

# Perinatal Outcomes of Women Intending to Give Birth in Birth Centers in Australia

Paula J. Laws, BAppPsych (Hons), Sally K. Tracy, DMid, RM, and Elizabeth A. Sullivan, MBBS, MPH, MMed

**ABSTRACT:** **Background:** A recent Australian study showed perinatal mortality was lower among women who gave birth in a birth center than in a comparable low-risk group of women who gave birth in a hospital. The current study used the same large population database to investigate whether perinatal outcomes were improved for women intending to give birth in a birth center at the onset of labor, regardless of the actual place of birth. **Methods:** Data were obtained from the National Perinatal Data Collection (NPDC) in Australia. The study included 822,955 mothers who gave birth during the 5-year period, 2001 to 2005, and their 836,919 babies. Of these, 22,222 women (2.7%) intended to give birth in a birth center at the onset of labor. Maternal and perinatal factors and outcomes were compared according to the intended place of birth. Data were not available on congenital anomalies, or cause, or timing of death. **Results:** Women intending to give birth in a birth center at the onset of labor had lower rates of intervention and of adverse perinatal outcomes compared with women intending to give birth in a hospital, including less preterm birth and low birthweight. No statistically significant difference was found in perinatal mortality for term babies of mothers intending to give birth in a birth center compared with term babies of low-risk women intending to give birth in a hospital (1.3 per 1,000 births [99% CI = 0.66, 1.95] vs 1.7 per 1,000 births [99% CI = 1.50, 1.80], respectively). **Conclusions:** Term babies of women who intended to give birth in a birth center were less likely to be admitted to a neonatal intensive care unit or special care nursery, and no significant difference was found in other perinatal outcomes compared with term babies of low-risk women who intended to give birth in a hospital labor ward. Birth center care remains a viable option for eligible women giving birth at term. (BIRTH 37:1 March 2010)

**Key words:** Australia, birth center, intended place of birth, perinatal outcomes

A recent Australian population-based study investigated perinatal outcomes for all birth centers in Australia according to actual place of birth and showed that perinatal mortality was lower in a birth center than in a comparable low-risk group of women who gave birth in a hospital (1). The study

has been criticized because it did not examine the outcomes of women who intended to give birth in a birth center but were transferred to a hospital labor ward.

Several Australian studies have examined characteristics and outcomes of women by their intended place of

Paula Laws is Senior Research Officer, Perinatal and Reproductive Epidemiology Research Unit, School of Women's and Children's Health, University of New South Wales; Sally Tracy is Professor of Midwifery, University of Sydney; and Elizabeth Sullivan is Associate Professor and Director, Perinatal and Reproductive Epidemiology Research Unit, School of Women's and Children's Health, University of New South Wales, Sydney, Australia.

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Address correspondence to Paula Laws, BAppPsych (Hons), Perinatal and Reproductive Epidemiology Research Unit, Level 2, McNevin Dickson Building, Randwick Hospitals Campus, Randwick, NSW 2031, Australia.

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birth and have found better outcomes for women intending to give birth in a birth center, even if they were transferred to a hospital during labor (2,3). Maternal and neonatal outcomes shown to be more favorable included lowered rates of cesarean section and instrumental delivery, fewer interventions such as induction and analgesia, higher rate of intact perineum, and lower rates of admission to special care nursery (2,3). Various international studies have shown similar findings (4–7).

Research has been undertaken to ascertain a definition of birth centers in the Australian context:

A birth center is a midwifery-managed unit separate from a labor ward—but with established links to a referral service—offering both antenatal care and care during birth to women at low risk of medical complications. Birth centers are characterized by a commitment to normality of pregnancy and birth, and a homelike environment (8).

Where necessary, women with medical or obstetric complications are transferred to standard care. Most birth centers in Australia are co-located within or alongside a hospital offering maternity services (8,9). In 2005, 3.2 percent of women who gave birth in Australia were reported as intending to give birth in a birth center, and 1.9 percent were reported as actually doing so (10).

The current study aimed to use the same large population database to investigate the perinatal outcomes of women intending to give birth in a birth center, irrespective of the actual place of birth.

## Methods

Data were obtained from the National Perinatal Data Collection (NPDC), a population-based cross-sectional data collection on pregnancy and childbirth. Information is included in the NPDC for all births in Australia, both live and stillborn, of infants weighing at least 400 g birthweight or at least 20 weeks' gestation. Data are obtained from mothers and from hospital or other records and are usually compiled at the time of the birth by a midwife or other staff member.

NPDC data were extracted for the four states and territories that had operating birth centers and for which data on the intended place of birth at the onset of labor were available. Jurisdictions included New South Wales, Queensland, Western Australia, and the Australian Capital Territory. This study included women who gave birth during the 5-year period from January 1, 2001, to December 31, 2005, in these four jurisdictions. Ethics approval was obtained from the University of New South Wales Human Research Ethics Committee and the Australian Institute of Health and Welfare Ethics

Committee. Approval was also obtained from state and territory health departments.

