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Gastroschisis in Colorado: Recent Trends and Maternal and Infant Risk Factors

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Introduction

Gastroschisis is a congenital (birth) defect of the abdominal wall in which the baby's intestines, and sometimes other abdominal organs, protrude from the belly through a small hole. Gastroschisis occurs in approximately 1 in 2,300 live births,[1] and mortality for gastroschisis may approach 10 percent. Rates of gastroschisis have been increasing in many developed and developing countries with no tenable explanation or specific known causes for this trend. Colorado's rates of gastroschisis reflect this increasing trend. In 1994, the prevalence rate was 2.78 per 10,000 live births, and increased to 3.54 per 10,000 live births in 2011. Rates of gastroschisis are particularly high among younger mothers, including teen moms.

In most cases gastroschisis is an isolated birth defect; however, it also can be associated with other defects, particularly those with possible vascular mechanisms of origin. Reported overall incidence of concurrent anomalies is 7 to 30 percent, which may include anencephaly, cleft lip and palate, ectopia cordis, atrial septal defect, diaphragmatic hernia, scoliosis, syndactyly and amniotic band syndrome. Although these anomalies are not related directly to the gastroschisis defect, they contribute to the morbidity.[2]

Gastroschisis and omphalocele (another type of abdominal wall defect) also are among the most frequently encountered congenital anomalies in pediatric surgery. In the United States the combined incidence of these anomalies is 1 in 2,000 live births. Epidemiologic data compiled over the last 40 years show that the incidence of omphalocele has remained constant and is associated with increased maternal age, while the incidence of gastroschisis is increasing and is associated with young maternal age (most strikingly in those under 20 years of age).[3]

The cause of gastroschisis is unknown. One strategy to help determine the cause, develop prevention strategies, and prepare for timely diagnosis and treatment is to study potential risk factors associated with an increased risk of having a baby with gastroschisis.

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Methods

Colorado Responds to Children with Special Needs (CRCSN) is the Colorado Department of Public Health and Environment's (CDPHE) population-based surveillance system established to monitor the occurrence of birth defects throughout Colorado. This program collects data on infants and children in whom a congenital anomaly is diagnosed before their third birthday. Diagnostic data are obtained from multiple sources such as vital records (birth and death certificates), hospital discharge records, voluntary physician reports, genetic clinics and other specialty medical clinics. Data also are collected actively through medical record review for special studies, although the primary method of case ascertainment is passive.

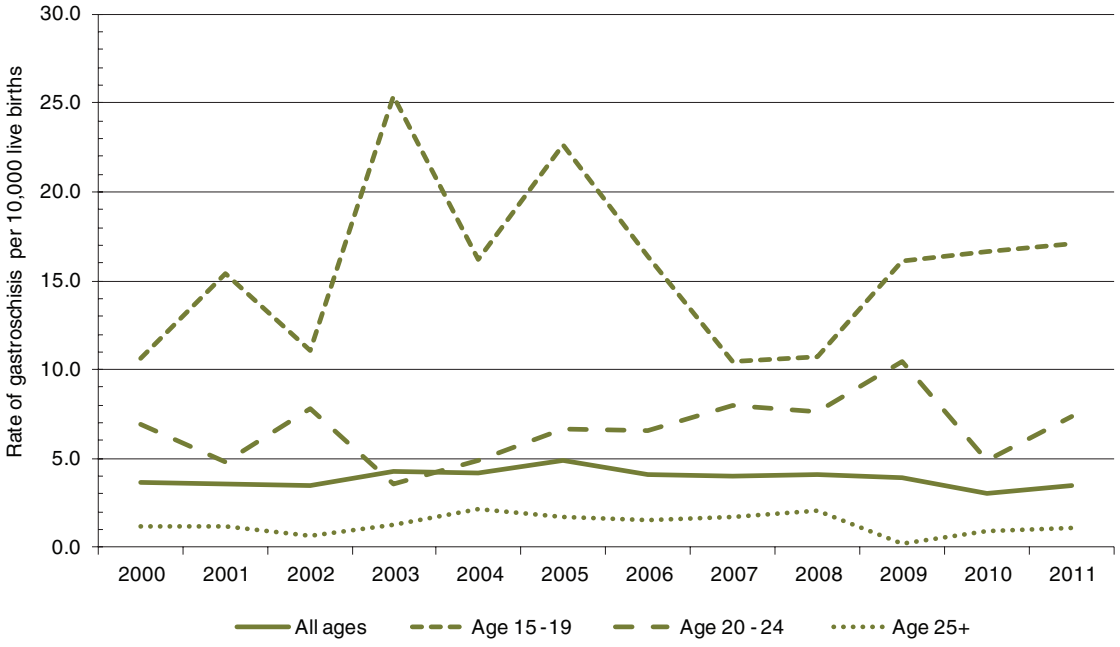
Diagnostic data are supplemented by information about maternal demographics (such as race and ethnicity, age, education and income), maternal reproductive history (including the number, outcomes and intervals of previous pregnancies), maternal health (height and weight/body mass index and prenatal care utilization) and birth characteristics (birth weight and estimated gestational age). This information is derived from linking CRCSN data to birth certificates, which are maintained by the Vital Statistics Unit in the Health Statistics Section, also at CDPHE. Vital statistics data utilized for this report are based on the 2003 revision of the U.S. standard certificate of live birth.

