

OUTCOMES OF CARE IN BIRTH CENTERS

The National Birth Center Study*

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Abstract We studied 11,814 women admitted for labor and delivery to 84 free-standing birth centers in the United States and followed their course and that of their infants through delivery or transfer to a hospital and for at least four weeks thereafter. The women were at lower-than-average risk of a poor outcome of pregnancy, according to many but not all of the recognized demographic and behavioral risk factors.

Among the women, 70.7 percent had only minor complications or none; 7.9 percent had serious emergency complications during labor and delivery or soon thereafter, such as thick meconium or severe shoulder dystocia. One woman in six (15.8 percent) was transferred to a hospital; 2.4 percent had emergency transfers.

BIRTH centers are nonhospital facilities organized to provide family-centered maternity care for women judged to be at low risk of obstetrical complications. The first birth centers were developed to serve rural communities. In 1975, the Maternity Center Association established the first urban birth center in New York City.¹ As of 1987, at least 240 other centers had opened, although many subsequently closed, primarily because of the liability-insurance crisis. Most states now regulate birth centers by licensure, a program of accreditation has been established, and the services of birth centers are covered by most health care insurance plans.

Safety is the major concern. Previous studies of birth centers have been retrospective and relatively small.²⁻¹⁴ In 1982 an Institute of Medicine committee concluded that reliable information about the relative safety and efficacy of all birth settings was lacking. It recommended research to include "well-conducted prospective descriptive and observational studies."¹⁵ Statements from the American Academy of Pediatrics and the American College of Obstetricians and Gynecologists discouraged the use of birth centers until better data were available.¹⁶ Because few poor outcomes would be expected among women who had been screened to exclude those with recognizable high-risk conditions, a large study was needed to describe the outcomes of birth-center care accurately. The National Birth Center Study was designed to respond to the recommendations of the Institute of Medicine committee and to address the concerns of the American College of Obstetricians and Gynecologists and the American Academy of Pediatrics. It is a nationwide prospective descriptive study of the care provided in free-standing birth centers. This report examines the labor, delivery, follow-up care, and outcomes of 11,814 women who were admitted in labor to 84 birth centers from mid-1985 through 1987.

METHODS

Recruitment of Birth Centers

The National Association of Childbearing Centers maintains a master list of U.S. birth centers known to its staff. In early 1985, the association invited all 134 centers on its list to participate in the study, which was due to begin in June of that year. Six centers that opened or became known to the association during the remainder of 1985 or during 1986 were also asked to join the study. Of the 140 centers invited to participate, 89 centers in 35 states actually did so. Between November 1986 and July 1987, 80 of these centers were visited in order to evaluate their data-collection procedures and the completeness and reliability of their data. The remaining nine centers either had not yet entered the study or had closed before the site visits were completed. Data from these nine centers were included in the analyses. Five centers were excluded from the study before the analysis of data because the site visits showed that either they had not enrolled all their patients or the data from their clinical records were not sufficiently consistent with recorded observations. Thus, this study is based on data from 84 birth centers.

In early 1987, we obtained lists of all birth centers known to the health authorities of 45 states. Before obtaining these lists, the National Association of Childbearing Centers knew of 140 centers, of which only 8 were located in the five states that did not provide the information requested. The state authorities listed 20 free-standing birth centers not previously included on the association's master

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list. Of the combined total of 160 centers known to either the state authorities or the association, 84 (52.5 percent) were included in this study.

Sixty of the 84 centers were operated by certified nurse-midwives, 11 by obstetrician-gynecologists, 6 by family practitioners or other physicians, 3 by licensed or lay midwives, 3 by obstetrician-gynecologists and certified nurse-midwives, and 1 by a team of certified nurse-midwives and lay midwives. As compared with the centers studied, other birth centers known to be in operation from 1985 through 1987 were more likely to be located in Western states, to be run by lay midwives or physicians other than obstetricians, to serve many low-income clients, and to be unaccredited and unlicensed by the state.

