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Perinatal mortality and morbidity up to 28 days after birth among 743 070 low-risk planned home and hospital births: a cohort study based on three merged national perinatal databases

A de Jonge,[a] CC Geerts,[a] BY van der Goes,[b] BW Mol,[c] SE Buitendijk,[d] JG Nijhuis[e]

[a] Department of Midwifery Science, AVAG and the EMGO Institute of Health and Care Research, VU University Medical Centre, [b] Department of Obstetrics and Gynaecology, Amsterdam Medical Centre, Amsterdam, The Netherlands [c] School of Paediatrics and Reproductive Health, University of Adelaide, Adelaide, SA, Australia [d] University of Leiden, Leiden, [e] Department of Obstetrics and Gynaecology, GROW School for Oncology and Developmental Biology, Maastricht University Medical Centre, Maastricht, The Netherlands
Correspondence: Dr A de Jonge, Department of Midwifery Science, AVAG and the EMGO Institute of Health and Care Research, VU University Medical Center, Van der Boechorststraat 7, 1081 BT, Amsterdam, The Netherlands. Email ank.dejonge@vumc.nl

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Objective To compare rates of adverse perinatal outcomes between planned home births versus planned hospital births.

Design A nationwide cohort study.

Setting The Netherlands.

Population Low-risk women in midwife-led care at the onset of labour.

Methods Analysis of national registration data.

Main outcome measures Intrapartum and neonatal death, Apgar scores, and admission to a neonatal intensive care unit (NICU) within 28 days of birth.

Results Of the total of 814 979 women, 466 112 had a planned home birth and 276 958 had a planned hospital birth. For 71 909 women, their planned place of birth was unknown. The combined intrapartum and neonatal death rates up to 28 days after birth, including cases with discrepancies in the registration of the moment of death, were: for nulliparous women, 1.02‰ for planned home births versus 1.09‰ for planned hospital births, adjusted odds ratio (aOR) 0.99, 95% confidence interval (95% CI) 0.79–1.24; and for parous women, 0.59‰ versus 0.58‰, aOR 1.16, 95% CI 0.87–1.55. The rates of NICU admissions and low Apgar scores did not significantly differ among nulliparous women (NICU admissions up to 28 days, 3.41‰ versus 3.61‰, aOR 1.05, 95% CI 0.92–1.18). Among parous women the rates of Apgar scores below seven and NICU admissions were significantly lower among planned home births (NICU admissions up to 28 days, 1.36 versus 1.95‰, aOR 0.79, 95% CI 0.66–0.93).

Conclusions We found no increased risk of adverse perinatal outcomes for planned home births among low-risk women. Our results may only apply to regions where home births are well integrated into the maternity care system.

Keywords Homebirth, midwifery, perinatal mortality.

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Introduction

The relative risks of perinatal outcomes among planned home births is a topic of debate.[1] A recent Cochrane review showed that there has only been one feasibility randomised controlled trial on the safety of planned home birth, which included 11 women.[1]

The largest prospective cohort study so far was conducted in England.[2] Rates of a composite outcome of perinatal death and serious infant morbidity were similar for parous women in all birth settings, but were poorer for nulliparous women with planned home birth compared with planned birth in a consultant unit. Two large studies in the Netherlands showed similar perinatal outcomes for planned home births and planned hospital births among low-risk women in midwife-led care.[3,4] Most other recent international studies showed no differences in perinatal outcomes for planned home versus planned hospital births at the onset of labour, although the power of most studies was not large enough to find significant differences in rare

outcomes.[5–8] Although the home birth rate is falling, about 20% of women in the Netherlands still give birth at home.[9] This country therefore provides an ideal setting for conducting a large cohort study into the safety of home birth.

