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Intrapartum and neonatal mortality in low-risk term women in midwife-led care and obstetrician-led care at the onset of labor: A national matched cohort study

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Abstract

Introduction: Midwife-led models of care have been the subject of debate for many years. We conducted a study to compare intrapartum and neonatal mortality rates in midwife-led (primary) versus obstetrician-led (secondary) care at the onset of labor in low-risk term women.

Material and methods: We performed an unmatched and a propensity score matched cohort study using data from the national perinatal audit registry (PAN) and from the national perinatal registry (PERINED) of the Netherlands. We included women with singleton pregnancies (without congenital anomalies or antepartum fetal death) who gave birth at term between 2010 and 2012. We excluded the following major risk factors: non-vertex position of the fetus, previous cesarean birth, hypertension, diabetes mellitus, prolonged rupture of membranes (≥24 hours), vaginal bleeding in the second half of pregnancy, nonspontaneous start of labor and post-term pregnancy (≥42 weeks). The primary outcome was intrapartum or neonatal mortality up to 28 days after birth. Secondary outcome measures were mode of delivery and a 5-minute Apgar score <7.

Results: We included 259 211 women. There were 100/206 642 (0.48‰) intrapartum and neonatal deaths in the midwife group and 23/52 569 (0.44‰) in the obstetrician group (odds ratio [OR] 1.11, 95% CI 0.70-1.74). Propensity score matched analysis showed mortality rates of 0.49‰ (26/52 569) among women in midwife-led care and 0.44‰ (23/52 569) for women in obstetrician-led care (OR 1.13, 95% CI 0.65-1.98). In the midwife group there were significantly lower rates of vaginal instrumental deliveries (8.4% vs 13.0%; matched OR 0.65, 95% CI 0.62-0.67) and intrapartum cesarean sections (2.6% vs 8.2%; matched OR 0.32, 95% CI 0.30-0.34), and fewer neonates with low Apgar scores (<7 after 5 minutes) (0.69% vs 1.11%; matched OR 0.61, 95% CI 0.53-0.69).

Abbreviations: CI, confidence interval; OR, odds ratio; PAN, Perinatal Audit Netherlands; PERINED, Perinatal Registry Netherlands.

Conclusions: Among low-risk term women, there were comparable intrapartum and neonatal mortality rates for women starting labor in midwife-led vs obstetrician-led care, with lower intervention rates and fewer low Apgar scores in the midwife group.

KEYWORDS

intrapartum mortality, low risk, midwifery, neonatal mortality, perinatal audit, perinatal mortality, risk selection

1 | INTRODUCTION

The safety of the Dutch obstetric system has been subject of debate for many years.[1-4] The typical obstetric system in the Netherlands is characterized by a formal distinction between independent midwife-led care and obstetrician-led care. Dutch guidelines are used to define low-, medium- and high-risk pregnant women.[5] Pregnant women without known risk factors are usually monitored in midwife-led care, although they can opt for obstetrician-led care. If complications occur or risk factors are identified at any time during pregnancy, labor or postpartum, then women are referred to obstetrician-led care. Women who start labor in midwife-led care can opt for home birth or midwife-led hospital birth. Midwife-led care therefore includes home births and midwife-led hospital births (using intermittent auscultation), whereas obstetrician-led care is always set in a hospital (using fetal trace monitoring with cardiotocography). Previous studies in the Utrecht and Amsterdam regions of the Netherlands showed conflicting results when comparing perinatal mortality in women who started labor in midwife-led versus obstetrician-led care.[3,6]

In the Utrecht region of the Netherlands (from 2007 to 2008), Evers et al found an increased risk of perinatal mortality in the midwife-led care group (1.39‰ versus 0.60‰; unadjusted relative risk 2.3, 95% CI 1.1-4.8), despite the fact that women starting labor in obstetrician-led care were predominantly high risk.[2] We repeated this study in the Amsterdam region (from 2005 to 2008) and found no significant difference in intrapartum and neonatal mortality rates between groups (0.70‰ in midwife-led group versus 0.80‰ in obstetrician-led group; unadjusted relative risk 0.88, 95% CI 0.52-1.46).[6] However, evaluating these groups by start of labor is challenging, mostly because of the differences in patient characteristics in midwife-led and obstetrician-led care, lack of power (due to low mortality rates among term pregnancies in a regional cohort) and the data quality of the registry data to define, for example, line of care at the start of labor and low-risk status.[3,7-10]

