OBSTETRICS

Neonatal mortality in the United States is related to location of birth (hospital versus home) rather than the type of birth attendant

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BACKGROUND: Planned home births have leveled off in the United States in recent years after a significant rise starting in the mid-2000s. Planned home births in the United States are associated with increased patient-risk profiles. Multiple studies concluded that, compared with hospital births, absolute and relative risks of perinatal mortality and morbidity in US planned home births are significantly increased.

OBJECTIVE: To explore the safety of birth in the United States by comparing the neonatal mortality outcomes of 2 locations, hospital birth and home birth, by 4 types of attendants: hospital midwife; certified nurse-midwife at home; direct-entry ("other") midwife at home; and attendant at home not identified, using the most recent US Centers for Disease Control and Prevention natality data on neonatal mortality for planned home births in the United States. Outcomes are presented as absolute risks (neonatal mortality per 10,000 live births) and as relative risks of neonatal mortality (hospital-certified nurse-midwife odds ratio, 1) overall, and for recognized risk factors.

STUDY DESIGN: We used the most current US Centers for Disease and Prevention Control Linked Birth and Infant Death Records for 2010—2017 to assess neonatal mortality (neonatal death days 0—27 after birth) for single, term (37+ weeks), normal-weight (>2499 g) infants for planned home births and hospital births by birth attendants: hospital-certified nurse-midwives, home-certified nurse-midwives, home other midwives (eg, lay or direct-entry midwives), and other home birth attendant not identified.

RESULTS: The neonatal mortality for US hospital midwife-attended births was 3.27 per 10,000 live births, 13.66 per 10,000 live births for all planned home births, and 27.98 per 10,000 live births for unintended/unplanned home births. Planned home births attended by direct-entry midwives and by certified nurse-midwives had a significantly elevated absolute and relative neonatal mortality risk compared with certified nurse-midwife—attended hospital births (hospital-certified nurse-midwife: 3.27/10,000 live births odds ratio, 1; home birth direct-entry midwives: neonatal mortality 12.44/10,000 live births, odds ratio, 3.81, 95% confidence interval, 3.12—4.65, $P<.0001$; home birth—certified nurse-midwife: neonatal mortality 9.48/10,000 live births, odds ratio, 2.90, 95% confidence interval, 2.90; $P<.0001$). These differences increased further when patients were stratified for recognized risk factors.

CONCLUSION: The safety of birth in the United States varies by location and attendant. Compared with US hospital births attended by a certified nurse-midwife, planned US home births for all types of attendants are a less safe setting of birth, especially when recognized risk factors are taken into account. The type of midwife attending US planned home birth appears to have no differential effect on decreasing the absolute and relative risk of neonatal mortality of planned home birth, because the difference in outcomes of US planned home births attended by direct-entry midwives or by certified nurse-midwives is not statistically significant.

Key words: hospital births, midwives, neonatal deaths, neonatal mortality, planned home birth, safety

Planned home births have leveled off in the United States in the past 4 years after a significant rise starting in the mid-2000s[1] (Figure 1). The American College of Obstetricians and Gynecologists (ACOG) committee opinion on planned home birth stated that "... planned home birth is associated with a twofold to threefold increased risk of neonatal death when compared with planned hospital birth ...."[2] Planned midwife-attended home births in the United States are associated with increased patient-risk profiles,[3] and multiple studies concluded that, compared with hospital births, absolute and relative risks of perinatal mortality and morbidity in US planned home births are significantly increased.[4–9]

The objective of this study was to analyze the safety of US intended births by location and attendant, using the most recent data on neonatal mortality for planned home births as indicated in the US Centers for Disease Control and Prevention (CDC) Linked Birth/Infant Death records.[10] Our goal was to explore the safety of birth by comparing the outcomes of 2 locations, hospital birth and planned home birth, by 4 types of attendants: hospital-certified midwife; home-certified nurse-midwife; home "other" (also known as direct-entry type) midwife; and attendant at home not identified. Outcomes are presented as absolute risks (neonatal mortality per 10,000 live births), and as relative risks of neonatal mortality (hospital certified nurse-midwife odds ratio, 1) overall, and for recognized risk factors.