Data Collection and Analysis

The staff members at the participating centers told each prospective patient about the study and indicated that although the patient would not be identified personally, data about her pregnancy and care would be included. If a woman did not want information about her pregnancy to be so used, she was free to terminate her relation with the birth center. However, none did so. The procedure used to protect the privacy of the study subjects was approved by the research committee of the Maternity Center Association.

Data on each woman in the study were recorded on a pre-numbered four-part form. Each participating center was given enough forms to serve the total number of clients it anticipated over a one-year period. Part I was used to collect demographic data and information on risk factors and was completed after the first prenatal visit. Part II, which included information about prenatal care and complications, was completed either when the woman was admitted to the birth center for intrapartum care or when she discontinued her care before such admission. Part III asked for information on care and complications during labor and birth and immediately afterward, the circumstances of and reasons for any transfer to a hospital, and care received during hospitalization by those transferred; it was completed at discharge from the hospital or birth center. Part IV covered care and complications during the postpartum and neonatal periods and the mother's evaluation of her own care at the birth center; it was completed when she returned at four to six weeks for her postpartum examination. Of the women who were transferred to hospitals during or immediately after labor and delivery, 60 percent returned to the birth centers for a postpartum visit. Information about the time required to transport women or their infants to a hospital was collected for a sample of 20 percent of the women who were transferred (387 women). The centers made special efforts to follow the care of infants who were in fair or poor condition at discharge from the birth center.

Information was gathered on the occurrence and severity of 29 specific intrapartum and immediate postpartum and neonatal complications. Each complication was assigned a score of 1 to 3 to indicate its seriousness with respect to the risk of death or permanent damage. The complications were also scored from 1 to 3 to reflect the need for an urgent transfer to hospital care. Complications that received a score of 3 on both scales, such as the presence of thick meconium or sustained fetal distress, were regarded in this analysis as serious emergencies that occurred in the birth center. The scoring system (available on request) was based on current literature and the advice of the study's advisory committee and other experienced clinicians.

The collection of data in each center was supervised by a designated staff member who had been trained in regional group meetings and with whom frequent contact was maintained by telephone. The forms were completed by the care providers. The completed forms were returned monthly, read by optical scanning, edited for inconsistency or incompleteness, and updated after the centers were contacted for corrections. Selected data from the five excluded centers were examined to determine whether the exclusions had influenced the major results of the study.

Study Subjects

Initial and ongoing screening and triage are an underlying principle of care in free-standing birth centers. A cohort of 17,856 women was enrolled in the study, but 6042 of the women (33.8 percent)

were never admitted to birth centers for intrapartum care. Referral to a hospital for prenatal complications was the main reason (in 2557 women) for the discontinuation of birth-center care. Other women discontinued such care because their centers closed or the women moved, changed their minds, were not pregnant, or had abortions. This paper describes the results in the remaining 11,814 women (66.2 percent of those initially enrolled) who were actually admitted to birth centers for intrapartum care. All health outcomes reported include those of the women and infants who were transferred from the birth centers to hospitals during or soon after labor and delivery, as well as those of the women who gave birth in the centers.

RESULTS

Prenatal Screening and Referral

The women who received intrapartum care in the 84 birth centers made an average of 11.3 prenatal visits to the centers. All but 2.6 percent had at least four visits. Twenty-nine percent had complications of some type during prenatal care. The most common complications were urinary tract infections, anemia, and transient hypertension.

Characteristics of the Women

Table 1 compares the women admitted to the birth centers for labor with all women who gave birth in the United States in 1986, according to nine demographic and behavioral variables associated with perinatal risk, as well as the gestational age and birth weight of their infants. The women who used birth centers were less likely than their counterparts in the general population to smoke, drink alcohol, or be black, unmarried, poorly educated, or under 18 years of age, although a higher proportion of the birth-center patients were Hispanic. (Four centers accounted for more than 80 percent of the Hispanic women.) The patients at the birth centers were more likely to have finished college and somewhat less likely to be poor or in a parity grouping associated with high risk — that is, with a first baby or a sixth or subsequent pregnancy. The birth-center patients were less likely to have started prenatal care during the first trimester but were also less likely to have waited until the last trimester. Almost all the women had adequate diets during pregnancy; 1.5 percent reported the use of marijuana or other illegal drugs.

