

BIRTH DEFECT RELATED INFANT AND FETAL MORTALITY

Background

Infant mortality, which is classified as a death prior to an infant's first birthday, occurs in 6 out of every 1,000 live births in the United States.^{1,2} In the U.S. and Michigan alike, birth defects are the leading cause of infant mortality.³

Birth defects are also a leading cause of fetal mortality.^{4,5} Fetal mortality, which is classified as death of a fetus at 20 weeks of gestation or more, occurs in 6 out of every 1,000 live births in the U.S.^{1,6}

Infant and fetal mortality are a tragedy on a personal level, and like birth defects, are broad indicators of population health.

Unfortunately, preventing birth defect related infant and fetal deaths proves difficult. The cause of birth defects is often unknown and their contribution to individual mortality may be unclear.

Studies have shown that maternal demographic factors such as minority race and low levels of educational attainment, and maternal health factors like chronic diabetes, may contribute to the risk of birth defects as well as other adverse birth outcomes.⁷⁻¹³ Therefore, addressing these factors may be an essential avenue of prevention.

Birth defects are reported to the Michigan Birth Defects Registry (MBDR) by hospitals and other reporting entities. Infant and fetal death certificates are submitted to the Division of Vital Records and Health Statistics. This issue presents infant and fetal mortality trends in relation to birth defects, for babies born in Michigan between 2004 and 2013.

Points of Interest

- ✦ Birth defects are a leading cause of infant and fetal mortality.³⁻⁵
- ✦ Preterm birth and low birth weight often accompany birth defects.^{10,12}
- ✦ Maternal and infant vulnerability, as measured by the co-occurrence of multiple risk factors, may play a role in the relationship between birth defects and infant death.

Etiology

The leading causes of infant death include:³

- Birth defects
- Preterm and low birth weight deliveries
- Maternal complications of pregnancy
- Sudden Unexpected Infant Death Syndrome (SUIDS)
- Birth injuries

The cause of fetal death in most babies is unknown.

Possible causes include:⁵

- Birth defects or genetic problems
- Other fetal health conditions
- Problems with the placenta or umbilical cord
- Maternal health conditions

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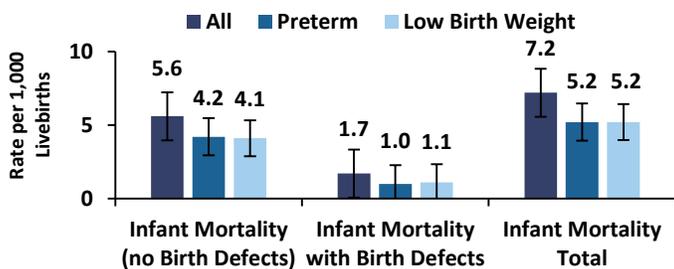
Infant Deaths and Birth Defects per Live Birth-Death Linked Data and MBDR Reporting, 2004-2013

Occurrence

In general, birth defects are categorized by the location or system of the body that is affected. Some are structural, such as ‘a hole in the heart.’ Others are functional, such as metabolic disease. This analysis focused on the rate of all structural birth defects per MBDR reporting because they tend to be the most apparent at birth and within infancy. In Michigan between 2004 and 2013, the overall infant mortality rate (IMR) was 7.2 per 1,000 live births. During this time frame, 46,051, around 3.8 percent, of the 1,204,642 infants that were born in Michigan, were reported to the MBDR as diagnosed with a structural birth defect. During this same time period, 8,631 Michigan babies experienced an infant death; 1,980 of these infants were reported to the MBDR. Among them, the IMR was 1.7 per 1,000 live births (Figure 1).

We also stratified the IMR of infants with and without a reported birth defect by adverse birth outcomes. The IMR of all infants born preterm and for those born at a low birth weight was 5.2 per 1,000 live births. The IMR of infants with a reported birth defect that were also born preterm or low birth weight was 1.0 and 1.1 per 1,000 live births, respectively (Figure 1).

Figure 1. Infant Mortality Rate in all Livebirths, Livebirths with Birth Defects, and Livebirths without Birth Defects (2004-2013)



Demographics

Among infants that had a reported structural birth defect, maternal demographics, as reported on the birth certificate, differed between those that experienced an infant death and those that did not (Table 1). Statistically significant differences were found for maternal age, race, source of payment used for delivery, quality of maternal care (Kotelchuck Index), and singleton vs. multiple gestation. Mothers of infants in these groups were not statistically different by maternal education,

Table 1: Maternal Risk Factors, Infant Death vs. No Infant Death in Infants with a Reported Structural Birth Defect (2004-2013)

