastrointestinal	17	43.1	25.1-69.1
	Genitourinary	31	78.7	53.4-111.7
	Musculoskeletal	10	25.4	12.2-46.7
	Chromosomal	5	12.7	4.1-29.6

Table 7. Tennessee Birth Defects Counts and Rates by Maternal Resident County, 2005-2009

County	*Birth Defect*	*Count*	*Rate*	*95%CI*
Trousdale	**Total Cases**	**13**	**280.2**	**149.2-479.1**
	Central Nervous System	1	21.6	0.5-120.1
	Ear and Eye	0	0.0	0.0-79.5
	Cardiovascular	4	86.2	23.5-220.7
	Orofacial	0	0.0	0.0-79.5
	Gastrointestinal	2	43.1	5.2-155.7
	Genitourinary	5	107.8	35.0-251.5
	Musculoskeletal	1	21.6	0.5-120.1
	Chromosomal	0	0.0	0.0-79.5
Unicoi	**Total Cases**	**57**	**628.4**	**476.0-814.2**
	Central Nervous System	1	11.0	0.3-61.4
	Ear and Eye	1	11.0	0.3-61.4
	Cardiovascular	21	231.5	143.3-353.9
	Orofacial	3	33.1	6.8-96.7
	Gastrointestinal	17	187.4	109.2-300.1
	Genitourinary	10	110.3	52.9-202.8
	Musculoskeletal	2	22.1	2.7-79.7
	Chromosomal	2	22.1	2.7-79.7
Union	**Total Cases**	**61**	**493.5**	**377.5-634.0**
	Central Nervous System	4	32.4	8.8-82.9
	Ear and Eye	1	8.1	0.2-45.1
	Cardiovascular	30	242.7	163.8-346.5
	Orofacial	6	48.5	17.8-105.7
	Gastrointestinal	10	80.9	38.8-148.8
	Genitourinary	11	89.0	44.4-159.2
	Musculoskeletal	0	0.0	0.0-29.8
	Chromosomal	2	16.2	2.0-58.5
Van Buren	**Total Cases**	**7**	**243.1**	**97.7-500.8**
	Central Nervous System	0	0.0	0.0-128.1
	Ear and Eye	1	34.7	0.9-193.5
	Cardiovascular	3	104.2	21.5-304.4
	Orofacial	1	34.7	0.9-193.5
	Gastrointestinal	2	69.4	8.4-250.9
	Genitourinary	0	0.0	0.0-128.1
	Musculoskeletal	1	34.7	0.9-193.5
	Chromosomal	1	34.7	0.9-193.5

Table 7. Tennessee Birth Defects Counts and Rates by Maternal Resident County, 2005-2009

County	*Birth Defect*	*Count*	*Rate*	*95%CI*
Warren	**Total Cases**	**75**	**285.1**	**224.2-357.3**
	Central Nervous System	7	26.6	10.7-54.8
	Ear and Eye	0	0.0	0.0-14.0
	Cardiovascular	37	140.6	99.0-193.8
	Orofacial	3	11.4	2.4-33.3
	Gastrointestinal	17	64.6	37.6-103.5
	Genitourinary	12	45.6	23.6-79.7
	Musculoskeletal	8	30.4	13.1-59.9
	Chromosomal	4	15.2	4.1-38.9
Washington	**Total Cases**	**305**	**447.5**	**398.7-500.7**
	Central Nervous System	16	23.5	13.4-38.1
	Ear and Eye	2	2.9	0.4-10.6
	Cardiovascular	173	253.9	217.4-294.6
	Orofacial	13	19.1	10.2-32.6
	Gastrointestinal	49	71.9	53.2-95.1
	Genitourinary	60	88.0	67.2-113.3
	Musculoskeletal	14	20.5	11.2-34.5
	Chromosomal	7	10.3	4.1-21.2
Wayne	**Total Cases**	**36**	**449.4**	**314.8-622.2**
	Central Nervous System	1	12.5	0.3-69.6
	Ear and Eye	0	0.0	0.0-46.1
	Cardiovascular	16	199.8	114.2-324.4
	Orofacial	1	12.5	0.3-69.6
	Gastrointestinal	8	99.9	43.1-196.8
	Genitourinary	10	124.8	59.9-229.6
	Musculoskeletal	5	62.4	20.3-145.7
	Chromosomal	2	25.0	3.0-90.2
Weakley	**Total Cases**	**68**	**377.1**	**292.9-478.1**
	Central Nervous System	1	5.5	0.1-30.9
	Ear and Eye	1	5.5	0.1-30.9
	Cardiovascular	30	166.4	112.3-237.5
	Orofacial	3	16.6	3.4-48.6
	Gastrointestinal	19	105.4	63.4-164.6
	Genitourinary	14	77.6	42.5-130.3
	Musculoskeletal	1	5.5	0.1-30.9
	Chromosomal	4	22.2	6.0-56.8