Materials and Methods

We used the most current CDC Linked Birth and Infant Death Records[10] for 2010—2017, to assess neonatal mortality (neonatal death on days 0—27 after birth) for single, term (37+ weeks), normal-weight (>2499 g) infants for home births indicated in birthplace as intended (interchangeably known as planned), and hospital births by birth

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AJOG at a Glance

Why was this study conducted?

To compare neonatal mortality at planned home births with that of hospital births attended by certified nurse-midwives.

Key findings

Planned US home births, whether attended by direct-entry midwives or by certified nurse-midwives, had a significantly greater risk of neonatal mortality compared with certified nurse-midwife-attended hospital births (neonatal mortality: home births direct-entry midwives: 12.44/10,000 live births, odds ratio, 3.81, $P<.0001$; home births certified nurse-midwife: 9.48/10,000, odds ratio, 2.90, $P<.0001$; hospital certified nurse-midwives: 3.27/10,000 live births odds ratio 1).

What does this add to what is known?

The type of midwife attending US planned home birth has no significant differential effect on the increased absolute and relative risk of neonatal mortality of planned US home birth.

The causes of the increased neonatal mortality at US planned home births are likely the location and the failure to select women at low risk of neonatal mortality.

attendants: hospital-certified nurse-midwives, planned home birth—certified nurse-midwives, planned home birth direct-entry midwives (midwives without the level training of certified nurse-midwives), and not identified other home attendants. The CDC natality database categorizes home births as either intended, not intended, or unknown if intended. In this study, we used the categories of intended interchangeably with planned, and not intended interchangeably with unplanned. Hospital deliveries by certified nurse-midwives served as comparison. Home births categorized as not intended were excluded from this study, as were home births categorized as unknown whether intended (most of the unknown were from the State of California, where all home births are categorized as unknown whether intended), and births where the birth attendant was listed as "unknown or not stated."

This dataset (linked file) contains detailed information for the approximately 4 million births in the United States each year for which a birth certificate is created, including birth setting, birth attendant, and neonatal mortality,[10] and is generally the preferred source for infant and neonatal mortality in the United States.[11]

Period-linked files use all births in a year as the denominator and all deaths in a year as the numerator, regardless of when the birth occurred (eg, if the birth was in late 2015 and the neonatal death occurred in 2016, that death is counted in the 2016 numerator). Studies using linked US birth and death records are considered reliable and have been used in numerous studies.[11–14]

The 2010—2017 period-linked birth and infant deaths dataset[10] was analyzed to examine neonatal mortality (defined as the death of a live-born neonate days 0—27 of life in term (≥37 weeks), normal size (birthweight of ≥2500 g), singleton births by birth setting (planned home and hospital) and attendant: hospital-certified nurse-midwife, planned home birth—certified nurse-midwife, planned home birth by direct-entry midwife, and planned home birth attendant not identified. We also examined the relative and absolute risks associated with delivery by setting and attendant with birth by hospital certified nurse-midwives as comparison. The odds ratios and 95% confidence intervals (CIs) were computed here: https://www.medcalc.org/calc/odds_ratio.php. We calculated neonatal mortality overall and for frequently occurring common risk factors (≥35 years maternal age, ≥41 weeks gestational age, nulliparity). Our study used nonidentifiable data from a publicly available dataset and was not considered human subjects research and therefore did not require review by Zucker Medical School at Hofstra/Northwell Institutional Review Board.