Maternal Risk Factor	Infant Death ¹ (n = 1,980) n (%)	No Infant Death ¹ (n = 44,071) n (%)	P-Value
Maternal Age			0.01
<15 and >35 yrs	330 (16.7)	6,385 (14.5)	
16-34 yrs	1,650 (83.3)	37,686 (85.5)	
Maternal Race			<0.01
White	1,345 (67.9)	28,171 (63.9)	
Non white ²	635 (32.1)	15,900 (36.1)	
Maternal Education			0.16
<High School	396 (20.0)	8,253 (18.7)	
High School or greater	1,584 (80.0)	35,818 (81.3)	
Source of Payment			<0.01
Private insurance	1,014 (51.2)	25,053 (56.9)	
Medicaid or other form	966 (48.8)	19,018 (43.1)	
Chronic Diabetes			0.17
Yes	70 (3.5)	1,318 (3.0)	
Chronic Hypertension			0.57
Yes	45 (2.3)	919 (2.1)	
Smoking			0.63
Yes	372 (18.8)	8,090 (18.4)	
Kotelchuck Index			<0.01
Adequate Plus or Inadequate	1,237 (62.5)	19,542 (44.3)	
Adequate or Intermediate	743 (37.5)	24,529 (55.7)	
Multiple Gestation			<0.01
Yes	223 (11.3)	2,979 (6.8)	
Named Parents			0.05
One parent	474 (23.9)	9,719 (22.1)	
Multiple parents	1,506 (76.1)	34,352 (77.9)	

¹Numbers and percentages are based on births to mothers living in Michigan at the time of delivery. Data are current through January 2016.

²Includes women who do not define themselves as White and includes Native American and Asian/Pacific Islander.

chronic diabetes status, chronic hypertension status, smoking, and maternal support (named parents).

Among infants with a reported structural birth defect, we found differences in adverse birth outcomes between those that experienced an infant death and those that did not (Table 2). Babies that experienced an infant death were more likely to have been born preterm (< 37 weeks' gestation), at a low birth weight (<2,500 grams), and to have been admitted to the NICU than babies who lived until their first birthday.

Table 2: Infant Risk Factors, Infant Death vs. No Infant Death in Infants with a Reported Birth Defect (2004-2013)

Adverse Birth Outcome	Infant Death ¹ (n = 3,439) n (%)	No Infant Death ¹ (n = 130,490) n (%)	P-value
Preterm			<0.01
Yes	1,203 (60.8)	10,895 (24.7)	
Low Birth Weight			<0.01
Yes	1,295 (65.4)	10,035 (22.8)	
NICU Admission			<0.01
Yes	1,132 (57.2)	10,444 (23.7)	

¹Numbers and percentages are based on births to mothers living in Michigan at the time of delivery. Data are current through January 2016.

Maternal and Infant Vulnerability

Determinants of health are factors that contribute to a person’s overall health. The maternal demographics observed here include biological, medical, behavioral, and social factors that can affect health. Many social determinants of health contribute to the risk of birth defects and infant mortality, although not all of these are known risk factors for both outcomes. For example, minority maternal race is a major risk factor for infant mortality, but is not strongly correlated to birth defects overall.^{14,15}

The cause of birth defects is often unknown. A mother’s vulnerability, as measured by the number of concurrent risk factors she experiences, may play a role.⁷ Likewise, adverse birth outcomes frequently accompany birth defects leading to greater infant vulnerability.^{10,12} Therefore, we investigated whether or not infants born with birth defects to vulnerable mothers, as well as infants born with birth defects who are at increased

vulnerability due to adverse birth outcomes, may be at greater risk for infant death.

To examine this potential association, we calculated two vulnerability scores for each live birth in Michigan between 2004 and 2013. The first score was based on how many of the ten maternal risk factors from Table 1 were present (Mother’s vulnerability), and the second was based on how many of the three adverse birth outcomes from Table 2 were present within a given infant (Infant’s vulnerability). Maternal risk factors and adverse birth outcomes were measured as present or absent depending on whether it was a factor that applied to a respective infant. The more maternal risk factors or adverse birth outcomes that were present, the higher the vulnerability score. The results of this analysis revealed that among infants with a reported structural birth defect, the risk of infant death increased with increasing maternal (RR 6.10; 95 percent CI 5.79-6.44) and infant (RR 3.25; 95 percent CI 3.08-3.44) vulnerability (Table 3).

Table 3: Risk of Infant Death in Infants with Structural Birth Defects by Maternal and Infant Vulnerability (2004-2013)

Birth Outcome	Adj. Risk Ratio (95%CI)	P-value
Birth Defect (Adjusted for Mother’s Vulnerability)¹	6.10 (5.79-6.44)	<0.01
Birth Defect (Adjusted for Infant’s Vulnerability)²	3.25 (3.08-3.44)	<0.01

¹Refer to Table 1 for the list of maternal factors that are included within this vulnerability score.

²Refer to Table 2 for the list of infant adverse birth outcomes that are included within this vulnerability score.

