

The Centers for Birth Defects Research and Prevention (CBDRP) and the Centers for Disease Control and Prevention (CDC) distribute BD-STEPS News.

The purpose of this newsletter is to inform study participants and the public of the CBDRP activities and current news about birth defects.

About the Birth Defects Study To Evaluate Pregnancy exposureS

The Birth Defects Study To Evaluate Pregnancy exposureS ([BD-STEPS](#)) builds on the findings of the National Birth Defects Prevention Study ([NBDPS](#)), whose investigators have been looking at possible causes of birth defects for more than 25 years.

Through BD-STEPS, investigators study factors that may influence the risk for having a baby with a birth defect. BD-STEPS focuses on factors that can be changed to reduce the chances of having a baby being born with a birth defect. Factors that could affect the risk of birth defects include:

- Diabetes and obesity
- Travel and lifestyle
- Treatments for long-term health conditions (such as asthma or high blood pressure)
- Treatments for infertility
- Other medication use during pregnancy

In 2016, certain study sites expanded their birth defects surveillance systems to find all pregnancies that end in stillbirth. These programs are:

- Looking at new ways to find and study stillbirths
- Interviewing women who lost their baby during pregnancy
- Finding common experiences and exposures among those women
- Sharing this information with the medical community and the public

BD-STEPS began telephone interviews with women from seven states (Arkansas, California, Georgia, Iowa, Massachusetts, New York, and North Carolina) in July 2014 and began funding an eighth state (Texas) in 2023. Interviewers called women who had pregnancies affected by birth defects and women whose pregnancies were not affected by birth defects. BD-STEPS also conducted telephone interviews with women from two states (Arkansas and Massachusetts) who had pregnancies affected by stillbirth in which the baby did not have birth defects. These began in 2016, and funding for a third state (New York) was added in 2023. Through these interviews, investigators collect information about the factors mentioned above and how they might relate to birth defects or stillbirth or both. When enough information is collected, investigators analyze these data and publish scientific papers about their findings.

In this issue

About the Birth Defects Study To Evaluate Pregnancy exposureS 1

Recent Findings from the Birth Defects Study To Evaluate Pregnancy exposureS and the National Birth Defects Prevention Study 2

Spotlight on BD-STEPS Research Centers..... 6

Directory of the Research Centers 7



Recent Findings from the Birth Defects Study To Evaluate Pregnancy exposureS and the National Birth Defects Prevention Study

BD-STEPS data from about 9,000 interviews are currently being analyzed. Interviews for the NBDPS were completed in March 2013, but investigators continue to study the information. During the 14 years of interviews, more than 43,000 women from 10 states (Arkansas, California, Georgia, Iowa, Massachusetts, New Jersey, New York, North Carolina, Texas, and Utah) took part in the NBDPS. More than 23,000 families also provided cheek cell samples, which are used to study how genetics play a role in birth defects. Investigators have published more than 445 scientific papers using NBDPS and BD-STEPS data. Below are some of the recent research findings.



Prescription Medication Use is Common during the First Trimester of Pregnancy

- Medication use in pregnancy is common for the treatment of a variety of conditions.
- Investigators found that the proportion of women taking at least one prescription medication increased from 37% in 1997-2001 during NBDPS to 50% in 2014-2018 in BD-STEPS.
- This increase was most apparent for medications used to treat nausea/vomiting, which increased from 3.8% to 14.8%. Increases in use were also seen for medications used to treat infections, depression/anxiety, infertility, thyroid disease, diabetes, and epilepsy.
- Use of any prescription medication in early pregnancy was found to be most common among older, non-Hispanic White women with more years of education.