Birth Weight and Gestational Age

The birth-center patients had fewer preterm or low-birth-weight babies and a higher proportion of large infants than their counterparts in the general population. Most birth-center patients who had preterm labor or intrauterine growth retardation had been referred directly to hospitals and therefore were not included among the women in this report. Thus, the low incidence of low birth weight in this study cannot be interpreted to result from the prenatal care at the birth centers.

Type of Practitioner

Certified nurse-midwives or students of nurse-midwifery provided care during 78.6 percent of the labors and 80.6 percent of the births that occurred in the centers. Physicians, primarily obstetricians, provided

Table 1. Characteristics of 11,814 Women Admitted to Birth Centers in Labor, 1985 to 1987, and of All U.S. Women Who Gave Birth in 1986.

CHARACTERISTIC	WOMEN IN BIRTH CENTERS	ALL WOMEN WHO GAVE BIRTH*
	percent	
Age (yr)		
<18	2.3	4.7
18-34	89.9	88.3
≥35	7.8	7.0
Years of education†		
<12	12.4	15.5
12	32.3	43.7
13-15	23.5	22.1
≥16	31.8	18.7
Unmarried	12.3	23.4
Race or ethnicity‡		
Non-Hispanic white	78.4	68.1
Black	3.9	16.5
Hispanic	16.3	11.0
Other	1.3	4.4
Low economic status§	24.9	27.0
Parity		
0	39.3	41.6
1	33.4	33.0
2-4	25.8	23.7
5-10	1.5	1.7
Trimester of first prenatal care¶		
1st	61.7	75.9
2nd	34.9	18.1
3rd or no care	3.4	6.0
Cigarettes/day during pregnancy		
None	90.3	74.5
1-10	5.9	12.0
≥11	3.8	13.5
Drinks/wk during pregnancy		
None	88.7	60.9
<3	10.8	35.9
≥3	0.5	3.2
Gestational age of infants (wk)		
<37	2.4	10.0
38-41	86.2	76.3
≥42	11.4	13.7
Birth weight of infants (g)**		
<2501	0.8	6.8
2501-4000	82.8	82.1
>4000	16.4	11.1

*Data are from the National Center for Health Statistics.¹⁷

†Among women over 18 years of age.

‡Estimated for all U.S. women who gave birth from the 1980 and 1986 U.S. Census and vital-registration data (and Ventura S, National Center for Health Statistics: personal communication).

§Data on all U.S. women who gave birth are from the *Federal Register*.¹⁸

¶Data on women in birth centers exclude women who transferred to birth-center care after receiving some antepartum care through another provider.

||Data refer to 1980 birth cohort as studied by Prager et al.¹⁹

**The distribution of U.S. births includes births <2500 g in the low-birth-weight category, whereas the birth-center data are divided to include birth weights <2501 g in the lowest category.

care during 9.9 percent of the labors and 16.0 percent of the deliveries at the birth centers. Midwives who were not certified nurse-midwives cared for 3.8 percent of the women in labor and 3.0 percent during birth. Registered nurses managed 7.7 percent of the labors and 0.4 percent of the births.

Intrapartum Care

Only 1.3 percent of the women had artificial rupture of membranes or were given oxytocin to induce labor. Forty-two percent were given some treatment to augment the forces of labor; 32.4 percent had artificial rupture of membranes before 5 cm of cervical dilatation, 1.0 percent had nipple stimulation, and 1.4 per-

cent received oxytocin. However, 10.5 percent of all women in labor were diagnosed as having "failure to progress"; instead of stimulating their labors with oxytocin, the centers transferred 83.3 percent of these women to hospital care.

Fifty-two percent of the women had fewer than four vaginal examinations, 14.7 percent had intravenous infusions, and 9.3 percent had enemas. The fetal heart rate was monitored by portable Doppler ultrasonography in 87.2 percent of the women; in 7.5 percent the fetus was monitored electronically (internally in 1.1 percent). All but 5.0 percent drank or ate while in labor at the birth center; 43.4 percent took showers, baths, or both, and 34.6 percent were given body massage. Ninety-seven percent were accompanied by friends or family members, often including young children.