Results

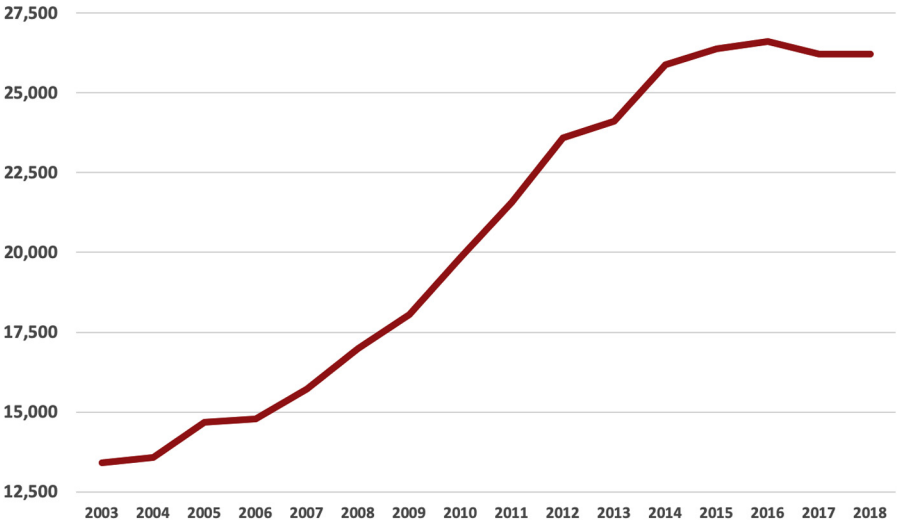
Between 2010 and 2017, there were 195,026 home births and 2,280,044 hospital midwife-attended births in the United States. In total, 177,156 (87%) home births were categorized as intended/planned home births and 17,870 (9.2%) were categorized as unintended/unplanned home births. For the purpose of comparative analysis, unintended/unplanned home births were excluded from the study. The majority of the 177,156 planned home births were attended by direct-entry midwives (50.4%; n=89,247), followed by certified nurse-midwives (28.6%; n=50,658) and other attendants not identified (21%; n=37,251). Table 1 shows the characteristics of women for each of the types of birth attendant.

The neonatal mortality rates were significantly elevated for all planned home births: 13.66 per 10,000 live births (242/177,156; odds ratio, 4.19; 95% CI, 3.62—4.84, $P<.0001$) and for unintended/unplanned home births: 27.98 per 10,000 live births (50/17,870; odds ratio, 8.58; 95% CI, 6.44—11.43, $P<.0001$), compared with hospital-certified nurse-midwife-attended births: 3.27 per 10,000 live births (odds ratio, 1: 745/2,280,044) (Table 2).

Nearly all of midwife-attended home births were planned (98.5%: 139,905/142,049). Overall, planned home births attended by direct-entry midwives and certified nurse-midwives had a significantly elevated absolute and relative neonatal mortality risk compared with certified nurse-midwife—attended hospital births (home birth direct-entry "other" midwives: neonatal mortality 12.44/10,000 live births, odds ratio, 3.81, 95% CI, 3.12—4.65, $P<.0001$), home birth—certified nurse-midwife: neonatal mortality 9.48/10,000, odds ratio, 2.90, 95% CI, 2.90; $P<.0001$; hospital-

certified nurse-midwives: 3.27/10,000 live births odds ratio, 1 (Table 3). Both types of midwives at intended home births had significantly elevated absolute and relative neonatal mortality risks compared with hospital midwives, not only in patients with increased risks (nulliparous women, women ≥41 weeks of gestation, and those ≥35 years of age) but also for those with lower-risk profiles (Table 3). Although there was an overall trend of home birth direct-entry midwives having a greater overall neonatal mortality, when compared with home birth—certified nurse-midwives, the difference between them was not statistically significant (direct-entry midwives: odds ratio, 1.31, 95% CI, 0.93—1.84, P=.11), likely because of the number of births in each group. For each of the 3 risk factors (age ≥41 years, nulliparity, gestational age ≥41 weeks) there was a more than 50% increased trend in neonatal mortality of home births direct-entry midwives over home birth—certified nurse-midwives, but it did not reach statistical significance.

FIGURE 1
US Midwife-attended planned home births: 2003—2018



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Comment

Principal findings of the study

The location of birth (home vs hospital) rather than the birth attendant determines neonatal mortality risks in the United States. Planned home birth, regardless of birth attendant, has an increased absolute and relative risk of neonatal mortality overall and when analyzed by recognized risk factors as compared with hospital births. There is a significantly increased absolute and relative neonatal mortality risk among planned home births, both for certified nurse-midwives and direct-entry midwives compared with hospital births attended by nurse-midwives.