When comparing only low-risk women in the Amsterdam region cohort, there were no statistically significant differences in mortality between midwife-led and obstetrician-led care, but the difference in absolute rates (0.75‰ versus 0.19‰; odds ratio [OR] 4.0, 95% CI 0.85-18.9) warranted further evaluation on a national level.[11]

These studies were based on data of women who delivered over a decade ago and several national and regional strategies have been implemented to improve birth outcomes and reduce perinatal mortality in the Netherlands since then. One of these initiatives was the start of the national Perinatal Audit Netherlands (PAN), with a focus on the audit of term perinatal deaths in a multidisciplinary approach.[12] The first 3 years of the national audit study focused on term perinatal mortality. We aspired to use the results of this audit to compare data on intrapartum and neonatal mortality risk in low-risk pregnancies of term women who started labor in midwife-led vs obstetrician-led care in a Dutch national cohort.

Key message

This national matched cohort study suggests that women with low-risk pregnancies benefit from starting labor in midwife-led care. This is possible in a well-integrated maternity system as exists in the Netherlands.

2 | MATERIAL AND METHODS

We used the national data from the PERINED organization (national perinatal registry) in the Netherlands for singletons born after 37.0 weeks, between 1 January 2010 and 31 December 2012. Two databases were used. For the denominator we used the PERINED records of all live births without neonatal death, within our time frame. This is a national database in which 98% of all perinatal caregivers (midwives, obstetricians, general practitioners and pediatricians) register pregnancy outcomes. The database with linked year records of all births has been described earlier.[13] For our numerator (perinatal mortality cases), we used the prospectively collected database of all term perinatal deaths that were audited and registered in the PAN database.[12,13] All PAN data were registered by perinatal healthcare professionals with specific details needed to construct the narrative that is used during the audit. This is a registry database with additional collected process data.[12] All 90 hospitals with obstetric and pediatric care facilities and surrounding midwifery practices during the study period were participating in the national audit. The audit panel, who reviewed all cases, included community midwives, midwives in secondary care, obstetricians, neonatologists, nurses, general practitioners, pathologists, registrars, medical students and students in midwifery (with an average of 31 healthcare professionals per session).[12] We excluded all women with a pregnancy complicated by antenatal stillbirth or congenital anomalies.

To define the low-risk population, women with pregnancies with the following 8 risk factors were excluded: non-vertex position of the

fetus, previous cesarean birth, hypertension, diabetes mellitus, prolonged rupture of membranes (≥24 hours), vaginal bleeding in the second half of pregnancy, non-spontaneous start of labor (induced labor or elective cesarean section) and post-term pregnancy (≥42 weeks).

The determinant was the responsible obstetric care provider at the start of labor, ie midwife-led or obstetrician-led care. Our primary outcome measure was the incidence of intrapartum or neonatal (up to 28 days) mortality. Secondary outcome measures were mode of delivery (vaginal, vaginal instrumental, cesarean section) and low Apgar score (5-minute Apgar <7).

Propensity scores were generated using a logistic model. A propensity score is the probability of a person being assigned to a particular treatment group given a set of observed covariates, and attempts to reduce selection bias by equating groups based on these covariates. We calculated the probability of starting labor in obstetrician-led care, based on the available covariates of parity, maternal age (4 groups), socio-economic status, ethnicity, gestational age, birthweight (5 groups) and gender of the child. One-to-one nearest-neighbor matching with replacement was used. This means that an individual from the comparison group (midwife-led care) is chosen as a matching partner for a treated individual (obstetrician-led care) that is closest in terms of propensity score, and the untreated individual can be used more than once as a match.[14,15] Propensity score matching is now commonly used in obstetric care.[16,17]

Propensity score distribution was plotted to examine the distributions before and after matching. Patient characteristics of the unmatched and matched groups were compared between the groups, with use of chi-squared tests for discrete variables and Student's t-tests for continuous variables. Primary outcomes by type of care were compared for the unmatched and matched cohorts, and ORs with 95% CIs were generated with the use of logistic regression. We performed subgroup analyses by parity (nulliparous vs multiparous).