Table 8. Tennessee Birth Defects Counts and Rates by Maternal Diabetes, 2005-2009

County	*Birth Defect*	*Count*	*Rate*	*95%CI*
White	**Total Cases**	**44**	**286.5**	**208.1-384.6**
	Central Nervous System	2	13.0	1.6-47.0
	Ear and Eye	0	0.0	0.0-24.0
	Cardiovascular	16	104.2	59.5-169.2
	Orofacial	7	45.6	18.3-93.9
	Gastrointestinal	7	45.6	18.3-93.9
	Genitourinary	16	104.2	59.5-169.2
	Musculoskeletal	3	19.5	4.0-57.1
	Chromosomal	2	13.0	1.6-47.0
Williamson	**Total Cases**	**309**	**293.2**	**261.4-327.8**
	Central Nervous System	18	17.1	10.1-27.0
	Ear and Eye	3	2.8	0.6-8.3
	Cardiovascular	121	114.8	95.3-137.2
	Orofacial	22	20.9	13.1-31.6
	Gastrointestinal	32	30.4	20.8-42.9
	Genitourinary	100	94.9	77.2-115.4
	Musculoskeletal	19	18.0	10.9-28.2
	Chromosomal	25	23.7	15.4-35.0
Wilson	**Total Cases**	**190**	**278.0**	**239.9-320.5**
	Central Nervous System	6	8.8	3.2-19.1
	Ear and Eye	2	2.9	0.4-10.6
	Cardiovascular	83	121.5	96.7-150.6
	Orofacial	11	16.1	8.0-28.8
	Gastrointestinal	27	39.5	26.0-57.5
	Genitourinary	60	87.8	67.0-113.0
	Musculoskeletal	13	19.0	10.1-32.5
	Chromosomal	12	17.6	9.1-30.7

Source: Tennessee Department of Health, Division of Policy, Planning and Assessment, Tennessee Birth Defects Registry 2005-2009.

Note:
[1]Counts include cases resulting from live births and fetal deaths.
[2]Rates were computed per 10,000 live births except for Hypospadias per 10,000 live male births.
[3]Statistical significance was determined by Poisson regression with statistical probabilities indicated as: p < 0.001***, P < 0.01** , p < 0.05*.
[4]95 percent confidence intervals for 100 or less cases are exact Poisson; otherwise confidence intervals are based on the normal approximation.
[5]Diagnostic data were derived from the Tennessee Hospital Discharge Data System (2005-2010), the Tennessee Death Statistical System (2005-2009) and the Tennessee Fetal Death Statistical System (2005-2009).
[6]Total live births were derived from the Tennessee Birth Statistical system (2005-2009).

Table 8. Tennessee Birth Defects Counts and Rates by Maternal Diabetes, 2005-2009

Birth Defect	*No Diabetes*	*Diabetes*
Central Nervous System * **	**983**	**31**
Rate	**23.6**	**77.7**
95% confidence interval	**22.2-25.1**	**52.8-110.3**
Anencephalus	47	0
Rate	1.1	0.0
95% confidence interval	0.8-1.5	0.0-9.2
Spina bifida without anencephalus	174	4
Rate	4.2	10.0
95% confidence interval	3.6-4.8	2.7-25.7
Hydrocephalus without spina bifida ***	282	17
Rate	6.8	42.6
95% confidence interval	6.0-7.6	24.8-68.2
Encephalocele	55	1
Rate	1.3	2.5
95% confidence interval	1.0-1.7	0.1-14.0
Microcephalus *	465	10
Rate	11.2	25.1
95% confidence interval	10.2-12.2	12.0-46.1
Ear and Eye	**168**	**2**
Rate	**4.0**	**5.0**
95% confidence interval	**3.4-4.7**	**0.6-18.1**
Aniridia	6	1
Rate	0.1	2.5
95% confidence interval	0.1-0.3	0.1-14.0
Anophthalmia/microphthalmia	40	1
Rate	1.0	2.5
95% confidence interval	0.7-1.3	0.1-14.0
Congenital cataract	102	1
Rate	2.5	2.5
95% confidence interval	2.0-3.0	0.1-14.0
Anotia/microtia	28	0
Rate	0.7	0.0
95% confidence interval	0.4-1.0	0.0-9.2
Cardiovascular * **	**6,727**	**257**
Rate	**161.6**	**643.9**
95% confidence interval	**157.8-165.5**	**567.6-727.7**

