Obstetrics: *Original Research*

# Comparison of Midwifery and Obstetric Care in Low-Risk Hospital Births

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**OBJECTIVE:** To compare midwife and obstetrician labor practices and birth outcomes in women with low-risk pregnancies delivered in the hospital.

**METHODS:** We conducted a retrospective cohort study of singleton births of 37 0/7–42 6/7 weeks of gestation at 11 hospitals between January 1, 2014, and December 31, 2018. Exclusions included intrapartum transfer from home-birth center, antepartum stillbirth, previous cesarean delivery, practitioner other than midwife or obstetrician, prelabor cesarean, prepregnancy maternal disease, and pregnancy complications or risk factors. Interventions (induction, artificial rupture of membranes, epidural, oxytocin, and episiotomy), mode of delivery, maternal outcomes (third- or fourth-degree laceration, postpartum hemorrhage, blood transfusion, and severe maternal morbidity), and newborn outcomes (shoulder dystocia, 5-minute Apgar score less than 7, resuscitation at delivery, birth trauma, and neonatal intensive care unit admission) were examined by practitioner type. We used modified Poisson regression models adjusted for individual confounders to assess risk ratios, stratified by parity, for health care provider type and perinatal outcomes.

**RESULTS:** The study cohort comprised 23,100 births (3,816 midwife and 19,284 obstetrician). Compared with obstetricians, midwifery patients had significantly lower intervention rates, an approximately 30% lower risk of cesarean delivery in nulliparous patients (adjusted relative risk [aRR] 0.68; 95th% CI 0.57–0.82), and an approximately 40% lower risk of cesarean in multiparous patients (aRR 0.57; 95th% CI 0.36–0.89). Operative vaginal birth was also less common in nulliparous patients (aRR 0.73; 95th% CI 0.57–0.93) and multiparous patients (aRR 0.30; 95th% CI 0.14–0.63). Shoulder dystocia was more common in multiparous patients receiving midwifery care (aRR 1.42; 95th% CI 1.04–1.92).

**CONCLUSIONS:** In low-risk pregnancies, midwifery care in labor was associated with decreased intervention, decreased cesarean and operative vaginal births, and, in multiparous women, an increased risk for shoulder dystocia. Greater integration of midwifery care into maternity services in the United States may reduce intervention in labor and potentially even cesarean delivery, in low-risk pregnancies. Larger research studies are needed to evaluate uncommon but important maternal and newborn outcomes.

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The current model for maternity care in the United States differs from many developed countries in that it is predominantly physicians rather than midwives who provide care for low-risk pregnancies and

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only 10% of all births are attended by midwives.[1] There is however considerable evidence supporting the benefits of midwifery care. A 2016 Cochrane Collaboration Systematic Review based on 11 studies all performed outside of the United States (in Australia, Canada, New Zealand, and the United Kingdom) concluded that midwife-led models of care are associated with less intervention, increased likelihood of a spontaneous vaginal delivery, similar rates of cesarean delivery, greater satisfaction with care, and similar outcomes for mothers and newborns.[2] In addition, for low-risk pregnancies, midwife-led care has been associated with decreased cost in some studies.[2]

There is a growing body of data on community (birth center and home) births in the United States in the form of the Midwives Alliance of North America Statistics Project, including a study of more than 47,000 births.[3] In contrast, there is relatively little information on midwifery care in U.S. hospitals and how that compares with care provided by obstetricians. Additionally, existing studies comparing obstetrician and midwifery care for hospital births are limited by inclusion of births taking place 10 years ago or more,[4,5] inability to adjust for important confounders or lack of maternal outcome data,[6,7] and by small size.[8]

The goal of this study was to overcome some of the limitations of previous studies and evaluate whether intrapartum care with midwives was associated with similar practices and outcomes to care provided by obstetricians in a contemporary low-risk U.S. pregnant population giving birth in a hospital.

## METHODS

This retrospective cohort study included planned hospital births at sites participating in a multi-center quality improvement collaborative (the Obstetrical Care Outcomes Assessment Program) for all or part of the study period (January 1, 2014–December 31, 2018). Hospitals were excluded if they did not provide information on practitioner type, did not offer intrapartum care by midwives and by obstetricians, or if they had less than 50 midwife births during the study period. Although licensed midwives may be granted hospital privileges, we are not aware of any practicing in participating hospitals during the study period. Consequently, the midwives in the study are likely all certified nurse midwives.

The Obstetrical Care Outcomes Assessment Program is an ongoing clinician-led, voluntary, quality initiative.[9] The program uses health care provider-specific, chart-abstracted data for quality improvement from all births at participating sites. Multiple hospitals in the Northwest United States, including urban, suburban, and rural centers supported by I, II, III, and IV levels of maternal care,[10] participate in the program. Trained abstractors (obstetric providers, nurses, and health care data and quality improvement specialists) collect data from maternal and newborn medical records. The data capture a wide range of variables related to maternal demographic characteristics, prepregnancy health, pregnancy complications, labor course, delivery, and postnatal outcomes for mothers and newborns. Abstracted data are entered into a cloud-based, standardized data tool. Data undergo real-time quality checks performed both at the site and aggregate level. Monthly web meetings and unlimited access to Obstetrical Care Outcomes Assessment Program staff for education and support are available. Audit of volume of deliveries entered into the Obstetrical Care Outcomes Assessment Program database against billing records is conducted annually, with a minimum of 90% agreement required. The Western Institutional Review Board determined in 2015 that the Obstetrical Care Outcomes Assessment Program is exempt from institutional review board review based on the use of deidentified data and the absence of intervention or interaction between the researcher and individual.