During the 5-year period, 827,065 women gave birth to 841,075 babies in the study population. Of these, 22,222 women (2.7%) were reported as intending at the onset of labor to give birth in a birth center. The "intention at onset of labor" refers to the intended place of birth at the onset of regular uterine contractions, induction, or at the time of elective cesarean section, regardless of the gestation. This data element has been previously validated in one jurisdiction and excellent concordance between the medical record and perinatal data collection form was found (11). Most of the women intended to give birth in a hospital (96.8%); 0.5 percent of women who intended to give birth at home or in other settings, or whose intended place of birth was not recorded, were excluded. There remained 822,955 mothers and 836,919 babies who were included for analysis.

Maternal characteristics were compared for women intending to give birth in a birth center and in a hospital labor ward, including age, indigenous status, parity, reported preexisting diabetes or hypertension, and admitted patient-elected accommodation status (whether the woman was admitted as a public or private patient). Maternal outcomes including pregnancy-related diabetes or hypertension, presentation at birth, onset of labor, method of birth, episiotomy, and third- or fourth-degree perineal tear were also compared. Perinatal outcomes examined included preterm birth (<37 completed weeks' gestation); low birthweight (<2,500 g); low Apgar score (defined as <7 at 5 min); admission to a special care nursery or neonatal intensive care unit; high level of resuscitation (defined as endotracheal intubation and/or external cardiac massage and ventilation); and perinatal mortality (including stillbirths and neonatal deaths of live-born babies up to 28 days). Data on lethal or nonlethal congenital anomalies or cause of death were not available.

A low-risk group of women intending to give birth in a hospital was constructed for comparison with the birth center women. The criteria were as follows: women who were 20 to 34 years of age, had no preexisting hypertension or diabetes, had no pregnancy-induced hypertension or gestational diabetes, and gave birth to a singleton baby in a vertex presentation at 37 to 41 weeks of completed gestational age, with a birthweight greater than or equal to 2,500 g.

Maternal and perinatal factors were compared on an intention-to-treat basis. Women who intended to give birth in a birth center were presented as one group, regardless of whether they were transferred to a hospital labor ward or delivery suite during labor.

### Data Analysis

Data analyses were conducted using the Statistical Package for Social Sciences (SPSS), version 15.0 (12). Analyses included descriptive analyses, chi-square testing to examine differences between demographic characteristics and outcomes for all birth centers compared with all hospitals, and all birth centers compared with a low-risk and term hospital group, and logistic regression to calculate the adjusted odds of perinatal death. Further analyses using the Poisson distribution were conducted to compare perinatal outcomes at term. The significance level for all significance testing was set at  $p < 0.01$ .

## Results

### Descriptive Data

Of the 22,222 women who intended at the onset of labor to give birth in a birth center during 2001 to 2005, two-thirds were reported as actually giving birth in a birth center (65.6%). Overall, 33.9 percent of these women were reported as giving birth in a hospital labor ward, representing the intrapartum transfers. A small percentage of women gave birth at home or before arrival (0.5%). In this study, all women who intended to give birth in a birth center were analyzed as a single group.

Women intending to give birth in a birth center were slightly older compared with women intending to give birth in a hospital labor ward (mean age of 29.9 yr vs 29.3 yr, respectively), and fewer of these women identified themselves as indigenous (1.2% vs 4.1%; Table 1). A larger proportion of first-time mothers were in the birth center group compared with the hospital group (45.3% vs 41.3%), and a larger proportion of the birth center women were public patients (89.2% vs 63.6%).

A comparison of selected maternal outcomes by the intended place of birth showed that women intending to give birth in a birth center had fewer interventions compared with low-risk and term women intending to give birth in a hospital. Birth center women had lower rates of induction (11.6% vs 24.2%, respectively), episiotomy (7.7% vs 15.9%), cesarean section (7.1% vs 22.1%), and instrumental deliveries (7.6% vs 11.0%; Table 2). The birth center group experienced a higher rate of third- or fourth-degree perineal tears (2.1% vs 1.7%).

Babies of women intending to give birth in a birth center had lower rates of adverse perinatal outcomes compared with babies of women intending to give birth in hospitals, such as less preterm birth (1.8% vs 8.0%)

and low birthweight (1.4% vs 6.3%; Table 3). The birth center group, however, showed a higher rate of post-term birth (4.3% vs 1.6%), and 95.7 percent of these intended birth center post-term births occurred at 42 weeks. Live-born babies of all women intending to give birth in a birth center had a lower rate of admission to a special care nursery or neonatal intensive care unit compared with low-risk and term women intending to give birth in a hospital (6.9% vs 8.1%).