An active medical record review of children reported to CRCSN with an ICD9-CM code of 756.73 or 756.79 was conducted to confirm the reported diagnosis of gastroschisis. Live birth prevalence rates, based on total live births to Colorado resident mothers, were calculated by birth year and maternal and infant risk factors and characteristics. A multivariate logistic regression model was used to estimate adjusted odds ratios for these selected maternal and infant risk factors and characteristics.

Results

For the years 2000-2011, CRCSN confirmed a diagnosis of gastroschisis in 321 live births to mothers who were residents of Colorado. Increases in rates of gastroschisis during this time period were greatest among births to mothers ages 15-19 years (Figure 1).

Figure 1. Gastroschisis prevalence rates by maternal age group: Colorado residents, 2000-2011.



Source: Colorado Responds to Children with Special Needs and Vital Statistics Unit, Health Statistics Section, Colorado Department of Public Health and Environment.

For the combined years 2007-2011, gastroschisis prevalence was lowest among births weighing 2,500 or more grams, those born at an estimated gestational age of 37 or more weeks, older maternal age, mothers with a bachelor's degree or greater education, or those in higher income categories. Delayed or absent prenatal care, having no previous pregnancies, maternal age less than 20 years old, and maternal weight gain during pregnancy below the IOM recommendations were factors associated with a higher prevalence of gastroschisis (Table 1).

Table 1. Gastroschisis counts, rates, and 95% confidence intervals, by selected maternal and infant characteristics: Colorado residents, 2007-2011.