The cohort was restricted to births where the intrapartum practitioner type was either an obstetrician or a midwife. The Obstetrical Care Outcomes Assessment Program collects data on the type of practitioner who provides prenatal care, admits the woman to the hospital, provides care in labor, and performs the delivery. We followed an intent-to-treat approach where women were classified as being in the midwife group or in the obstetrician group if their intrapartum care was provided by that practitioner type, which could differ from the practitioner type who attended the delivery. To optimize attribution of intrapartum care to the appropriate practitioner type (obstetrician or midwife) and to exclude transfers of care for pregnancy risk factors, we included only those midwifery births where the woman was both admitted to labor and delivery and received her intrapartum care by a midwife. Likewise, a woman was assigned to the obstetrician group if she was admitted by and received her intrapartum care by an obstetrician. We excluded births for which the prenatal care was provided by a midwife, but the admitting practitioner was an obstetrician.

To create a cohort without identifiable measured risk factors before labor, we limited to gestational ages 37 0/7 to 42 6/7 weeks, singleton, cephalic, births and excluded antepartum stillbirths. Cesarean deliveries undertaken without attempting vaginal birth or labor were excluded. We excluded pregnancies with any of the risk factors noted in Box 1. Specifically, we excluded those with a history of previous cesarean delivery, preexisting diabetes or hypertension, prior stillbirth, age 45 years or older, class III obesity (body mass index [BMI, calculated as weight in kilograms divided by height in meters squared] 40 or higher), or any "other" prepregnancy complications noted in an open-text field. We also excluded any pregnancy complications including known fetal anomalies (irrespective of severity), gestational diabetes, hypertensive disorders of pregnancy, cholestasis, nicotine, marijuana, alcohol, or illegal substance use, incomplete or absent prenatal care, induction of labor specified for medical reasons or where the indication was not recorded, and where complications were entered into an "other pregnancy complications" open-text field. Births that were induced electively at 41 weeks of gestation or more without any other medical indication were not excluded.

Patient characteristics (including age, race, parity, BMI, weight gain during pregnancy, and height), presence of private health insurance, hospital level of maternal care,[10] and neonatal birth weight were examined by intrapartum practitioner type (midwife or obstetrician). Birth weight percentiles were based on sex-specific birth weight charts from U.S. national birth data.[11]

**Box 1. Prepregnancy and Pregnancy Complications and Risk Factors**

**Prepregnancy risk factors**

- Previous cesarean delivery
- Chronic hypertension
- Prepregnancy diabetes
- History of stillbirth
- BMI ($kg/m^2$) 40 or higher
- Age 45 y or older at delivery
- Any "other" prepregnancy complications

**Pregnancy complications or risk factors**

- Fetal anomalies
- Gestational diabetes
- Hypertensive disorders of pregnancy
- Cholestasis of pregnancy
- Nicotine use in pregnancy
- Alcohol use in pregnancy
- Marijuana use in pregnancy
- Substance abuse
- Incomplete prenatal care
- Induction of labor for any medical or unknown cause (see list below)*
- Any "other" pregnancy complications

*Inductions were excluded if the indication was suspected intrauterine growth restriction, abnormal antepartum testing, chorioamnionitis, isoimmunization, oligohydramnios, polyhydramnios, other, or if the indication was not recorded.

To describe any differences in practices, characteristics of labor and intervention rates were compared between the midwife and obstetrician groups. These included gestational age of 41+0 weeks or greater at birth, rate of spontaneous labor (as opposed to induction), cervical dilation on admission for those admitted in spontaneous labor, oxytocin use, epidural, artificial rupture of membranes in those with intact membranes at hospital admission, and episiotomy. The rates of artificial rupture of membranes, oxytocin augmentation, and epidural were calculated for both spontaneous labors and inductions. The rate of delivery by a practitioner type other than the intrapartum practitioner type was also assessed. The rate of physiologic birth (defined as spontaneous labor, no artificial rupture of membranes, no oxytocin, no epidural, spontaneous vaginal birth, and no episiotomy) was also examined. This was based on American College of Obstetricians and Gynecologists' ReVITALize definition of physiologic childbirth with the exception of opiate and nitrous oxide use, which we could not ascertain.[12] Time (in hours) from admission to delivery, total maternal hospital stay, and newborn hospital stay were also compared.