### Adjusted Odds of Perinatal Death

The odds of perinatal death were significantly lower among women who intended to give birth in a birth center compared with those who intended to give birth in a hospital, for both primiparas and multiparas (OR = 0.39, 99% CI = 0.26, 0.58 and OR = 0.29, 99% CI = 0.18,

**Table 1. Selected Maternal Characteristics of Women who Gave Birth, by Intended Place of Birth, 2001 to 2005**

Characteristics	Intended Place of Birth No. (%)	
	All Hospitals (n = 800,733)	All Birth Centers (n = 22,222)
Maternal age (yr) <sup>a</sup>		
<20	40,115 (5.0)	540 (2.4)
20–24	126,624 (15.8)	2,922 (13.1)
25–29	227,657 (28.4)	6,736 (30.3)
30–34	259,871 (32.5)	7,851 (35.3)
≥35	146,347 (18.3)	4,173 (18.8)
Not stated	119 (0.0)	—
Indigenous status <sup>a</sup>		
Aboriginal or Torres Strait Islander	33,003 (4.1)	261 (1.2)
Nonindigenous	767,389 (95.8)	21,960 (98.8)
Not stated	341 (0.0)	1 (0.0)
Parity <sup>a</sup>		
Primiparas	330,950 (41.3)	10,060 (45.3)
Multiparas	469,317 (58.6)	12,160 (54.7)
Not stated	466 (0.1)	2 (0.0)
Preexisting medical conditions <sup>a</sup>		
None/not stated	788,799 (98.5)	22,131 (99.6)
Yes	11,934 (1.5)	91 (0.4)
Admitted patient-elected accommodation status <sup>a</sup>		
Public	501,882 (63.6)	19,600 (89.2)
Private	261,632 (33.2)	1,739 (7.9)
Not stated	25,485 (3.2)	640 (2.9)

<sup>a</sup>Distribution of these factors is significantly ( $p < 0.01$ ) different between the groups "all hospitals" and "all birth centers" using chi-squared tests.

0.46, respectively; Table 4). After adjusting for gestational age, maternal age, maternal indigenous status, and admitted patient-elected accommodation status, the ratios for stillbirth, neonatal death, and perinatal death showed no significant difference between the intended places of birth.

### *Perinatal Outcomes for Term Births*

Term babies of mothers intending to give birth in a birth center compared with term babies of low-risk

women intending to give birth in a hospital had lower perinatal mortality rates (1.5 per 1,000 births vs 1.9 per 1,000 births, respectively, for primiparas; and 1.1 per 1,000 births vs 1.5 per 1,000 births, respectively, for multiparas; Table 5). The crude perinatal death rates were 1.3 per 1,000 births (99% CI = 0.66, 1.95) to women with an intended place of birth of a birth center at term and 1.7 per 1,000 births (99% CI = 1.50, 1.80) to low-risk women with an intended place of birth of a hospital at term. Neither parity-specific nor crude rate differences between the groups were statistically significant. Further analyses using

**Table 2. Selected Maternal Outcomes of All Women who Intended to Give Birth in a Birth Center or a Hospital, or Low-Risk and Term Women who Intended to Give Birth in a Hospital, 2001 to 2005<sup>a</sup>**

<i>Maternal Outcome</i>	<i>Intended Place of Birth</i>		
	<i>All Hospitals</i> (n = 800,733)	<i>Hospital: Low Risk and Term<sup>b</sup></i> (n = 475,791)	<i>All Birth Centers</i> (n = 22,222)
Obstetric complications <sup>c</sup>			
None/not stated	722,570 (90.2)	—	21,452 (96.5)
Yes	78,163 (9.8)	—	770 (3.5)
Presentation <sup>c</sup>			
Vertex	758,142 (94.7)	—	21,839 (98.3)
Breech	36,100 (4.5)	—	284 (1.3)
Other	5,969 (0.7)	—	99 (0.4)
Not stated	522 (0.1)	—	—
Onset of labor <sup>c,d</sup>			
Spontaneous	456,648 (57.0)	302,361 (63.5)	19,353 (87.1)
Induced	206,815 (25.8)	115,132 (24.2)	2,579 (11.6)
No labor	137,200 (17.1)	582,69 (12.2)	290 (1.3)
Not stated	70 (0.0)	29 (0.0)	—
Method of birth <sup>c,d</sup>			
Spontaneous vaginal	486,108 (60.7)	318,454 (66.9)	18,901 (85.1)
Instrumental vaginal	80,923 (10.1)	52,353 (11.0)	1,696 (7.6)
Vaginal breech	3,269 (0.4)	—	46 (0.2)
Cesarean section	230,299 (28.8)	104,951 (22.1)	1,579 (7.1)
Other	83 (0.0)	20 (0.0)	—
Not stated	51 (0.0)	13 (0.0)	—
Episiotomy <sup>c,e</sup>			
No	480,186 (84.2)	311,831 (84.1)	19,059 (92.3)
Yes	90,058 (15.8)	58,941 (15.9)	1,583 (7.7)
Not stated	56 (0.0)	35 (0.0)	1 (0.0)
3rd/4th degree tears <sup>c,e</sup>			
No/not stated	555,496 (98.4)	360,623 (97.3)	19,369 (97.9)
Yes	8,837 (1.6)	6,127 (1.7)	422 (2.1)
Mean postnatal length of stay for women discharged home (days)	3.5	3.2	2.3

