# ACHI
## INSPIRING HEALTHY ACTS

# Factors Associated With C-Section Delivery for First-Time Mothers in Arkansas, 2019-2021

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## KEY POINTS

- More than 1 in 4 (27.5%) low-risk deliveries for first-time mothers in Arkansas were via cesarean section, or C-section.
- Black first-time mothers were 30% more likely to have a C-section in Arkansas than White first-time mothers for low-risk deliveries.
- Among first-time mothers, overweight mothers and mothers with severe obesity were 43% and 300% more likely, respectively, to have a C-section during a low-risk delivery compared to first-time mothers with a normal weight.
- The probability of a first-time mother with a low-risk delivery having a C-section ranged from 10% to 29%, depending on the hospital where the delivery occurred.

## SUMMARY

### What is already known about this topic?

Cesarean section (C-section) deliveries have higher risks of severe complications than vaginal deliveries, and Arkansas has one of the highest C-section rates in the United States. According to a previous statewide Arkansas Center for Health Improvement analysis for 2019-2021, the rate of C-sections performed by county ranged from 15.2% to 45.3% for first-time mothers with a single, full-term baby in a head-down position (also referred to as a low-risk delivery).[1]

**DATA POINTS**

## 27.5%
of all first-time mothers with low-risk deliveries had C-sections

Black first-time mothers were
## 30%
more likely than White first-time mothers to have a C-section during a low-risk delivery

First-time mothers with severe obesity were
## 300%
more likely than normal weight first-time mothers to have a C-section during a low-risk delivery

## >3X
variation in C-section rates for first-time mothers with low-risk deliveries by hospital

## What is added by this report?

In this research brief, Arkansas Department of Health birth certificate data from 2019 through 2021 were used to estimate associations between maternal sociodemographic, health, and healthcare factors — including hospital of delivery — and Arkansas first-time mothers who had C-sections for low-risk deliveries.

## What are the implications for public health practice?

Differences in maternal characteristics and hospital of delivery could explain variations in C-section rates performed for first-time mothers in Arkansas with low-risk deliveries. First-time mothers with a C-section are much more likely to have subsequent C-sections and be impacted by the risks associated with them. Understanding variations in observed C-section rates and the maternal and prenatal characteristics associated with them could enable reductions in potentially avoidable C-sections.

## INTRODUCTION

Vaginal deliveries are typically safer and have a lower risk of severe complications and death than cesarean section (C-section) deliveries.[2] C-section rates in the US began to increase in the 1980s after improvements to the safety of the procedure reduced risks for both the child and mother.[3] Since the 1980s, C-section rates have approximately doubled — from around 16% to around 32% in 2019[3] — making it the most commonly performed major operating room procedure in the country.[4] Despite improvements in the safety of the procedure, the increase in C-section rates is concerning given the potential negative health consequences for both the mother and child.[2,3,5,6]

Negative health consequences of C-sections for mothers include increased risk of chronic pain, irregular bleeding, postpartum infection, postpartum depression, morbidity, and mortality.[2,3,7] C-sections also present potential negative health consequences to the newborn child, including altered immune development, respiratory conditions, reduced intestinal gut microbiome diversity, and subsequent increased risks of developing allergies, asthma, type 1 diabetes, and obesity.[3,5,6,8,9] Given these negative consequences, one of the goals of Healthy People 2030 — a 10-year federal initiative to enhance overall health and well-being in the US — is to reduce potentially avoidable C-sections to improve health outcomes for mothers and their babies.[10]