We compared the midwife and obstetrician groups' population, labor characteristics, and interventions using $\chi^2$ or Fisher exact tests (for low counts) and analysis of variance or Kruskal-Wallis tests as appropriate to the data distribution. For labor characteristics and interventions, we also calculated relative risks (RR) and constructed 95% Wald asymptotic confidence limits.

Outcome measures comprised mode of delivery (spontaneous vaginal, operative vaginal, and cesarean delivery), maternal complications, and newborn complications. Maternal complications included third- or fourth-degree laceration, postpartum hemorrhage, blood transfusion, and severe maternal morbidity. Severe maternal morbidity was based on the 18 diagnostic indicators in the Centers for Disease Control and Prevention's severe maternal morbidity definition.[13] The indicators were ascertained from six diagnosis-specific fields in the Obstetrical Care Outcomes Assessment Program database (amniotic fluid embolism, disseminated intravascular coagulation, thromboembolism, eclampsia, blood transfusion, and hysterectomy) and from entry of any of the other 12 Centers for Disease Control and Prevention indicators of severe maternal morbidity in either of two pregnancy-complication and postpartum-complication free text fields.

Newborn outcomes included shoulder dystocia (based on recording of this clinical diagnosis in the medical record rather than specified diagnostic criteria), 5-minute Apgar score less than 7, glucose instability, admission to the neonatal intensive care unit or transfer to a higher level of care for newborn reasons; resuscitation at delivery (comprising any of intubation, positive pressure ventilation, epinephrine, chest compressions, or an umbilical line), and birth trauma (including fetal laceration, fracture of the clavicle, humerus, or skull, brachial plexus injury, intracranial hemorrhage, or subgaleal hemorrhage).

We used a modified Poisson regression model[14,15] to estimate risk ratios for outcomes in the midwife group compared with the obstetrician group, stratified by parity (nulliparous compared with multiparous). Models were adjusted for maternal age (continuous), initial BMI (continuous), height (continuous), induction of labor (categorical), epidural (categorical), and race–ethnicity (white compared with all others) (categorical) and used an exchangeable correlation structure[15] to account for clustering by hospital and health care provider. We present unadjusted and adjusted RRs (95th CIs) only for outcomes with sufficient counts per cell to detect meaningful differences when comparing the midwife and obstetrician groups. Outcomes with insufficient statistical power are presented in descriptive form as frequencies and 95% CIs in the midwife and obstetrician groups. In sensitivity analyses, we also used a propensity score matching[16] approach as an alternate method to control for confounding (Appendix 1, available online at http://links.lww.com/AOG/B580).

## RESULTS

Of the 86,786 births at the 11 eligible hospitals during the study period, a total of 23,100 births were included in the final study cohort: 3,816 (16.5%) received intrapartum care from midwives and 19,284 (83.5%) from obstetricians (Fig. 1). Of note, across all 11 hospitals and practitioner types, 34% of patients met our “low-risk” criteria; ranging from 21% to 43% at different hospital sites. The hospitals comprised levels of maternal care I (n=1), II (n=5), and III–IV (n=5); more than 70% of all births in the study were in level III–IV hospitals (Table 1).

On evaluation of patient characteristics, approximately 45% of women in both the midwife and the obstetrician group were nulliparous. The distribution