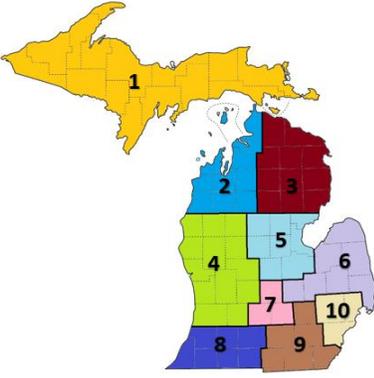
Burden of Birth Defects and Infant Mortality Throughout Michigan, 2004-2013

Occurrence

The burden of birth defect related infant mortality is not evenly distributed throughout the state of Michigan (Table 4). Michigan is broken down into ten prosperity regions based on common geographic, demographic, and economic factors. When the birth defects and infant mortality are examined by prosperity region, it is evident that the burden is greater in some regions than others. During the study period, birth defect related infant mortality rates were the highest in prosperity regions 4 (2.08 per 1,000 live births) and 5 (2.18 per 1,000 live births). Oppositely, birth defect related infant mortality rates were the lowest in prosperity regions 1 (0.85 per 1,000 live births) and 6 (1.13 per 1,000 live births).

Table 4: Structural Birth Defect Related Infant Mortality Rates by Prosperity Region (2004-2013)

Prosperity Region	Infant Mortality Rate ^{1,2}
1	0.85
2	1.96
3	1.70
4	2.08
5	2.18
6	1.13
7	1.39
8	1.87
9	1.26
10	1.59



Footnotes to Table 4.
¹Infant mortality rates are based on births to mothers living in Michigan at the time of delivery. Data are current through January 2016.
²Infant mortality rate expressed as deaths per 1,000 live births.
 *Regions approximate Michigan's prosperity regions.

Table 5: Maternal Risk Factors, Structural Birth Defect vs. No Structural Birth Defect in Fetal Deaths (2004-2013)

Maternal Demographic	Birth Defects ¹ (n = 1,342) n (%)	No Birth Defects ¹ (n = 5,163) n (%)	P-Value
Maternal Age			<0.01
<15 and >35	277 (21.0)	878 (17.3)	
16-34	1,042 (79.0)	4,205 (82.7)	
Maternal Race			<0.01
White	926 (69.0)	3,144 (60.9)	
Non white ²	416 (31.0)	2,019 (39.1)	
Maternal Education			0.03
<High School	198 (14.8)	891 (17.3)	
High School or greater	1,144 (85.2)	4,272 (82.7)	
Source of Payment			<0.01
Private Insurance	643 (47.9)	2,875 (55.7)	
Medicaid or other form	699 (52.1)	2,288 (44.3)	
Chronic Diabetes			0.90
Yes	34 (2.5)	134 (2.6)	
Chronic Hypertension			0.04
Yes	47 (3.5)	249 (4.8)	
Smoking			<0.01
Yes	340 (25.3)	1,577 (30.5)	
Multiple Gestation			0.01
Yes	87 (6.5)	451 (8.7)	
Marital Status			0.64
Married	617 (45.9)	2,411 (46.7)	
Not Married	725 (54.1)	2,752 (53.3)	

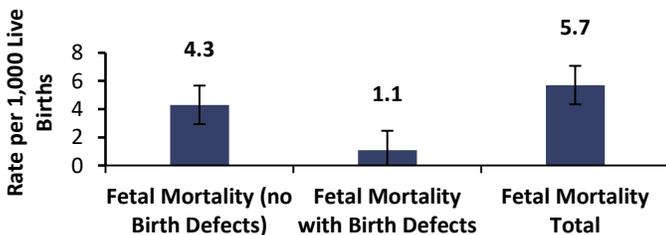
¹Numbers and percentages are based on births to mothers living in Michigan at the time of delivery. Data are current through January 2016.
²Includes women who do not define themselves as White and includes Native American and Asian/Pacific Islander.

Fetal Deaths and Birth Defects per Fetal Death Certificate, 2004-2013

Occurrence

In the United States, the fetal mortality rate is around 6.05 per 1,000 live births.^{1,6} In Michigan between 2004 and 2013, the fetal mortality rate was 5.7 per 1,000 live births. During this time frame, 6,909 fetal deaths occurred in Michigan. Of these deaths, 1,342 were reported as having a structural birth defect on their fetal death certificate. Among those reported as having a structural birth defect on their death certificate, the fetal mortality rate was 1.1 per 1,000 live births (Figure 2).

Figure 2. Fetal Mortality Rate in all Livebirths, Livebirths with Birth Defects, and Livebirths without Birth Defects (2004-2013)



Demographics

We assessed certain demographic factors for reported fetal deaths. We found differences between those that were reported as having a structural birth defect and those without a reported birth defect (Table 5). Those with a structural birth defect were statistically different in maternal age, race, education, source of payment for delivery, chronic hypertension status, smoking, and singleton vs. multiple gestation. The two groups did not differ by chronic diabetes or marital status.