All data analyses were conducted using R statistical software version 3.4.2 with the Matchit library (https://www.r-project.org/) for matched analysis and statistical package SAS version 9.4 (SAS Institute, Cary, NC, USA). Two-sided p-value <.05 indicated statistical significance.

2.1 | Ethical approval

The committee for research and ethics of the Netherlands Perinatal Registry (PERINED) approved the use of data for this study (9 February 2017; approval No. 17.11).

3 | RESULTS

A total of 465 974 term women delivered a singleton pregnancy without congenital anomalies or antepartum fetal death in the years 2010 to 2012. After excluding the women with 8 pre-defined risk factors, 259 211 women were defined as low risk at start of labor (Table 1). There were 206 642 (80%) women who started labor in midwife-led care and 52 569 (20%) low-risk women who started labor in obstetrician-led care. There were 123 deliveries that ended in intrapartum or neonatal death (123/259 211; 0.47‰), of which 100 (0.48‰) were in the midwife-led care group at the onset of labor and 23 (0.44‰) in the obstetrician-led care group.

3.1 | Baseline characteristics

Table 2 shows the baseline characteristics of the unmatched study population. Women who were in midwife-led care at start of labor

TABLE 1 Overview of the inclusion and exclusion groups of singleton term infants born in the Netherlands between 2010 and 2012

	PAN database		PERINED database		
	With mortality		Without mortality		Total
Singletons	**957**	**%***	**478 144**	**%***	**479 101**
Step 1: ineligible					
Antenatal stillbirths	514	54	–	–	
Congenital anomalies	177	18	12 436	3	
Subtotal	**266**		**465 708**		**465 974**
Step 2: exclusion of high-risk groups	**142**		**205 721**		**205 863**
Non-vertex position of the fetus	29	11	27 116	6	
Previous cesarean birth	10	4	34 416	7	
Hypertension	22	10	38 651	9	
Diabetes mellitus	2	1	7513	2	
Prolonged rupture of membranes	15	8	30 468	8	
Bleeding in second half of gestation	19	10	1808	0.5	
Intervention at start of labor (induced or elective CS)	44	27	63 498	19	
Post-term pregnancy	1	1	2251	0.7	
Total	**124**		**259 987**		**260 111**
Unknown line of care at onset delivery	1		899		900
Total included	**123**		**259 088**		**259 211**

Abbreviations: CS, cesarean section; PAN, Perinatal Audit Netherlands; PERINED, Perinatal Registry Netherlands.

*Multiple exclusion criteria possible, therefore adding up to over 100%.