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Unfortunately, Arkansas has one of the highest rates of C-sections in the US.[11] The current rate of C-sections among first-time mothers in Arkansas with low-risk deliveries is 27.5% (see Table 1), which is almost four percentage points above the Healthy People 2030 goal of 23.6%.[10] In part because of Arkansas's high rates of C-sections and the potential negative health consequences of C-sections, the Arkansas Center for Health Improvement (ACHI) has recently launched a focused effort to make the birthing journey healthier for mothers, highlighting vaginal deliveries as a safer mode of delivery.[12] Previous evidence suggests the primary drivers of C-sections among women with low-risk deliveries are sociodemographic factors and financial incentives for the hospitals performing the procedure.[13] However, there is value in quantifying the association of individual-level sociodemographic factors and hospital-level clinical practice variations with C-sections in Arkansas so that policymakers can make informed decisions about how to reduce the number of potentially avoidable C-sections.
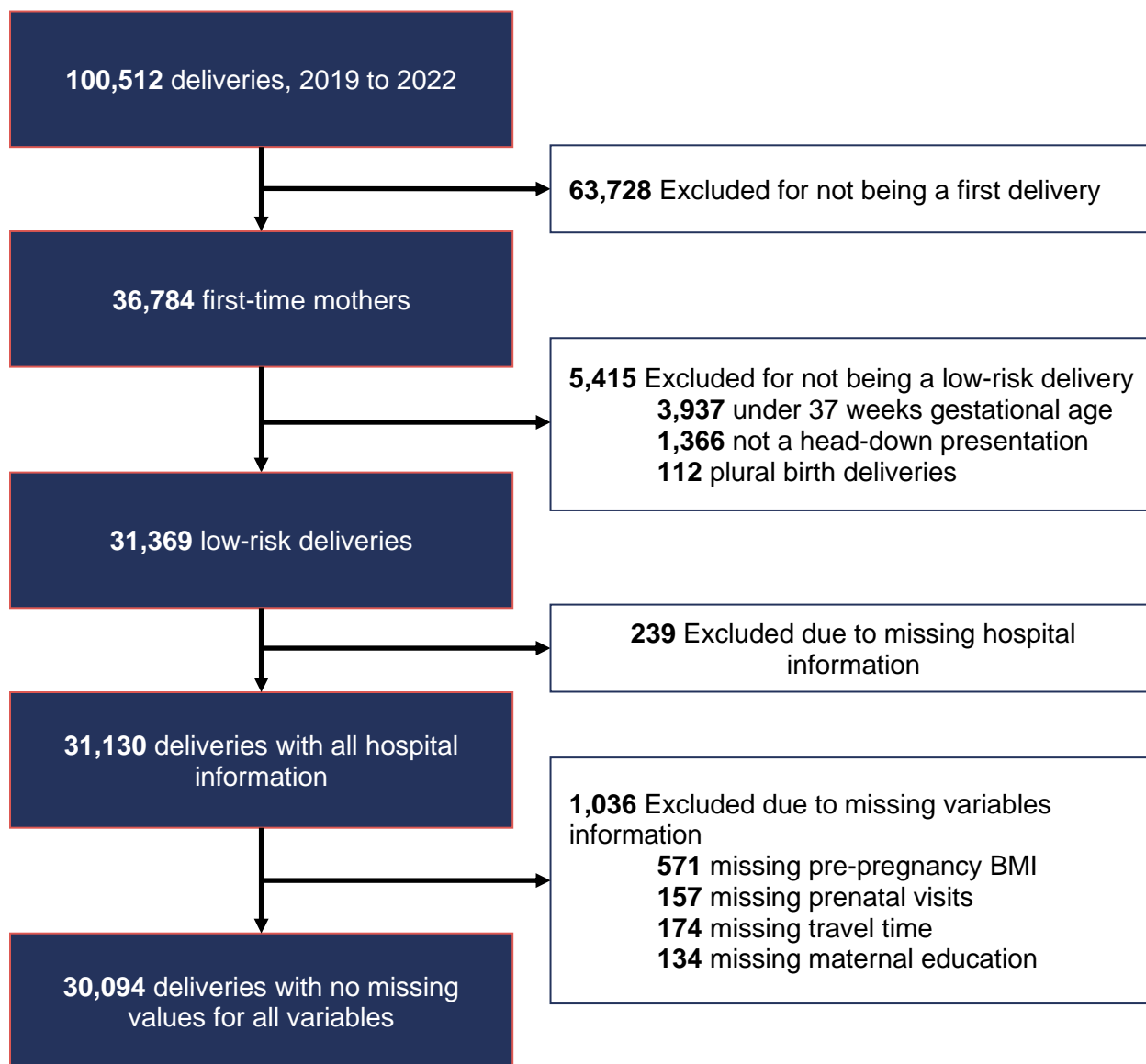
To assess risk factors for C-sections and identify avenues for intervention, ACHI conducted an analysis exploring which variables make C-sections more likely among first-time mothers having a single, full-term baby in a head-down position with no other known risk factors. (For the purpose of brevity, we refer to the deliveries for these mothers as having a "low-risk delivery") This research brief aims to determine the associations of the following variables on the likelihood of a first-time mother having a C-section in Arkansas: maternal sociodemographic, health, and healthcare factors — including hospital of delivery.