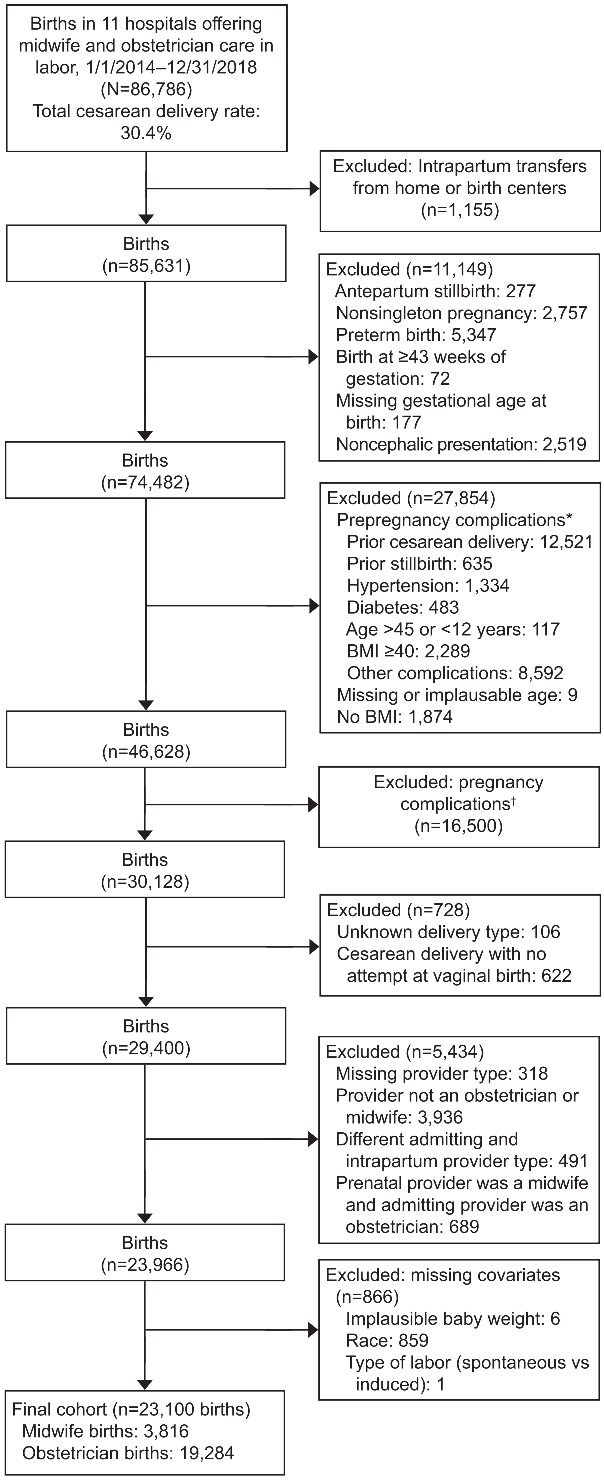


**Fig. 1.** Description of study population. *See prepregnancy risk factors in Box 1. †See pregnancy complications in Box 1.

*Souter. Midwifery and Obstetric Care in Low-Risk Hospital Births. Obstet Gynecol 2019.*

**Table 1. Characteristics of the Study Population**

| Characteristic | Nulliparous | | | Multiparous | | |
|---|---|---|---|---|---|---|
| | Obstetrician (n=9,096) | Midwife (n=1,710) | *P* | Obstetrician (n=10,188) | Midwife (n=2,106) | *P* |
| Maternal age (y) | 28.1±5.1 | 28.5±5.2 | .004 | 30.8±4.8 | 30.8±4.7 | .495 |
| Younger than 20 | 530 (5.8) | 94 (5.5) | .003 | 60 (0.6) | 16 (0.8) | .222 |
| 20–29 | 4,898 (53.8) | 840 (49.1) | | 3,800 (37.3) | 785 (37.3) | |
| 30–34 | 2,748 (30.2) | 583 (34.1) | | 4,022 (39.5) | 833 (39.6) | |
| 35–39 | 819 (9.0) | 175 (10.2) | | 1,962 (19.3) | 420 (19.9) | |
| 40–44 | 101 (1.1) | 18 (1.1) | | 344 (3.4) | 52 (2.5) | |
| 35 or older | 920 (10.1) | 193 (11.3) | .143 | 2,306 (22.6) | 472 (22.4) | .824 |
| Race | | | | | | |
| White | 5,456 (60.0) | 1,255 (73.4) | <.001 | 6,572 (64.5) | 1,542 (73.2) | <.001 |
| African American | 255 (2.8) | 67 (3.9) | | 333 (3.3) | 104 (4.9) | |
| Asian or Pacific Islander | 2,523 (27.7) | 229 (13.4) | | 1,944 (19.1) | 220 (10.4) | |
| Other | 862 (9.5) | 159 (9.3) | | 1,339 (13.1) | 240 (11.4) | |
| Maternal weight | | | | | | |
| Initial BMI (kg/m$^2$) | 24.7±4.5 | 24.9±4.5 | .110 | 25.6±4.9 | 25.3±4.7 | .008 |
| Less than 25 | 5,507 (60.5) | 1,017 (59.5) | .510 | 5,354 (52.6) | 1,174 (55.7) | .026 |
| 25–29.9 | 2,389 (26.3) | 447 (26.1) | | 2,922 (28.7) | 582 (27.6) | |
| 30–34.9 | 882 (9.7) | 186 (10.9) | | 1,373 (13.5) | 260 (12.3) | |
| 35 or higher | 318 (3.5) | 60 (3.5) | | 539 (5.3) | 90 (4.3) | |
| 30–39 | 1,200 (13.2) | 246 (14.4) | .184 | 1,912 (18.8) | 350 (16.6) | .021 |
| Maternal weight gain within IOM guidelines | 2,965 (32.6) | 534 (31.2) | .267 | 3,498 (34.3) | 738 (35.0) | .534 |
| Final BMI 30 or higher | 29.7 (4.7) | 30.0 (4.7) | .053 | 30.0 (4.7) | 29.9 (4.6) | .280 |
| Missing final BMI | 44 | 5 | | 47 | 10 | |
| Maternal height (cm) | 163.4±7.0 | 164.5±7.3 | <.001 | 163.5±7.1 | 164.2±7.2 | <.001 |
| Health insurance | | | | | | |
| Commercial payer | 6,624 (75.6) | 1,241 (75.0) | .589 | 6,365 (65.2) | 1,348 (66.6) | .224 |
| Missing payer | 335 | 55 | | 424 | 82 | |
| Hospital maternal level of care[10] | | | | | | |
| I | 194 (2.1) | 31 (1.8) | <.001 | 258 (2.5) | 23 (1.1) | <.001 |
| II | 1,931 (21.2) | 454 (26.5) | | 2,334 (22.9) | 471 (22.4) | |
| III–IV | 6,971 (76.6) | 1,225 (71.6) | | 7,596 (74.6) | 1,612 (76.5) | |
| Birth weight (kg) | 3,404±428 | 3,456±429 | <.001 | 3,499±433 | 3,568±430 | <.001 |
| Greater than the 90th percentile for gestational age* | 785 (8.6) | 167 (9.8) | .125 | 1,445 (14.2) | 352 (16.7) | .003 |
| Less than the 10th percentile for gestational age* | 1,000 (11.0) | 160 (9.4) | .046 | 596 (5.9) | 84 (4.0) | <.001 |
| Missing birth weight, sex, or both | 16 | 5 | | 19 | 1 | |