Even "lower-risk" patients with planned homebirths had more than 4-fold increased neonatal mortality rates when compared with hospital births. Compared with certified nurse-midwife—attended hospital birth, the home setting of intended birth regardless of type of midwife is a less safe birth location.

The CDC natality database[10] is the most comprehensive and reliable US national source of birth data and permits highly reliable classification of births as planned home births because 98.5% of midwife-attended home births were planned. Moreover, our study confirms that although other midwife-attended planned home births had greater neonatal mortality rates than certified nurse-midwife—attended planned home births, these differences were not statistically significant. The type of midwife attending planned home birth appears to have no significant differential effect on decreasing the absolute and relative risk of neonatal mortality of planned home birth, because the difference in outcomes of planned home births attended by direct-entry midwives and planned home births by certified nurse-midwives is not statistically significant.

Comparison with the literature

Our study confirms previous US studies showing significantly increased absolute and relative risk of neonatal mortality among planned home births (4.5-fold to15-fold increased neonatal mortality rates).[5,6,8] Previous studies on adverse outcomes in planned home births in the United States covered 1 state,[8] rather than the entire country or from shorter time periods,[5,8] whereas this study covered all US states.

Clinical implications

There are several reasons why US planned home births have an increase in neonatal mortality.

First, most planned home births in the United States are not low risk,[3] and the significantly increased perinatal mortality in US planned home births is likely due to a greater risk-profile of US planned home births.[3] The most important factors of the significantly increased risks of neonatal deaths among US midwife-attended home births are labor and delivery issues (eg, asphyxia).[15]

ACOG guidelines state that "… the appropriate selection of candidates for home birth ... is critical to reduce perinatal mortality rates ...."[16] Increased patient-risk profiles at planned home births are related to greater risks of adverse maternal and neonatal outcomes.[17] For women with recognized risk factors, planned homebirth is associated with significantly greater rates of perinatal mortality ..."[18] and appropriate patient selection reduces adverse neonatal outcomes among planned home births.[19] However, contraindicated US home births have been

TABLE 1
Characteristics of women attended by hospital midwives and women attended by 3 types of home birth attendant for intended deliveries

	Hospital midwives	Home-certified nurse-midwife	Home other (direct-entry) midwife	Attendant not identified	All intended
Maternal age, y					
<35	1,993,522 (87.4)	39,009 (77.0)	70,373 (78.9)	28,851 (77.5)	138,233 (78.0)
≥35	286,522 (12.6)	11,649 (23.0)	18,874 (21.1)	8,400 (22.5)	38,923 (22.0)
Gestational age, wk					
<41	1,814,277 (78.6)	3,9513 (78.0)	69,683 (78.1)	29,172 (78.3)	138,368 (78.1)
≥41	465,676 (20.4)	11,145 (22.0)	19,564 (21.9)	8,079 (21.7)	38,788 (21.9)
Parity					
0	885,581 (38.8)	10,601 (20.9)	17,564 (19.7)	6,063 (16.3)	34.228 (19.3)
>0	1,394,463 (61.7)	4,0057 (79.1)	71,683 (80.3)	31,188 (83.7)	142,928 (80.7)
Multiparity					
<5	2,149,892 (94.3)	40,719 (80.4)	70,469 (79.0)	25,275 (67.9)	136,463 (77.0)
≥5	130,152 (5.7)	9,939 (19.6)	18,778 (21.0)	11, 976 (32.1)	40,693 (23.0)

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increasing in number from 1990 to 2015.[20] A greater risk-profile is associated with adverse outcomes,[21] and greater US perinatal morbidity and mortality rates at planned home births are likely due to increased risks such as advanced maternal age, obesity, breech, and previous cesarean delivery, which have a high prevalence among in US planned home births when compared with home birth in other high-income countries.[3]

