

# The Michigan Monitor

Following trends, promoting prevention  
and linking families to resources

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### Points of Interest

- Only about 54% of infants who fail their final hearing screen have an audiologic evaluation by 3 months of age.
- Infants with co-morbid conditions are less likely to have a diagnostic evaluation by 3 months of age.
- Infants with alimentary canal or digestive system defects were less likely to have an audiologic evaluation by 3 months of age than those who did not have those defects.

## Birth Defects and Hearing Loss

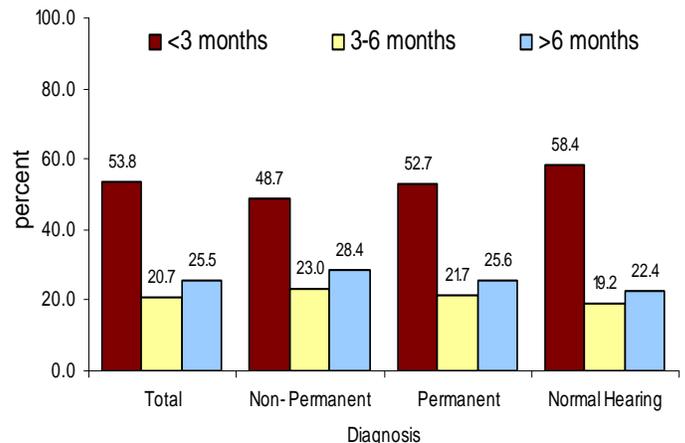
Many infants born with hearing loss have no additional medical issues, however, about 1/3 will have other health concerns, including birth defects. Infants with certain conditions may have urgent medical issues which delay hearing screens, while others may be screened early due to having birth defects that are obvious risk factors for hearing loss. The Michigan Birth Defects Program works with the Early Hearing Detection and Intervention (EHDI) Program, housed in the Michigan



Department of Community Health (MDCH), to help identify infants and children with hearing loss. The Michigan Birth Defects Registry (MBDR) data can be linked to EHDI data to verify reports of hearing loss in each program and to explore factors, such as additional defects, that may affect timely screening and diagnosis of hearing loss. This issue of the *Michigan Monitor* explores factors associated with early detection of hearing loss using data from both the MBDR and EHDI.

## Early Hearing Detection and Intervention (EHDI) Program

Congenital hearing loss is one of the most common types of birth defects, affecting about 1 to 3 infants per 1,000 live births in Michigan. Research has shown that early identification of hearing loss and enrollment in intervention services may lead to significant benefits in childhood development, including improvements in emotional development, language, learning, and social skills.<sup>1</sup> As part of MDCH, the EHDI Program works to identify infants with hearing loss and follows these infants to enrollment in early intervention services. The MI EHDI program works to accomplish the National EHDI goals, established by the CDC, state, and other national agencies. These goals include: 1) all newborns will be screened for hearing loss no later than **1 month** of age, preferably before hospital discharge, 2) all infants who screen positive for hearing loss will have a diagnostic audiologic evaluation no later than **3 months** of age, and 3) all infants identified with hearing loss will receive appropriate early intervention services no later than **6 months** of age.<sup>2</sup> However, Michigan, as well as the US, is not meeting the goal that all infants have a diagnosis by 3 months of age. In Michigan, a total of 54% of infants who were born in 2008 and failed their last hearing screen had a diagnostic evaluation by 3 months of age. By diagnosis category, 49% of those with non-permanent hearing loss, 53% of those with permanent hearing loss, and 58% of those with normal hearing had an audiologic evaluation by 3 months of age. Factors that may prevent early diagnosis of hearing loss need to be explored to identify more efficient strategies for improvement.



**Figure 1:** Age at diagnostic evaluation by type of diagnosis for infants who failed their last hearing screen: Michigan EHDI, 2008.<sup>3</sup>

# Risk Factors Associated with Early Hearing Diagnostic Evaluations among Michigan Infants

*MBDR and Michigan EHDI Data, 2004-2006*

## Purpose

The purpose of this study was to estimate the effects of selected variables and birth defects on early hearing diagnostic evaluations among Michigan infants. Predictors selected for analyses included total number of co-morbid conditions, result of final hearing screen, hearing loss diagnosis, and maternal race, age, and education.