BMI, body mass index; IOM, Institute of Medicine (now known as the National Academy of Medicine).
Data are mean±SD, n (%), or n unless otherwise specified.
Chi-squared or Fisher exact tests (for low counts) were used to compare categorical variable. Continuous variables were assessed using analysis of variance or Kruskal-Wallis tests as appropriate to the underlying distribution.
* Birth weight percentiles are based on U.S. national birth weight standards for gestational week and sex (Duryea et al).[11]

of race was different between the obstetrician and midwifery groups with fewer minority population women in the midwife group compared with the obstetrician group for both nulliparous (26.6% vs 40.0% $P<.001$) and multiparous women (26.8% vs 35.5% $P<.001$) (Table 1).

Most other patient characteristics were similar between the two groups (Table 1). Compared with the midwife group, the obstetrician group had a higher mean maternal BMI in multiparous women (25.6 vs 25.3; $P<.008$) and neonates with a lower mean birth weight in nulliparous women (3,404 vs 3,456 g; $P<.001$) and in multiparous women (3,499 vs 3,568 g; $P<.001$). Mean maternal height was higher in the midwife group for both nulliparous and multiparous women (164.5 vs 163.4 cm and 164.2 vs 163.5 cm, respectively) ($P<.001$). However, although statistically significant, the absolute differences between the two groups were very small and their clinical significance is unknown.

**Table 2. Labor Characteristics and Interventions**

| | Nulliparous | | | Multiparous | | |
|---|---|---|---|---|---|---|
| | Obstetrician (n=9,096) | Midwife (n=1,710) | RR (95% CI) | Obstetrician (n=10,188) | Midwife (n=2,106) | RR (95% CI) |
| Induction of labor | 1,859 (20.4) | 252 (14.7) | 0.72 (0.64–0.81) | 2,173 (21.3) | 272 (12.9) | 0.61 (0.54–0.68) |
| Birth at 41 wk of gestation or more | 1,873 (20.6) | 432 (25.3) | 1.23 (1.12–1.34) | 953 (9.4) | 346 (16.4) | 1.76 (1.57–1.97) |
| Cervix on admission* 3 cm or less | 3,112 (43.4) | 394 (27.5) | 0.63 (0.58–0.69) | 1,850 (23.4) | 260 (14.4) | 0.62 (0.55–0.70) |
| Missing cervical examination | 69 | 26 | | 100 | 32 | |
| Artificial rupture of membranes† | | | | | | |
| Spontaneous labor | 2,800 (67.2) | 477 (56.9) | 0.85 (0.79–0.90) | 3,560 (64.2) | 666 (51.5) | 0.80 (0.76–0.85) |
| Induction of labor | 1,044 (77.6) | 110 (64.3) | 0.83 (0.74–0.93) | 1,766 (87.9) | 179 (74.8) | 0.85 (0.79–0.92) |
| Oxytocin | | | | | | |
| Spontaneous labor | 3,685 (50.9) | 576 (39.5) | 0.78 (0.73–0.83) | 2,210 (27.6) | 319 (17.4) | 0.63 (0.57–0.70) |
| Induction of labor | 1,647 (88.6) | 221 (87.7) | 0.99 (0.94–1.04) | 1,956 (90.0) | 209 (76.8) | 0.85 (0.80–0.91) |
| Epidural | | | | | | |
| Spontaneous labor | 5,779 (79.9) | 853 (58.5) | 0.73 (0.70–0.77) | 4,857 (60.6) | 720 (39.3) | 0.65 (0.61–0.69) |
| Induction of labor | 1,682 (90.5) | 196 (77.8) | 0.86 (0.80–0.92) | 1,737 (79.9) | 160 (58.8) | 0.74 (0.66–0.81) |
| Episiotomy | 483 (6.7) | 58 (3.8) | 0.57 (0.43–0.74) | 190 (1.9) | 22 (1.1) | 0.55 (0.36–0.86) |
| Physiologic birth‡ | 294 (3.2) | 157 (9.2) | 2.84 (2.36–3.42) | 848 (8.3) | 403 (19.1) | 2.30 (2.06–2.56) |
| Different practitioner type at birth | 35 (0.4) | 290 (17.0) | 29.87 (22.3–39.9) | 82 (0.8) | 74 (3.5) | 4.01 (2.98–5.40) |