Second, US direct-entry midwives who deliver the majority of planned home births have limited education and licensing requirements. The ACOG committee opinion on planned home birth states that "… women should be informed that several factors are critical to reducing perinatal mortality rates ..." and that "...these factors include the appropriate selection of candidates for home birth; the availability of a certified nurse—midwife, certified midwife or midwife whose education and licensure meet International Confederation of Midwives' Global Standards for Midwifery Education."[16] Direct-entry midwives, whose educational programs require a minimum of high school diploma or equivalent,[22] deliver most midwife-attended planned home births in the Unites States. Direct-entry midwives are neither certified nurse-midwives nor certified midwives, they often deliver without licensure, and do

TABLE 2
Absolute and relative risk of neonatal mortality by location and birth attendant for intended deliveries

Location and attendant	Neonatal mortality per 10,000 live births (n/all)	OR (95% CI)	*P* value
Hospital midwife	3.27 (745/2,280,044)	1	
Intended home birth—certified nurse-midwife	9.48 (48/50,658)	2.90 (2.17—3.89)	<.0001
Intended home birth other (direct-entry) midwife	12.44 (111/89,247)	3.81 (3.12—4.65)	<.0001
Intended home birth someone else	22.28 (83/37,251)	6.83 (5.44—8.57)	<.0001
All intended home births	13.66 (242/177,156)	4.19 (3.62—4.84)	<.0001

Comparisons between intended home birth attendants:

Intended home birth certified nurse-midwife OR, 1

Intended home birth other (direct-entry) midwife: OR, 1.31 (95% CI, 0.93—1.84) *P*=.11

Intended homebirth someone else: OR, 2.35 (1.65—3.36) *P*<.0001.

CI, confidence interval; *OR*, odds ratio.

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TABLE 3
Absolute and relative risks neonatal mortality per 10,000 live births by risk factors, location, and birth attendant for intended births

	Per 10,000 (n/total)	Odds ratio (95% confidence interval)	*P* value
Greater risks			
Neonatal mortality ≥35 y			
Hospital midwife	2.93 (84/186,522)	1	
Intended home birth—certified nurse-midwife	11.16 (13/11,649)	3.81 (2.12—6.83)	<.0001
Intended home birth other (direct-entry) midwife	16.42 (31/18,874)	5.61 (3.71—8.47)	<.0001
Intended home birth (other attendant)	21.43 (18/8,400)	7.32 (4.40—12.19	<.0001
Intended home birth (all)	21.43 (62/38,923)	5.44 (3.92—7.55)	<.0001
Neonatal mortality para=0			
Hospital midwife	3.6 (319/885,581)	1	
Intended home birth—certified nurse-midwife	12.26 (13/10,601)	6.04 (3.43—10.61)	<.0001
Intended home birth other (direct-entry) midwife	22.77 (40/17,564)	11.23 (7.97—15.82)	<.0001
Intended home birth (other attendant)	26.39 (16/6,063)	13.01 (7.80—21.71)	<.0001
Intended home birth (all)	20.16 (69/34,228)	14.05 (10.64—18.55)	<.0001
Neonatal mortality ≥41 wk			
Hospital midwife	3.71 (173/465,767)	1	
Intended home birth—certified nurse-midwife	9.87 (11/11,145)	2.67 (1.45—4.89)	<.0001
Intended home birth other (direct-entry) midwife	16.36 (32/19,564)	4.41 (3.02—6.43)	<.0001
Intended home birth (other attendant)	25.99 (21/8,079)	7.01 (4.46—11.04	<.0001
Intended home birth (all)	16.50 (64/38,788)	4.50 (3.38—6.00)	<.0001
Lower risks			
Neonatal mortality <35 y			
Hospital midwife	3.32 (661/1,993,522)	1	
Intended home birth—certified nurse-midwife	8.97 (35/39,009)	2.71 (1.93—3.80)	<.0001
Intended home birth other (direct-entry) midwife	11.37 (80/70,373)	3.43 (2.72—4.33)	<.0001
Intended home birth (other attendant)	22.53 (65/28,851)	6.81 (5.28—8.79)	<.0001
Intended home birth (all)	13.02 (180/138,233)	3.93 (3.33—4.64)	<.0001
Neonatal mortality para >0			
Hospital midwife	3.05 (426/1,394,423)	1	
Intended home birth—certified nurse-midwife	8.74 (35/40,057)	2.86 (2.3—4.04)	<.0001
Intended home birth other (direct-entry) midwife	9.90 (71/71,683)	3.24 (2.52—4.17)	<.0001
Intended home birth (other attendant)	21.48 (67/31,188)	7.05 (5.44—9.12)	<.0001
Intended home birth (all)	12.10 (173/142,928)	3.97 (3.32—4.73)	<.0001
Neonatal mortality 37—40 wk			
Hospital midwife	3.15 (572/1,814,277)	1	
Intended home birth—certified nurse-midwife	9.36 (37/39,513)	2.97 (2.13—4.14)	<.0001
Intended home birth other (direct-entry) midwife	11.34 (79/69,683)	3.60 (2.84—4.55)	<.0001
Intended home birth (other attendant)	21.25 (62/29,172)	6.75 (5.20—8.78)	<.0001
Intended home births (all)	12.86 (178/138,368)	4.08 (3.45—4.82)	<.0001

