

Outcomes of planned home births with certified professional midwives: large prospective study in North America

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Abstract

Objective To evaluate the safety of home births in North America involving direct entry midwives, in jurisdictions where the practice is not well integrated into the healthcare system.

Design Prospective cohort study.

Setting All home births involving certified professional midwives across the United States (98% of cohort) and Canada, 2000.

Participants All 5418 women expecting to deliver in 2000 supported by midwives with a common certification and who planned to deliver at home when labor began.

Main outcome measures Intrapartum and neonatal mortality, perinatal transfer to hospital care, medical intervention during labor, breast feeding, and maternal satisfaction.

Results 655 (12.1%) women who intended to deliver at home when labor began were transferred to hospital. Medical intervention rates included epidural (4.7%), episiotomy (2.1%), forceps (1.0%), vacuum extraction (0.6%), and caesarean section (3.7%); these rates were substantially lower than for low risk US women having hospital births. The intrapartum and neonatal mortality among women considered at low risk at start of labor, excluding deaths concerning life threatening congenital anomalies, was 1.7 deaths per 1000 planned home births, similar to risks in other studies of low risk home and hospital births in North America. No mothers died. No discrepancies were found for perinatal outcomes independently validated.

Conclusions Planned home birth for low risk women in North America using certified professional midwives was associated with lower rates of medical intervention but similar intrapartum and neonatal mortality to that of low risk hospital births in the United States.

Introduction

Despite a wealth of evidence supporting planned home birth as a safe option for women with low risk pregnancies,¹⁻⁴ the setting remains controversial in most high resource countries. Views are particularly polarized in the United States, with interventions and costs of hospital births escalating and midwives involved with home births being denied the ability to be lead professionals in hospital, with admitting and discharge privileges.⁵ Although several Canadian medical societies^{6,7} and the American Public Health Association⁸ have adopted policies promoting or acknowledging the viability of home births, the American College of Obstetricians and Gynecologists continues to oppose it.⁹ Studies on home birth have been criticized if they have been too small to accurately assess perinatal mortality, unable to distinguish planned from unplanned home births accurately, or retrospective with the potential of bias from selective reporting. To tackle these issues we carried out a large prospective study of planned home births. The North American Registry of Midwives provided a rare opportunity to study the practice of a defined population of direct entry midwives involved with home birth across the continent. We compared perinatal outcomes with those of studies of low risk hospital births in the United States.

Methods

The competency based process of the North American Registry of Midwives provides a certified professional midwife credential, primarily for direct entry midwives who attend home births, including those educated through apprenticeship. Our target population was all women who engaged the services of a certified professional midwife in Canada or the United States as their primary caregiver for a birth with an expected date of delivery in 2000. In autumn 1999, the North American Registry of Midwives made participation in the study mandatory for recertification and provided an electronic database of the 534 certified professional midwives whose credentials

were current. We contacted 502 of the midwives (94.0%); 32 (6.0%) could not be located through email, telephone, post, or local associations, 82 (15.4%) had stopped independent practice, and 11 (2.1%) had retired. We sent a binder with forms and instructions for the study to the 409 practicing midwives who agreed to participate.

Data collection

For each new client, the midwife listed identifying information on the registration log form at the start of care; obtained informed consent, including permission for the client to be contacted for verification of information after care was complete; and filled out a detailed data form on the course of care. Every three months the midwife was required to send a copy of the updated registration log, consent forms for new clients, and completed data forms for women at least six weeks post partum. To confirm that forms had been received for each registered client, we linked the entered data to the registration database. We reviewed the clinical details and circumstances of stillbirths and intrapartum and neonatal deaths and telephoned the midwives for confirmation and clarification. To verify this information we obtained reports from coroners, autopsies, or hospitals on all but four deaths. For these four, we obtained peer reviews.

Validation and satisfaction

We contacted a stratified, random 10% sample, of over 500 mothers, including at least one client for every midwife in the study. The mothers were asked about the date and place of birth, any required hospital care, any problems with care, the health status of themselves and their baby, and 11 questions on level of satisfaction with their midwifery care.