Wax et al.[10] summarised the evidence on the safety of home birth in a meta-analysis of observational studies. They included more than 500 000 births, of which more than 95% came from our previous Dutch study.[3] No difference in perinatal mortality was found between planned home birth and planned hospital birth; however, they also examined neonatal mortality, and only included studies with the outcome of neonatal mortality up to 28 days after birth. Our Dutch study included neonatal deaths up to 7 days after birth, and was therefore excluded from this analysis.[3] Based on the remaining sample size of 47 632 births of neonates without congenital abnormalities, they concluded that the odds ratio (OR) for neonatal mortality among planned home births, compared with planned hospital births, was 2.87 (95% confidence interval, 95% CI 1.32–6.25). These results have been criticised by many because of methodological errors in the study.[11–15] The question of what the results might have shown if the Dutch study had been included for the analysis on neonatal mortality has also been raised.[16]

We therefore compared adverse perinatal outcomes between low-risk women with planned home birth versus planned hospital birth at the onset of labour, as we did in 2009;[3] however, this time we used data over a period of ten instead of 7 years, results were reported for nulliparous and parous women separately, and we examined outcomes up to 28 days after birth.

Methods

We performed a nationwide study, using national registration data, to compare perinatal outcomes between planned home births and planned hospital births at the onset of labour among low-risk women in midwife-led care.

In the Netherlands, three separate databases are used for the collection of perinatal registration data: one for primary care (national perinatal database 1), one for secondary obstetric care (national perinatal database 2), and one for paediatric care (national neonatal register).[17] During the study period, data were entered into the national database at the Netherlands Perinatal Registry (PRN) from 94 to 99% of the primary midwifery care practices, 99–100% of the obstetric units, and 49–69% of the paediatric units.[17] All academic hospitals entered their data into the database. The three databases have been linked via a validated method to create one national perinatal database.[18]

In the perinatal database, we identified all women who gave birth between 1 January 2000 and 31 December 2009, who were in primary midwife-led care at the onset of labour, and who had no medical indication for hospital birth. These women were therefore considered to be at low risk of complications. We have described the Dutch maternity care system elsewhere.[3] In short, primary care midwives in the Netherlands provide care to low-risk women only. If risk factors arise during pregnancy, during labour, or in the postpartum period, a woman is referred to secondary obstetrician-led care. The indications for referral can be found in the Obstetric Indication List, which has been agreed upon by obstetricians, midwives, paediatricians, and general practitioners.[19] Indications include, for example, medical conditions, preterm and post-term labour, malpresentation, previous caesarean section, and pre-eclampsia. Continuous fetal monitoring, augmentation, medical pain relief, and other interventions only take place in secondary care.

Low-risk women in midwife-led care at the onset of labour can plan to give birth at home or in hospital.[3] The midwife records a woman's planned place of birth during pregnancy. For a number of women the planned place of birth is unknown: some of these women wait until labour to decide where they want to give birth, and for others the midwife failed to record the intended place of birth.

The women in our study had a spontaneous onset of labour, gave birth between 37 and 42 weeks gestation to a single baby, and did not have a known medical or obstetric risk factor before labour. Women in primary care with medium risk, for example because of a previous postpartum haemorrhage, are not offered a home birth and were therefore not included in the study. Other exclusion criteria comprised not having received prenatal care, missing national perinatal database-1 form, unknown planned place of birth, prolonged ruptured membranes for more than 24 hours without contractions, an intrauterine death before labour began, and a child with a congenital abnormality.

Planned home births versus planned hospital births (including births planned in alongside midwifery units) in midwife-led care at the onset of labour were compared, regardless of the actual place of birth. This means that women who planned to give birth at home but who were later transferred to hospital were included in the planned home birth group; this is comparable with an 'intention to treat analysis' in a randomised controlled trial.

The following outcomes were compared between the groups: intrapartum death; neonatal death up to 7 days after birth; neonatal death up to 28 days after birth; Apgar scores below seven and below four at 5 minutes after birth; and admission to a neonatal intensive care unit (NICU) up to 7 days and up to 28 days after birth. We also combined intrapartum death with neonatal death up to 28 days after birth, and intrapartum or neonatal death with NICU admission up to 28 days after birth (with the latter defined as severe adverse perinatal outcome). We used the official

definition of NICU admission of the national registry, which is based on admission to a perinatology centre in combination with a diagnosis of severe neonatal morbidity that requires admission to a NICU. Neonates that were admitted to a secondary hospital first and that were subsequently transferred to a NICU were also included. This differs from our previous study in which we only included NICU admissions directly after birth.[3]

Maternal age was divided into categories (below 25, 25–34, and 35 years or older), as was gestational age (37^{+0}–37^{+6}, 38^{+0}–40^{+6}, and 41^{+0}–41^{+6} weeks), because both variables were not linearly related to the log odds of adverse perinatal outcomes. We classified ethnic background dichotomously as 'Dutch' or 'non-Dutch'. No subcategories were created for non-Dutch ethnic background because these categories are not filled in uniformly by midwives.[3] Socio-economic position was derived from social-status scores based on postal codes, developed by the National Institute for Social Research (Sociaal Cultureel Planbureau, SCP), based on level of education, employment, and income. These scores were divided into low, medium, and high based on the 25 and 75 percentile cut-off points.