## Methods

The Michigan EHDI Program data was linked to the MBDR via live birth records as an intermediate file, using the birth certificate number as a common, unique identifier, for birth years 2004 through 2006. Crude and adjusted associations (odds ratios [OR's] and 95% confidence intervals [CI's]) between the outcome and predictors from the linked data were determined.

## Results

A total of 1,115 infants with an audiologic evaluation were identified from the linked MBDR-EHDI file. Of those infants, 46% received an evaluation by three months of age. Of infants with an evaluation, 414 (42.8%) had permanent hearing loss, 720 (54.9%) failed the final hearing screen, and 643 (58.9%) had at least one birth defect per MBDR reporting. For mothers of these infants, 818 (73.5%) were white, 700 (62.8%) were 25 years or older, and 479 (43.9%) had a college education or higher (Table 1).

Diagnosis by 3 months of age was *highest* among those who: had one additional anomaly, had failed the final hearing screen, had non-permanent hearing loss, were neither black nor white, had a mother younger than 25 years, and a college education or higher. Diagnosis by 3 months was *lowest* among those who: had more than three additional anomalies, had passed

**Table 1:** Estimated crude and adjusted effects (OR and 95% CI) of selected factors on early diagnostic evaluations: MBDR-EHDI data, 2004-2006.<sup>4</sup>

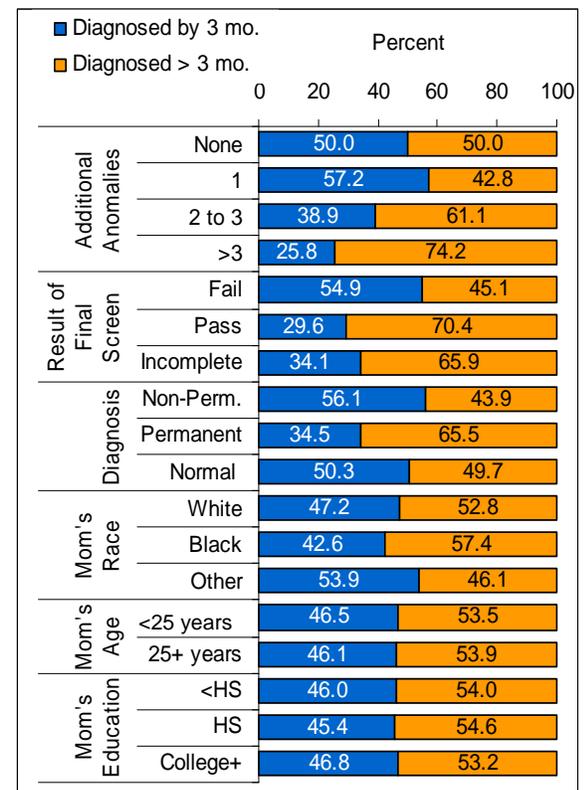
Risk Factors	Number Infants	Crude OR	Adjusted	
			OR	95% CI
<b>Total Additional Anomalies</b>				
None	448	1	1	
One	285	1.3	1.2	(0.83, 1.7)
Two to Three	203	<b>0.64</b>	<b>0.58</b>	<b>(0.39, 0.87)</b>
More than Three	155	<b>0.35</b>	<b>0.35</b>	<b>(0.22, 0.55)</b>
<b>Result of Final Screen</b>				
Fail	720	1	1	
Pass	304	<b>0.35</b>	<b>0.31</b>	<b>(0.22, 0.43)</b>
Incomplete	91	<b>0.43</b>	<b>0.38</b>	<b>(0.22, 0.68)</b>
<b>Diagnosis</b>				
Non-Permanent	264	1	1	
Permanent	414	<b>0.41</b>	<b>0.42</b>	<b>(0.30, 0.59)</b>
Normal Hearing	290	0.80	0.81	(0.55, 1.2)
<b>Maternal Race</b>				
White	818	1	1	
Black	256	0.83	<b>0.70</b>	<b>(0.49, 0.98)</b>
Other	39	1.3	1.32	(0.64, 2.7)
<b>Maternal Age</b>				
< 25 years old	415	1	1	
25+ years old	700	0.99	0.96	(0.70, 1.3)
<b>Maternal Education</b>				
<High School	235	1	1	
High School	377	0.98	1.0	(0.71, 1.5)
College or More	479	1.0	1.1	(0.72, 1.6)