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not meet the International Confederation of Midwives' Global Standards for Midwifery Education.

In this study, both home birth direct-entry midwives and home birth—certified nurse-midwives had significantly greater neonatal mortality rates when compared with hospital certified nurse-midwives.

Third, at planned home births, there is an inability to monitor labor adequately and care for a newborn at risk. Grünebaum et al[15] showed that the major cause of underlying causes of neonatal deaths at home births included intrapartum-related complications such as birth asphyxia or lack of breathing at birth.

Fourth, transfers to the hospital from a planned home births have increased additional risks and consequently adverse outcomes. Up to 45% of women are transferred from a planned home birth from home to the hospital.[23] The documented increased absolute and relative neonatal mortality rates at planned home births documented in our study are likely a significant underestimate of actual adverse birth outcomes among planned home births as documented previously.[4] Women transferred from a planned home birth to the hospital are more likely to have greater rates of preexisting medical conditions and adverse outcomes such as fetal and neonatal deaths.[8] Adverse outcomes among hospital births resulting from planned home births are attributed to hospital births and not planned home births because US birth certificate data record only the ultimate place of birth and do not routinely include information on whether a hospital birth was a planned home or hospital birth.

US home birth supporters repeatedly state that low-risk home births have good outcomes, citing international evidence from countries with well-integrated systems such as England, the Netherlands, Germany, and Australia that suggest no increase in neonatal morbidity or mortality for low-risk planned home births.[4,24–26] They claim that "..intended birth setting does not significantly affect perinatal outcomes…."[4] However, neonatal outcome data of international studies of home births from other high-income countries only included low-risk patients based on their strict guidelines of patient selection (hence the argument that low risk planned home births are safe).

The arguments in support of US planned home births citing "good outcomes in low-risk pregnancies" usually fail to mention that US planned home births cannot be safe because they are far from low risk,[3] likely due to the absence of guidelines for patient selection.[9]

Consequently, the increased perinatal mortality rates at US planned home births are likely due to increased patient-risk profiles, the lower education requirements of US direct-entry midwives, inability to monitor labor adequately at home and care for a newborn at risk, and increased adverse outcomes associated with transfer to the hospital from a planned home birth.

In other high-income countries with established midwifery systems, home birth midwives are well integrated into the health care system.[4] This is not true of the United States. Moreover, direct-entry midwives, who deliver usually only at home, have lower entry requirements, spend less time in training, have little academic training, and have little to no experience with hospital deliveries.

One reason cited for women desiring an out-of-hospital birth is the avoidance of unnecessary procedures and interventions, such as cesarean delivery,[4] and studies show that patients with previous cesarean delivery are frequent among the risks observed at US home births.[3] In response, instead of expecting women with previous cesarean deliveries to attempt a planned home birth, hospitals should be encouraged to increase the availability of trial of labor after cesarean delivery when appropriate.[27]

Recent publications demonstrated that elective induction of labor at 39 weeks is associated with a significantly lower risk of cesarean delivery, maternal peripartum infection, and fewer adverse perinatal outcomes.[28–31] Inductions are not an option at planned home births. Consequently, women planning a planned home birth are deprived of the option of an induction at 39 weeks or beyond. In addition, if they subsequently have a cesarean delivery after transfer to the hospital, they are unnecessarily put at risk of increased cesarean delivery and further adverse outcomes in subsequent pregnancies.[3]