Data analysis

Analyses were performed in SAS 9.2.(Foundation for Microsoft Windows, SAS Institute Inc., Cary, NC, USA) We compared perinatal outcomes of planned home birth with planned hospital birth for nulliparous and parous women separately. For each outcome we calculated the crude and adjusted odds ratios and their 95% confidence intervals. We adjusted odds ratios for potential confounding factors known to be associated with planned place of birth and adverse perinatal outcomes:[3] gestational age, maternal age, ethnic background, and socio-economic position.

The moment of death is not always recorded similarly between the three perinatal databases (national perinatal databases 1 and 2 and national neonatal register). Therefore, the PRN uses a definition based on assumptions about which database is most likely to be right about the moment of death. To be as transparent as possible, we included all cases whereby death was recorded in a certain period (for example neonatal death up to 7 days after birth) in at least one of the databases, even if it was recorded for another period in one or more of the other databases. For the total incidence of intrapartum death and neonatal mortality up to 28 days after birth we conducted separate analyses for 'uncertain' and 'certain' time of death. For uncertain time of death we included all cases whereby death was recorded as intrapartum or neonatal death up to 28 days after birth in at least one of the databases, even if it was recorded as antepartum death or death after 28 days in one or more of the other databases. For certain time of death we only included cases without a record of antepartum death or neonatal death after 28 days on any of the three forms. We conducted sensitivity analyses to examine the effect of unplanned place of birth. First, we assumed that all women with unknown planned place of birth had planned to have home births, and subsequently that all of these women had planned hospital births. The start of labour in primary or secondary care is based on information from national perinatal databases 1 and 2, which may not always be consistent. We also conducted sensitivity analyses for women without discrepancies in information between these forms.

Results

Among the 814 979 women in midwife-led care at the onset of labour, the planned place of birth was unknown for 71 909 (8.8%) women (Figure 1). Of the remaining 743 070 women, 466 112 (62.7%) had planned to have a home birth at the onset of labour and 276 958 (37.3%) had planned to have a hospital birth. Table 1 shows the baseline characteristics of these women. Women with planned home births were more likely to be 25–34 years of age, of Dutch origin and more often had a medium or high socio-economic position than those with planned hospital birth. They were also more likely to give birth at 41^{+0}–41^{+6} weeks of gestation, and were less likely to give birth at 37^{+0}–37^{+6} weeks of gestation.

Intrapartum and neonatal mortality

If all deaths were taken into account (including cases in which there was a discrepancy in the registration of the moment of death, in the perinatal databases), the total incidence of intrapartum and neonatal death up to 28 days after birth was, for nulliparous women, 1.02 per 1000 among planned home births and 1.09 per 1000 among planned hospital births (aOR 0.99, 95% CI 0.79–1.24), and for parous women these rates were 0.59 per 1000 among planned home births and 0.58 per 1000 among planned hospital births (aOR 1.16, 95% CI 0.87–1.55) (Table 2). If only cases with a certain moment of death were included (without discrepancies in registration), the total incidence of intrapartum and neonatal death up to 28 days after birth was, for nulliparous women, 0.78 per 1000 among planned home births and 0.81 per 1000 among planned hospital births (aOR 1.01, 95% CI 0.78–1.31), and for parous women these rates were 0.43 per 1000 among planned home births and 0.44 per 1000 among planned hospital births (aOR 1.08, 95% CI 0.78–1.51).