RR, relative risk.
Data are n (%) or n unless otherwise specified.
* First cervical dilation recorded on admission restricted to women in spontaneous labor.
† Denominator for artificial rupture of membranes includes only women with intact membranes at hospital admission.
‡ Physiologic birth was defined as spontaneous labor, no artificial rupture of membranes, no oxytocin, no epidural, spontaneous vaginal birth, and no episiotomy.[12]

There was no statistically significant difference between the midwife and obstetrician groups in the use of oxytocin during induction of labor in nulliparous women. For all other interventions, midwifery care was associated with significantly less intervention (Table 2). Births among nulliparous women in the midwife group were less likely to be associated with induction of labor (252/1,710 [14.7%] vs 1,859/9,096 [20.4%] RR 0.72; 95% CI 0.64–0.81) and episiotomy (58/1,710 [3.8%] vs 483/9,096 [6.7%] RR 0.57; 95% CI 0.43–0.74), and more likely to be associated with birth at 41 0/7 weeks of gestation or more (432/1,710 [25.3%] vs 1,873/9,096 [20.6%] RR 1.23; 95% CI 1.12–1.34) compared with the obstetrician group. Births among nulliparous women in spontaneous labor in the midwife group were less likely to be associated with cervical dilation on admission 3 cm or less (394/1,710 [27.5%] vs 3,112/9,096 [43.4%] RR 0.63; 95% CI 0.58–0.69), epidural use (853/1,458 [58.5%] vs 5,779/7,237 [79.9%] RR 0.73; 95% CI 0.70–0.77), artificial rupture of the membranes (477/839 [56.9%] vs 2,800/4,164 [67.2%] RR 0.85; 95% CI 0.79–0.90), and oxytocin augmentation (576/1,458 [39.5%] vs 3,685/7,237 [50.9%] RR 0.78; 95% CI 0.73–0.83), and more likely to be associated with physiologic birth (157/1,710 [9.2%] vs 294/9,096 [3.2%] RR 2.84; 95% CI 2.36–3.42) compared with the obstetrician group (Table 2). Similar results were observed for multiparous women (Table 2).

Seventeen percent of nulliparous women (290/1,710) and 3.5% (74/2,106) of multiparous women in the midwife group were delivered by an obstetrician or other nonmidwife practitioner. For the obstetrician group, 99.6% (35/9,096) of nulliparous women and 99.2% (82/10,188) of women in the obstetrician group were delivered by an obstetrician. Median time from admission to delivery was longer for multiparous women in the obstetrician group (5.9 vs 4.6 hours; $P<.001$) (Table 3). Total hospital stay for mothers and for newborns was either similar or slightly shorter in the midwife group compared with the obstetrician group (Table 3).

After adjustment for confounders (maternal age, BMI, height, race, induction of labor, and epidural, including hospital and practitioner as random effects),

**Table 3. Length of Hospital Stay**

| | Nulliparous | | | Multiparous | | |
|---|---|---|---|---|---|---|
| | Obstetrician (n=9,096) | Midwife (n=1,710) | *P** | Obstetrician (n=10,188) | Midwife (n=2,106) | *P** |
| Admission-to-delivery time (h), all labors | 12.2 (10.2) | 12.0 (11.4) | .126 | 5.9 (6.4) | 4.6 (6.6) | <.001 |
| Spontaneous labor, no epidural | 5.7 (7.7) | 6.5 (7.7) | <.001 | 2.3 (4.1) | 2.7 (3.9) | <.001 |
| Spontaneous labor, with epidural | 12.0 (8.5) | 13.4 (9.6) | <.001 | 6.2 (5.3) | 5.6 (5.4) | .036 |
| Induced labor | 18.7 (13.7) | 22.4 (15.4) | <.001 | 9.8 (5.9) | 11.9 (8.2) | <.001 |
| Missing admission-to-delivery time | 23 | 2 | | 49 | 10 | |
| Maternal total hospital stay (h), all deliveries | 50.1 (24.9) | 48.9 (21.4) | .001 | 35.3 (11.6) | 35.4 (13) | .147 |
| Missing total maternal stay | 17 | 1 | | 19 | 1 | |
| Newborn total hospital stay (h), all deliveries | 38.0 (21.4) | 36.3 (19.5) | <.001 | 29.1 (12.0) | 29.5 (11.8) | .637 |
| Missing newborn stay | 91 | 23 | | 160 | 30 | |

Data are median (interquartile range) unless otherwise specified.
* Kruskal-Wallis test.