Twenty-four percent of the nulliparous women and 6.2 percent of the parous women received an analgesic, tranquilizer, or sedative during labor. Three percent of the women were given anesthetics other than local infiltration for an episiotomy or for repair of laceration. Pain relief was inadequate in 2.4 percent of the women, 66.2 percent of whom were transferred to hospitals.

Of the women who gave birth in the centers, 99.4 percent had spontaneous vaginal deliveries. Vacuum extractors were used to assist delivery in 0.4 percent, and forceps were used in 0.2 percent. Forty-three percent of the women were in an upright or semiupright position for delivery (37.8 percent sitting, 3.6 percent squatting, and 0.8 percent standing), 29.0 percent were on their sides, and 21.3 percent were supine or in the lithotomy position.

More than a third of the women (34.2 percent) delivered with an intact perineum, and 17.6 percent had an episiotomy without a laceration. The remaining women had lacerations: 45.7 percent had first- or second-degree, 1.6 percent had third-degree, and 0.8 percent had fourth-degree lacerations.

Complications in the Birth Centers

Twenty percent of the women and their babies had no complications during labor, delivery, or the immediate postpartum and neonatal period. Another 50.8 percent had complications that posed no inherent risk of death or permanent damage, such as transient fetal distress, failure to progress, maternal temperature below 37.8°C, less than fourth-degree perineal lacerations, and minor congenital anomalies. Somewhat more serious complications, such as maternal temperature above 37.8°C, birth weight above 4499 g, moderate shoulder dystocia, retained placenta, and hypertension, occurred during labor and delivery in 21.3 percent of the women.

One or more serious emergency complications occurred in the birth centers in 7.9 percent of the mothers or their infants. Table 2 shows the frequency of these serious emergency complications and the percentages of the women or infants with each type of complication who were transferred to hospitals. Each complication was categorized as "usually requiring

Table 2. Incidence of Serious Emergency Complications in Birth Centers and Transfer Rate for Women and Infants with Each Complication.

COMPLICATION	INCIDENCE	TRANSFERS TO HOSPITALS
	no. (%) ^a	no. (%)
Labor		
Thick meconium	484 (4.1)	210 (43.4)
Sustained fetal distress	211 (1.8)	132 (62.6)
Abruptio placentae	24 (0.2)	5 (20.8)
Prolapsed cord	4 (0.03)	4 (100.0)
Delivery or immediate postpartum		
Postpartum hemorrhage requiring transfer	50 (0.5)	50 (100.0)
Severe shoulder dystocia	15 (0.15)	2 (13.3)
Nonvertex presentation diagnosed at birth	6 (0.06)	1 (16.7)
Multiple gestation diagnosed at birth	4 (0.04)	1 (25.0)
Postpartum eclampsia	1 (0.01)	1 (100.0)
Immediate neonatal		
Cyanosis	66 (0.7)	25 (37.9)
Intrauterine pneumonia or other infection	57 (0.6)	32 (56.1)
5-Minute Apgar score <7	55 (0.5)	27 (49.1)
Great effort required to establish respirations	38 (0.4)	10 (26.3)
Serious congenital anomaly	38 (0.4)	17 (44.7)
Suspected aspiration of meconium	21 (0.2)	17 (81.0)
Birth weight <2001 g	6 (0.06)	1 (16.7)
Total†	928 (7.9)	437 (47.1)

^aFor complications during labor, percentages are based on data for all 11,814 women admitted to birth centers in labor, minus small but varying numbers of women for whom information was missing. For complications during delivery and the immediate postpartum and neonatal periods, percentages are based on the 10,350 births that occurred in or on the way to birth centers or on the way to hospitals, minus small but varying numbers of women for whom information was missing.

[†]The total number of mothers or infants with emergency complications is less than the sum of the incidence rates for each complication because 119 women had two or more serious emergency complications.

immediate hospital care for optimal treatment” according to the scoring system developed for this analysis. However, only 47.1 percent of the women or infants were actually transferred. When serious complications occur close to the time of birth, there may not be enough time to transfer the patient until after the crisis has passed; then, if the complication has been managed successfully, there may be no need for transfer. The numbers and percentages shown in the table include only complications that occurred in the birth centers and thus do not include the low Apgar scores of infants born in hospitals after a transfer.