Apgar scores

The rate of Apgar scores below seven at 5 minutes after birth was, for nulliparous women, 7.90 per 1000 among planned home births and 8.85 per 1000 among planned

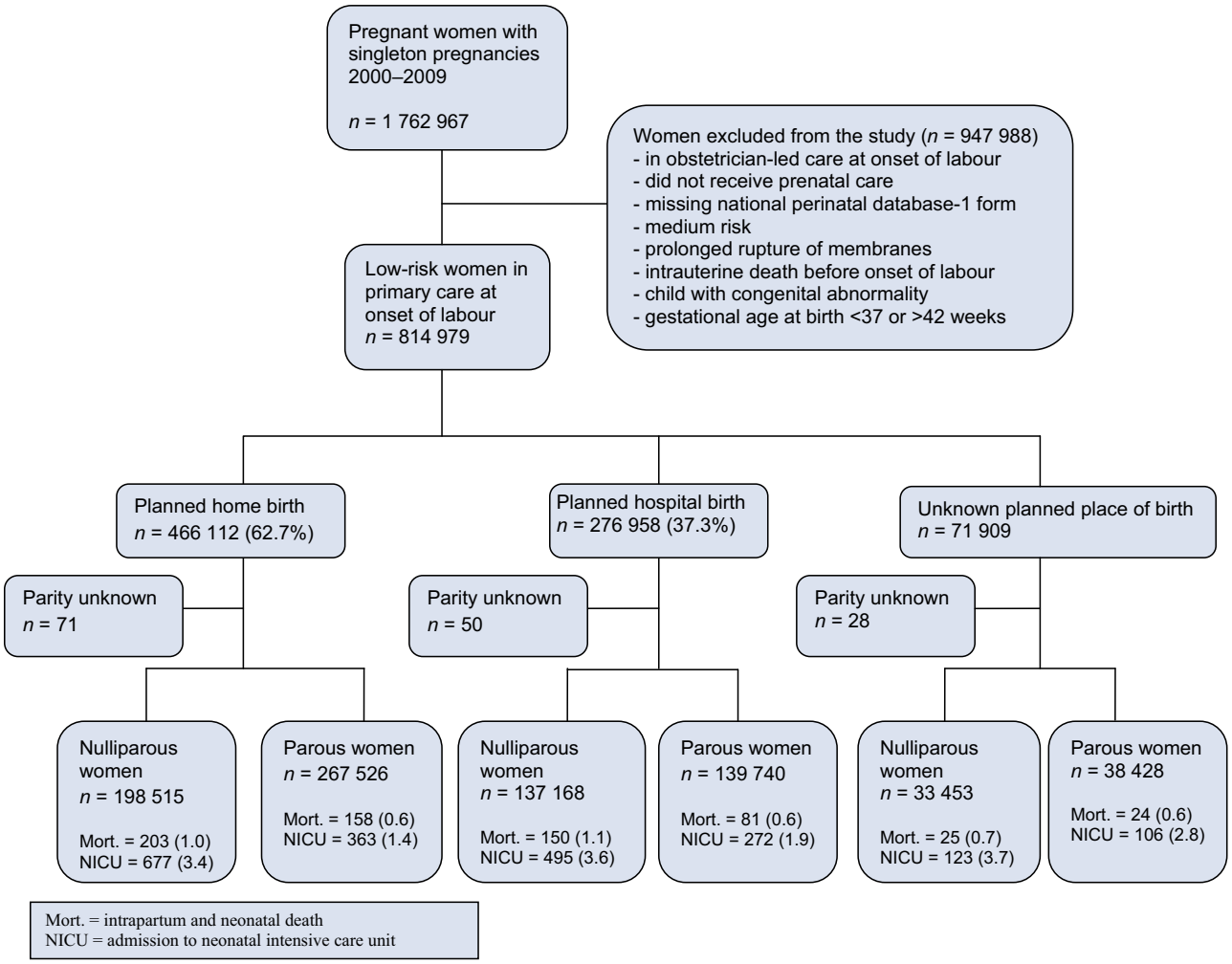

Figure 1. Study population.

hospital births (aOR 0.95, 95% CI 0.87–1.02); for Apgar scores below four these rates were 1.05 per 1000 among planned home births and 1.21 per 1000 among planned hospital births (aOR 0.91, 95% CI 0.74–1.14).

For parous women rates of Apgar scores below seven were 3.20 per 1000 among planned home births and 4.57 per 1000 among planned hospital births (aOR 0.77, 95% CI 0.69–0.86); for Apgar scores below four these rates were 0.62 per 1000 among planned home births and 0.72 per 1000 among planned hospital births (aOR 0.92, 95% CI 0.70–1.20).