Maternal/infant characteristic		Total live births	Gastroschisis prevalance			
		Count	Count	Rate per 10,000 live births	95% LCL	95% UCL
Total		340,916	127	3.7	3.1	4.4
Infant sex	Female	165,832	59	3.6	2.7	4.5
	Male	175,079	68	3.9	3.0	4.8
Birth weight	2,500+ grams	310,606	44	1.4	1.0	1.8
	1,500-2,499 grams	25,779	70	27.2	20.8	33.5
	<1,500 grams	4,422	13	29.4	13.4	45.4
Estimated gestational age	37+ weeks	308,780	45	1.5	1.0	1.9
	34-36 weeks	23,168	59	25.5	19.0	32.0
	<34 weeks	8,658	23	26.6	15.7	37.4
Prenatal care initiation	1st trimester	260,078	59	2.3	1.7	2.8
	2nd or 3rd trimester	67,657	56	8.3	6.1	10.4
	No prenatal care	4,902	11	22.4	11.1	37.6
Gravidity (previous pregnancies)	Zero	113,860	65	5.7	4.3	7.1
	One	98,525	27	2.7	1.7	3.8
	More than one	128,007	35	2.7	1.8	3.6
Maternal age (in years)	<15	408	0	0.0	23.5	23.5
	15-19	29,560	41	13.9	9.6	18.1
	20-24	75,183	58	7.7	5.7	9.7
	25-29	95,079	18	1.9	1.0	2.8
	30-34	85,747	7	0.8	0.3	1.5
	35-39	44,507	*	*	*	*
	40-44	9,665	*	*	*	*
	45+	767	0	0.0	12.5	12.5
Maternal pre-pregnancy BMI	Underweight (<18.5)	14,204	12	8.4	3.7	13.2
	Normal (18.5-24.9)	171,856	76	4.4	3.4	5.4
	Overweight (25.0-29.9)	79,410	21	2.6	1.5	3.8
	Obese (30.0+)	58,299	7	1.2	0.5	2.3
	Unknown	17,147	11	6.4	3.2	10.8
Maternal weight gain during pregnancy	Below IOM range/inadequate	70,825	43	6.1	4.3	7.9
	Within IOM range/adequate	107,143	35	3.3	2.2	4.3
	Above IOM range/excessive	141,885	36	2.5	1.7	3.4
	Unknown	21,063	13	6.2	2.8	9.5
Interpregnancy interval	First birth	140,577	76	5.4	4.2	6.6
	<18 mos. interval	129,405	31	2.4	1.6	3.2
	18+ mos. interval	56,480	17	3.0	1.6	4.4
	Unknown interval	8,443	*	*	*	*
	Unknown if previous live birth	6,011	*	*	*	*
Maternal race and ethnicity	White,non-Hispanic	204,246	60	2.9	2.2	3.7
	White,Hispanic	89,115	48	5.4	3.9	6.9
	Black/African American	16,822	7	4.2	1.6	7.8
	Asian American/Pacific Islander	12,329	4	3.2	0.8	7.2
	American Indian/Native Alaskan	3,411	*	*	*	*
	Unknown	14,993	6	4.0	1.4	7.8
Maternal education	Less than high school	65,543	43	6.6	4.6	8.5
	High school	69,457	45	6.5	4.6	8.4
	Some college or associates degree	93,502	31	3.3	2.1	4.5
	Bachelors degree or higher	108,329	5	0.5	0.1	1.0
	Unknown	4,085	3	7.3	1.4	18.0
Household income	<$15,000	75,356	52	6.9	5.0	8.8
	$15,000-$24,999	39,316	16	4.1	2.1	6.1
	$25,000-$34,999	29,433	10	3.4	1.6	5.8
	$35,000-$49,999	28,433	7	2.5	1.0	4.6
	$50,000-$74,999	43,853	4	0.9	0.2	2.0
	$75,000+	77,302	3	0.4	0.1	1.0
	Unknown	47,223	35	7.4	5.0	9.9

95% LCL and UCL represent the lower and upper limits of the 95% confidence interval of the prevalence rate.
* Indicates one or two events in category.
Maternal pre-pregnancy BMI and weight gain during pregnancy based on 2009 IOM recommendations.
Source: Colorado Responds to Children With Special Needs and Vital Statistics Unit, Colorado Department of Public Health and Environment.

In order to assess the independent contribution of these various maternal and infant characteristics to the occurrence of gastroschisis, multivariate logistic regression was performed (which included all of the variables included in Table 1). Characteristics remaining as statistically significant in this multivariate model were birth weight, estimated gestational age, maternal age and prenatal care. Both low (1,500-2,500 grams) and very low-weight births (<1,500 grams) were associated with increased risk of gastroschisis (adjusted odds ratio/OR=6.7 and 6.9, respectively), as were both late-preterm births (those born at 34 to 36 weeks gestation; OR=6.4) and early-preterm births (less than 34 week; OR=3.4). Maternal ages of 15-19 years (OR=3.1) and 20-24 (OR=2.61) remained the maternal age groups associated with a significantly increased risk of having an infant with gastroschisis, as did late initiation of prenatal care (during the 2nd or 3rd trimester; OR=2.3) or no provision of prenatal care (OR=3.2). The influence of these variables on the observed risk for the occurrence of gastroschisis was similar to those noted in the univariate analysis (Table 2).