We looked for associations between the occurrence of serious emergency complications and the presence of either recognized demographic and behavioral risk factors or specific prenatal complications. None of these factors were predictive of complications in this population, which had already been screened during prenatal care.

Intrapartum, Immediate Postpartum, and Newborn Transfers

Of the 11,814 women admitted to birth centers for intrapartum care, 15.8 percent were transferred to hospitals during or soon after labor and birth. Table 3 shows data on these transfers according to subject

(mother or infant), timing of the transfer, and urgency. Three fourths of the transfers took place before delivery (11.9 percent of the women admitted to birth centers for intrapartum care): 57.5 percent of the transfers before delivery were attributed to failure to progress, 13.4 percent to the presence of meconium in the amniotic fluid, and 10.0 percent to fetal distress. In addition, 0.8 percent of the postpartum mothers and 1.7 percent of the newborn infants were transferred. Hemorrhage and a retained placenta were the two most frequent reasons for the transfers of postpartum mothers; respiratory distress was the usual reason for the transfers of newborns. Of the total number of mothers and infants, 2.4 percent were transferred under circumstances that the care provider considered to constitute an emergency. Among the sample of 387 women and newborns for whom information was collected on the time required to complete a transfer, 39.7 percent of those considered to have emergency complications were in transit for fewer than 6 minutes, and 13.7 percent were in transit for more than 15 minutes.

Nulliparity was associated with an increased likelihood of transfer: 28.9 percent of the nulliparous women or their infants were transferred, but only 7.3 percent of the parous women. The transfer rates were similar among parous women of higher or lower parity. Failure to progress accounted for 52.0 percent of the transfers of nulliparous women and 20.9 percent of the transfers of parous women. Fifteen percent of 4610 nulliparous women were transferred for this reason, as compared with 1.5 percent of 7121 parous women.

Cesarean Sections

The overall rate of cesarean section was 4.4 percent. The most common reasons for performing a cesarean section were failure to progress (64.8 percent), fetal distress or the presence of meconium in the amniotic fluid (16.5 percent), and a nonvertex presentation (4.6 percent). The percentage of nulliparous women who had cesarean sections was 9.9 percent: 8.2 percent for failure to progress and 1.7 percent for other reasons. Among the parous women, 0.6 percent had cesarean sections because of failure to progress and 0.2 percent for other reasons. Among 1405 women trans-

Table 3. Transfers among 11,814 Women Admitted to Birth Centers for Intrapartum Care, According to Timing, Subject (Mother or Infant), and Determination of Emergency Status.

TIMING AND SUBJECT	No. (%) OF TRANSFERS ^a	
	EMERGENCY	ALL
Before delivery	177 (1.5)	1405 (11.9)
1st Stage of labor	111 (0.9)	1119 (9.5)
2nd Stage of labor	66 (0.6)	263 (2.2)
Stage unknown	0 (0.0)	23 (0.2)
After delivery	83 (0.7)	294 (2.5)
Maternal transfers	42 (0.4)	100 (0.8)
Newborn transfers	41 (0.4)	194 (1.7)
Timing unknown	24 (0.2)	170 (1.4)
All	284 (2.4)	1869 (15.8)

^aPercentages refer to all 11,814 subjects.

ferred to hospitals before delivery, 37.1 percent had cesarean sections.

Among the women who had cesarean sections, 115 (22 percent) had eaten solid food during labor. None of them aspirated the contents of the stomach while under anesthesia. The expected incidence of such aspiration (about 1 per 2000 in patients who underwent general anesthesia²⁰) is such that the practice of eating during labor must still be questioned, despite the absence of complications observed in this sample.

Patient Satisfaction

Of the women who received intrapartum care in birth centers and were not transferred, 75.7 percent completed evaluations of their care. Of these, 98.8 percent stated that they would recommend the center to friends, and 94.0 percent indicated that they would use the birth center in another pregnancy. Of the women who were transferred, 54.1 percent completed evaluations; 96.9 percent said they would recommend the birth center, and 83.3 percent said they would return to the center for a subsequent birth.