<sup>a</sup>No data were available on lethal or nonlethal congenital anomalies.

<sup>b</sup>Low-risk and term: women who were 20 to 34 years of age, had no preexisting hypertension or diabetes, had no pregnancy-induced hypertension or gestational diabetes, and gave birth to a singleton baby in a vertex presentation at 37 to 41 weeks of completed gestation, with a birthweight greater than or equal to 2,500 g.

<sup>c</sup>Distribution of these factors is significantly ( $p < 0.01$ ) different between the groups "all hospitals" and "all birth centers" using chi-squared tests.

<sup>d</sup>Distribution of these factors is significantly ( $p < 0.01$ ) different between the groups "hospital: low risk and term" and "all birth centers" using chi-squared tests.

<sup>e</sup>Vaginal births only.

the Poisson distribution confirmed this finding and showed no difference in overall perinatal mortality ( $OR = 0.79$ , 99% CI = 0.48, 1.31). The perinatal mortality rates did not change when babies born at 42 weeks were included.

When other perinatal outcomes were compared for these groups of women who had live-born babies, little difference was found for low Apgar scores and high level of resuscitation. Babies of women who intended to give birth in a birth center were significantly less likely to be admitted to a neonatal intensive care unit or a special care nursery (Table 6). The difference remained significant after exclusion of births by cesarean section. The significant difference between the term birth center and hospital groups was seen among both primiparas and multiparas, and overall, 5.8 percent of

birth center mothers (99% CI = 5.36, 6.19) compared with 8.1 percent of hospital mothers (99% CI = 8.02, 8.22).

### *Perinatal Outcomes for Term and Post-Term Births*

When perinatal outcomes were compared using the same criteria, but including post-term births (i.e., all births at 37 weeks' gestation or more), little difference was found in the perinatal mortality rates (Table 7) or other outcomes (Table 8) compared with the term birth outcomes. The overall perinatal mortality rates were 1.6 per 1,000 births to low-risk women intending to give birth in a hospital and 1.3 per 1,000 births to women intending to give birth in a birth center.

**Table 3. Selected Perinatal Outcomes for Babies of All Women who Intended to Give Birth in a Birth Center or a Hospital, or Low-Risk and Term Women who Intended to Give Birth in a Hospital, 2001 to 2005<sup>a</sup>**

<i>Perinatal Outcome</i>	<i>Intended Place of Birth</i>		
	<i>All Hospitals</i> (n = 814,687)	<i>Hospital: Low Risk and Term<sup>b</sup></i> (n = 475,791)	<i>All Birth Centers</i> (n = 22,232)
Gestational age (wk) <sup>c</sup>			
<37	65,050 (8.0)	—	410 (1.8)
37–41	736,859 (90.4)	—	20,875 (93.9)
≥42	12,707 (1.6)	—	947 (4.3)
Not stated	71 (0.0)	—	—
Birthweight (g) <sup>c,d</sup>			
<1,500	8,484 (1.0)	—	30 (0.1)
1,500–2,499	42,896 (5.3)	—	296 (1.3)
2,500–4,499	743,356 (91.9)	—	21,265 (95.9)
≥4,500	14,416 (1.8)	—	589 (2.7)
Not stated	141 (0.0)	—	2 (0.0)
Apgar score at 5 min <sup>c,d</sup>			
<7	10,855 (1.3)	4,035 (0.8)	198 (0.9)
7–10	797,875 (98.6)	470,914 (99.1)	21,977 (99.1)
Not stated	562 (0.1)	277 (0.1)	7 (0.0)
High level of resuscitation <sup>c–f</sup>			
No	798,781 (98.7)	471,951 (99.3)	22,014 (99.2)
Yes	8,315 (1.0)	2,013 (0.4)	131 (0.6)
Not stated	2,197 (0.3)	1,262 (0.3)	37 (0.2)
Admission to NICU/SCN <sup>c,d,f</sup>			
No	685,925 (84.8)	436,608 (91.9)	20,644 (93.1)
Yes	123,327 (15.2)	38,603 (8.1)	1,537 (6.9)
Not stated	41 (0.0)	15 (0.0)	1 (0.0)

<sup>a</sup>No data were available on lethal or nonlethal congenital anomalies.