intrapartum care from midwives was associated with an approximately 30% lower risk of cesarean delivery in nulliparous (183/1,710 [10.7%] vs 1,894/9,096 [20.8%] adjusted relative risk [aRR] 0.68; 95th% CI 0.57–0.82) and an approximately 40% lower risk of cesarean in multiparous women (23/2,106 [1.1%] vs 264/10,188 [2.6%] aRR 0.57; 95th% CI 0.36–0.89), and lower risk of operative vaginal birth in nulliparous (106/1,710 [6.2%] vs 976/9,096 [10.7%] aRR 0.73; 95th% CI 0.57–0.93) and multiparous women (13/2,106 [0.6%] vs 296/10,188 [2.9%] aRR 0.30; 95th% CI 0.14–0.63). There was an increased risk of shoulder dystocia in multiparous women in the midwife group compared with the obstetrician group (107/2,106 [5.1%] vs 318/10,188 [3.1%]); after adjusting for maternal age, BMI, height, race, induction of labor, and epidural, including hospital and practitioner as random effects, this represented an approximately 40% increase in recorded shoulder dystocia (aRR 1.42; 95th% CI 1.04–1.92). No statistically significant differences were observed in any of the other maternal or newborn outcomes; however, multiple outcomes were underpowered to assess statistical differences (Tables 4 and 5). The results of the propensity score matching for maternal and newborn outcomes were unchanged from the modified Poisson regression model (Appendix 1, http://links.lww.com/AOG/B580).

## DISCUSSION

Our goal was to compare midwives and obstetricians with respect to their intrapartum practices and outcomes in a low-risk, contemporary, pregnant population giving birth in hospital in the United States. We used an intention-to-treat model where outcomes were attributed to the practitioner type (midwife or obstetrician) who admitted the patient and provided intrapartum management irrespective of the practitioner type at delivery. We found women in the midwife group had less intervention in labor, higher rates of physiologic birth, and similar hospital length of stay, compared with those in the obstetrician group. In addition, the risk of cesarean delivery was approximately one third lower in nulliparous women and more than 40% lower in multiparous women in the midwife group.

An increased risk for shoulder dystocia was observed in multiparous births in the midwife group, consistent with the findings of Weisband et al.[8] This observation highlights the importance of continuous, multidisciplinary, clinical audit, and assessment of balancing measures when evaluating cesarean delivery rates.

The association between midwifery care and less intervention in labor is well established,[2,4,5,8] but international studies suggest midwifery care does not result in lower cesarean rates.[2] This may be different in the United States. A recent observational study from Ohio reported lower cesarean rates with midwifery compared with obstetrician care after adjusting for patient characteristics.[8] Nijagal et al[6] also reported a midwife-laborist model to be associated with lower cesarean rates compared with obstetrician-only care. Subsequent expansion of the midwife-laborist model

**Table 4. Maternal Outcomes**

| | Nulliparous | | | | Multiparous | | | |
|---|---|---|---|---|---|---|---|---|
| | Obstetrician (n=9,096) | Midwife (n=1,710) | RR (95% CI) | aRR* (95% CI) | Obstetrician (n=10,188) | Midwife (n=2,106) | RR (95% CI) | aRR* (95% CI) |
| Type of birth | | | | | | | | |
| Spontaneous vaginal | 6,305 (69.3) | 1,434 (83.9) | 1.21 (1.18–1.24) | 1.12 (1.09–1.16) | 9,652 (94.7) | 2,071 (98.3) | 1.04 (1.03–1.05) | 1.02 (1.02–1.03) |
| Operative vaginal | 976 (10.7) | 106 (6.2) | 0.58 (0.48–0.70) | 0.73 (0.57–0.93) | 296 (2.9) | 13 (0.6) | 0.21 (0.12–0.37) | 0.30 (0.14–0.63) |
| Cesarean | 1,894 (20.8) | 183 (10.7) | 0.51 (0.45–0.59) | 0.68 (0.57–0.82) | 264 (2.6) | 23 (1.1) | 0.42 (0.28–0.64) | 0.57 (0.36–0.89) |
| Complications | | | | | | | | |
| 3rd- or 4th-degree laceration† | 519 (7.2) | 74 (4.8) | 0.67 (0.53–0.85) | 0.79 (0.58–1.07) | 104 (1.0) | 21 (1.0) | ‡ | ‡ |
| Postpartum hemorrhage | 310 (3.4) | 68 (4.0) | ‡ | ‡ | 154 (1.5) | 47 (2.2) | ‡ | ‡ |
| Blood transfusion | 60 (0.66) | 13 (0.76) | ‡ | ‡ | 21 (0.21) | 7 (0.33) | ‡ | ‡ |
| Severe maternal morbidity§ | 64 (0.70) | 14 (0.82) | ‡ | ‡ | 24 (0.2) | 7 (0.3) | ‡ | |

RR, relative risk; aRR, adjusted relative risk.

* Relative risks are adjusted for maternal age (years), BMI (kg/m$^2$), race (white or nonwhite), induction of labor (yes or no), epidural (yes or no), and height (cm). Hospital and practitioner were included as random effects.

† Denominator includes vaginal births only.

‡ Statistical models are underpowered for this outcome owing to low cell counts or difference between groups is too small to detect with this sample size.

§ Severe maternal morbidity includes: amniotic fluid embolism, disseminated intravascular coagulation, amniotic fluid embolism, thromboembolism, eclampsia, thromboembolism, blood transfusion, hysterectomy, and free text entry of any of the other 12 CDC indicators of severe maternal morbidity.[13]

was accompanied by a decrease in cesarean delivery.[7] Given these reports and our findings, the possibility that midwifery care may decrease cesarean delivery in contemporary low-risk U.S. hospital births merits further investigation.