Follow-up

Eighty-three percent of the women had a postpartum examination or other visit at the center four to six weeks after the birth. Among the 2046 women who did not make such a visit (17.3 percent), all but 26 had babies who were in good condition at discharge from the birth center or hospital. We tried to determine whether any of these 26 infants had died but were unable to obtain at least a part of the necessary information about each infant, in most instances because the birth center had closed, key staff members had moved, and the log book linking the study numbers to the records of the individual mothers could not be located. However, staff members at the seven centers that had cared for the mothers of 14 of these infants certified that their centers had never had an intrapartum stillbirth or a maternal or neonatal death. Five of the remaining 12 infants were born in hospitals after the mothers had been transferred because the labor failed to progress; 3 others were transferred as neonates for respiratory distress but had normal birth weights and five-minute Apgar scores of 7 or higher. Although the lack of identifying information precluded a review of their hospital records, it is unlikely that any of these eight infants died. Four infants remain for whom a safe neonatal outcome cannot be demonstrated: one whose mother was transferred to the hospital during labor because of thick meconium but not as an emergency; two born in birth centers and not transferred; and one born in a birth center and then transferred to a hospital.

Outcomes

Apgar scores and mortality rates were used as measures of final outcome. There were 11,814 mothers and no maternal deaths. Among the babies, 0.6 percent

had five-minute Apgar scores below 7. There were 11,826 births and a total of 15 intrapartum or neonatal deaths, of which 7 were due to the presence of lethal congenital anomalies (Table 4). The rate of intrapartum death (stillbirth) was 0.4 per 1000 births (0.3 if the deaths from lethal congenital anomalies are excluded) (Table 5). The neonatal mortality rate was 0.8 per 1000 births (0.3 if the lethal congenital anomalies are excluded). The overall mortality rate, including intrapartum and neonatal deaths, was 1.3 per 1000 births (0.7 if the lethal anomalies are excluded). The circumstances leading to the eight deaths not associated with lethal congenital anomalies are shown in Table 4.

DISCUSSION

We believe that despite the lack of a control group, this descriptive study provides meaningful results in the context of historical data on low-risk hospital birth. The difficulties of obtaining an appropriate control group for a large prospective study of alternative birth settings are discussed in the 1982 report of the Institute of Medicine, "Research Issues in the Assessment of Birth Settings."¹⁵

Table 5 shows the outcomes in this study and in five earlier studies of low-risk hospital deliveries.²¹⁻²⁵ Although the studies span a period of 17 years, no time trend is apparent. Most of the reduction in neonatal mortality during this period has been due to the improved survival of preterm infants with low birth weight,²⁶ who were excluded from each of the hospital studies. Although no group of hospital patients is completely comparable to the women in our study, the other studies excluded not only low-birth-weight infants but also twins, nonvertex presentations, repeat cesarean sections, and women with ma-

Table 4. Intrapartum and Neonatal Deaths among 11,826 Infants (Including 12 Sets of Twins) of Mothers Receiving Intrapartum Care at Birth Centers.

CATEGORY OF DEATH	NUMBER
Total intrapartum and neonatal	15
From lethal congenital anomalies (1 intrapartum, 6 neonatal)	7
From other causes	8
Intrapartum	4
Term pregnancy, partial placenta previa, abruption (died in birth center)	
Term pregnancy, transfer during first stage of labor because of thick meconium and sustained fetal distress (died in hospital)	
Post-term pregnancy, placental abruption (died in birth center)	
Post-term pregnancy, mother had low-grade fever and pre-eclampsia during labor (died in birth center)	
Neonatal	4
Term pregnancy, sustained fetal distress, transferred during first stage of labor, born in hospital with intrauterine pneumonia and pneumothorax (died in hospital)	
Term pregnancy, prolonged rupture of membranes, born in birth center, developed respiratory distress, transferred, pneumonia with hyaline membrane disease (died in hospital)	
Post-term pregnancy, thick meconium and sustained fetal distress, transferred during first stage of labor, born in hospital, five-minute Apgar score of 3 (died in hospital)	
Term pregnancy, uncomplicated labor, born in birth center, five-minute Apgar score of 10, death at one week of age, autopsy revealed no cause of death (died at home)	

Table 5. Outcomes in Five Studies of Low-Risk Hospital Births and in the National Birth Center Study.