[Werler MM, Kerr SM, Ailes EC, et al. Patterns of Prescription Medication Use during the First Trimester of Pregnancy in the United States, 1997-2018. Clin Pharmacol Ther. 2023;114\(4\):836-844. doi:10.1002/cpt.2981](#)



Exploring Connections Between Low Carbohydrate Diet and Neural Tube Defects

- Consuming foods fortified with folic acid or taking vitamins with folic acid helps prevent serious birth defects of the brain and spine, known as neural tube defects (NTDs). This study looked at women's diet during pregnancy and how it may influence their risks of NTDs.
- Two previous studies showed a possible connection between low-carbohydrate diets and risk of NTDs. Investigators hoped to identify new clues for this connection.
- Using an artificial intelligence approach to look at the data, investigators analyzed over 200 exposures. No variable was found to explain the connection between low-carbohydrate diets and risk of NTDs.
- Additional studies may help identify why a low-carbohydrate diet may increase the risk of neural tube defects.

[Shaw GM, Yang W, Weber KA, Olshan AF, Desrosiers TA: National Birth Defects Prevention Study. A search for factors associated with reduced carbohydrate intake and NTD risk in two population-based studies. Birth Defects Res. 2024;116\(3\):e2328. doi:10.1002/bdr2.2328](#)



Antifungal Medication Use During Pregnancy Is Common

- Yeast infections are common during pregnancy, but how often they occur and what treatments are used is less known.
- This study used BD-STEPS data to look at occurrence of yeast infections during the first trimester and what types of medications were used as treatment.
- Researchers found that 9.8% of study participants reported yeast infections during their first trimester of pregnancy and 8.6% used an antifungal to treat their yeast infection.
- Approximately half (52.7%) of participants reported using a prescription antifungal, and 45.0% reported using an over-the-counter medication.

[Papadopoulos EA, Howley MM, Fisher SC, et al. Patterns of Yeast Infections and Antifungal Use in the First Trimester of Pregnancy: Findings from the Birth Defects Study to Evaluate Pregnancy exposureS, 2014-2019. *J Womens Health \(Larchmt\)*. 2025;34\(10\)1232-1239. doi:10.1177/15409996251363394](#)



Coronal Craniosynostosis and Genetics

- Coronal nonsyndromic craniosynostosis (cNCS) is a condition where skull bones fuse too early in a baby's development, leading to long-term complications for normal brain and skull growth and function.
- Investigators used NBDPS data to examine the genetic factors leading to cNCS.
- The study found six genes associated with cNCS, including four located on the same chromosome.
- These genes were found to be important in formation of the brain and skull and in bone mineral levels.
- The investigators also found similar associations when they looked at the role of these genes in animal models.

[Nicoletti P, Zafer S, Matok L, et al. Regulatory elements in SEM1-DLX5-DLX6 \(7q21.3\) locus contribute to genetic control of coronal nonsyndromic craniosynostosis and bone density-related traits. *Genet Med Open*. 2024;2:101851. doi:10.1016/j.gimo.2024.101851](#)



Maternal Physical Activity and Risk of non-Cardiac Birth Defects

- Physical activity includes exercise and movement of the body throughout the day like taking the stairs or active house cleaning.
- Physical activity before and during pregnancy helps to keep a healthy weight and lower the risk of health problems such as diabetes. However, there is not a lot of information on whether different types or amounts of physical activity affect the chances of having a baby with a birth defect.
- Investigators used data from NBDPS and BD-STEPS to study physical activity such as walking or medium-to-high levels of exercise. They found that mothers who were more physically active before getting pregnant had a lower risk of having a baby with birth defects of the spinal cord (spina bifida), face/mouth (cleft palate), urinary tract (hypospadias), rectum (anorectal atresia), and arm/leg (transverse limb deficiency). However, higher amounts of physical activity were also linked to some birth defects, including gastroschisis.
- Overall, these findings suggest that being physically active before pregnancy might lower the chances of having a baby with certain birth defects.
- More studies could help investigators understand the reasons why physical activity might help prevent some types of birth defects and not others.

