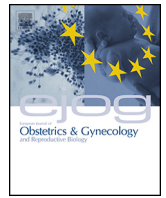




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## Trends in the delivery route of twin pregnancies in the United States, 2006–2013<sup>☆</sup>



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### ABSTRACT

**Objectives:** To determine the trends of cesarean delivery rate among twin pregnancies from 2006 to 2013. **Study design:** This is a population-based, cross-sectional analysis of twin live births from United State birth data files of the National Center for Health Statistics for calendar years 2006 through 2013. We stratified the population based on the gestational age groups, maternal race/ethnicity, advanced maternal age (AMA) which was defined by age more than 35 years and within the standard birth weight groups (group 1: birth weight 500–1499 g, group 2: birth weight 1500–2499 g and group 3: birth weight >2500 g). We also analyzed the effect of different risk factors for cesarean delivery in twins.

**Results:** There were 1,079,102 infants born of twin gestations in the U.S. from 2006 to 2013, representing a small but significant increase in the proportion of twin births among all births (3.2% in 2006 versus 3.4% in 2013). The rate of cesarean delivery in twin live births peaked at 75.3% in 2009, and was significantly lower (74.8%) in 2013. The rate of the twin live birth with the breech presentation increased steadily from 26.3% in 2006 to 29.1% in 2013. For the fetus of the twin pregnancy presented as breech, the cesarean delivery rate peaked at 92.2% in 2010, falling slightly but significantly in the ensuing 3 years. The results demonstrated that the decrease in cesarean delivery rate was due to fewer cesareans in non-Hispanic white patients; all other ethnic subgroups showed increasing rates of cesarean delivery throughout the study. Gestational diabetes, gestational hypertension, previous cesarean delivery and breech presentation were all significant risk factors for cesarean delivery during the entire study period. Induction of labor and premature rupture of the membranes were associated with lower rates of cesarean delivery in twins.

**Conclusion:** The recent decrease in the cesarean delivery rate in twin gestation appears to be largely attributable to a decline in cesarean among pregnancies complicated by breech presentation in non-Hispanic white women, and may reflect a health care disparity that deserves further research.

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### Introduction

Epidemiologic studies from the United States demonstrated a 36% increase in the proportion of twin births among all live births from 1995 through 2008 (2.5%–3.4%) [1]. The rate of cesarean delivery in twin pregnancies also rose dramatically during this time period, from approximately 50% in 1989 to almost 75% in 2008 [1,2]. Factors contributing to this increased rate of cesarean delivery may include challenging decision regarding the ideal

route of delivery for twins presenting as non-vertex, the proper impact of prematurity on route of delivery, and the safety of trial of labor after cesarean in twin pregnancies. Large-scale studies interrogating the impact of these factors on more current cesarean delivery rates are essential to guide and prioritize future efforts aimed at decreasing cesarean rates in twin pregnancies. Given the recognized importance of prevention of the first cesarean in efforts to curtail the U.S. cesarean rate, the need for identification of risk factors and clear indications for cesarean delivery in twin pregnancies has taken on additional significance, since delivery practices in twin gestations often have implications extending to singleton deliveries as well [3–7].

We sought to investigate whether published trends in cesarean delivery for twin gestations in the U.S. seen prior to 2006 have continued, and to interrogate the impact of maternal medical conditions and perinatal factors on the route of delivery during this contemporary time interval.

## Materials and methods

This is a U.S. population-based, cross-sectional analysis of twin live births. We used the publicly available U.S. birth data files accessible through online Vital Statistics [8]. Data were collected by the National Center for Health Statistics from 2006 through 2013. This report includes data on items that were collected on the 2003 revision of the U.S. Standard Certificate of Live Birth [9]. More than 99% of births that occur in the U.S. are registered [10]. The 2003 revision of the U.S. birth certificates were used by 19 states in 2006 and reached to 41 states plus DC in 2013. The 41 states and DC that utilized the 2003 revision of U.S. birth certificate represented 90% of all U.S. births in 2013.