Admission to a neonatal intensive care unit

The rate of NICU admissions up to 28 days after birth was, for nulliparous women, 3.41 per 1000 among planned home births and 3.61 per 1000 among planned hospital births (aOR 1.05, 95% CI 0.92–1.18), and for parous women the rates were 1.36 per 1000 among planned home births and 1.95 per 1000 among planned hospital births (aOR 0.79, 95% CI 0.66–0.93) (Table 3).

Severe adverse perinatal outcome (intrapartum and neonatal death and admission to NICU within 28 days of birth)

The total rate of severe adverse perinatal outcomes was, for nulliparous women, 4.17 per 1000 among planned home births versus 4.47 per 1000 among planned hospital births (aOR 1.03, 95% CI 0.92–1.15), and for parous women the rate was 1.82 per 1000 among planned home births versus 2.41 per 1000 among planned hospital births (aOR 0.87, 95% CI 0.75–1.01) (Table 3). Of all 284 neonatal deaths, 133 babies had been admitted to NICU (data not shown).

Sensitivity analyses

When all women with unplanned place of birth were recoded as having a planned home birth, the adjusted

Table 1. Characteristics of low-risk women in primary midwife-led care at the start of labour

Variable	Intended place of birth at onset of labour**							
	Nulliparous women				Parous women			
	Home *n* = 198 515 (59.1%)		Hospital *n* = 137 168 (40.9%)		Home *n* = 267 526 (65.7%)		Hospital *n* = 139 740 (34.3%)	
	n	%	*n*	%	*n*	%	*n*	%
Gestational age*								
37^{+0}–37^{+6}	9490	4.8	7155	5.2	8126	3.0	5056	3.6
38^{+0}–40^{+6}	143 338	72.2	100 968	73.6	199 686	74.6	105 191	75.3
41^{+0}–41^{+6}	45 687	23.0	29 045	21.2	59 714	22.3	29 493	21.1
Maternal age*								
<25 years	32 193	16.2	35 852	26.1	12 428	4.7	12 231	8.8
25–34 years	150 272	75.7	87 990	64.2	191 345	71.5	93 773	67.1
≥35 years	16 007	8.1	13 298	9.7	63 693	23.8	33 708	24.1
Missing	43		28		60		28	
Ethnic background*								
Dutch	182 530	92.5	95 970	70.4	241 323	90.9	88 463	63.9
Non-Dutch	14 840	7.5	40 331	29.6	24 159	9.1	49 945	36.1
Missing	1145		867		2044		1332	
Socio-economic position*								
Low	52 775	26.9	51 317	38.1	60 316	22.8	51 913	37.8
Medium	96 065	49.0	52 968	39.3	134 702	51.0	53 493	38.9
High	47 313	24.1	30 540	22.7	69 328	26.2	32 095	23.3
Missing	2362		2343		3180		2239	

*$P < 0.0001$.
**Totals may not add up because of rounding error.

differences for NICU admission up to 28 days after birth among parous women became non-significant (aOR 0.87, 95% CI 0.74–1.03) (see Table S1). When women with unplanned place of birth were recoded as having planned hospital birth, differences for NICU admission up to 7 days after birth and severe adverse perinatal outcome among parous women became significant (NICU admission up to 7 days after birth, aOR 0.73, 95% CI 0.62–0.87; severe adverse perinatal outcome, aOR 0.78, 95% CI 0.68–0.89). All other results remained similar after sensitivity analyses (see Tables S1 and S2).

Missing data

The following data were missing for women's characteristics: parity $n = 121$, maternal age $n = 159$, ethnic background $n = 5388$, and socio-economic status $n = 10\,124$. Missing data were excluded for the multivariable analyses, and comprised <5% for all variables. Information on mortality was missing for 26 planned home births and for 20 planned hospital births ($P = 0.384$), and information on Apgar scores was missing for 113 planned home births and 75 planned hospital births ($P = 0.457$).

Among planned hospital births, compared with planned home births, more data were missing for socio-economic status and ethnicity (1.66 versus 1.19% and 0.80 versus 0.68%, respectively). There were no significant differences between these groups in missing data for intrapartum and neonatal mortality. Ethnicity was missing less frequently in case of intrapartum or neonatal mortality compared with no mortality (0 versus 0.74%), and for nulliparous women in the case of NICU admission compared with no NICU admission (0.09 versus 0.60%).