## METHODS

### Data Source

This study used Arkansas Department of Health (ADH) birth certificate data from January 2019 through December 2021 to identify the study population, which consisted of first-time mothers in Arkansas who had a low-risk delivery at one of the 38 hospitals in the state. From all 100,512 deliveries with ADH birth certificates, a majority of the deliveries were excluded because they were not first-time deliveries (n = 63,728) or because they did not qualify under the definition of a low-risk delivery (n = 5,415); see Figure 1. We excluded deliveries earlier than 37 gestational weeks because pre-term deliveries are associated with increased odds of having a C-section.[14,15] Deliveries were also excluded if there was missing information for the delivering hospital (n = 239) or missing information for one of the variables (n = 1,036).

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FIGURE 1. ATTRITION DIAGRAM INDICATING NUMBER OF DELIVERIES EXCLUDED (TOTAL EXCLUDED: 70,400)

**100,512** deliveries, 2019 to 2022

**63,728** Excluded for not being a first delivery

**36,784** first-time mothers

**5,415** Excluded for not being a low-risk delivery
**3,937** under 37 weeks gestational age
**1,366** not a head-down presentation
**112** plural birth deliveries

**31,369** low-risk deliveries

**239** Excluded due to missing hospital information

**31,130** deliveries with all hospital information

**1,036** Excluded due to missing variables information
**571** missing pre-pregnancy BMI
**157** missing prenatal visits
**174** missing travel time
**134** missing maternal education

**30,094** deliveries with no missing values for all variables

Abbreviation: BMI, body mass index.

## Outcomes

The primary outcome assessed was whether a first-time mother had a C-section for a low-risk delivery. The secondary outcome was the likelihood of a C-section by hospital.

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## Covariates

Our model adjusted for variables that have previously been associated with C-section risk.[8,9] Data for these sociodemographic variables were obtained from ADH birth certificate records. Sociodemographic variables are:

- Race/ethnicity (White, Black, Hispanic, or other)
- Mother's age (categorically)
- Participation in the Special Supplemental Nutrition Program for Women, Infants, and Children, or WIC (yes or no)
- Mother's education level (less than high school, high school or GED certificate, some college, bachelor's degree, or master's degree or higher)
- Maternal marital status (married or not married)
- Primary payer for the delivery (commercial, Medicaid, or self-pay/other)

Using birth certificate data, we also controlled for the following maternal health and healthcare factors:

- Pre-pregnancy body mass index (BMI) weight class (underweight, normal weight, overweight, obesity class I, or severe obesity)
- Smoked during pregnancy (yes or no)
- Pre-pregnancy diabetes (yes or no)
- Pre-pregnancy hypertension (yes or no)
- Time of first prenatal visit (first trimester, second trimester, third trimester, or no prenatal visits)
- Gestational diabetes (yes or no)
- Gestational hypertension (no hypertension, gestational hypertension, or eclampsia)
- Sexually transmitted infection, or STI, present during delivery (yes or no)
- Membrane ruptured (yes or no)
- Prolonged labor (yes or no)
- Gestational age (37-38 weeks, 39-40 weeks, or 41 weeks or more)
- Day of delivery (Monday-Sunday)
- Travel time to the hospital (expressed in 5-minute increments)
- Delivery hospital

Mother's pre-pregnancy weight was classified using the World Health Organization's BMI cutoffs in kg/m$^2$, which are: less than 18.5 for underweight, 18.5 to 24.9 for normal weight, 25 to 29.9

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for overweight, and 30 to 34.9 for class I obesity. Due to small numbers, obesity class II (35 to 39.9) and obesity class III (40 or greater) were consolidated into one category named severe obesity, which consists of mothers with BMIs of 35 or greater.[16]

## Statistical Analysis

Frequency measures for categorical variables and means for continuous measures for deliveries with and without a C-section were calculated. Chi-square tests and t-tests were then used to evaluate unadjusted differences in variables between deliveries with and without a C-section.