Data analysis

Our analysis focused on personal details of the clients, reasons for leaving care prenatally, the rates and reasons for transfer to hospital during labor and post partum, medical interventions, health and admission to hospital of the newborn or mother from birth up to six weeks post partum, intrapartum and neonatal mortality, and breast feeding. We compared medical intervention rates for the planned home births with data from birth certificates for all 3 360 868 singleton, vertex births at 37 weeks or more gestation in the United States in 2000, as reported by the National Center for Health Statistics,¹⁰ which acted as a proxy for a comparable low risk group. We also compared medical intervention rates with the listening to mothers survey,⁵ a national survey weighted to be representative of the US birthing population aged 18-44. Intrapartum and neonatal death rates were compared with those in other North American studies of at least 500 births that were either planned out of hospital or comparable studies of low risk hospital births.

Results

A total of 409 certified professional midwives from across the United States and two Canadian provinces registered 7623 women whose expected date of delivery was in 2000. Eighteen of the 409 midwives (4.4%) and their clients were excluded from the study because they failed to actively participate and had decided not to recertify or left practice. Sixty mothers (0.8%) declined participation. The figure provides an overview of why women left care before labor and their intended place of birth at the start of labor.

Characteristics of the mothers

We focused on the 5418 women who intended to deliver at home at the start of labor. Table 1 compares them with all women who gave birth to singleton, vertex babies of at least 37 weeks or more gestation in the United States in 2000 according to 13 personal and behavioral variables associated with perinatal risk. Women who started birth at home were on average older, of a lower socioeconomic status and higher educational achievement, and less likely to be African-American or Hispanic than women having full gestation, vertex, singleton hospital births in the United States in 2000. (See table 1 in appendices)

Transfers to hospital

Of the 5418 women, 655 (12.1%) were transferred to hospital intrapartum or post partum. Table 2 describes the transfers according to timing, urgency, and reasons for transfer. Five out of every six women transferred (83.4%) were transferred before delivery, half (51.2%) for failure to progress, pain relief, or exhaustion. After delivery, 1.3% of mothers and 0.7% of newborns were transferred to hospital, most commonly for maternal hemorrhage (0.6% of total births), retained placenta (0.5%), or respiratory problems in the newborn (0.6%). The midwife considered the transfer urgent in 3.4% of intended home births. Transfers were four times as common among primiparous women (25.1%) as among multiparous women (6.3%), but urgent transfers were only twice as common among primiparous women (5.1%) as among multiparous women (2.6%). (See table 2 in appendices)

Medical interventions

Individual rates of medical intervention for home births were consistently less than half those in hospital, whether compared with a relatively low risk group (singleton, vertex, 37 weeks or more gestation) that will have a small percentage of higher risk births or the general population having hospital births (table 3). Compared with the relatively low risk hospital group, intended home births were associated with lower rates of electronic fetal monitoring (9.6% versus 84.3%), episiotomy (2.1% versus 33.0%), caesarean section (3.7% versus 19.0%), and vacuum extraction (0.6% versus 5.5%). The caesarean rate for intended home births was 8.3% among primiparous women and 1.6% among multiparous women (**See table 3 in appendices**).

Outcomes

No maternal deaths occurred. After we excluded four stillborns who died before labor but whose mothers still chose home birth, and three babies with fatal birth defects, five deaths were intrapartum and six occurred during the neonatal period (see box). This was a rate of 2.0 deaths per 1000 intended home births. The intrapartum and neonatal mortality was 1.7 deaths per 1000 low risk intended home births after planned breeches and twins (not considered low risk) were excluded. The results for intrapartum and neonatal mortality are consistent with most North American studies of intended births out of hospital¹⁴⁻²⁴ and low risk hospital births (**See table 4 in appendices**).

Breech and multiple births at home are controversial among home birth practitioners. Among the 80 planned breeches at home there were two deaths and none among the 13 sets of twins. In the 694 births (12.8%) in which the baby was born under water, there was one intrapartum death (birth at 41 weeks, five days) and one fatal birth defect death.

Apgar scores were reported for 94.5% of babies; 1.3% had Apgar scores below 7 at five minutes. Immediate neonatal complications were reported for 226 newborns (4.2% of intended home births). Half the immediate neonatal complications concerned respiratory problems, and 130 babies (2.4%) were placed in the neonatal intensive care unit.