[Evenson KR, Mowla S, Olshan AF, et al. Maternal physical activity, sitting, and risk of non-cardiac birth defects. *Pediatr Res.* 2024;95\(1\):334-341. doi:10.1038/s41390-023-02768-y](#)

Diarrhea and Risk for Birth Defects

- A previous study observed an association between maternal diarrhea and neural tube defects. Two additional studies observed associations between maternal gastrointestinal infections and other types of birth defects.
- NBDPS investigators analyzed data on the association between maternal diarrhea and 32 categories of birth defects. They also assessed whether using multivitamins had any impact on these results.
- They found modest associations between short bouts of diarrhea and nine categories of birth defects. They did not find any significant associations among women who reported longer periods of diarrhea. They also did not observe any change in the results according to whether women reported using multivitamins.
- The results of this analysis continue to support the theory that diarrhea or a gastrointestinal infection during early pregnancy can result in increased risk of certain structural birth defects. This may be due to the effect of fever or inflammation from a gastrointestinal infection. Another possible explanation may be that gastrointestinal infections result in decreased absorption of vitamins from both food and vitamin supplements.

[Waller DK, Mohan Dass NL, Oluwafemi OO, et al. Maternal Diarrhea During the Periconceptional Period and the Risk of Birth Defects. *National Birth Defects Prevention Study, 2006-2011. Birth Defects Res.* 2025;117\(2\):e2438. doi:10.1002/bdr2.2438](#)



Assessment of Stillbirths Is Limited in Arkansas

- The American College of Obstetricians and Gynecologists (ACOG) recommends that when a woman has a stillbirth, certain tests and procedures be performed.
- Investigators from the Arkansas BD-STEPS site looked at how often healthcare practitioners followed these recommended guidelines.
- During 2015—2020, over 1,000 stillbirths were identified in Arkansas. Of those, only 2% received all four ACOG recommended evaluations and 15% had none.
- Barriers to these evaluations included lack of insurance coverage for some of the tests and no uniform protocols for evaluating and classifying stillbirths.
- The investigators concluded that more education is needed for providers to communicate the importance of the ACOG recommended tests and procedures.

[Whitcombe DD, Magann EF, Fahr EC, Ramseyer A, Ounpraseuth S, Nembhard WN. Examination of a Stillbirth Workup: A Rural Statewide Experience. South Med J. 2022;115\(11\):818-823. doi:10.14423/SMJ.0000000000001471](#)

Collecting Information Directly is Critical in Understanding the Causes of Birth Defects

- Many studies of risk factors for birth defect use information from medical records or insurance claims. However, these types of data may not have complete information on when, how much, how often, or for what reason a medication was used.
- BD-STEPS investigators suggested that collecting information directly from women is an important source of some information on medication exposures.
- By talking to women, BD-STEPS and other similar studies can collect details about when women actually took a medication. They can also learn about over-the-counter medications and herbal supplements. These types of exposures are rarely captured in healthcare databases.
- Because pregnant women are not included in clinical trials for medications, BD-STEPS and other similar studies play a crucial role in understand the safety of medications during pregnancy.

[Ailes EC, Werler MM, Howley MM, Jenkins MM, Reefhuis J. Real-world data are not always big data: the case for primary data collection on medication use in pregnancy in the context of birth defects research. Am J Epidemiol. 2024;193\(9\):1211-1214. doi:10.1093/aje/kwae060](#)

Spotlight on BD-STEPS Research Centers

BD-STEPS Research Centers work together to collect and analyze data. You can read about each of the Research Centers below.

ARKANSAS

Each year in Arkansas, about 1,300 babies are born with a birth defect. The Arkansas Center for Birth Defects Research and Prevention collects data from the [Arkansas Reproductive Health Monitoring System](#), one of the oldest active birth defects monitoring systems. Research at the Arkansas Center focuses on lifestyle (such as smoking) and genetic (inherited) factors that might increase the risk for birth defects, specifically [congenital heart defects](#) and [hypospadias](#). Additionally, the Arkansas Center conducts multiple research and community-based initiatives to understand the socioeconomic, demographic, and genetic risk factors that increase the risk for stillbirths.

CALIFORNIA

Each year in California, nearly 13,000 babies are born with a birth defect. The California Center for Birth Defects Research and Prevention at Stanford University partners with the California Department of Public Health, [California Birth Defects Monitoring Program](#) to participate in BD-STEPS. The California Center conducts studies on numerous types of birth defects to learn how our diet, environmental circumstances, and our genetics may influence the risk of babies being born with birth defects.