A mixed-effects logistic regression model was used to determine which factors were associated with having a C-section. The model was adjusted for the maternal sociodemographic, health, and healthcare factors listed above. Given that vaginal deliveries are associated with a lower risk of severe complications, the population was then restricted to the factors most associated with first-time mothers who had a vaginal low-risk delivery to create a referent mother. A random effect was applied for each delivery hospital to account for the correlation between observations.[17] The random effects were converted to represent the probability that a referent mother would have a C-section at each hospital.

# FINDINGS

## Characteristics of First-Time Mothers With Low-Risk Deliveries Who Had a C-Section Differed From Those Who Had a Vaginal Delivery

Maternal sociodemographic, health, and healthcare factors play a role in determining whether a mother has a C-section. Therefore, we characterized first-time mothers with low-risk deliveries to identify maternal differences between C-section and vaginal delivery rates.

The final sample contained 30,094 deliveries among first-time mothers classified as having a low-risk delivery. Approximately 27.5% (n = 8,282) of all low-risk deliveries were via C-section. First-time mothers with low-risk deliveries who had a C-section compared to those with low-risk deliveries who did not have a C-section statistically differed for all variables except for WIC-participation status ($p$ = .418), smoking status ($p$ = .053), having a ruptured membrane ($p$ = .058), and STI status during delivery ($p$ = .119); see Table 1. First-time mothers with low-risk deliveries who had a C-section, on average, were older, were more educated, had a higher pre-pregnancy weight classification, and were more likely to be Black (20.1% vs. 15.9%) compared

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to those who did not have a C-section. Additional differences between the percentages of first-time mothers with low-risk deliveries who did and did not have a C-section can be found in Table 1.

TABLE 1. DESCRIPTIVE STATISTICS TO COMPARE UNADJUSTED DIFFERENCES BETWEEN FIRST-TIME MOTHERS WHO HAD A LOW-RISK VAGINAL VS C-SECTION DELIVERY

| Maternal Variables | Vaginal Deliveries n = 21,812 (72.5%) | C-Section Deliveries n = 8,282 (27.5%) | Chi-Square Test or T-Test (*p* value) |
|---|---|---|---|
| Race/ethnicity | | | |
| White | 68.0% | 65.8% | .001 |
| Black | 15.9% | 20.1% | |
| Hispanic | 10.5% | 8.3% | |
| Other | 5.6% | 5.8% | |
| Age category | | | |
| Under 20 | 19.7% | 11.7% | .001 |
| 20-24 | 39.2% | 34.5% | |
| 25-29 | 25.6% | 29.0% | |
| 30-34 | 12.1% | 16.8% | |
| 35-39 | 2.9% | 6.6% | |
| 40 or older | 0.4% | 1.3% | |
| WIC during pregnancy | 40.8% | 40.2% | .418 |
| Educational attainment | | | |
| Less than high school | 11.6% | 8.2% | .001 |
| High school or GED certificate | 33.6% | 31.4% | |
| Some college | 28.4% | 30.9% | |
| Bachelor's degree | 17.2% | 18.8% | |
| Master's degree or higher | 9.2% | 10.7% | |
| Marital status | | | |
| Married | 47.4% | 50.4% | .001 |
| Payment source | | | |
| Commercial | 56.3% | 60.4% | .001 |
| Medicaid | 40.4% | 36.8% | |
| Self-pay/other | 3.3% | 2.8% | |
| Pre-pregnancy weight class | | | |
| Underweight | 0.4% | 0.2% | .001 |
| Normal weight | 43.2% | 27.3% | |
| Overweight | 25.8% | 24.6% | |
| Obesity class I | 15.0% | 19.5% | |