TABLE 2 Maternal and child characteristics by line of care at onset of labor

		Unmatched cohort						Matched cohort				
		Midwife-led		Obstetrician-led				Midwife-led		Obstetrician-led		P-value after matching
	n	206 642		52569		*P*-value		n	52 569		52 569	
Gestational age (wk)	37	7778	3.8%	4034	7.7%	<0.0001	Gestational age (weeks)	37	3975	7.6%	4043	7.7%	0.97
	38	22 520	10.9%	8154	15.5%			38	8168	15.5%	8154	15.5%	
	39	57 608	27.9%	14 760	28.1%			39	14 758	28.1%	14 760	28.1%	
	40	79 735	38.6%	17 724	33.7%			40	17 781	33.8%	17 724	33.7%	
	41	39 001	18.9%	7897	15.0%			41	7887	15.0%	7897	15.0%	
Parity	Nulliparous	88 610	42.9%	24 056	45.8%	<0.0001	Parity	Nulliparous	24 168	46.0%	24 056	45.8%	0.49
	Multiparous	118 032	57.1%	28 513	54.2%			Multiparous	28 401	54.0%	28 513	54.2%	
Maternal age (y)	<25 years	23 814	11.5%	7164	13.6%	<0.0001	Maternal age (year)	<25 years	7174	13.6%	7164	13.6%	0.85
	25-29	66 899	32.4%	14 432	27.5%			25-29	14 483	27.6%	14 432	27.5%	
	30-34	79 417	38.5%	18 147	34.5%			30-34	18 208	34.6%	18 147	34.5%	
	≥35 years	36 458	17.7%	12 826	24.4%			>=35 years	12 704	24.2%	12 826	24.4%	
Ethnicity	Western	172 951	83.7%	38 963	74.1%	<0.0001	Ethnicity	Western	38 907	74.0%	38 963	74.1%	0.69
	non-Western	33 691	16.3%	13 606	25.9%			non-Western	13 662	26.0%	13 606	25.9%	
SES	low	46 889	22.7%	14 852	28.3%	<0.0001	SES	low	14 856	28.3%	14 852	28.3%	0.95
	mid	107 088	51.8%	24 785	47.1%			mid	24 862	47.3%	24 785	47.1%	
	high	52 665	25.5%	12 932	24.6%			high	12 851	24.4%	12 932	24.6%	
Birthweight (grams)							Birthweight (grams)						
<2750		5838	2.8%	3734	7.1%	<0.0001	<2750		3756	7.1%	3734	7.1%	0.99
2750-3250		45 901	22.2%	14 562	27.7%		2750-3250		14 599	27.8%	14 562	27.7%	
3250-3500		43 189	20.9%	10 685	20.3%		3250-3500		10 700	20.4%	10 685	20.3%	
3500-3750		45 318	21.9%	9847	18.7%		3500-3750		9855	18.7%	9847	18.7%	
3750-4000		33 352	16.1%	7042	13.4%		3750-4000		7002	13.3%	7042	13.4%	
≥4000		33 044	16.0%	6699	12.7%		≥4000		6657	12.7%	6699	12.7%	
Gender	Boy	104 158	50.4%	26 778	50.9%	0.03	Gender	Boy	26 795	51.0%	26 778	50.9%	0.92
	Girl	102 484	49.6%	25 791	49.1%			Girl	25 774	49.0%	25 791	49.1%	
Predicted probability		0.20	0.069	0.23	0.089	<0.0001	Predicted probability		0.23	0.088	0.23	0.089	0.09
Gestational age (median)		39.6	1.0	39.3	1.1	<0.0001	Gestational age (median)		39.3	1.1	39.3	1.1	0.38
Maternal age (year) (mean)		30.5	4.7	30.9	5.4	<0.0001	Maternal age (year) (mean)		30.8	5.1	30.9	5.4	0.0001
Birthweight (median)		3551	444	3444	484	<0.0001	Birthweight (median)		3446	470	3,443	485	0.58

Abbreviation: SES, socioeconomic status.

were more frequently multiparous, more often of western ethnicity and were less frequently of low socio-economic status than the obstetrician-led group. Their mean maternal age was lower (30.5 vs 30.9 years, $P < 0.0001$), they were less likely to give birth at 37 weeks of gestation and had a higher birthweight (3551 g vs 3444 g, $P < 0.0001$; Table 2). Before matching, the mean (SD) propensity score of a midwife-led care record was 0.196 (0.069) in the midwife group, and 0.230 (0.089) in the obstetrician group ($P < 0.0001$).

After matching, low-risk women in midwife-led care (n = 52 569) and low-risk women in obstetrician-led care (n = 52 569) were similar between groups for gestational age, parity, ethnicity, socio-economic status, fetal gender and birthweight (Table 2). Mean maternal age was slightly lower (30.8 vs 30.9 years; $P = 0.0001$) in the midwife group, however, the matching variable maternal age in categories was equal. Plotting of propensity score distribution showed similar distribution between the 2 groups after matching (Supporting Information Figure S1). The propensity score was 0.230 (0.088) in the midwife group, which was comparable to the obstetrician group 0.230 (0.089) ($P = 0.09$).