GEORGIA/CDC

Each year in Georgia, about 4,000 babies are born with birth defects. CDC coordinates BD-STEPS activities and serves as the Georgia Center for Birth Defects Research and Prevention. CDC tracks the number of birth defects in Atlanta through the [Metropolitan Atlanta Congenital Defects Program](#), which has collected data in Atlanta since 1968 and continues to serve as a model for other state birth defects tracking systems. CDC studies how many types of factors, such as medicine use during pregnancy, genes, occupational exposures, and infections might affect the risk for birth defects. CDC also coordinates and leads studies of risk factors for stillbirth.

IOWA

Each year in Iowa, more than 1,200 pregnancies are affected by birth defects. The Iowa Center for Birth Defects Research and Prevention studies pregnancies across the state. Studies include urban and rural residents with differences in personal behaviors such as smoking, alcohol use, and exposure to farming chemicals and other toxins. The [Iowa Registry for Congenital and Inherited Disorders](#) was established in part to study how a person's genes and behaviors might affect birth defect risk. For BD-STEPS, the Iowa Center will look at the impact of personal behaviors, environmental exposures, and genes on birth defects.

MASSACHUSETTS

Each year in Massachusetts, about 2,800 pregnancies are affected by birth defects. The [Massachusetts Center for Birth Defects Research and Prevention](#) started in 1997 and is a partnership between the Massachusetts Department of Public Health, Boston University School of Public Health, and Mass General Hospital for Children. The Massachusetts Center has experts in a wide range of research areas, including [congenital heart defects](#), limb deficiencies, gastroschisis, and other birth defects. It also conducts perinatal health research studies of children and pregnant women, with specialized expertise in medication use, nutrition, obesity, and stillbirth—both with and without birth defects.

NEW YORK

Each year in New York, more than 7,000 babies are born with birth defects. Experts at the New York Center for Birth Defects Research and Prevention study maternal disease, medication use, and other environmental exposures that might lead to birth defects. The New York Center collaborates with faculty and students at University at Albany's College of Integrated Health Sciences. Additionally, the NY Center works with scientists at the [Wadsworth Center](#), the public health laboratory at the New York State Department of Health on genetic analyses of newborn screening blood spots to help understand causes of birth defects. Investigators in New York have recently expanded their focus to include understanding risk factors for stillbirth.

NORTH CAROLINA

Each year in North Carolina, more than 4,000 babies are born with birth defects. [The North Carolina Center for Birth Defects Research and Prevention](#) is a partnership between the Epidemiology Department at the University of North Carolina at Chapel Hill and the North Carolina Division of Public Health's Birth Defects Monitoring Program. The North Carolina Center has a multidisciplinary group of investigators working to identify how genetics affect birth defect risk, and to identify potentially actionable environmental and behavioral risk factors that can serve as targets for clinical or public health interventions to prevent birth defects in the future.

TEXAS

Approximately one in ten infants in the United States are born in Texas, with an estimated 24,000 affected by birth defects each year. [The Texas Center for Birth Defects Research and Prevention](#) is a part of the Birth Defects Epidemiology and Surveillance Branch of the Texas Department of State Health Services. Investigators conduct population-based epidemiologic research studies to understand the causes of specific birth defects, with a focus on health differences across population groups, especially between individuals living on the border with Mexico compared to those living in non-border areas.

Directory of the Research Centers

To reach a BD-STEPS study coordinator, please email BD-STEPS@cdc.gov.
Below is the contact information for each BD-STEPS Center.

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For more information or to learn more about birth defects,
visit the BD-STEPS website <http://bdsteps.org/>



Newsletter Ideas and Mailing:

Please contact your Center listed in the directory if you:

- Want to share your experience about the NBDPS or BD-STEPS
- No longer wish to receive this newsletter
- Need to update your mailing address
- Would like to receive the newsletter via e-mail

Also, please let us know if you have topic ideas for future issues.