\*Adjusted for all factors in the table.

the final hearing screen, had permanent hearing loss, were black, had a mother 25 years or older, and a high school education only (Figure 2).

Table 1 shows the estimated crude and adjusted associations (OR's and 95% CI's) between

the risk factors and diagnosis by three months of age. Those who had two to three co-morbid anomalies were about 2/3 as likely and those with more than three co-morbid anomalies were about 1/3 as likely as those with no additional anomalies to be diagnosed by 3 months of age. Those who had passed or had an incomplete final hearing screen were about 1/3 as likely as those who failed the final screen to have a timely diagnosis. Those with permanent hearing loss were less likely to be diagnosed by three months than those with non-permanent hearing loss (OR=0.42). Those who were black were less likely to be diagnosed by three months, compared to those who were white (OR=0.70). Maternal age and education were not associated with early diagnosis.



**Figure 2:** Percentage of total infants with diagnosis by 3 months of age, by selected factors: MBDR-EHDI data, 2004-2006.<sup>4</sup>

**Table 2:** Estimated crude and adjusted effects (OR and 95% CI) of birth defects on early diagnostic evaluations: MBDR-EHDI data, 2004-2006.<sup>4</sup>

Additional Anomaly	Number of Infants	Crude OR	Adjusted <sup>1</sup>	
			OR	95% CI
CNS	85	<b>0.61</b>	1.2	(0.62, 2.2)
Eye	46	0.89	1.4	(0.64, 3.0)
Ear, Face, Neck	71	1.1	1.3	(0.70, 2.4)
Heart and Circulatory	255	<b>0.54</b>	0.66	(0.43, 1.0)
Respiratory	84	<b>0.44</b>	0.98	(0.53, 1.8)
Cleft Lip/Palate	47	0.85	0.88	(0.38, 2.0)
Alimentary / Digestive	90	<b>0.24</b>	<b>0.35</b>	<b>(0.17, 0.72)</b>
Genital and Urinary	96	1.0	1.5	(0.86, 2.7)
Musculoskeletal	163	0.98	<b>1.7</b>	<b>(1.1, 2.7)</b>
Integument	36	0.64	0.65	(0.28, 1.5)
Chromosomal	83	0.79	1.1	(0.62, 1.9)
Other and Unspecified	70	<b>0.44</b>	0.73	(0.37, 1.5)

\*For each category, the reference is those who did not have that specific diagnosis, but have any other diagnosis or diagnoses.

<sup>1</sup>Adjusted for total number of anomalies, result of final screen, diagnosis, race, age, and education.

## Additional Anomalies

Additional analysis of the data was performed to assess the effect of specific types of birth defects on having a timely diagnostic evaluation for hearing loss. Those with alimentary canal or digestive system defects were about 1/3 as likely to have a timely audiologic evaluation compared to those without the defect, after controlling for all factors listed in Table 1 (Table 2). After adjusting for the same factors, those with musculoskeletal defects were almost two times as likely as those without musculoskeletal defects to have an early evaluation (Table 2). Those with central nervous system (CNS), heart, respiratory, or other conditions were less likely to have an audiologic evaluation by three months, compared to those without any of the conditions, but the association did not hold after controlling for all factors.