Table 2. Gastroschisis-associated adjusted odds ratios for selected maternal characteristics: Colorado residents, 2007-2011.

Maternal/infant characteristic		Multivariate logistic regression			
		Adjusted odds ratio (OR)	95% LCL	95% UCL	p-value
Birth weight	2,500+ grams		Referent		
	1,500-2,499 grams	6.7	4.0	11.1	<0.0001
	<1,500 grams	6.9	2.7	17.2	<0.0001
Estimated gestational age	37+ weeks		Referent		
	34-36 weeks	6.4	3.9	10.7	<0.0001
	<34 weeks	3.4	1.6	7.4	<0.0001
Maternal age (in years)	<15	-	-	-	-
	15-19	3.1	1.7	6.5	0.0004
	20-24	2.6	1.5	4.6	0.0008
	25-29		Referent		
	30-34	0.6	0.2	1.4	0.19
	35-39	0.1	0.0	1.1	0.06
	40-44	1.0	0.2	4.4	0.99
	45+	-	-	-	-
Prenatal care initiation	1st trimester		Referent		
	2nd or 3rd trimester	2.3	1.6	3.3	<0.0001
	No prenatal care	3.2	1.6	6.4	0.0014

95% LCL and UCL represent the lower and upper limits of the 95% confidence interval of the adjusted odds ratio.
Odds ratios were adjusted for all variables appearing in Table 1.
- Indicates zero events in category.
Source: Colorado Responds to Children With Special Needs and Vital Statistics Unit of the Health Statistics Section, Colorado Department of Public Health and Environment.

Discussion

In this report, we focused on assessing possible risk factors for a birth defect whose occurrence is increasing throughout the world, with no known cause or explanation. Several maternal and infant characteristics were associated with either high or low prevalence of gastroschisis in the univariate analysis. While most of these characteristics did not remain statistically significant in the multivariate logistic model, it is interesting to note that it is likely that many of these are highly correlated (for example, low maternal age and no previous pregnancies, and educational attainment of less than a bachelor's degree).

Several maternal risk factors suspected to be associated with gastroschisis have been investigated, and there is a consistent association with young maternal age (< 20 years of age). Torfs et al. reported a tenfold increased risk of gastroschisis occurrence where maternal age was between 15 and 19 years of age.[4] Bugge et al., Salihu et al., Forrester and Merz, also have demonstrated the preponderance of gastroschisis among infants born to young mother.[5-7] Emusu et al., using data from the New York State Congenital Malformations Registry also concluded that young maternal age was a risk factor for low birth weight and very preterm birth among gastroschisis-affected fetuses. The results from the study showed that the risks for low birth weight, very low birth weight, preterm and early preterm birth were 70 percent, 142 percent, 34 percent and 180 percent higher, respectively, among gastroschisis-affected fetuses of teen mothers. Body mass index (BMI) and nutrient deficiencies in maternal dietary intake also are being considered as possible risk factors for gastroschisis.[8] Torfs et al. found that low alpha-carotene, low total glutathione and high nitrosamine intake during the trimester prior to conception have been associated with gastroschisis. This led to the hypothesis that the young age of mothers may lead to maternal fetal competition for nutrients with the result being maternal dietary inadequacy.[9] In addition, Lam et al. found a higher risk of gastroschisis for underweight mothers and a lower risk for overweight mothers, and the California Birth Defects Monitoring Program revealed that underweight young mothers who presented with a BMI less than 18.1 had a greater risk of having a child with gastroschisis.[10]

The increased risk of a child with gastroschisis presenting with low birth weight and fewer estimated weeks of gestation (<34 weeks) could be attributable to local clinical practice in Colorado and the American College of Obstetrics and Gynecology (ACOG) protocol for early delivery of these children when detected in utero. The association of low birth weight also could be attributed to the fact that data demonstrate that the birth weights of babies with gastroschisis are significantly lower than those of the general population and are similar in different populations. These findings support the notion that a normally functioning intestinal tract is essential for normal fetal growth.[8]

Gastroschisis is often diagnosed prenatally and can be seen on ultrasound as early as the 14th week of pregnancy. When maternal alpha-fetoprotein (AFP) levels are elevated, obstetricians look for defects by having the expectant mother undergo a detailed prenatal ultrasound. With gastroschisis, this test will show loops of bowel (intestines) floating freely in amniotic fluid. More frequent ultrasounds are generally recommended to continue monitoring the fetus. The mother is usually referred to a pediatric surgeon for consultation and counseling.