SOURCE OF DATA*	NO. OF BIRTHS	NO. OF DEATHS PER 1000 BIRTHS†			INFANTS WITH FIVE-MINUTE APGAR SCORES <7	BIRTHS BY PRIMARY CAESAREAN SECTION
		INTRAPARTUM	NEONATAL	TOTAL		
Beth Israel Hospital, Boston, 1969-1975 ²¹	12,055				<i>percent</i>	
Lowest-risk women						
With monitoring		Unreported	1.1	Unavailable	—	—
Without monitoring		Unreported	0.5	Unavailable	—	—
Community hospital, Cincinnati, 1974-1975 ²²						
Normal pregnancies						
All						
With monitoring	4,144	1	3.4	4.3	—	—
Without monitoring	2,293	0	0.9	0.9	—	—
National Natality Survey, 1980 (low-risk births) ²³	2,935	Unreported	2.5	Unavailable	1	8.4
University of Illinois and 11 surrounding hospitals, 1982-1985 ²⁴						
Uncomplicated term births						
All						
Without anomalies	8,135	0	2.1	2.1	0.8	8.3
Uncomplicated post-term births						
All						
Without anomalies	3,457	0	2.6	2.6	1.7	17.6
With anomalies		0	2.1	2.1		
Parkland Memorial Hospital, Dallas, 1982-1985 ²⁵	14,618	0	1	1	0.2	—
84 U.S. birth centers, 1985-1987‡						
Infants of women admitted for intrapartum care						
All						
Without anomalies	11,826	0.4 (5)	0.8 (10)	1.3 (15)	0.6	4.4
Term births						
All		0.3 (4)	0.3 (4)	0.7 (8)		
Without anomalies	9,871	0.2 (2)	0.7 (7)	0.9 (9)	0.6	4.1
Post-term births§						
All		0.2 (2)	0.3 (3)	0.5 (5)		
Without anomalies	1,306	1.5 (2)	2.3 (3)	3.8 (5)	1.2	7.3
With anomalies		1.5 (2)	0.8 (1)	2.3 (3)		

*Monitoring denotes electronic fetal monitoring, and anomalies denotes lethal congenital anomalies.

†Values in parentheses are actual numbers of deaths.

‡The number of term and post-term births shown for the birth centers is less than the total number of births because gestational age was unknown for 649 infants. The number of term and post-term deaths is also less than the total number of deaths because one preterm infant died of a congenital anomaly.

§Births after 42 or more weeks of gestation.

for medical or prenatal complications. Neutra et al. stratified 15,846 live births at Beth Israel Hospital in Boston into five categories of risk.²¹ The data shown are for the group at lowest risk and exclude deaths from congenital abnormalities. Amato's 4144 "normal" patients included only 57 percent of the maternity patients at a community hospital in Cincinnati.²² He also excluded women with meconium-stained amniotic fluid or a postmature infant and those who had had stimulation with oxytocin or prolonged rupture of the membranes. The National Natality Survey conducted in 1980 by the National Center for Health Statistics was based on a probability sample of 9941 live births in the United States during that year.²³ Besides the exclusions listed earlier, the survey file was culled to exclude mothers who smoked more than 10 cigarettes per day, had more than three alcoholic drinks per week, had fewer than four prenatal visits, or were unmarried, black, or under 18 years old (Keppel K, National Center for Health Statistics, personal communication). Eden et al. screened 60,456 births at 12 hospitals in a midwestern perinatal-referral network to identify 11,592 uncomplicated term and post-term pregnancies in women between 16 and 39 years of age.²⁴ Leveno et al.

identified 42 percent of 34,995 births at Parkland Memorial Hospital, in Dallas, as low risk.²⁵