Of note, the categories of diagnoses are not exclusive, meaning that children with more than one defect may be in more than one category. This issue was resolved by additionally analyzing single and multiple anomalies. Diagnoses reporting is per the MBDR and the severity of each case is not known. Additional analyses for infants with multiple conditions should be explored in detail to assess explanations for early or late audiologic diagnoses. In order to gain more insight, the sample size could be increased by analyzing additional years of data.

## References

- <sup>1</sup>Yoshinaga-Itano C, Sedey A. Early speech development in children who are deaf or heard-of-hearing: Interrelationships with language and hearing. *Volta Review*. 1999; 103: 570-575.
- <sup>2</sup>National EHDI Goals. Centers for Disease Control and Prevention. Found on 2 August 2010 at <http://www.cdc.gov/ncbddd/ehdi/nationalgoals.htm>
- <sup>3</sup>Michigan Early Hearing Detection and Intervention (EHDI) Data, 2008.
- <sup>4</sup>Linked Michigan Birth Defects Registry (MBDR) and Michigan Early Hearing Detection and Intervention Data, 2004-2006.
- <sup>5</sup>Hearing Screening. American Speech-Language-Hearing Association (ASHA). Found on 12 August 2010 from <<http://www.asha.org/public/hearing/testing/>>

## Public Health Implications and Future Directions

More knowledge of the factors contributing to timely diagnosis of hearing loss is necessary to develop strategies targeted to those who are not fully benefiting from early intervention services. Extra attention and care must be given to infants with multiple conditions so that they have timely diagnoses and referral to appropriate services. Early enrollment in intervention services for hearing loss can help improve childhood and language development.<sup>1</sup> Screening for hearing loss should not stop at infancy. School-age children should continue to have hearing screens to identify late-onset hearing loss so that they may receive appropriate services early.<sup>5</sup> Additionally, children with hearing loss and other co-morbid conditions, along with their families, may benefit from a clinical genetic evaluation to identify potential genetic risk factors.



## Information and Resources

Information about the **Michigan EHDI Program and Guide By Your Side** can be found at: [www.michigan.gov/ehdi](http://www.michigan.gov/ehdi). For information about communication options go to the **Hands and Voices** website ([www.mihandsandvoices.org](http://www.mihandsandvoices.org)).

Information about *Early On*<sup>®</sup>, Michigan's early intervention system is at [www.1800earlyon.org](http://www.1800earlyon.org). The Children's Special Health Care Services Program can help families provide for their child's medical needs. Go to: [www.michigan.gov/cshcs](http://www.michigan.gov/cshcs).

For information on **immunizations for children with cochlear implants** go to: <http://www.medpagetoday.com/Surgery/Otolaryngology/21398>

Families can find information about childhood hearing loss, including **causes, communication, genetic evaluation, parent support** and more at [www.babyhearing.org](http://www.babyhearing.org) (English and Spanish) and [www.raisingdeafkids.org](http://www.raisingdeafkids.org).

The **American Speech and Hearing Association** has information and resources for health professionals at [www.asha.org](http://www.asha.org).

The **Region 4 Genetics Collaborative** provides a guide to genetic services referral for health professionals at [www.region4genetics.org](http://www.region4genetics.org).

## Following trends, promoting prevention and linking families to resources

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## Program Updates

From 2005-2009, the MDCH Fetal Alcohol Syndrome Prevention and Follow-up Program, in collaboration with the MBDR and the Centers for Disease Control and Prevention (CDC), conducted a surveillance project targeting children affected by medical conditions that may indicate a diagnosis of Fetal Alcohol Syndrome (FAS). However, in 2009 Michigan was not included in the three out of fifteen states approved for CDC funding. Therefore, we have embarked on a plan to continue monitoring the prevalence of Fetal Alcohol Syndrome in Michigan, and carry out our prevention and follow-up efforts with existing resources. Using methods of active case ascertainment and abstracting, we are gathering data using secure database software (FASLINK) which will enable us to confirm cases and monitor follow up and referral activities. Though the list of participants is too long to include here, we would like to give special recognition and thanks to our colleagues at MDCH and to each of the developmental and genetics clinics in Michigan that are currently working along with us to fulfill this mission.

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