Once the diagnosis of gastroschisis is confirmed, plans are generally made for the baby to be delivered by caesarean section in a hospital with a neonatal intensive care unit, where the infant can receive the special care that will be required. If ultrasound tests indicate that the baby's lungs are mature, an expectant mother may be advised to have a cesarean section at about 34 - 36 weeks of pregnancy. Surgery for the gastroschisis is typically done as soon as the infant's condition is stabilized, usually within 12 to 24 hours after delivery. More than 90 percent of infants born with gastroschisis survive and their long-term prognosis is excellent.

While the prevalence is increasing, the etiology remains unknown. The cause of gastroschisis is likely to be multifactorial, but the consistent relationship to young maternal age strongly supports the need for further research into related factors. In this study we identified several risk factors in Colorado births that also have been associated with the occurrence of gastroschisis in other studies. From a public health perspective, it is

important to note that many of these factors are modifiable: young maternal age, no prenatal care, inappropriate weight gain, and low birth weight are examples that can be addressed. The Colorado Department of Public Health and Environment is currently employing strategies to address these potential risk factors through its *Colorado's 10 Winnable Battles* initiatives.[11]

Birth defects are common, costly and critical. Every 4 ½ minutes a baby is born with a birth defect in the United States.[12] Increasing awareness of the importance of maternal periconception health is a critical component of public health efforts to reduce the risk of disease and adverse outcomes in both mother and child.

References

1. Parker SE, Mai CT, Canfield MA, Rickard R, Wang Y, Meyer RE, 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 Research (Part A): Clinical and Molecular Teratology. 2010; 88(12): 1008-1016.
2. Laughon M, Meyer R, Bose C, Wall A, Otero E., Heerens A., Clark R. 2003. Rising birth prevalence of gastroschisis. Journal of Perinatology. 2003; 23:291-293.
3. Glasser JG. 2006. Pediatric Omphalocele and Gastroschisis, www.emedicine.com/ ped/topic1642.htm. Dec. 1, 2011.
4. Torfs CP, Velie EM, Oechsli FW, Bateson TF, Curry CJ.1994. A population-based study of gastroschisis: demographic, pregnancy, and lifestyle risk factors. Teratology. 1994; 50(1):44-53.
5. Bugge M, Holm NV. Abdominal wall defects in Denmark, 1970-89. Paediatric Perinatal Epidemiology. 2002; 16(1): 73-81.
6. Salihu HM, Bosny JP, et al. Omphalocele and gastroschisis in the State of New York, 1992-1999. Birth Defects Research (Part A): Clinical and Molecular Teratology. 2003; 67:630–636.
7. Forrester MB, Merz RD. 1999. Epidemiology of abdominal wall defects, Hawaii, 1986-1997. Teratology. 1999; 60(3):117-23.
8. Emusa D, Salihu HM, Aliyu ZY, Pierre-Louis BJ, Druschel CM, Kirby RS. 2005. Gastroschisis, low maternal age, and fetal morbidity outcomes. Birth Defects Research (Part A): Clinical and Molecular Teratology. 2005; 73:649-654.
9. Torfs CP, Lam PK, Schaffer DM, Brand RJ. Association between mother's nutrient intake and their offspring's risk of gastroschisis. Teratology. 1998; 58(6):241-50.
10. Lam PK, Torfs CP, Brand RJ. A low pregnancy body mass index is a risk factor for an offspring with gastroschisis. Epidemiology. 1999; 10(6): 717-21.
11. Colorado's 10 Winnable Battles. www.colorado.gov/cs/Satellite/CDPHE-Main/CBON/1251628821910
12. National Birth Defects Prevention Network. www.nbdpn.org/bdpm2013.php