Health in first six weeks post partum

Health problems in the six weeks post partum were reported for 7% of newborns. Among the 5200 (96%) mothers who returned for the six week postnatal visit, 98.3% of babies and 98.4% of mothers reported good health, with no residual health problems. At six weeks post partum, 95.8% of these women were still breast feeding their babies, 89.7% exclusively.

Outcome validation and client satisfaction

Among the stratified, random 10% sample of women contacted directly by study staff to validate birth outcomes, no new transfers to hospital during or after the birth were reported and no new stillbirths or neonatal deaths were uncovered. Mothers' satisfaction with care was high for all 11 measures, with over 97% reporting that they were extremely or very satisfied. For a subsequent birth, 89.6% said they would choose the same midwife, 9.1% another certified professional midwife, and 1.7% another type of caregiver.

Discussion

Women who intended at the start of labor to have a home birth with a certified professional midwife had a low rate of intrapartum and neonatal mortality, similar to that in most studies of low risk hospital births in North America. A high degree of safety and maternal satisfaction were reported, and over 87% of mothers and neonates did not require transfer to hospital.

A randomized controlled trial would be the best way to tackle selection bias of mothers who plan a home birth, but a randomized controlled trial in North America is unfeasible given that even in Britain, where home birth has been an incorporated part of the healthcare system for some time, and where cooperation is more feasible, a pilot study failed.³¹ Prospective cohort studies remain the most comprehensive instruments available.

Our results for intrapartum and neonatal mortality are consistent with most other North American studies of intended births out of hospital and studies of low risk hospital birth (table 4). A meta-analysis² and the latest research in Britain,^{34 32} Switzerland,³³ and the Netherlands³⁴ have reinforced support of home birth. Researchers reported high overall perinatal mortality in a study of home birth in Australia,³⁵ qualifying that low risk home births in Australia had good outcomes but that high risk births gave rise to a high rate of avoidable death at home.³⁶ Two prospective studies in North America found positive outcomes for home birth,^{23 24} but the studies were not of sufficient size to provide relatively stable perinatal death rates. None of this evidence, including ours, is consistent with a study in Washington State based on birth certificates.²¹ That study reported an increased risk with home birth

but lacked an explicit indication of planned place of birth, creating the potential inclusion of high risk unplanned, unattended home births.^{28 37}

Our study has several strengths. Internationally it is one of the few, and the largest, prospective studies of home birth, allowing for relatively stable estimates of risk from intrapartum and neonatal mortality. We accurately identified births planned at home at the start of labor and included independent verification of birth outcomes for a sample of 534 planned home births. We obtained data from almost 400 midwives from across the continent.

Regardless of methodology, residual confounding of comparisons between home and hospital births will always be a possibility. Women choosing home birth (or who would be willing to be randomised to birth site in a randomized trial) may differ for unmeasured variables from women choosing hospital birth. For example, women choosing home birth may have an advantageous enhanced belief in their ability to give birth safely with little medical intervention. On the other hand, women who choose hospital birth may have a psychological advantage in North America associated with not having to deal with the social pressure and fears of spouses, relatives, or friends from their choice of birth place.

Our results may be generalisable to a larger community of direct entry midwives. The North American Registry of Midwives was created in 1987 to develop the certified professional midwife credential—a route for formal certification for midwives involved in home birth who were not nurse midwives and who came from diverse educational backgrounds. Thus the women who chose to become certified professional midwives were a subset of the larger community of direct entry midwives in North America whose diverse educational backgrounds and midwifery practice were similar to certified professional midwives. From 1993 to 1999, using an earlier iteration of the data form, we collected largely retrospective data on a voluntary basis mainly from direct entry midwives involved with home births approached through the Midwives Alliance of North America Statistics and Research Committee and the Canadian Midwives Statistics' Collaboration. This earlier unpublished data of over 11 000 planned home births showed similar demographics, rates of intervention, transfers to hospital, and adverse outcomes.