Discussion

Main findings

In this large, nationwide cohort study covering a period of 10 years no significant differences were found in the rates of intrapartum and neonatal death up to 28 days after birth between planned home births and planned hospital births among low-risk women. Among parous women the rate of Apgar scores below seven and NICU admissions up to 28 days after birth was lower among planned home births compared with planned hospital births; all other comparisons for NICU

Table 2. Intrapartum and neonatal mortality among births in midwife-led care at the onset of labour

	Nulliparous women		Parous women	
	Intended place of birth at onset of labour		Intended place of birth at onset of labour	
	Home *n* = 198 515	Hospital *n* = 137 168	Home *n* = 267 526	Hospital *n* = 139 740
Intrapartum and neonatal death (uncertain and certain time of death), 0–28 days, *n/N* (‰)**	203/198 515 (1.02)	150/137 168 (1.09)	158/267 526 (0.59)	81/139 740 (0.58)
Crude OR (95% CI)	0.94 (0.76–1.16)	Reference	1.02 (0.78–1.33)	Reference
aOR (95% CI)	0.99 (0.79–1.24)	Reference	1.16 (0.87–1.55)	Reference
Intrapartum and neonatal death (certain time of death), 0–28 days, *n/N* (‰)*,**	157/198 469 (0.78)	111/137 129 (0.81)	116/267 484 (0.43)	62/139 721 (0.44)
Crude OR (95% CI)	0.98 (0.77–1.25)	Reference	0.98 (0.72–1.33)	Reference
aOR (95% CI)	1.01 (0.78–1.31)	Reference	1.08 (0.78–1.51)	Reference
Intrapartum death, *n/N* (‰)**	113/198 515 (0.57)	86/137 168 (0.63)	87/267 526 (0.33)	44/139 740 (0.31)
Crude OR (95% CI)	0.91 (0.69–1.20)	Reference	1.03 (0.72–1.48)	Reference
aOR (95% CI)	1.02 (0.76–1.37)	Reference	1.31 (0.89–1.94)	Reference
Neonatal death, 0–7 days, *n/N* (‰)**	95/198 412 (0.48)	67/137 088 (0.49)	72/267 444 (0.27)	36/139 697 (0.26)
Crude OR (95% CI)	0.98 (0.72–1.34)	Reference	1.04 (0.70–1.56)	Reference
aOR (95% CI)	0.98 (0.70–1.36)	Reference	1.07 (0.70–1.65)	Reference
Neonatal death, 0–28 days, *n/N* (‰)**	100/198 412 (0.50)	70/137 088 (0.51)	76/267 444 (0.28)	38/139 697 (0.27)
Crude OR (95% CI)	0.99 (0.73–1.34)	Reference	1.04 (0.71–1.54)	Reference
aOR (95% CI)	0.97 (0.70–1.34)	Reference	1.07 (0.70–1.62)	Reference

aOR, adjusted for gestational age, maternal age, socio-economic position, and ethnicity.
*Certain time of death: no discrepancies in information on time period of death (antepartum, intrapartum, or neonatal death within 28 days) between obstetrician, midwife and neonatologist. For the combined intrapartum and neonatal death <28 days, this means that one or more professionals recorded either intrapartum or neonatal death and none of the professionals recorded antepartum death or neonatal death after 28 days.
**Uncertain and certain time of death: obstetrician, midwife and neonatologist did not all report the same time of death. This led to some overlap of deaths in the subcategories.

admissions and the total rate of severe adverse perinatal outcomes did not significantly differ between both groups.

Strengths and limitations

A major strength of our study is the large sample size. Additionally, the study was carried out in a country where home birth is still common, and therefore the maternity care system is well equipped to deal with emergencies during home births.

Our study has some limitations. First, the planned place of birth was missing for about 9% of the women included in the study. In addition, some paediatric data were missing. In particular, this was a problem for NICU admissions and neonatal deaths occurring between 7 and 28 days after birth, because midwives and obstetricians only record perinatal deaths up to 7 days after birth; however, it is likely that this information was missing randomly for planned home and planned hospital births, as this was dependent on whether a paediatric department took part in the national registration and not on planned place of birth.