Table 8. Tennessee Birth Defects Counts and Rates by Maternal Diabetes, 2005-2009

Birth Defect	*No Diabetes*	*Diabetes*
Common truncus(CCHD) ***	40	4
Rate	1.0	10.0
95% confidence interval	0.7-1.3	2.7-25.7
Transposition of great arteries ***	252	13
Rate	6.1	32.6
95% confidence interval	5.3-6.8	17.3-55.7
Transposition of great arteries(CCHD) **	92	5
Rate	2.2	12.5
95% confidence interval	1.8-2.7	4.1-29.2
Tetralogy of fallot(CCHD)	247	6
Rate	5.9	15.0
95% confidence interval	5.2-6.7	5.5-32.7
Ventricular septal defect ***	1,873	64
Rate	45.0	160.4
95% confidence interval	43.0-47.1	123.5-204.8
Atrial septal defect ***	3,789	132
Rate	91.0	330.7
95% confidence interval	88.1-94.0	276.7-392.2
Atrioventricular septal defect **	161	7
Rate	3.9	17.5
95% confidence interval	3.3-4.5	7.1-36.1
Pulmonary valve atresia and stenosis **	436	11
Rate	10.5	27.6
95% confidence interval	9.5-11.5	13.8-49.3
Pulmonary valve atresia and stenosis(CCHD)	68	2
Rate	1.6	5.0
95% confidence interval	1.3-2.1	0.6-18.1
Tricuspid valve atresia and stenosis(CCHD)	48	1
Rate	1.2	2.5
95% confidence interval	0.9-1.5	0.1-14.0
Ebstein's anomaly	35	1
Rate	0.8	2.5
95% confidence interval	0.6-1.2	0.1-14.0
Aortic valve stenosis	84	1
Rate	2.0	2.5
95% confidence interval	1.6-2.5	0.1-14.0

Table 8. Tennessee Birth Defects Counts and Rates by Maternal Diabetes, 2005-2009

Birth Defect	*No Diabetes*	*Diabetes*
Hypoplastic left heart syndrome(CCHD) ***	131	7
Rate	3.1	17.5
95% confidence interval	2.6-3.7	7.1-36.1
Patent ductus arteriosus ***	2,418	111
Rate	58.1	278.1
95% confidence interval	55.8-60.4	228.8-334.9
Coarctation of aorta ***	264	13
Rate	6.3	32.6
95% confidence interval	5.6-7.2	17.3-55.7
Orofacial	**815**	**7**
Rate	**19.6**	**17.5**
95% confidence interval	**18.3-21.0**	**7.1-36.1**
Cleft palate without cleft lip	316	4
Rate	7.6	10.0
95% confidence interval	6.8-8.5	2.7-25.7
Cleft lip with and without cleft palate	456	2
Rate	11.0	5.0
95% confidence interval	10.0-12.0	0.6-18.1
Choanal atresia	73	1
Rate	1.8	2.5
95% confidence interval	1.4-2.2	0.1-14.0
Gastrointestinal	**2,289**	**31**
Rate	**55.0**	**77.7**
95% confidence interval	**52.8-57.3**	**52.8-110.3**
Esophageal atresia/tracheoesophageal fistula	100	3
Rate	2.4	7.5
95% confidence interval	2.0-2.9	1.6-22.0
Rectal and large intestinal atresia/stenosis	241	5
Rate	5.8	12.5
95% confidence interval	5.1-6.6	4.1-29.2
Pyloric stenosis	1,810	19
Rate	43.5	47.6
95% confidence interval	41.5-45.5	28.7-74.3
Hirshsprung's disease (congenital megacolon)	128	3
Rate	3.1	7.5
95% confidence interval	2.6-3.7	1.6-22.0

Table 8. Tennessee Birth Defects Counts and Rates by Maternal Diabetes, 2005-2009