As with the prospective US national birth centre study¹⁹ and the prospective US home birth study,²³ the main study limitation was the inability to develop a workable design from which to collect a national prospective low risk group of hospital births to compare morbidity and mortality directly. Forms for vital statistics do not reliably collect the information on medical risk factors required to create a retrospective hospital birth group of precisely comparable low risk,³⁸⁻⁴⁰ and hospital discharge summary records for all births are not nationally accessible for sampling and have some limitations, being primarily administrative records.

One exception, and an important adjunct to our study, was Schlenzka's study in California.²² In this PhD thesis, Schlenzka was able to establish a large defined retrospective cohort of planned home and hospital births with similar low risk profiles, because birth and death certificates in California include intended place of birth and these had been linked to hospital discharge abstracts for 1989-90 for a caesarean section study. When the author compared 3385 planned home births with 806 402 low risk hospital births, he consistently found a non-significantly lower perinatal mortality in the home birth group. The results were consistent regardless of liberal or more restrictive criteria to define low risk, and whether or not the analysis involved simple standardizations of rates or extensive adjustment for all potential risk variables collected.²²

An economic analysis found that an uncomplicated vaginal birth in hospital in the United States cost on average three times as much as a similar birth at home with a midwife⁴¹ in an environment where management of birth has become an economic, medical, and industrial enterprise.⁴² Our study of certified professional midwives suggests that they achieve good outcomes among low risk women without routine use of expensive hospital interventions. Our results are consistent with the weight of previous research on safety of home birth with midwives internationally. This evidence supports the American Public Health Association's recommendation⁸ to increase access to out of hospital maternity care services with direct entry midwives in the United States. We recommend that these findings be taken into account when insurers and governing bodies make decisions about home birth and hospital privileges with respect to certified professional midwives.

Categories of intrapartum and postpartum deaths (n=14) among 5418 women intending at start of labor to deliver at home

Intrapartum deaths (n=5)

Term pregnancy, transferred in first stage, cord prolapse discovered with artificial rupture of membranes in hospital

Term pregnancy, breech transported in second stage because of decelerations, delivered during transport

Term pregnancy, breech, transport after birth at home

Term pregnancy, 41 weeks five days. Subgaleal, subdural, subarachnoid haemorrhage. No fetal heart irregularities detected with routine monitoring. Apgar scores 1 and 0

Post-term pregnancy at 42 weeks three days, nuchal cord 6X and a true knot

Neonatal deaths (n=9)

Lethal congenital anomalies (n = 3):

Dwarf and related anomalies

Acrocallosal syndrome

Trisomy 13 Other causes (n = 6):

Term pregnancy, average labor. Apgar scores 6/2. Transported immediately, died at $1\frac{1}{2}$ hours of age in hospital. Autopsy said "mild medial hypertrophy of the pulmonary arterioles which suggest possible persistent pulmonary hypertension of a newborn or persistent fetal circulation...some authorities would argue this is a SIDS and others disagree based on the age. Regardless, infant suffered hypoxia and cardiopulmonary arrest"

Term pregnancy, Apgar scores 9/10. Suddenly stopped breathing at 15 hours of age. Died at five days in hospital, sudden infant death syndrome

Term pregnancy, transport at first assessment because of decelerations, rupture of vasa previa before membranes ruptured, caesarean section, died in hospital two days after birth

Term pregnancy, Apgar scores 9/10. Baby died at 26 hours. Sudden infant death syndrome

Post-term pregnancy, 42 weeks two days age based on clinical data as mother not aware of last menstrual period and refused ultrasonography. One deceleration during second stage, which resolved with position change. Apgar scores 3/2. Brain damage associated with anoxia, baby died at 16 days

Term pregnancy. Mother and baby transported to hospital because mother, not baby, seemed ill, but both discharged within 24 hours. Mother, not baby, given antibiotics by physician a few days after the birth for general sickness. Baby readmitted from home at 16 days because of nursing problems, died at 19 days of previously undetected Group B streptococcus

What is already known on this topic

Planned home births for low risk women in high resource countries where midwifery is well integrated into the healthcare system are associated with similar safety to low risk hospital births

Midwives involved with home births are not well integrated into the healthcare system in the United States

Evidence on safety of such home births is limited

What this study adds

Planned home births with certified professional midwives in the United States had similar rates of intrapartum and neonatal mortality to those of low risk hospital births