<sup>b</sup>Low-risk and term: babies born to women who were 20 to 34 years of age, had no preexisting hypertension or diabetes, had no pregnancy-induced hypertension or gestational diabetes, and gave birth to a singleton baby in a vertex presentation at 37 to 41 weeks of completed gestation, with a birthweight greater than or equal to 2,500 g.

<sup>c</sup>Distribution of these factors is significantly ( $p < 0.01$ ) different between the groups "all hospitals" and "all birth centers" using chi-squared tests.

<sup>d</sup>Live births only.

<sup>e</sup>Includes endotracheal intubation and/or external cardiac massage and ventilation.

<sup>f</sup>Distribution of these factors is significantly ( $p < 0.01$ ) different between the groups "hospital: low risk and term" and "all birth centers" using chi-squared tests.

NICU/SCN = neonatal intensive care unit/special care nursery.

**Table 4. Adjusted Risk of Perinatal Death for Women who Intended to Give Birth in a Birth Center or a Hospital, 2001 to 2005<sup>a</sup>**

Perinatal Outcome	All Hospitals		All Birth Centers	
	No. (%)	No. (%)	OR (99% CI)	AOR (99% CI) <sup>b</sup>
<b>Primiparas</b>				
Live-born/survived <sup>c</sup>	333,489 (98.9)	10,019 (99.6)	1.00	1.00
Stillborn	2,451 (0.7)	28 (0.3)	0.38 (0.23–0.62)*	0.99 (0.70–1.40)
Live-born/neonatal death	1,094 (0.3)	13 (0.1)	0.40 (0.19–0.81)*	1.00 (0.61–1.65)
Perinatal death	3,545 (1.1)	41 (0.4)	0.39 (0.26–0.58)*	0.99 (0.74–1.33)
Total births	337,034 (100.0)	10,060 (100.0)	—	—
<b>Multiparas</b>				
Live-born/survived <sup>c</sup>	472,694 (99.1)	12,136 (99.7)	1.00	1.00
Stillborn	2,936 (0.6)	22 (0.2)	0.29 (0.17–0.51)*	0.99 (0.70–1.40)
Live-born/neonatal death	1,381 (0.3)	10 (0.1)	0.28 (0.12–0.64)*	1.00 (0.62–1.61)
Perinatal death	4,317 (0.9)	32 (0.3)	0.29 (0.18–0.46)*	0.98 (0.73–1.31)
Total births	477,011 (100.0)	12,168 (100.0)	—	—
<b>Total<sup>d</sup></b>				
Live-born/survived <sup>c</sup>	806,645 (99.0)	22,157 (99.7)	1.00	1.00
Stillborn	5,392 (0.7)	50 (0.2)	0.34 (0.23–0.49)*	0.99 (0.78–1.26)
Live-born/neonatal death	2,480 (0.3)	23 (0.1)	0.34 (0.20–0.58)*	1.00 (0.71–1.41)
Perinatal death	7,872 (1.0)	73 (0.3)	0.34 (0.25–0.46)*	0.98 (0.80–1.21)
Total births	814,517 (100.0)	22,230 (100.0)	—	—

\*p < 0.01. <sup>a</sup>No data were available on lethal or nonlethal congenital anomalies or cause of death; <sup>b</sup>adjusted OR (AOR): adjusted for gestational age, maternal age, maternal indigenous status, and admitted patient-elected accommodation status; <sup>c</sup>survived 28 days.; <sup>d</sup>total includes births to women whose parity was not reported.

**Table 5. Perinatal Death at Term among Women who Intended to Give Birth in a Birth Center Compared with Low-Risk Women who Intended to Give Birth in a Hospital, 2001 to 2005<sup>a</sup>**

Perinatal Outcome	Intended Place of Birth No. (%)	
	All Hospitals: Low Risk and Term <sup>b</sup>	All Birth Centers: Term <sup>c</sup>
<b>Primiparas</b>		
Live-born/survived <sup>d</sup>	190,297 (99.81)	9,207 (99.85)
Stillborn	270 (0.14)	9 (0.10)
Live-born/neonatal death	97 (0.05)	5 (0.05)
Perinatal death	367 (0.19)	14 (0.15)
Perinatal mortality per 1,000 births	1.9	1.5
<b>Multiparas</b>		
Live-born/survived <sup>d</sup>	284,454 (99.85)	11,458 (99.89)
Stillborn	294 (0.10)	8 (0.07)
Live-born/neonatal death	124 (0.04)	5 (0.04)
Perinatal death	418 (0.15)	13 (0.11)
Perinatal mortality per 1,000 births	1.5	1.1

\*No data were available on lethal or nonlethal congenital anomalies or cause of death; <sup>b</sup>low-risk and term: women who were 20 to 34 years of age, had no preexisting hypertension or diabetes, had no pregnancy-induced hypertension or gestational diabetes, and gave birth to a singleton baby in a vertex presentation at 37 to 41 weeks of completed gestation, with a birthweight greater than or equal to 2,500 g; <sup>c</sup>term: 37 to 41 weeks of completed gestation and a birthweight greater than or equal to 2,500 g; <sup>d</sup>survived 28 days.