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| Maternal Variables | Vaginal Deliveries n = 21,812 (72.5%) | C-Section Deliveries n = 8,282 (27.5%) | Chi-Square Test or T-Test (p value) |
|---|---|---|---|
| Severe obesity | 12.0% | 26.5% | |
| Smoked during pregnancy | 10.9% | 11.7% | .053 |
| Pre-pregnancy diabetes | 0.4% | 1.3% | .001 |
| Pre-pregnancy hypertension | 1.4% | 3.3% | .001 |
| First prenatal visit | | | |
| No prenatal visit | 1.0% | 0.8% | .001 |
| First trimester | 72.3% | 74.6% | |
| Second trimester | 22.7% | 20.6% | |
| Third trimester | 4.0% | 4.0% | |
| Gestational diabetes | 4.1% | 7.1% | .001 |
| Gestational hypertension | | | |
| No hypertension | 91.1% | 85.9% | .001 |
| Gestational hypertension | 8.7% | 13.6% | |
| Eclampsia | 0.2% | 0.5% | |
| STI present | 4.8% | 4.4% | .093 |
| Membrane ruptured | 1.6% | 1.9% | .058 |
| Prolonged labor | 2.8% | 4.0% | .001 |
| Gestational age | | | |
| Gestation between 37 and 38 weeks | 30.3% | 30.6% | .001 |
| Gestation between 39 and 40 weeks | 65.8% | 64.0% | |
| Gestation at 41 weeks or more | 3.9% | 5.5% | |
| Day of delivery | | | |
| Monday | 15.3% | 14.3% | .001 |
| Tuesday | 17.5% | 19.0% | |
| Wednesday | 17.5% | 19.3% | |
| Thursday | 17.1% | 17.8% | |
| Friday | 14.6% | 15.2% | |
| Saturday | 9.5% | 8.3% | |
| Sunday | 8.4% | 6.1% | |
| Travel time in 5-minute increments, mean | 4.4 | 4.7 | .001 |

Abbreviations: C-section, cesarean section; WIC, Supplemental Nutrition Program for Women, Infants, and Children; STI, sexually transmitted infection. Frequency percentages are reported for qualitative variables and the mean is reported for travel time. The chi-square test was conducted for qualitative variables, while a t-test was used for travel time.

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## The Odds of First-Time Mothers With Low-Risk Deliveries Having a C-Section Varied by Maternal Characteristics

Because significant differences were observed in the rates of low-risk deliveries in first-time mothers via C-sections vs vaginal deliveries in our study population, we adjusted for variables to find those associated with the likelihood of having a C-section delivery.

The adjusted odds ratios in Table 2 indicate that first-time mothers with low-risk deliveries who are Black (1.30 OR, 95% CI 1.20-1.42) or identified as Other in the race/ethnicity category (1.25 OR, 95% CI 1.11-1.41) were more likely to have a C-section compared to White first-time mothers. In addition, there is a gradient-specific relationship between age and the odds of having a C-section. First-time mothers with low-risk deliveries who were under age 20 were less likely to have a C-section (0.74 OR, 95% CI 0.67-0.81) compared to mothers between the ages of 20 and 24. The odds of having a C-section continued to go up as age increased. For example, a mother 25-29 years old was approximately 38% more likely to have a C-section than a mother between 20 and 24, and a mother who was 40 or older was more than four times as likely to have a C-section than a mother 20-24 years of age.

First-time mothers with low-risk deliveries and a higher pre-pregnancy weight classification had higher odds of having a C-section. Women classified as overweight prior to pregnancy were 43% more likely to have a C-section compared to those classified as normal weight, and women having had severe obesity prior to pregnancy were three times more likely to have a C-section compared to normal-weight women. Health conditions that increased the likelihood of a first-time mother with a low-risk delivery having a C-section included pre-pregnancy diabetes (2.44 OR, 95% CI 1.80-3.30), pre-pregnancy hypertension (1.44 OR, 95% CI 1.21-1.72), gestational diabetes (1.26 OR, 95% CI 1.12-1.42), gestational hypertension (1.53 OR, 95% CI 1.40-1.67), or eclampsia (2.93 OR, 95% CI 1.86-4.62). Having a prolonged labor (1.33 OR, 95% CI 1.15-1.54) was also significantly associated with an increased likelihood of having a C-section.