Birth Defect	*No Diabetes*	*Diabetes*
Biliary atresia	30	1
Rate	0.7	2.5
95% confidence interval	0.5-1.0	0.1-14.0
Genitourinary * **	**3,604**	**68**
Rate	**86.6**	**170.4**
95% confidence interval	**83.8-89.4**	**132.3-216.0**
Bladder exstrophy	22	0
Rate	0.5	0.0
95% confidence interval	0.3-0.8	0.0-9.2
Hypospadias ***	2,242	40
Rate	105.4	198.8
95% confidence interval	101.1-109.8	142.0-270.7
Epispadias	56	0
Rate	1.3	0.0
95% confidence interval	1.0-1.7	0.0-9.2
Obstructive genitourinary defect ***	1,162	24
Rate	27.9	60.1
95% confidence interval	26.3-29.6	38.5-89.5
Renal agensis/hypoplasia ***	200	9
Rate	4.8	22.6
95% confidence interval	4.2-5.5	10.3-42.8
Musculoskeletal *	**941**	**16**
Rate	**22.6**	**40.1**
95% confidence interval	**21.2-24.1**	**22.9-65.1**
Reduction deformity, upper limbs	88	3
Rate	2.1	7.5
95% confidence interval	1.7-2.6	1.6-22.0
Reduction deformity, lower limbs	85	3
Rate	2.0	7.5
95% confidence interval	1.6-2.5	1.6-22.0
Gastroschisis	223	1
Rate	5.4	2.5
95% confidence interval	4.7-6.1	0.1-14.0
Omphalocele	120	2
Rate	2.9	5.0
95% confidence interval	2.4-3.4	0.6-18.1

Table 8. Tennessee Birth Defects Counts and Rates by Maternal Diabetes, 2005-2009

Birth Defect	*No Diabetes*	*Diabetes*
Diaphragmatic hernia	151	2
Rate	3.6	5.0
95% confidence interval	3.1-4.3	0.6-18.1
Congenital hip dislocation *	308	7
Rate	7.4	17.5
95% confidence interval	6.6-8.3	7.1-36.1
Chromosomal	**678**	**9**
Rate	**16.3**	**22.6**
95% confidence interval	**15.1-17.6**	**10.3-42.8**
Trisomy 13	33	1
Rate	0.8	2.5
95% confidence interval	0.5-1.1	0.1-14.0
Down syndrome	582	7
Rate	14.0	17.5
95% confidence interval	12.9-15.2	7.1-36.1
Trisomy 18	67	1
Rate	1.6	2.5
95% confidence interval	1.2-2.0	0.1-14.0
Fetus or newborn affected by maternal alcohol use	**88**	**0**
Rate	**2.1**	**0.0**
95% confidence interval	**1.7-2.6**	**0.0-9.2**
Total Cases * **	**14,560**	**367**
Rate	**349.8**	**919.6**
95% confidence interval	**344.1-355.5**	**827.9-1019**
Total Live Births	**416,287**	**3,991**

Source: Tennessee Department of Health, Division of Policy, Planning and Assessment, Tennessee Birth Defects Registry 2005-2009.

Note:
[1]Counts include cases resulting from live births and fetal deaths.
[2]Rates were computed per 10,000 live births except for Hypospadias per 10,000 live male births.
[3]Statistical significance was determined by Poisson regression with statistical probabilities indicated as: p < 0.001***, P < 0.01** , p < 0.05*.
[4]95 percent confidence intervals for 100 or less cases are exact Poisson; otherwise confidence intervals are based on the normal approximation.
[5]Diagnostic data were derived from the Tennessee Hospital Discharge Data System (2005-2010), the Tennessee Death Statistical System (2005-2009) and the Tennessee Fetal Death Statistical System (2005-2009).
[6]Total live births were derived from the Tennessee Birth Statistical system (2005-2009).

Risk Factors and Prevention

Though the causal mechanisms of most birth defects are not fully understood, there are known risk factors that increase the likelihood of giving birth to a baby with a birth defect. Likewise, there are known ways to reduce one's risk of having a baby with a birth defect.

Prevention is the best strategy in public health. A woman can reduce her risk of delivering a baby born with a birth defect or other adverse outcome by taking precautions before and during pregnancy. The best time to start preventing pregnancy related complications is before a woman becomes pregnant. Most of the baby's vital organs and systems are formed in the first four to eight weeks of gestation, often before a woman knows she is pregnant. The majority of birth defects occur in this four to eight week period, and there are a number of actions a woman can take to improve her baby's health. However many of these actions are only effective if begun prior to pregnancy.