We used the database variable “plurality” for including twin live births. We then examined the association between maternal and perinatal factors and cesarean delivery including “mother’s race/Hispanic origin”, “total birth order”, “gestational diabetes”, “gestational hypertension”, “previous cesarean delivery”, “induction of labor”, “premature rupture of the membranes”, “breech or malpresentation”, “trial of labor attempted” and “gestation—detail in weeks” from the U.S. Standard Certificate of Live Birth.

The Vital Statistics database does not code for twin pairs per se, since we started our observation from 2006 and the pairs or sets of twins or higher order multiple births are not identified in those earliest years and the validity of the variable was questionable, we decided not to use set order as a variables to differentiate the order of twins. For the analysis of maternal and infant characteristics of sets of births and fetal deaths in multiple deliveries it is better to use the Matched Multiple Birth File 1995–2000 includes information on sets of twin, triplet and quadruplets [11]. The data also do

not distinguish between infants whose co-twin resulted in a live birth or stillbirth. Breech presentation could refer to each of twin live births has, either presenting or second twin.

We ran four sets of analyses. First, we stratified the data by five gestational age groups: group A: 24 0/7–31 6/7 weeks, group B: 32 0/7–33 6/7 weeks, group C: 34 0/7–36 6/7 weeks, group D: 37 0/7–38 6/7 weeks, group E: 39 0/7–40 6/7 weeks. We examined changes in cesarean delivery rates between 2006 and 2013 by gestational age at delivery groups. In the second analysis, we examined the trends in cesarean deliveries within subgroups based on maternal race/ethnicity defined as non-Hispanic white, non-Hispanic black, Hispanic, and women of other ethnicities. In the third analysis, we examined the effect of advanced maternal age (AMA) which was defined by age more than 35 years. Finally, we observed the trends of cesarean delivery within the standard birth weight groups which has been presented in National Vital Statistics Reports as “Births: final data annual reports” each year (group 1: birth weight 500–1499 g, group 2: birth weight 1500–2499 g and group 3: birth weight >2500 g) [12].

To examine the association between mode of delivery and various obstetrical factors, we used the GENMOD procedure in SAS to fit a generalized linear model to the data by maximum likelihood estimation. The GENMOD procedure can fit models to correlated responses by the Generalized Estimating Equation (GEE) method. In each model, mode of delivery was the outcome and each obstetrical factor the independent variable of interest. The unit of analysis was live births. Initially, univariate relative risk (RR) for cesarean delivery as a function of obstetrical factor and corresponding 95% confidence interval (CI) was assessed. For each variable, a final multivariable model included all the other obstetrical factors as well as previous cesarean delivery and mother’s age. Corresponding adjusted RRs and 95% CI’s were estimated. We performed analysis for years 2009, which was the peak point for most rates and 2013 separately, followed by 2009–2013 as a whole. Within each of the obstetrical factors (i.e., preterm), change in cesarean deliveries rates between 2009 and 2013 was assessed by Cochran–Armitage trend test. All statistical analysis was performed using SAS 9.4 (Cary, NC). The Baylor College of Medicine IRB determined that this epidemiological study using the Vital Statistics database, does not constitute human subjects research and the data are de-identified.

## Results

From 2006 through 2013 there were 1,079,102 infants born of twin gestations in the U.S. representing 3.3% of all live births. The mean maternal age at delivery was  $29.8 \pm 6.2$  years for all twin births,  $30.1 \pm 6.3$  years for those delivering by cesarean delivery

**Table 1**  
Maternal characteristics and mode of delivery rates for twin live births in the US form 2006–2013.

Maternal characteristics		Twin mode of delivery <sup>a</sup>	
		Vaginal delivery	Cesarean delivery
Maternal age groups (y)	Total N: 1,079,102	Total N: 272,384	Total N: 804,743
Under 20	4.5	29.1	70.9
20–29	42.9	27.9	72.1
30–39	46.8	23.7	76.3
40 and over	5.8	15.7	84.3
Race/ethnicity			
Non-Hispanic whites	59.9	25.9	74.1
Non-Hispanic blacks	16.6	26.4	73.6
Hispanic	16.4	22.9	77.1
Other ethnicities	6.1	21.9	78.1
Not stated	1.0	28.5	71.5

Data are %, unless otherwise specified.

<sup>a</sup> There were also 1975 cases from all twin births in which the delivery method was not stated.

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