A first-time mother with an early-term low-risk delivery, defined as occurring between 37 and 38 weeks of gestation, was less likely to have a C-section (0.84 OR, 95% CI 0.78-0.89), compared to mothers who had a full-term delivery. Having a late-term delivery, defined as occurring at 41 weeks or more of gestation, increased the likelihood of having a C-section (1.55 OR, 95% CI 1.36-1.75).

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First-time mothers having a low-risk delivery on a Monday (0.87 OR, 95% CI 0.79-0.96), Saturday (0.83 OR, 95% CI 0.74-0.92), or Sunday (0.72 OR, 95% CI 0.64-0.82) were less likely to have a C-section compared to mothers delivering in the middle of the week (Wednesday). Travel time to the delivery hospital influenced outcomes, with every five minutes of additional travel time associated with an increased likelihood of first-time mothers with low-risk deliveries having a C-section (1.01 OR, 95% CI 1.00-1.01). Educational attainment, marriage status, payer source, smoking during pregnancy, or timing of first prenatal visit had no association with having a C-section in the adjusted model that accounts for each of the variables discussed above.

TABLE 2. ODDS RATIOS FOR THE ADJUSTED MODEL PREDICTIVE OF A FIRST-TIME MOTHER WITH A LOW-RISK DELIVERY HAVING A C-SECTION

| Maternal Variables | Adjusted Odds Ratio | Lower CI | Upper CI |
| --- | --- | --- | --- |
| Race/ethnicity | | | |
| White | REF | | |
| Black | 1.30 | 1.20 | 1.42 |
| Hispanic | 0.95 | 0.86 | 1.05 |
| Other | 1.25 | 1.11 | 1.41 |
| Age category | | | |
| Under 20 | 0.74 | 0.67 | 0.81 |
| 20-24 | REF | | |
| 25-29 | 1.38 | 1.28 | 1.49 |
| 30-34 | 1.74 | 1.58 | 1.90 |
| 35-39 | 2.80 | 2.45 | 3.21 |
| 40 or older | 4.08 | 3.03 | 5.50 |
| WIC during pregnancy | 1.08 | 1.01 | 1.16 |
| Educational attainment | | | |
| Less than high school | 0.96 | 0.86 | 1.06 |
| High school or GED certificate | REF | | |
| Some college | 1.00 | 0.93 | 1.07 |
| Bachelor's degree | 0.96 | 0.87 | 1.05 |
| Master's degree or higher | 0.95 | 0.85 | 1.07 |
| Marital status | | | |
| Married | 0.95 | 0.89 | 1.02 |
| Payment source | | | |
| Commercial | REF | | |
| Medicaid | 0.99 | 0.92 | 1.06 |
| Self-pay/other | 1.01 | 0.85 | 1.19 |
| Pre-pregnancy weight class | | | |