Medical intervention rates for planned home births were lower than for planned low risk hospital births

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Appendix

Table 1 Characteristics of 5418 women planning home births with certified professional midwives in the United States, 2000, compared with all singleton, vertex births at ≥ 37 weeks' gestation in the United States, 2000. Values are percentages unless stated otherwise

| Characteristics | No (%) of women planning home birth* (n=5418) | All singleton, vertex births at ≥ 37 weeks gestation in USA, 2000† (n=3 360 86) |
|-----------------|---|--|
| Mother's age: | | |
| ≤ 19 | 130 (2.4) | 11.6 |
| 20-24 | 930 (17.2) | 25.3 |
| 25-29 | 1554 (28.7) | 27.1 |
| 30-34 | 1423 (26.3) | 22.9 |
| 35-39 | 969 (17.9) | 10.9 |
| ≥ 40 | 327 (6.0) | 2.1 |
| Parity: | | |
| 0 | 1690 (31.2) | 40.2 |
| 1 | 1295 (23.9) | 32.8 |

| | | |
|---------------------------------------|-------------|------|
| ≥2 | 2415 (44.6) | 27 |
| Mother's formal education: | | |
| High school or less | 2152 (39.2) | 52.4 |
| Any college | 1272 (23.2) | 21.6 |
| College graduate | 1169 (21.3) | 22.7 |
| Postgraduate | 692 (12.7) | 6.0 |
| Partner status at time of birth: | | |
| Has partner | 5169 (95.4) | NA |
| No partner | 164 (3.1) | NA |
| Ethnicity: | | |
| White | 4846 (89.4) | 58.2 |
| Hispanic | 216 (4.0) | 20.2 |
| African-American | 70 (1.3) | 14.1 |
| Other | 140 (2.6) | 5.8 |
| Other special groups: | | |
| Amish | 467 (8.7) | NA |
| Mennonite | 194 (3.6) | NA |
| Socioeconomic status [†] : | | |
| Low | 1256 (23.2) | 19 |
| Middle | 3244 (59.9) | 44 |
| Upper | 664 (12.3) | 21 |
| Location: | | |
| City | 1891 (34.9) | NA |
| Small town | 1506 (27.9) | NA |
| Rural | 1734 (32.0) | NA |
| Time (trimester) prenatal care began: | | |
| 1st | 2483 (45.8) | 81.8 |
| 2nd | 2075 (38.2) | 12.6 |

| | | |
|--|-------------|------|
| 3rd | 803 (14.8) | 2.7 |
| Smoked during pregnancy: | | |
| No | 5099 (94.1) | 76.2 |
| Yes: | 164 (3.0) | 8.9 |
| 1-9 cigarettes/day | 86 (1.6) | 6.4 |
| ≥10 cigarettes/day | 78 (1.4) | 2.5 |
| Unknown or not stated | 155 (2.9) | 14.9 |
| Alcohol intake (drinks/week) during pregnancy: | | |
| None | 5162 (95.3) | 85.7 |
| Yes: | 136 (2.5) | 0.8 |
| <2 | 113 (2.1) | NA |
| ≥2 | 23 (0.4) | NA |
| Unknown or not stated | 120 (2.2) | 13.6 |
| Gestational age of infants (weeks): | | |
| <37 | 77 (1.4) | — |
| 37-41 | 4834 (89.2) | 91.7 |
| ≥42 | 361 (6.7) | 8.3 |
| Birthweight (g): | | |
| <2501 | 60 (1.1) | 2.4 |
| 2501-3999 | 3787 (69.8) | 86.5 |
| ≥4000 | 1319 (24.3) | 11.1 |

NA=Not available.

* Percentages do not always add up to 100 owing to missing values.

† Based on data from birth certificates for all 3 360 868 such births. Data reported by National Center for Health Statistics.¹⁰

‡ Based on midwife's evaluation.