**Table 6. Perinatal Outcomes for Term Live Births among Women who Intended to Give Birth in a Birth Center Compared with Low-Risk Women who Intended to Give Birth in a Hospital, 2001 to 2005<sup>a</sup>**

Perinatal Outcome	Intended Place of Birth No. (%)	
	All Hospitals: Low Risk and Term <sup>b</sup>	All Birth Centers: Term <sup>c</sup>
<b>Primiparas</b>		
Low Apgar score at 5 min (<7)	2,172 (1.1)	95 (1.0)
High level of resuscitation <sup>d</sup>	1,102 (0.6)	65 (0.7)
Admission to NICU/SCN	18,819 (9.9)	758 (8.2)
<b>Multiparas</b>		
Low Apgar score at 5 min (<7)	1,861 (0.7)	63 (0.5)
High level of resuscitation <sup>d</sup>	910 (0.3)	36 (0.3)
Admission to NICU/SCN	19,765 (6.9)	436 (3.8)

<sup>a</sup>No data were available on lethal or nonlethal congenital anomalies.

<sup>b</sup>Low risk and term: women who were 20 to 34 years of age, had no preexisting hypertension or diabetes, had no pregnancy-induced hypertension or gestational diabetes, and gave birth to a singleton baby in a vertex presentation at 37 to 41 weeks of completed gestation, with a birthweight greater than or equal to 2,500 g.

<sup>c</sup>Term: 37 to 41 weeks of completed gestation and greater than or equal to a birthweight of 2,500 g.

<sup>d</sup>Includes endotracheal intubation and/or external cardiac massage and ventilation.

NICU/SCN = neonatal intensive care unit/special care nursery.

## Discussion

Birth centers remain an option for women who satisfy low-risk criteria and wish to give birth in a hospital setting. This study is the first large investigation of outcomes of women who intended to give birth in a birth center at the onset of labor, using Australian data. The study by Tracy et al examined perinatal outcomes according to actual place of birth, which meant that women who were transferred from a birth center to a hospital during labor were included with the hospital births (1). Previous analyses have shown that the transferred women had poorer perinatal outcomes, such as more preterm birth and low birthweight, and higher rates of intervention compared with women who were not transferred (i.e., stayed in birth centers and gave birth there; 13). Results of the study by Tracy et al showed lower perinatal mortality rates for babies born in birth centers, compared with babies born in

hospital. The use of actual place of birth was a major and valid criticism of the study (14,15). This study aimed to address this issue by presenting outcomes by intended place of birth.

It was recommended by critics Davey and King that gestational age should be controlled for in the analyses for the table presenting the adjusted risk of perinatal death (14; Table 4). When analyzed by intended place of birth and after adjustment for gestational age, maternal age, maternal indigenous status, and admitted patient-elected accommodation status, perinatal death rates were not significantly different for women intending to give birth in a birth center. In addition, including births that occurred at 42 weeks' gestation or later did not affect perinatal mortality rates (Table 7).

An important aspect of birth center care is selection. Women intending to attend a birth center may have been excluded owing to medical conditions and complications not controlled for in this analysis. A

**Table 7. Perinatal Death at or After 37 Weeks' Gestation among Women who Intended to Give Birth in a Birth Center Compared with Low-Risk Women who Intended to Give Birth in a Hospital, 2001 to 2005<sup>a</sup>**

Perinatal Outcome	Intended Place of Birth No. (%)	
	All Hospitals: Low Risk and Term/Post-Term <sup>b</sup>	All Birth Centers: Term/ Post-Term <sup>c</sup>
Primiparas		
Live-born/survived <sup>d</sup>	195,342 (99.80)	9,711 (99.83)
Stillborn	277 (0.14)	10 (0.10)
Live-born/ neonatal death	101 (0.05)	5 (0.05)
Perinatal death	378 (0.19)	15 (0.15)
Perinatal mortality per 1,000 births	1.9	1.5
Multiparas		
Live-born/survived <sup>d</sup>	288,723 (99.84)	11,899 (99.89)
Stillborn	296 (0.10)	8 (0.07)
Live-born/ neonatal death	124 (0.04)	5 (0.04)
Perinatal death	420 (0.15)	13 (0.11)
Perinatal mortality per 1,000 births	1.5	1.1

<sup>a</sup>No data were available on lethal or nonlethal congenital anomalies or cause of death.