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| Maternal Variables | Adjusted Odds Ratio | Lower CI | Upper CI |
|---|---|---|---|
| Underweight | 0.89 | 0.76 | 1.05 |
| Normal | REF | | |
| Overweight | 1.43 | 1.33 | 1.53 |
| Obesity class I | 1.94 | 1.79 | 2.10 |
| Severe obesity | 3.02 | 2.79 | 3.26 |
| Smoked during pregnancy | 1.08 | 0.99 | 1.18 |
| Pre-pregnancy diabetes | 2.44 | 1.80 | 3.30 |
| Pre-pregnancy hypertension | 1.44 | 1.21 | 1.72 |
| First prenatal visit | | | |
| No prenatal visit | 0.88 | 0.66 | 1.16 |
| First trimester | REF | | |
| Second trimester | 0.96 | 0.89 | 1.02 |
| Third trimester | 1.03 | 0.90 | 1.19 |
| Gestational diabetes | 1.26 | 1.12 | 1.42 |
| Gestational hypertension | | | |
| No hypertension | REF | | |
| Gestational hypertension | 1.53 | 1.40 | 1.67 |
| Eclampsia | 2.93 | 1.86 | 4.62 |
| STI present | 1.05 | 0.92 | 1.20 |
| Membrane ruptured | 1.21 | 0.99 | 1.47 |
| Prolonged labor | 1.33 | 1.15 | 1.54 |
| Gestational age | | | |
| Gestation between 37 and 38 weeks | 0.84 | 0.78 | 0.89 |
| Gestation between 39 and 40 weeks | REF | | |
| Gestation at 41 weeks or more | 1.55 | 1.36 | 1.75 |
| Day of delivery | | | |
| Monday | 0.87 | 0.79 | 0.96 |
| Tuesday | 1.01 | 0.92 | 1.10 |
| Wednesday | REF | | |
| Thursday | 0.96 | 0.88 | 1.05 |
| Friday | 0.96 | 0.88 | 1.06 |
| Saturday | 0.83 | 0.74 | 0.92 |
| Sunday | 0.72 | 0.64 | 0.82 |
| Travel time in 5-minute increments | 1.01 | 1.00 | 1.01 |

Abbreviations: C-section, cesarean section; Lower CI, lower bound of the 95% confidence interval; Upper CI, upper bound of the 95% confidence interval; REF, referent; WIC, Supplemental Nutrition Program for Women, Infants, and Children; STI, sexually transmitted infection.

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## C-Sections for First-Time Mothers With Low-Risk Deliveries Varied Three-Fold Between Hospitals

Hospital variations in C-section rates have been documented and may be related to patient characteristics or hospital clinical management and practice patterns.[13] A referent mother in our study was defined as those with the characteristics associated with the best outcome (i.e., a first-time mother with a vaginal low-risk delivery with no other risk factors). This referent mother is White, aged 20-24, has a high school diploma or GED certificate, is not married, is commercially covered, has a normal pre-pregnancy weight class, did not smoke during pregnancy, did not have a pre-pregnancy health condition, had a first prenatal visit during the first trimester, did not have any pregnancy- or labor-related health conditions, and delivered an infant between the gestational ages of 39-40 weeks on a Wednesday (see Table 1). To determine hospital variations, we examined the independent hospital effects associated with a referent mother having a C-section.

Using this approach, we observed differences in C-section rates among Arkansas hospitals. In Figure 2, we display the probability that a referent mother would have a C-section based on the hospital at which she delivered. A mother with this profile would have a 29% probability of having a C-section in Hospital A, while that same mother would only have a 10% probability of having a C-section in Hospital LL.

FIGURE 2. C-SECTION PROBABILITY BY HOSPITAL FOR A MOTHER WITH CHARACTERISTICS ASSOCIATED WITH THE LOWEST RISK*
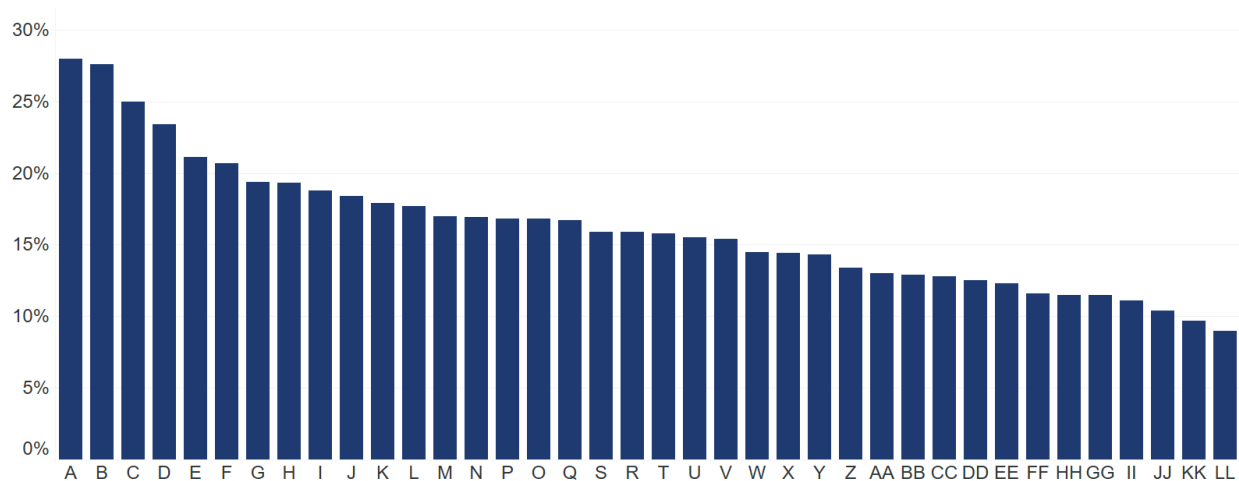