Addressing Infant and Fetal Mortality in Michigan

Infant Mortality Reduction Plan

Michigan's current [Infant Mortality Reduction Plan](#) will be sunseting soon. MDHHS and the Maternal Infant Strategy Group (MISG), in collaboration with regional partners, will be hosting town hall meetings to garner community input and support for the 2019-2022 Mother Infant Health Improvement Plan. The meetings will be held in 4 regions of the state, with invitations to anyone invested in improving the health of mothers and infants in Michigan. Goals for each meeting include introducing the plan, collecting feedback from the community to determine priorities and barriers to successful program implementation, and bridging community partners to work to improve health outcomes.

To register to attend the townhall meetings:
<https://www.surveymonkey.com/r/MIHIPTownHalls>



Fetal and Infant Mortality Review

[Fetal and Infant Mortality Review](#) (FIMR) is a process of identification and analysis of factors that contribute to fetal and infant death through chart review and interview of individual cases. FIMR complements other studies of infant death by using an approach that is community-based and designed to bring together local health providers, consumers, advocates and leaders to identify key issues and take action to address them.

Provider Tips

- ✦ Anticipate and screen for depression. Offer and/or link to mental health treatment.
- ✦ Fathers grieve too. Acknowledge that family members grieve and express themselves differently. Help bereaved caregivers find support.
- ✦ Bereaved parents may be eager to become pregnant again. Discuss the importance of recommended interpregnancy intervals.
- ✦ Discuss post-mortem examination to assess risk and inform prenatal care in a subsequent pregnancy.
- ✦ Help develop an interpartum care plan to address specific risk factors.
- ✦ Facilitate public health activities to address fetal and infant mortality.

MI Pregnancy Risk Assessment Monitoring System (PRAMS)

[Pregnancy Risk Assessment Monitoring System](#) (PRAMS) is a joint project between MDHHS and the Centers for Disease Control and Prevention (CDC). PRAMS' purpose is to find out why some babies are born healthy and others are not. The PRAMS questionnaire asks new mothers about their behaviors and experiences before, during and after their pregnancy. The PRAMS project collects information about a wide range of health determinants in order to understand their impact and better inform public health activities to improve the health of Michigan babies.

What does it mean?

Infant Death

A live birth that ends in death within the first year of life

Fetal Death

Intrauterine death of a fetus at 20 weeks' gestation or more and weighing 400 grams or more

Birth Defect

Structural, behavioral, functional, and metabolic disorders present at birth (also called congenital malformation and congenital anomaly)

**Birth Defects Education and Outreach Program,
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333 S. Grand Ave.
Lansing, MI 48913**

Toll Free: 1-866-852-1247

E-mail: BDRFollowup@michigan.gov

Website:

www.michigan.gov/birthdefectsinfo

The Michigan Monitor is online at:

www.michigan.gov/mchepi

MBDR reporting:

<http://www.michigan.gov/mbdr>

Give us your
feedback!

Public Health Impact and Next Steps

Our findings demonstrate the need for continued focus on supporting our most vulnerable populations, in order to decrease rates of infant mortality overall and to lower the impact of birth defects. We must continue our investment in programs that help women and babies receive recommended health screenings and follow up. In addition to optimizing routine post-

partum care, new mothers of infants with birth defects, as well as other adverse birth outcomes, need to connect with community and support services before discharge. Post-partum and well infant visits provide an essential opportunity for the provider to assess needs and refer to services. Finally, programs and providers must continue to coach clients in the practice of healthy behaviors before and during pregnancy.



Resources for health professionals and families

Birth Defects and Risk Factors

- MBDR Online Statistics: http://www.michigan.gov/mdhhs/0,5885,7-339-73970_2944_4669_4694---,00.html
- Michigan Fetal and Infant Mortality Review: http://www.michigan.gov/mdhhs/0,5885,7-339-73971_4911_4912-12563--,00.html
- Centers for Disease Control and Prevention, National Center on Birth Defects and Disabilities: www.CDC.gov/NCBDDD/birthdefects
- National Birth Defects Prevention Network (NBDPN): www.nbdpn.org
- March of Dimes: <http://www.marchofdimes.org/>

Mother, Child and Family Services and Supports

- Children's Special Health Care Services (CSHCS) Program and the Family Center: www.michigan.gov/cshcs and www.michigan.gov/familycenter
- Early On®, Michigan's early intervention system: www.1800earlyon.org
- Early Hearing Detection and Intervention: www.michigan.gov/ehdi
- Home Visiting Programs: www.michigan.gov/homevisiting
- Michigan's Family to Family Information Center: <http://f2fmichigan.org>

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