<sup>b</sup>Low risk and term/post-term: women who were 20 to 34 years of age, had no preexisting hypertension or diabetes, had no pregnancy-induced hypertension or gestational diabetes, and gave birth to a singleton baby in a vertex presentation at 37 weeks of completed gestation or later, with a birthweight greater than or equal to 2,500 g.

<sup>c</sup>Term/post-term: greater than or equal to 37 weeks of completed gestation and a birthweight greater than or equal to 2,500 g.

<sup>d</sup>Survived 28 days.

**Table 8. Perinatal Outcomes at or After 37 Weeks' Gestation for Live Births among Women who Intended to Give Birth in a Birth Center Compared with Low-Risk Women who Intended to Give Birth in a Hospital, 2001 to 2005<sup>a</sup>**

Perinatal Outcome	Intended Place of Birth No. (%)	
	All Hospitals: Low Risk and Term/Post-Term <sup>b</sup>	All Birth Centers: Term/ Post-Term <sup>c</sup>
Primiparas		
Low Apgar score at 5 min (<7)	2,285 (1.2)	102 (1.0)
High level of resuscitation <sup>d</sup>	1,168 (0.6)	73 (0.8)
Admission to NICU/SCN	19,504 (10.0)	797 (8.2)
Multiparas		
Low Apgar score at 5 min (<7)	1,900 (0.7)	69 (0.6)
High level of resuscitation <sup>d</sup>	928 (0.3)	41 (0.3)
Admission to NICU/SCN	20,066 (6.9)	459 (3.9)

<sup>a</sup>No data were available on lethal or nonlethal congenital anomalies.

<sup>b</sup>Low risk and term/post-term: women who were 20 to 34 years of age, had no preexisting hypertension or diabetes, had no pregnancy-induced hypertension or gestational diabetes, and gave birth to a singleton baby in a vertex presentation at 37 weeks of completed gestation or later, with a birthweight greater than or equal to 2,500 g.

<sup>c</sup>Term/post-term: greater than or equal to 37 weeks of completed gestation and a birthweight greater than or equal to 2,500 g.

<sup>d</sup>Includes endotracheal intubation and/or external cardiac massage and ventilation.  
NICU/SCN = neonatal intensive care unit/special care nursery.

proportion of women do not have the option of birth center care because of their past obstetric history or complications. Another possible reason for differences in outcomes, which has been demonstrated elsewhere, is higher socioeconomic status and higher level of education in the intended birth center group compared with women who intend to give birth in hospitals (16). These women have been shown more likely to be aware of, and to choose, a birth center as a place of birth, and socioeconomic status has previously been shown to be related to perinatal outcomes using this national dataset (10). Selection bias cannot be avoided in a study of birth centers, and this factor influences the results and generalizability of findings relating to the use of birth centers.

When the criteria used in the paper by Tracy et al were used to compare term women intending to give birth in birth centers with low-risk term women who intended to give birth in hospitals, the perinatal outcomes of low Apgar score at 5 minutes, admission to a neonatal intensive care unit or special care nursery, and perinatal mortality were less likely for babies of the birth center women (1); however, only the admission to neonatal intensive care unit or special care nursery outcome was shown to be significantly different. Again, women in the birth center group may have been healthier, because those women with certain medical conditions other than diabetes or hypertension (adjusted for in this analysis) would not necessarily have satisfied the entry criteria that would have enabled them to intend giving birth in a birth center. Although an attempt was made to obtain comparable risk status between the two groups, it was not possible to make them equal in terms of risk because of this selection bias. Compared with the actual place of birth analyses (1), the perinatal mortality results showed the same overall perinatal mortality rate for the low-risk hospital group (1.7 per 1,000 births) and a lower overall rate for the term birth center group (1.3 per 1,000 births compared with 1.5 per 1,000 births).

The findings in our study reflect those of Ryan and Roberts in a smaller study using Australian data (3). Their research examined outcomes for term women who intended to give birth in a Sydney birth center, or its co-located labor ward. Findings of the current study were in the same direction as this smaller study of 3,683 women (3). Interestingly, the findings in this study compare favorably with the earliest birth center data available from Rooks et al, where the overall intrapartum and neonatal mortality rates were 1.3 per 1,000 births and 0.9 per 1,000 births occurring at term (4). The rates of mortality and low Apgar scores were similar to those reported in large studies of low-risk hospital births.