The reasons underlying the association between midwifery care and lower cesarean rates in our study are not clear. A different approach to care and fewer interventions may be part of the explanation. However, women who select midwifery care may be more committed to vaginal birth and less likely to opt for medical intervention when faced with options compared with those who choose obstetrician care.

The most important limitation of our study was the lack of power to evaluate uncommon outcomes (including severe maternal morbidity and most newborn outcomes) owing to the relatively small population in the midwifery group and the need to adjust for multiple confounding factors. Larger studies would be needed to more fully evaluate midwifery care in the United States. Additionally, the findings may not be

**Table 5. Neonatal Outcomes**

| | Nulliparous | | | | Multiparous | | | |
|---|---|---|---|---|---|---|---|---|
| | Obstetrician (n=9,096) | | Midwife (n=1,710) | | Obstetrician (n=10,188) | | Midwife (n=2,106) | |
| | n | % (95% CI) | n | % (95% CI) | n | % (95% CI) | n | % (95% CI) |
| Shoulder dystocia | 219 | 2.4 (2.1–2.7) | 45 | 2.6 (1.9–3.4) | 318 | 3.1 (2.8–3.5) | 107 | 5.1 (4.1–6.0) |
| 5-min Apgar score less than 7* | 129 | 1.4 (1.2–1.7) | 25 | 1.5 (0.9–2.0) | 45 | 0.4 (0.3–0.6) | 13 | 0.6 (0.3–1.0) |
| Glucose instability | 144 | 1.6 (1.3–1.8) | 16 | 0.9 (0.5–1.4) | 73 | 0.7 (0.6–0.9) | 15 | 0.7 (0.4–1.1) |
| Resuscitation at delivery† | 412 | 4.5 (4.1–5.0) | 74 | 4.3 (3.4–5.3) | 153 | 1.5 (1.3–1.7) | 42 | 2.0 (1.4–2.6) |
| NICU admission | 594 | 6.5 (6.0–7.0) | 95 | 5.6 (4.5–6.6) | 288 | 2.8 (2.5–3.1) | 49 | 2.3 (1.7–3.0) |
| Birth trauma‡ | 14 | 0.2 (0.1–0.2) | 2 | 0.1 (0.0–0.3) | 15 | 0.1 (0.1–0.2) | 8 | 0.4 (0.1–0.6) |

NICU, neonatal intensive care unit.

* 5-minute Apgar score was missing for 33 nulliparous and 55 multiparous births.

† Resuscitation at delivery includes any of intubation, positive pressure ventilation, epinephrine, chest compressions, or an umbilical line.

‡ Birth trauma includes any of: fetal laceration; fracture of the clavicle, humerus, or skull; brachial plexus injury; intracranial hemorrhage; or subgaleal hemorrhage.

generalizable to a broader and more diverse patient population. Other limitations of our study include the observational design and potential for uncontrolled confounders, limited socioeconomic data, and lack of information on type of intrapartum fetal heart monitoring, nonpharmacologic pain management, and doulas. Although we could ascertain whether women in the midwifery group were delivered by an obstetrician, we were unable to capture intrapartum consultations (without transfer of care) between midwives and obstetricians or postpartum transfers. We were also unable to determine exactly when in labor an obstetrician became involved in the care of a midwifery patient or the indications for involving an obstetrician. Importantly, the study does not provide information on midwifery care for higher-risk populations or evaluate economic implications of different models of care. Data about care with family practice physicians are available and will be part of a future analysis.

Strengths include the study size, chart-abstracted data, the range of maternal and newborn outcomes, stratification by parity, and adjustment for multiple potential confounding factors in the analysis. We also addressed potential for bias at the hospital level or practitioner level by modeling using a clustered variance structure.

Our results have implications for clinical practice. The American College of Obstetricians and Gynecologists has provided guidance on strategies to avoid unnecessary intervention in labor[17] and has highlighted the importance of giving adequate time for progress in labor before undertaking cesarean delivery for dystocia.[18] Our study raises the question as to whether a less interventionist approach to labor may be associated with lower cesarean delivery rates in low-risk pregnancies.

The results may also have implications for planning maternity services. The United States is currently facing a work force crisis in maternity care[19] in parallel with an increase in higher-risk pregnancies.[20–22] Expanding midwifery care for low-risk hospital births may improve access to maternity providers and free up obstetrician time for higher risk pregnancies. In spite of a long history of predominantly physician-based maternity care in the United States, the most recent "Listening to Mothers in California" survey suggests that pregnant women are also open to midwifery care: 54% of respondents indicating that they planned to use (17%) or would consider using (37%) a midwife in a future pregnancy.[23] Increasing availability of midwifery care, public education about the scope and benefits of midwifery care, and increasing racial and ethnic diversity of midwives may support access to midwifery care by a more diverse patient population. Professional collaboration and greater integration of midwifery and obstetrician care may be a step towards optimizing maternity services in the United States.[24]

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