Despite the data showing the setting of home to be less safe for newborns in the United States, and especially in the absence of guidelines to select patients who are at low risk, home births that are not low risk continue to occur in the United States. Improving the safety of birth has been a paramount goal in obstetrics for decades. Outcomes in the hospital can be improved with implementation of guidelines and other patient safety programs,[32] and cesarean delivery rates can be reduced with these programs.[33] Home births are not integrated in the US health system.[4] Although other high-income countries such as England, Germany, and the Netherlands, for example, have national guidelines to select low-risk patients for planned home births, in the United States guidelines for practice such as for a planned home birth are often determined by state bodies.[4] Reducing the significantly increased absolute and relative risk of neonatal mortality in planned home births requires that birth attendants meet fundamental standards of professional responsibility, including adequate training and establishing and implementing evidence-based guidelines with the explicit goal of eliminating the increased absolute and relative risks of neonatal mortality of planned home birth.

Two steps should be taken immediately: Guidelines for home birth attendants should be established to clearly define contraindicated high-risk pregnancies for planned home births. With and without guidelines, all providers have a strict ethical obligation to inform women considering planned home birth when they have increased risks and recommend against planned home birth for women who are not low risk, and referring them for hospital birth.[34]

Research implications

Our data likely underestimate neonatal mortality outcomes at planned home

births. Present birth certificate data in most states do not include information as to whether a patient was transferred from a planned home birth to the hospital. Neonatal outcomes of transfers are therefore attributed to hospital deliveries and not planned home births. We agree with Hildingsson et al[35] that birth certificate data would be improved by adding information to each US birth certificate on whether a birth was a planned home birth for women who choose to initially give birth outside a hospital, especially for those who are then transferred to the hospital. This would permit future research based on an intent-to-treat analysis of the outcomes of planned home birth.

Strengths and limitations

The major strength of our study is that it uses the CDC natality and the Linked Birth/Infant Death Records databases, because they are the only US database for US births that is national in scope, includes all reported births and deaths, and reliably classify births and deaths by location and type of attendant. The CDC natality database[10] is the most comprehensive and reliable US national source of birth data and permits highly reliable classification of births as planned home births because 98.5% of midwife-attended home births were intended (or planned). The concern that previous studies of the safety of planned home birth using the CDC dataset are at risk for classification bias[4] therefore lacks an evidence base.

Another strength is that our study covers the most recently reported 8-year time span (2010–2017) for planned home births, which is among the largest data sets on planned home births reported in the US (n=177,156). An additional strength of our study is that we report on intended/planned home births only, as the current CDC database now categorizes types of home birth based on intended vs unintended, which we used to report the data.

There are some limitations to our study. Criticism has been expressed about certain data collected in birth and death certificates,[36] although others believe that the data are reliable.[37–39] Overall, up to 31.9% of all planned home births and up to 45.4% of nulliparous women have been reported to be transferred from a planned home birth to the hospital.[23] Actual neonatal mortality rates in planned home births are likely underreported because the CDC natality database does not collect data separately when a woman is transferred from a planned home birth to a hospital birth and only collects data on where the birth occurs. The likely greater adverse neonatal outcomes for patients transferred from home to the hospital are counted in the CDC-linked data as hospital births and not planned home birth neonatal outcomes. Therefore, actual neonatal mortality rates at planned home births are likely even greater than reported if transferred patient outcomes were reported by their intend as planned home births and not hospital births.

Conclusion

Birth location (home vs hospital) and not the birth attendant determines neonatal mortality in the United States. The increased absolute and relative neonatal mortality risks among planned home births in the United States are independent of the qualification of midwife birth attendants. Compared with hospital births attended by certified nurse-midwives, planned home birth in the United States, independent of birth attendant, is a less safe setting of planned birth, especially with their increased risks and in the absence of guidelines to exclude high-risk patients, and when recognized risk factors are taken into account. Neonatal mortality can be significantly optimized by intended hospital births. ■

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