*A 20- to 24-year-old, White, commercially covered, healthy, first-time mother with a low-risk delivery, who is a high school graduate.

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# IMPLICATIONS

This observational study examined the impacts of individual maternal variables and hospital-level effects on the likelihood that a first-time mother with a low-risk delivery would result in a C-section in Arkansas between 2019 and 2021. The findings in our analysis suggest that a combination of demographic, health, and hospital-level differences are associated with having a C-section for low-risk deliveries.

Overall, our findings align with what has been reported in the literature. The association of an increased risk of C-section based on race, particularly among Black mothers compared to White mothers as a referent, has been published in previous studies.[18,19] The association between age and having a C-section also has been observed in previous studies, indicating that as a mother gets older the likelihood of having a C-section increases.[20,21] Similarly, this study demonstrated that pre-pregnancy health factors (BMI class, hypertension, and diabetes) are associated with an increased likelihood of having a C-section during a low-risk delivery as reported in the literature.[22-26] Thus, pre-pregnancy health is another crucial factor to take into consideration when explaining variations in C-section rates among first-time mothers with low-risk deliveries. Gestational health factors (diabetes, hypertension, and eclampsia) and complications during labor also increase the likelihood of having a C-section in an otherwise low-risk delivery, which mirrors current literature.[27-30]

Non-maternal factors are also associated with the likelihood of having a C-section. For example, for every five minutes of travel time that a mother needed to arrive at the hospital, the odds of delivering via C-section increased by one percent. Mothers in our study who delivered a baby on the weekend (Saturday or Sunday) or on a Monday had significantly lower odds of having a delivery via C-section compared to mothers who delivered in the middle of the week (Wednesday). A study in California similarly observed a decrease in the likelihood of C-sections on the weekends.[31]

Finally, by restricting to a referent mother with characteristics most associated with the lowest risk and converting each hospital effect into a probability, our findings showed an approximate three-fold difference between hospitals in the probability of having a C-section. The observed variations in hospital rates cannot be fully examined with secondary data available. Internal hospital quality improvement assessments are suggested, and external quality review may be

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required. Ongoing evaluation of hospital C-section rates along with cost analyses may facilitate future research.

## Limitations

While we see a difference in low-risk delivery C-section rates between hospitals, we did not adjust for the specific characteristics of the hospitals. Thus, we cannot say what internal characteristics, practice patterns, or medical staffing may be driving the differences in C-section rates between hospitals for first-time mothers with low-risk deliveries.

Pre-pregnancy weight (used to derive BMI) may be self-reported and underreported.[32] The collection of data points regarding prenatal care for the birth records are collected in an inconsistent manner. Some are self-reported, and some may be collected from electronic health records.

Finally, because this is an association-based study, it is possible that residual unmeasured effects could influence the relationships between our variables and C-section deliveries.[33]

## Conclusion

Our analysis indicates significant associations between maternal sociodemographic, health, and healthcare factors — including hospital of delivery — and the likelihood of having a C-section among first-time mothers with low-risk deliveries. Each of these significant factors provides possible avenues for intervention to decrease the number of potentially avoidable C-sections performed in Arkansas for first-time mothers — thereby decreasing the likelihood of future C-sections — and improve the health of mothers and their children.

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