Unlike death, the outcome 'NICU admission' is not considered as a hard outcome.

Results from another Dutch study suggest that babies born in a secondary care hospital may be admitted to a high care unit for problems that result in NICU admission if babies are born in a hospital with a perinatology centre.[20] In primary care, the effect of place of birth on the likelihood of NICU admission is unknown. Babies born at home may be more likely to be referred to a NICU straight away in case of problems. Alternatively, babies born in a hospital with a perinatology centre may be more likely to be admitted to a NICU because of its proximity. Nevertheless, we used this outcome to enable the comparison of our results with other studies.[21,22]

The moment of death is not always recorded identically in the three databases of the national perinatal register. We conducted separate analyses based on intrapartum and

Table 3. NICU admission after births that started in midwife-led care

Intended place of birth at onset of labour	Nulliparous women			Parous women		
	n/N (‰)	Crude OR (95% CI)	aOR (95% CI)	*n/N* (‰)	Crude OR (95% CI)	aOR (95% CI)
Apgar score < 7 at 5 minutes						
Home	1568/198 372 (7.90)	0.89 (0.83–0.96)	0.95 (0.87–1.02)	855/267 371 (3.20)	0.70 (0.63–0.77)	0.77 (0.69–0.86)
Hospital	1213/137 054 (8.85)	Reference	Reference	638/139 656 (4.57)	Reference	Reference
Apgar score < 4 at 5 minutes						
Home	209/198 372 (1.05)	0.87 (0.71–1.07)	0.91 (0.74–1.14)	167/267 371 (0.62)	0.87 (0.68–1.12)	0.92 (0.70–1.20)
Hospital	166/137 054 (1.21)	Reference	Reference	100/139 656 (0.72)	Reference	Reference
Admission to NICU within 7 days*						
Home	644/198 412 (3.25)	0.94 (0.83–1.05)	1.04 (0.91–1.18)	327/267 444 (1.22)	0.74 (0.62–0.87)	0.84 (0.70–1.01)
Hospital	476/137 088 (3.47)	Reference	Reference	232/139 697 (1.66)	Reference	Reference
Admission to NICU within 28 days*						
Home	677/198 412 (3.41)	0.95 (0.84–1.06)	1.05 (0.92–1.18)	363/267 444 (1.36)	0.70 (0.60–0.82)	0.79 (0.66–0.93)
Hospital	495/137 088 (3.61)	Reference	Reference	272/139 697 (1.95)	Reference	Reference
Severe adverse perinatal outcome**						
Home	828/198 515 (4.17)	0.93 (0.84–1.04)	1.03 (0.92–1.15)	488/267 526 (1.82)	0.76 (0.66–0.87)	0.87 (0.75–1.01)
Hospital	613/137 168 (4.47)	Reference	Reference	337/139 740 (2.41)	Reference	Reference

aOR, adjusted for gestational age, maternal age, socio-economic position, and ethnicity.
*Neonates that were alive at birth; some may have died after NICU admission.
**A combination of intrapartum or neonatal mortality or NICU admission within 28 days of birth.

neonatal mortality rates with and without cases for which the moment of death was not consistent between the three databases. The true mortality incidences are likely to be between these two rates. In all analyses the odds ratios for the comparison of planned home births versus planned hospital births were similar.

Interpretation

Our results confirm our earlier findings that planned home births are not associated with increased rates of adverse perinatal outcomes, compared with planned hospital births, among low-risk women in primary care at the onset of labour in the Netherlands.[3] If our current results had been included in the meta-analysis conducted by Wax et al.,[10] their conclusion inevitably would have been that not only perinatal mortality but also neonatal mortality was similar for planned home births versus planned hospital births, as more than 95% of home births in their study came from our data. It should be noted, however, that home births are well integrated into the maternity care system in the Netherlands: midwives are trained in home births, the travel distances are short, and there is a good risk selection and transportation system. In several of the studies included in Wax's meta-analysis this was not the case.[23–25] Nove et al.[26] argued that the validity of pooling data from countries with very different maternity care systems should be questioned.