The proportion of low Apgar scores and the total mortality rate among infants born to women attending birth centers were in the same range as those in the five earlier studies. Our findings differed in two ways. The rate of cesarean section in the birth-center patients was roughly half that in the two studies that reported such information, and half the deaths in our study that were not caused by congenital anomalies occurred intrapartum, whereas there was only one intrapartum death in the three other studies that reported on this outcome. The higher incidence of intrapartum stillbirth at the birth centers was offset by a lower incidence of neonatal death, and the overall likelihood of a poor outcome was not higher among the infants of birth-center patients. It is possible that in a hospital the ability to deliver rapidly a fetus that is in distress during labor shifts some deaths from the intrapartum to the neonatal period.

We examined several sources of error that could have biased our findings. We do not know the outcomes of four infants and cannot exclude the possibility that one or more of them may have died. If all four died, the total mortality rate would increase by 0.3

deaths per 1000 births. The mortality rate at the 5 centers that were excluded because they did not conform to study standards was 7.2 per 1000, much higher than the rate at the other 84 centers. If these five centers had been retained in the study, the total mortality rate would have increased by another 0.3 per 1000 births. If in addition the four infants were assumed to have died, the total mortality rate would have reached 1.9 per 1000 births — still within the range reported for low-risk hospital births.

The birth centers included in this study may be safer than those not included. Centers not known to the National Association of Childbearing Centers have less access to continuing education relevant to the safety of birth-center care and may be less influenced by national standards. Fewer of the nonparticipating centers were licensed or accredited. Although the majority of birth centers in the United States participated in this study, they are probably unrepresentative of all birth centers in the same way that academic medical centers are unrepresentative of all hospitals. Among the five studies of low-risk hospital births, the lowest mortality rates were reported by the two academic medical centers.

As in most other multicenter studies, the data were collected by the care providers. Although this procedure creates a potential for bias, the findings during the site visits, the congruence between the study data and information from sample clinical records from each center, and the internal consistency of the data suggest that the data are reliable.

We found the neonatal mortality rate to be lower than that reported in previous multicenter studies of birth centers. Bennetts and Lubic reported a neonatal mortality rate of 4.6 per 1000 births among 1938 women cared for in 11 nurse-midwifery centers from 1972 through 1979.¹² Eakins and Richwald found 4 neonatal deaths per 1000 births among 2002 admissions to 16 birth centers in California in 1984.¹³ The National Association of Childbearing Centers calculated a neonatal mortality rate of 2.5 per 1000 deliveries from reports of births at 102 birth centers in 1983.¹⁴ The lower rate in our study may indicate a trend toward greater safety, reflecting the implementation of state regulation and licensure, accreditation, peer review, and programs of continuing education within the past five years.

The birth centers used few invasive, uncomfortable, or restrictive procedures and took many measures to provide comfort and support to the women during labor. Although in individual cases specific procedures and treatments are beneficial or necessary, each carries potential risk.²⁷⁻⁵³ Further study is needed to evaluate the effect of the birth-center approach on health outcome, cost, and patient satisfaction.

The combination of good outcomes and few cesarean sections found in this study is not unique and has been reported in studies of hospital-based nurse-midwifery care⁵⁴⁻⁶¹ and at the National Maternity Hospital in Dublin, Ireland.⁶²⁻⁶⁴ The latter has achieved

these outcomes through the implementation of a uniform protocol for the use of oxytocin whenever the rate of cervical dilatation is less than 1 cm per hour in a nulliparous woman. In our study, the outcomes were achieved in free-standing birth centers.

Birth centers offer a savings in cost^{65,66} and minimize the rate of cesarean section. Some centers serve rural populations that are too small to support a hospital obstetrical unit. They may be located in residential areas and can be designed to suit the needs of particular communities. Because they are small and generally nonbureaucratic, they may overcome social and emotional barriers that contribute to the poor use of care facilities by some groups of women.^{26,67,68}

Few innovations in health service promise lower cost, greater availability, and a high degree of satisfaction with a comparable degree of safety. The results of this study suggest that modern birth centers can identify women who are at low risk for obstetrical complications and can care for them in a way that provides these benefits.

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