3.2 | Outcomes

The unmatched cohort showed 100 (N = 206 642; 0.48‰) intrapartum and neonatal deaths in the midwife group and 23 (N = 52 569; 0.44‰) in the obstetrician group. The perinatal mortality risks for low-risk term women starting labor in midwife-led versus obstetrician-led care were comparable (OR 1.11, 95% CI 0.70-1.74; Table 3).

The subgroup analysis by parity showed that for nulliparous women, perinatal mortality rates were 0.68‰ vs 0.62‰ for midwife-led vs obstetrician-led care, respectively (unmatched OR 1.11, 95% CI 0.62-1.91). For multiparous women the mortality risk was 0.34‰ vs 0.28‰, respectively (unmatched OR 1.21, 95% CI 0.57-2.58; Table 3).

Within our matched cohort there were 26 (N = 52 569; 0.49‰) intrapartum and neonatal deaths in the midwife group and 23 (N = 52 569; 0.44‰) in the obstetrician group. The mortality risk for low-risk term women starting labor in midwife-led vs obstetrician-led care was comparable (OR 1.13, 95% CI 0.65-1.98; Table 3). Subgroup analysis by parity for the matched cohort showed for nulliparous women perinatal mortality rates of 0.62‰ vs 0.62‰ for midwife-led vs obstetrician-led care, respectively (matched OR 1.0, 95% CI 0.49-2.04). For multiparous women the mortality risk was 0.39‰ vs 0.28‰, respectively (matched OR 1.38, 95% CI 0.56-3.43); Table 3).

Results of the secondary outcomes in the unmatched cohort showed significantly fewer neonates with low Apgar scores (<7 after 5 minutes) in the midwife group (0.65% vs 1.12%; OR 0.58, 95% CI 0.53-0.64). Also, the instrumental delivery rates (8.2% vs 13.3%; OR 0.62, 95% CI 0.61-0.64) and cesarean section rates (2.4% vs 8.2%; OR 0.29, 95% CI 0.28-0.30; Table 3) were lower.

TABLE 3 Primary and secondary outcomes by line of care at onset of labor

	Unmatched cohort			Matched cohort		
	Midwife-led care N = 206 642	Obstetrician-led care N = 52 569	Odds ratio (95% CI)	Midwife-led care N = 52 569	Obstetrician-led care N = 52 569	Odds ratio (95% CI)
Primary outcome						
Intrapartum and neonatal mortality	100 (0.48‰)	23 (0.44‰)	1.11 (0.70-1.74)	26 (0.49‰)	23 (0.44‰)	1.13 (0.65-1.98)
Subgroups by parity						
Nulliparous	60/88 610 (0.68‰)	15/24 056 (0.62‰)	1.11 (0.62-1.91)	15/24 168 (0.62‰)	15/24 056 (0.62‰)	1.00 (0.49-2.04)
Multiparous	40/118 032 (0.34‰)	8/28 513 (0.28‰)	1.21 (0.57-2.58)	11/28 401 (0.39‰)	8/28 513 (0.28‰)	1.38 (0.56-3.43)
Secondary outcomes						
Low Apgar scores (<7 after 5 minutes)	1347 (0.65%)	587 (1.12%)	0.58 (0.53-0.64)	365 (0.69%)	587 (1.11%)	0.61 (0.53-0.69)
Mode of birth						
Instrumental vaginal	16 880 (8.2%)	6873 (13.1%)	0.62 (0.61-0.64)	4434 (8.4%)	6873 (13.0%)	0.65 (0.62-0.67)
Intrapartum cesarean section	4908 (2.4%)	4319 (8.2%)	0.29 (0.28-0.30)	1376 (2.6%)	4319 (8.2%)	0.32 (0.30-0.34)

After matching, these results remained statistically significant. There were fewer neonates with low Apgar scores (<7 after 5 minutes) in the midwife group (0.69% vs 1.11%; matched OR 0.61, 95% CI 0.53-0.69). Instrumental delivery rates and cesarean section rates were also lower in the midwife group (8.4% vs 13.0%; matched OR 0.65, 95% CI 0.62-0.67 and 2.6% vs 8.2%; matched OR 0.32, 95% CI 0.30-0.34, respectively; Table 3).