Ideally, studies into the safety of home birth should be randomised controlled trials; however, as women are not willing to be randomised for planned place of birth,[1,27] a prospective cohort study is the next best method. The largest prospective cohort study into place of birth so far has been conducted in England.[2] Although the study did not have enough power to show significant differences in mortality, nulliparous women with planned home birth at the onset of labour, compared with those planning a hospital birth, had a significantly higher rate of composite severe adverse neonatal outcome. Further studies are needed to explore the factors that may have contributed to the differences in these results, compared with our study, even though indications for transfer of care are similar in both countries.[19,28] One factor that may play a part is that home birth is still much more common in the Netherlands than in the UK, and therefore all professionals in the maternity care system are more used to dealing with complications that may arise. Secondly, travel distances in the Netherlands are likely to be shorter.[3]

In our study, the rates of Apgar scores below seven at 5 minutes after birth and NICU admissions up to 28 days after birth were lower among planned home births for parous women, but not for nulliparous women. In another Dutch study, a lower rate of severe adverse maternal outcomes was found among planned home births for parous women as well.[29] Only women in primary care at the onset of labour were included in the study, and they were therefore considered to be at low risk. Nevertheless, women who plan a home birth have more favourable characteristics

than those who plan a hospital birth.[3,30] We controlled the results for known confounding factors that are registered, i.e. gestational age, maternal age, ethnicity, and socio-economic position. Unfortunately, we could not control for other potential confounding factors. A previous Dutch study showed a significantly higher rate of overweight and previous instrumental vaginal births among parous women with planned hospital births, compared with planned home births, but no significant associations were found between smoking, alcohol consumption, or drug use and planned place of birth among nulliparous and parous women.[31] It is unlikely that significantly higher rates of adverse outcomes would be found for planned home births compared with planned hospital births, even if we had been able to control for these confounding factors. For example, in the large English cohort study mentioned before, the odds ratios changed from 1.76 to 1.75 among nulliparous women, and from 0.70 to 0.72 among parous women after adjusting results for confounding factors, including body mass index.[2] Ideally, a prospective cohort study in the Netherlands should be conducted to be able to control for all important confounding factors and to minimise the problem of missing data.

We did not answer the question of whether the definition of 'low risk' was appropriate in our studies. One Dutch study showed a higher perinatal mortality rate among term births that started in primary versus secondary care, regardless of the planned place of birth;[21] however, methodological difficulties in this study complicate the interpretation of the results.[32,33] For example, information for the numerator and the denominator was collected in different ways and did not come from the same population. Future studies are needed to give more insight into perinatal outcomes among low-risk women who start labour in primary versus secondary care.

The high perinatal mortality rate in the Netherlands relative to its European neighbours, coupled with the fact that the Dutch have the highest home birth rate in Europe, has raised doubts about the safety of this 'typical Dutch way of giving birth'.[21,34] In a secondary analysis of Euro-PERISTAT data on perinatal mortality rates in Europe in 2004, we showed that the Dutch perinatal mortality rate at term is lower or comparable with that of several other European countries with an extremely low home birth rate.[34,35] As planned home births by definition occur at term gestation, this finding suggests that home birth does not contribute to the relatively high perinatal mortality rate in the Netherlands.

Conclusion

This study did not show increased risks of intrapartum and neonatal mortality, and admission to NICU up to 28 days after birth, among low-risk women planning a home birth. A meta-analysis should be conducted with studies carried out in maternity care systems that are well equipped to assist women in giving birth at home. If home births are well integrated into the maternity care system, low-risk women should be advised that no association was found between planned home birth and adverse perinatal outcomes.

Disclosure of interests

All authors declare that they have no conflict of interests.

Contribution to authorship

AdJ conceived the idea for the study, wrote the article, and is guarantor of the study. CCG conducted the analyses. AdJ, CCG, BYvdG, BWM, SEB, and JGH contributed to the interpretation of the data. CCG, BYvdG, BWM, SEB, and JGH critically revised earlier drafts of the article for important intellectual content and gave final approval of the version to be published. All researchers had access to all of the research data.

Details of ethics approval

The ethical committee of VU University Medical Centre confirmed that ethical approval was not necessary for this study (reference number 11/399).

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Table S1. Sensitivity analyses for different definitions of planned place of birth.

Table S2. Sensitivity analyses for a definition of level of care at onset of labour without discrepancies between forms. ■

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