Preconception Health

- One of the best actions a woman can do to protect against birth defects and other negative health outcomes for herself and her baby is to connect with a healthcare provider that is regularly available to assess the woman's health prior to and post conception. Screening, monitoring, and treating common health problems such as high blood pressure and diabetes will help promote a healthy mother and baby. Making sure healthcare providers are aware of any prescription or nonprescription drugs and dietary supplements in use, as many of these could have adverse effects on a fetus. And, keeping regular appointments with healthcare providers, so they can monitor a woman's progress and help in dealing with any problems that could affect mother or baby.

Immunizations

- Being current on immunizations such as rubella and the flu is important too. Due to vaccinations, rubella also known as German measles is not as common as it once was, but international travel has brought it to the United States in recent years and minor epidemics have occurred among unvaccinated populations. Women who develop rubella during pregnancy risk affecting the fetus and their baby being born with congenital rubella syndrome.

- Babies affected by congenital rubella syndrome are at high risk of being born with birth defects of the heart and eyes, micorcephaly and sensorineural deafness. Receiving vaccinations prior to pregnancy protects both the baby and the mother from having to cope with the consequences of preventable infections. Chances of a fetus developing congenital rubella syndrome are estimated as greater than 50 percent, when the mother is infected early in pregnancy. The mumps, measles, rubella (MMR) vaccine is readily available and recommended for every person born after 1957 who has not had rubella. Influenza or the flu is another infection that can be minimized via vaccination.

Infections

- Toxoplasmosis is an additional infection to be avoided by women who are or may become pregnant. Babies born to women with a toxoplasmosis infection are at risk for hydrocephalus. Toxoplasmosis is caused by the parasite, Toxoplasma gondii. Toxoplasmosis is spread in several different ways, but cats are the primary vector of infection. Cats are infected from eating infected birds, rodents, and other small animals and pass the bacteria in their feces. For this reason, pregnant women are recommended to have someone else clean the cat litter box, or if they must to wear gloves while doing so, and wash their hands afterwards. Toxoplasma gondii is also spread through persons eating raw or undercooked meat, or handling it and not washing their hands afterwards. It is recommended to wash or peel all fruits and vegetables before eating; to thoroughly wash all cutting boards with soap and water; and to wear gloves when gardening or handling sand from a sandbox.

- Diabetes is a chronic disease affecting an increasing number of mothers. Babies born to mothers with type 1 and type 2 diabetes are at increased risk for: hydrocephaly; anotia/microtia; limb reduction defects; omphalocele; esophageal atresia; cleft lip with and without cleft palate; cleft palate; and hypospadias. Also the increased risk for the heart defects: atrioventricular septal defects; atrial septal defects; total anomalous return; tetralogy of Fallot; transposition of great arteries; atrial septal defect; and ventricular septal defect. Many of these birth defects may be prevented with prenatal care focused on controlling the diabetic mother’s blood sugar levels during pregnancy.

- Gestational diabetes is not associated with birth defects, because it develops later in pregnancy than the birth defect inception period. However, babies born to mothers with gestational diabetes are at risk of being born with a condition known as macrosomia, which is an extremely large body. This puts both the mother and baby at risk of serious birth trauma. Macrosomia babies are also at elevated risk for obesity and developing type 2 diabetes later in life.

- Folic Acid is a B-complex vitamin that is proven to be protective against neural tube defects such as anencephlus and spina bifida. It may also provide protection against other birth defects. To be fully effective a woman needs to begin taking the recommended daily dose of 400 micrograms at least a full month before becoming pregnant and continue to take folic acid daily during pregnancy. If a woman finds she is pregnant and has not been taking folic acid, it is best to start taking folic acid immediately and continue to do so thereafter. Folic acid is available in most multivitamins and is sold separately in folic acid tablets.

- Don't smoke cigarettes, drink alcohol or use illegal drugs. According to the March of Dimes, babies born to mothers who smoke cigarettes are more likely to be born premature and low birth weight. They are also more likely to be born with cardiovascular, orofacial, gastrointestinal, and musculoskeletal birth defects. There is no amount of alcohol that is safe to drink during pregnancy. When a pregnant woman drinks, the alcohol in her system passes from mother to baby through the placenta and umbilical cord. Drinking too much can cause fetal alcohol syndrome, which is a serious condition involving growth deficiencies; facial abnormalities; central nervous system impairment; behavioral disorder; and intellectual disabilities. Use of street drugs such as amphetamines and ecstasy are also associated with cleft lip; cleft palate; and club foot, as well as reduced head size; and intellectual disabilities.