Table 2 Transfers to hospital among 5418 women intending home births with a certified professional midwife in the United States, 2000, according to timing, urgency, and reasons

| Variable | No (%) needing urgent transfer | No (%) needing transfer |
|---|---------------------------------------|--------------------------------|
| Timing of transfers | | |
| Stage before delivery: | | |
| 1st* | 62 (1.1) | 380 (7.0) |
| 2nd* | 51 (0.9) | 134 (2.5) |
| Not specified | 4 (0.1) | 32 (0.6) |
| After delivery: | | |
| Maternal transfers | 43 (0.8) | 72 (1.3) |
| Newborn transfers | 25 (0.5) | 37 (0.7) |
| All | 185 (3.4) | 655 (12.1) |
| Reasons for transfer[†] | | |
| During labor: | | |
| Failure to progress in 1st stage | 4 (0.1) | 227 (4.2) |
| Failure to progress in 2nd stage | 12 (0.2) | 80 (1.5) |
| Pain relief | 4 (0.1) | 119 (2.2) |
| Maternal exhaustion | 1 (<0.1) | 112 (2.1) |
| Malpresentation | 20 (0.4) | 94 (1.7) |
| Thick meconium | 13 (0.2) | 49 (0.9) |
| Sustained fetal distress | 31 (0.6) | 49 (0.9) |
| Baby's condition | 5 (0.1) | 21 (0.4) |
| Prolonged or premature rupture of membranes | 0 | 19 (0.4) |
| Placenta abruptio or placenta previa | 5 (0.1) | 10 (0.2) |
| Haemorrhage | 5 (0.1) | 7 (0.1) |
| Pre-eclampsia or hypertension | 5 (0.1) | 13 (0.2) |
| Cord prolapse | 3 (0.1) | 6 (0.1) |
| Breech | 1 (<0.1) | 3 (0.1) |
| Other | 9 (0.2) | 17 (0.3) |

Post partum:

Newborn transfers:

| | | |
|-------------------------|----------|----------|
| Respiratory problems | 14 (0.3) | 33 (0.6) |
| Evaluation of anomalies | 2 (<0.1) | 8 (0.1) |
| Other reasons | 9 (0.2) | 17 (0.3) |

Maternal transfers:

| | | |
|-----------------------------|----------|----------|
| Haemorrhage | 21 (0.4) | 34 (0.6) |
| Retained placenta | 14 (0.3) | 28 (0.5) |
| Suturing or repair of tears | 1 (<0.1) | 14 (0.2) |
| Maternal exhaustion | 2 (<0.1) | 4 (0.1) |
| Other reasons | 5 (0.1) | 8 (0.1) |

* 104 of these women were transferred to hospital after midwives' first assessment of labor (1.9% of labors), 38 of which were considered urgent.

† Totals for urgent transfers are based on primary reason for transport only, but column for all transfers adds up to more than number transported as both primary and secondary reason (if reported) for transport to hospital are presented.

Table 3 Intervention rates for 5418 planned home births attended by certified professional midwives and hospital births in the United States

| Intervention | No (%) of intended home births with certified professional midwives in US, 2000 (n=5418) | Singleton, vertex births at ≥ 37 weeks gestation in US, 2000* (n=3 360 868) (%) | Survey of singleton births in all risk categories in US, 2000-1† (n=1583) (%) |
|---------------------------------|---|--|--|
| Electronic fetal monitoring | 520 (9.6) | 84.3 | 93 |
| Intravenous | 454 (8.4) | NR | 85 |
| Artificial rupture of membranes | 272 (5.0) | NR | 67 |
| Epidural | 254 (4.7) | NR | 63 |
| Induction of labor‡ | 519 (9.6) | 21.0 | 44 |
| Stimulation of labor | 498 (9.2) | 18.9 | 53 |
| Episiotomy | 116 (2.1) | 33.0 | 35 |
| Forceps | 57 (1.0) | 2.2 | 3 |
| Vacuum extraction | 32 (0.6) | 5.2 | 7 |
| Caesarean section | 200 (3.7) | 19.0 | 24 |

NR=not reported on birth certificate.

* Based on data from birth certificates for all 3 360 868 such births in United States in 2000. Data reported by National Center for Health Statistics.¹⁰ This subset of birthing women would generally be low risk, but would include a small percentage of higher risk women who would likely require more medical intervention.