This study is limited by the quality of maternal medical complications and conditions data, which are collected differently across the jurisdictions. It also does not use national data, because the intended place of birth at the onset of labor was not available for all jurisdictions. It was not possible to control for all exclusion criteria that birth centers use at initial booking or during pregnancy, and these criteria are known to differ considerably from center to center. No data were available on lethal or nonlethal congenital anomalies or cause or timing of death. In particular, it was not possible to distinguish between antepartum and intrapartum stillbirths—an important area for additional national data development and research, and it should be examined across all birth settings. However, the current study does use the same data collection and the same criteria as used previously, which provides further evidence with respect to the safety of birth centers.

This analysis cannot address the issue of maternal outcomes in detail and does not include all sociodemographic and risk factors associated with perinatal outcomes. Data showed that rates of interventions such as cesarean section and induction were higher in women who intended to give birth in a hospital labor ward, whether they were classified as low risk or not. Although maternal death rates in Australia are low (17), it is difficult to ascertain how common other serious maternal complications of pregnancy are without consistent and complete information. Better quality data are needed about all maternal outcomes, including postpartum hemorrhage, to evaluate fully the safety of birth center care. In addition, information on reasons for transfer of the mother or length of labor was not available.

## Conclusions

This study compared outcomes for women who intended to give birth in a birth center with outcomes for a group of low-risk women who intended to give birth in hospital, with an attempt to ascertain comparable risk status between women in the two groups. Intended place of birth analyses showed that perinatal mortality rates were not significantly different between the term hospital and birth center groups for either primiparas or multiparas. Babies of birth center women were significantly less likely to be admitted to a neonatal intensive care unit or special care nursery. No other significant differences were found in perinatal outcomes for term births between the two groups. Birth center care remains a viable option for eligible women giving birth at term.

## References

1. Tracy SK, Dahlen H, Caplice S, et al. Birth centers in Australia: A national population-based study of perinatal mortality associated with giving birth in a birth center. *Birth* 2007;34(3):194–201.
2. Homer C, Davis G, Petocz P, et al. Birth centre or labour ward? A comparison of the clinical outcomes of low-risk women in a NSW hospital. *Aust J Adv Nurs* 2000;18(1):8–12.
3. Ryan M, Roberts C. A retrospective cohort study comparing the clinical outcomes of a birth centre and labour ward in the same hospital. *Aust Midwifery J* 2005;18(2):17–21.
4. Rooks JP, Weatherby NL, Ernst EK, et al. Outcomes of care in birth centers: The National Birth Center Study. *N Engl J Med* 1989;321(26):1804–1811.
5. Holt J, Vold IN, Backe B, et al. Child births in a modified midwife-managed unit: Selection and transfer according to intended place of delivery. *Acta Obstet Gynecol Scand* 2001;80:206–212.
6. Walsh D, Downe SM. Outcomes of free-standing, midwife-led birth centers: A structured review. *Birth* 2004;31(3):222–229.
7. Stewart M, McCandlish R, Henderson J, Brocklehurst P. *Report of a Structured Review of Birth Centre Outcomes*. Oxford: National Perinatal Epidemiology Unit, 2005.
8. Laws PJ, Lim C, Tracy S, Sullivan EA. Characteristics and practices of birth centres in Australia. *Aust N Z J Obstet Gynaecol* 2009;49:290–295.
9. Griew K. Birth centre midwifery down under. In: Kirkham M, ed. *Birth Centres: A Social Model for Maternity Care*. London: Books for Midwives, 2003:209–222.
10. Laws PJ, Abeywardana S, Walker J, Sullivan EA. *Australia's Mothers and Babies 2005*. Perinatal Statistics Series No. 20. AIHW Cat. No. PER 39. Sydney, New South Wales: AIHW National Perinatal Statistics Unit, 2007.
11. Taylor L, Pym M, Bajuk B, et al. *New South Wales Mothers and Babies 1998*. Sydney, New South Wales: NSW Department of Health, 2000.
12. SPSS Inc. *SPSS for Windows, Rel. 15.0.1.1*. Chicago, Illinois: SPSS Inc., 2007.
13. Laws PJ, Sullivan EA. Epidemiology of women who give birth in birth centres, Australia 2000–2004: A population-based study. Poster. Perinatal Society of Australia and New Zealand 11th Annual Congress 2007. *J Paediatr Child Health* 2007;43(s1):A123.
14. Davey M-A, King J. Perinatal outcomes in birth centers [letter]. *Birth* 2008;35(1):85–86.
15. Rowe R, Stewart M, Puddicombe D. Perinatal outcomes in birth centers [letter]. *Birth* 2008;35(1):85–86.
16. Waldenstrom U, Nilsson C-A. Characteristics of women choosing birth center care. *Acta Obstet Gynecol Scand* 1993;72(3):181–188.
17. Sullivan EA, Hall B, King JF. *Maternal Deaths in Australia 2003–2005*. Maternal Deaths Series No. 3. AIHW Cat. No. PER 42. Sydney, New South Wales: AIHW National Perinatal Statistics Unit, 2008.

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