- While there are certain hereditary and genetic factors that cannot be reduced, this lists illustrates there are many environmental factors that public health, new mothers to be and health care providers can address together to assist in reducing birth defect occurrences in infants born in Tennessee.

Glossary of Terms

Agenesis Absence of part(s) of the body. Lack of development or failure to develop part(s) of the body.

Alpha-fetoprotein A protein produced by the fetus during gestation. The level of this protein can be measured during the pregnancy. The level of this protein is elevated in pregnancies with neural tube defects and may be decreased in pregnancies with Down syndrome.

Amniocentesis A method of prenatal diagnosis which a small amount of amniotic fluid is withdrawn to obtain fetal cells, which can be tested for the presence of some genetic diseases.

Anencephalus Congenital absence of the skull, with cerebral hemispheres completely missing or reduced to small masses attached to the base of the skull. Anencephaly is not compatible with life.

Aniridia The complete absence of the iris of the eye or a defect of the iris.

Anophthalmia A developmental defect characterized by complete absence of the eyes, or by the presence of vestigial eyes.

Anotia A congenital absence of one or both ears.

Aortic valve stenosis A cardiac anomaly characterized by a narrowing or stricture of the aortic valve.

Aplasia Absence of a tissue or organ due to lack of cell proliferation.

Atresia Absence or closure of a normal opening.

Atrial septal defect A congenital cardiac malformation in which there are one or several openings in the atrial septum (wall between the right and left atria). Most common type is called ostium secundum defect.

Biliary atresia A congenital absence or underdevelopment of one or more of the ducts in the biliary tract.

Bladder exstrophy Incomplete closure of the anterior wall of the bladder and the abdominal cavity. The upper urinary tract is generally normal. Often associated with anorectal and genital malformations.

Congenital cataract An opacity (clouding) of the lens of the eye that has its origin prenatally.

Choanal atresia or stenosis A congenital anomaly in which a bony or membranous formation blocks the passageway between the nose and the pharynx.

Chromosome Threadlike structure in cells that individual genes are arranged along.

Chromosome abnormalities A major group of genetic diseases in which alterations of chromosome number or structure occur and are observable by microscope.

Cleft lip The congenital failure of the fetal components of the lip to fuse or join, forming a groove or fissure in the lip. Infants with this condition can have difficulty feeding and may use assistive devices for feeding. This condition is corrected when the infant can tolerate surgery.

Cleft palate The congenital failure of the palate to fuse properly forming a grooved depression or fissure in the roof of the mouth. This defect varies in degree of severity. The fissure can extend into the hard and soft palate and into the nasal cavities. Infants with this condition have difficulty feeding, and may use assistive devices for feeding. Surgical correction is begun as soon as possible. Children with cleft palates are at high risk for hearing problems due to ear infections.

Coarctation of the aorta Localized narrowing of the aorta. This condition can vary from mild to severe.

Common truncus arteriosus A congenital heart defect in which the common arterial trunk fails to divide into pulmonary artery and aorta.

Confidence interval (95%) The interval that contains the true prevalence (which can only be estimated) 95% of the time.

Congenital Existing at or dating from birth although the defect may not be recognized at the time of birth.

Congenital hip dislocation Location of the head of the femur (bone of the upper leg) outside its normal location in the cup-shaped cavity formed by the hip bones (acetabulum).

Diaphragmatic hernia A failure of the diaphragm to form completely, leaving a hole. Abdominal organs can protrude through the hole into the chest cavity and interfere with development of the heart and lungs. Usually life-threatening and requires emergent surgery.

Down syndrome (Trisomy 21) The chromosomal abnormality characterized by an extra copy of chromosome 21. In rare cases this syndrome is caused by translocation. Down syndrome is characterized by moderate to severe retardation, sloping forehead, small ear canals, flat-bridge of the nose and short fingers and toes. Many infants have congenital heart disease.

Dysgenesis Anomalous or disorganized formation of an organ.

Dysplasia Disorganized cell structure or arrangement within a tissue or organ.

Ebstein anomaly A congenital heart defect in which the tricuspid valve is displaced downward into the right ventricle.

Edwards syndrome See Trisomy 18.

Embryonic period The first eight weeks after fertilization, during which most, but not all, organs are formed.

Encephalocele Herniation of the brain through a defect in the skull.