† Results from listening to mothers survey, October 2002. Percentages weighted to reflect US population of birthing women, aged 18-44.⁵ Includes about 20% of women not at low risk who may experience higher intervention rates.

‡ For certified professional midwives 2000 study and listening to mothers survey, both attempted and successful inductions were reported; for US birth certificate data only successful inductions are reported.

Table 4 Combined intrapartum and neonatal mortality in studies of planned out of hospital births or low risk hospital births in North America (at least 500 births)

| Type of studies and references | Location, period | No of births | Combined intrapartum and neonatal mortality (per 1000)* |
|--|-------------------------|---------------------|--|
| Low risk out of hospital births attended by midwives: | | | |
| Burnett et al ¹¹ | North Carolina, 1974-6 | 934 | 3.0† |
| Mehl et al ¹² | United States, 1977 | 1146 | 3.5 |

| | | | |
|-----------------------------------|---|--------|------------------|
| Schramm et al ¹³ | Missouri, 1978-84 | 1770 | 2.8 |
| Janssen et al ¹⁴ | Washington State, 1981-90 | 6944 | 1.7 [†] |
| Sullivan and Beeman ¹⁵ | Arizona, 1983 | 1243 | 2.4 |
| Tyson ¹⁶ | Canada, Toronto, 1983-8 | 1001 | 2.0 [†] |
| Hinds et al ¹⁷ | Kentucky, 1985 | 575 | 3.5 [†] |
| Durand ¹⁸ | Farm, Tennessee, 1972-92 | 1707 | 2.3 |
| Rooks et al ¹⁹ | 84 birth centres across United States, 1985-7 | 11 814 | 0.6 |
| Anderson et al ²⁰ | 90 home birth practices across United States, 1987-91 | 11 081 | 0.9 |
| Pang et al ²¹ | Washington State, 1989-96 | 6133 | 2.0 [†] |
| Schlenzka ²² | California, 1989-90 | 3385 | 2.4 |
| Murphy et al ²³ | United States, 1993-5 | 1350 | 2.5 |
| Janssen et al ²⁴ | Canada, British Columbia, 1998-9 | 862 | 2.3 |
| Johnson and Daviss ³⁷ | United States and Canada, 2000 | 5418 | 1.7 |

Low risk births attended by physicians or obstetricians in hospitals:

| | | | |
|-----------------------------|--|---------|----------------------|
| Neutra et al ²⁵ | One academic hospital in Boston (lowest risk women), 1969-75 | 12 055 | 0.5-1.1 [†] |
| Amato ²⁶ | One community hospital, 1974-5 | 4144 | 3.4 [†] |
| Adams ²⁷ | 15 hospitals | 10 521 | 1.7 |
| Rooks et al ²⁸ | National natality survey, 1980 | 2935 | 2.5 [†] |
| Janssen et al ¹⁴ | Washington, 1981-90 | 23 596 | 1.7 [†] |
| Leveno et al ²⁹ | One academic hospital in Dallas, 1982-5 | 14 618 | 1.0 |
| Eden et al ³⁰ | Twelve hospitals Illinois, 1982-5 | 8135 | 1.9 |
| Pang et al ²¹ | Washington State, 1989-96 | 10 593 | 0.7 [†] |
| Schlenzka ²² | California 1989-90 | 806 402 | 1.9 |
| Janssen et al ²⁴ | Canada, British Columbia, 1998-9 | 733 | 1.4 |

Table is presented for general comparison only. Direct comparison of relative mortality between individual studies is ill advised. as many rates are unstable because of small numbers of deaths, study designs may differ (retrospective versus prospective, assessment and definition of low risk, etc.), the ability to capture and extract late neonatal

mortality differs between studies, and significant differences may exist in populations studied with respect to factors such as socioeconomic status, distribution of parity, and risk screening criteria used. For example, see the study by Schlenzka. Although the crude mortality for low risk babies weighing over 2500 g intended at home was 2.4 per 1000 and intended in hospital was 1.9 per 1000, when standard methods were employed to adjust for differences in risk profiles of the two groups (indirect standardisation and logistic regression), both methods showed slightly lower risk for intended home births.

* Excludes lethal congenital anomalies.

† Neonatal mortality only, intrapartum mortality unreported.