Endocardial cushion defect In the complete form, a septal defect involving both the upper chambers (atria, atrial septal defect) and lower chambers (ventricles, ventricular septal defect) such that there is a single large atrioventricular septal defect. There are incomplete forms as well.

Epispadias Displacement of the opening of the urethra (urethral meatus) dorsally and proximally (on top and closer to the body) in relation to the tip of the glans of the penis.

Esophageal stenosis or atresia A narrowing or incomplete formation of the esophagus. Usually a surgical emergency. Frequently associated with a Tracheoesophageal Fistula.

Extremely low birth weight Birth weight less than 1,000 grams, regardless of gestational age.

Fetal alcohol syndrome A constellation of physical abnormalities (including characteristic abnormal facial features and growth retardation), and problems of behavior and cognition in children born to mothers who drank alcohol during pregnancy.

Fetal death (stillborn) Death prior to complete expulsion or extraction of an infant or fetus of 350 grams or more, or, in absence of weight, of 20 weeks' gestation or greater; death is indicated by the fact that, after expulsion or extraction, 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 (68-3-102).

Fetal period The period from the ninth week after fertilization through delivery.

Fetal ultrasound A diagnostic examination of the fetus using ultrasound (sound waves at a frequency above what is detectable to human hearing).

Fistula An abnormal passage from an internal organ to the body surface or between two internal organs or structures.

Folic acid deficiency A lack of folic acid in the mother's diet which may lead to an increased risk for neural tube defects. Current recommendations from the March of Dimes indicate that women who are or may become pregnant should take a folic acid supplement to decrease the risk of neural tube defect.

Gastroschisis A congenital opening of the abdominal wall with protrusion of the intestines. This condition is surgically treated.

Genetic counseling The delivery of information about the risks, natural history, and management of genetic diseases to patients and/or their families.

Hirschsprung's disease The congenital absence of autonomic ganglia (nerves controlling involuntary and reflexive movement) in the muscles of the colon. This results in immobility of the intestines and may cause obstruction or stretching of the intestines. This condition is repaired surgically in early childhood by the removal of the affected portion of the intestine.

Holocephalus The abnormal accumulation of fluid within the spaces of the brain.

Hydrocephalus The abnormal accumulation of fluid within the skull.

Hyperplasia Overgrowth characterized by an increase in the number of cells of tissue.

Hypoplasia A condition of arrested development in which an organ or part remains below the normal size or in an immature state.

Hypoplastic left heart syndrome Atresia, or a marked hypoplasia, of the aortic valve, atresia or marked hypoplasia for the mitral valve, with hypoplasia of the ascending aorta and underdevelopment of the left ventricle.

Hypospadias A congenital defect in which the urinary meatus (urinary outlet) is on the underside of the penis or on the perineum (area between the genitals and anus). The urinary sphincters are not defective so incontinence does not occur. The condition may be surgically corrected if needed for cosmetic, urologic, or reproductive reasons.

Infant death Death of a live-born infant before 12 months of age.

Live birth Spontaneous delivery of an infant that exhibits signs of life, including a heartbeat, spontaneous breathing, or movement of voluntary muscles. Transient cardiac contractions and fleeting respiratory efforts or gasps are not necessarily considered signs of life by all programs.

Lower limb reduction defects The congenital absence of a portion of the lower limb. There are two general types of defect, transverse and longitudinal. Transverse defects appear like amputations, or like missing segments of the limb. Longitudinal defects are missing rays of the limb (for example, a missing tibia and great toe).

Low birth weight Birth weight less than 2,500 grams, regardless of gestational age.

Malformation A primary morphologic defect resulting from an abnormal developmental process.

Maternal serum screening A diagnostic method that examines the mother's blood serum for indicators of anomalies in the process of fetal development.

Mental retardation A condition of below average intellectual ability (IQ less than 70) that is present from birth or infancy.

Microcephaly Congenital smallness of the head, with corresponding smallness of the brain.

Microphthalmia The congenital abnormal smallness of one or both eyes. Can occur in the presence of other ocular defects.

Microtia A small or maldeveloped external ear and atretic or stenotic external auditory canal.

Multifactorial A term used to describe characteristics or diseases that are caused by a combination of multiple genetic and environmental factors.

Multiple congenital anomaly Term used to describe the presence of more than one anomaly at birth.

Mutagen Substance that is known to cause a mutation.

Mutations Alterations in the sequence of DNA.

Neonatal death Death of a live-born infant within the first 28 days after birth. *Early neonatal death* refers to death during the first 7 days. *Late neonatal death* refers to death after 7 days but before 29 days.

Neonatal (newborn) period The first 28 days following delivery of a live-born infant.

Neural tube defect A defect resulting from failure of the neural tube to close in the first month of pregnancy. The major conditions include anencephaly, spina bifida, and encephalocele.

Obstructive genitourinary defect Stenosis or atresia of the urinary tract at any level. Severity of the defect depends largely upon the level of the obstruction. Urine accumulates behind the obstruction.

Omphalocele The protrusion of intestines into the umbilicus. The defect is usually closed surgically soon after birth.

Patau Syndrome See Trisomy 13

Patent ductus arteriosus A blood vessel between the pulmonary artery and the aorta. This is normal in fetal life, but can cause problems after birth, particularly in premature infants.

Periconceptual At or around the time of conception.

Perinatal Before, during, or after delivery. The exact time period may vary from 20 to 28 complete weeks of gestation through 7 to 28 days after delivery, depending on the context in which the term is used.

Postnatal After delivery.

Postterm infant An infant born after 42 completed weeks of gestation.

Prenatal Before delivery.

Preterm infant An infant born before 37 completed weeks of gestation.

Pulmonary artery anomaly Abnormality in the formation of the pulmonary artery such as stenosis or atresia.

Pulmonary valve atresia or stenosis Failure of formation of the pulmonary valve or a narrowing or obstruction of the pulmonary valve, resulting in obstruction of blood flow from the right ventricle to the pulmonary artery.

Pyloric stenosis A narrowing of the outlet from the stomach to the small intestine resulting in complete or partial obstruction of the passage of food and gastric contents.

Rectal and large intestinal atresia/stenosis Complete or partial occlusion of the lumen of one or more segments of the large intestine and/or rectum.

Reduction defects: lower and upper limbs The congenital absence of a portion of the lower or upper limbs. There are two general types of defect, transverse and longitudinal. Transverse defects appear like amputations with the complete or partial absence of the arm or leg. Longitudinal defects are missing rays of the limb and may involve the preaxial (thumb or big toe side) or central parts of the arm or leg.

Renal agenesis or dysgenesis The failure, or deviation, of embryonic development of the kidney.

Spina bifida An incomplete closure of the vertebral spine (usually posterior) through which spinal cord tissue or membranes (meninges) covering the spine herniated.

Stenosis A narrowing or constriction the diameter of a bodily passage or orifice.

Stenosis or atresia of the small intestine A narrowing or incomplete formation of the small intestine obstructing movement through the digestive tract.

Syndrome A pattern of multiple primary malformations or defects all due to a single underlying cause (for example, Down syndrome).

Teratogen A substance in the environment that can cause a birth defect.

Term infant An infant born after 37 complete weeks and before 42 complete weeks of gestation.

Tetralogy of Fallot The simultaneous presence of a ventricular septal defect, pulmonic stenosis, a malpositioned aorta that overrides the ventricular septum, and right ventricular hypertrophy.

Transposition of the great arteries	A congenital malformation in which the aorta arises from the right ventricle and the pulmonary artery from the left ventricle (opposite of normal), so that the venous return from the peripheral circulation is recirculated without being oxygenated in the lungs. Immediate surgical correction is needed. When this is not associated with other cardiac defects, and not corrected, it is fatal.
Tricuspid valve atresia or stenosis	A congenital cardiac condition characterized by the absence or constriction of the tricuspid valve.
Trisomy	A chromosomal abnormality characterized by one more than the normal number of chromosomes. Normally, cells contain two of each chromosome. In trisomy, cells contain three copies of a specific chromosome.
Trisomy 13 (Patau syndrome)	The chromosomal abnormality caused by an extra chromosome 13. Characterized by impaired midline facial development, cleft lip and palate, polydactyly and severe mental retardation. Most infants do not survive beyond 6 months of life.
Trisomy 18 (Edwards syndrome)	The chromosomal abnormality caused by an extra copy of chromosome 18. It is characterized by mental retardation, growth retardation, low-set ears, skull malformation and short digits. Survival for more than a few months is rare.
Trisomy 21	See Down Syndrome.
Ventricular Septal Defect	A congenital cardiac malformation in which there are one or several openings in the ventricular system (Muscular and fibrous wall between the right and left ventricle or right and left lower chambers of the heart).
Very Low Birth Weight	Birthweight less than 1,500 grams, regardless of gestational age.