3.3 | Place of birth

Thirty-seven percent of all women who started labor in midwife-led care actually gave birth at home, 29% at a hospital or birth center under the responsibility of a community midwife and 34% at a hospital under the responsibility of an obstetrician after referral to obstetrician-led care during labor (Supporting Information Table S1). After matching, 65% of all women who started labor in midwife-led care actually gave birth in midwife-led care and 35% in obstetrician-led care after intrapartum referral. The actual place of birth was 34% at home (Table S1).

4 | DISCUSSION

This study shows comparable intrapartum and neonatal mortality risk for low-risk term women starting labor in midwife-led vs obstetrician-led care in the Netherlands. This was seen in the matched cohort and in the unmatched cohort. The absolute mortality risk among term pregnancies is low both in the midwife-led care group and in the obstetrician-led care group. Subgroup analysis by parity showed no difference in mortality risk for nulliparous and multiparous women. In the midwife-led care group there were significantly fewer neonates with low Apgar scores, and significantly lower instrumental delivery and cesarean section rates.

A strength of this study was the thoroughness of the audit procedures, which included that nearly all mortality cases had already been audited in a multidisciplinary team. The defined Perinatal Audit Database, which included 86% of all term perinatal deaths in the Netherlands within these 3 years, had low risk of misclassification due to extensive audit procedures.[12] We hypothesize that time investment and barriers after recent implementation might have contributed to this incomplete coverage. It would be expected that if selection of cases for an audit-meeting is needed, the unexpected perinatal deaths in low-risk pregnancies without fetal congenital anomalies would have a higher likelihood of being discussed in an audit, in which case a higher coverage of our population in the PAN database can be expected. Furthermore, by using propensity score matching we were able to reduce confounding bias and improve comparability between groups.

A limitation of our study is that, because of privacy regulations, we were unable to review the individual audit reports regarding possible substandard factors (PARS database). We are therefore unable to draw conclusions regarding the causes of mortality. Results regarding causes of death were previously reported for the overall 2010-2012 Dutch Audit database (including antenatal deaths, high-risk pregnancies and congenital anomalies) and showed that the most frequently classified causes of death were placenta pathology (36%, mostly cord problems and placenta-bed pathology) and congenital anomalies (19%). The cause was unknown in 32% of cases.[12] In order to reduce the risk of bias of using 2 separate databases for our study, we compared our mortality cases from the PAN database with those within our timeframe registered in PERINED and found that, as we expected, there was a discrepancy in the number of mortality cases (PAN n = 123; PERINED n = 165). We found that the discrepancy was due to differences in the classification of inclusion variables, such as moment of death and risk factors. The thorough multidisciplinary classification in the PAN records (especially for moment of death and level of care at start of labor) is much more likely to be accurate and was used for the main analysis. An additional analysis using the total of 165 mortality cases did not lead to different conclusions.

Propensity score matching attempts to estimate the effect of an intervention by accounting for the measured covariates that predict receiving the treatment (starting labor in obstetrician-led care). Using this propensity score design enabled us to improve comparability between groups. However, it is only possible to account for known registered variables. Any hidden bias due to unregistered variables may remain after propensity score matching. It is plausible that low-risk women in the obstetrician-led care group had a relatively higher risk profile than women in the midwife-led care group, because defining high risk was challenging. We selected the most important risk factors for poor neonatal outcome that were available to us from the registry, but other important risk factors such as level of education, smoking during pregnancy and maternal body mass index, were not available. Our low-risk obstetrician-led care group therefore also includes women with other indications for obstetrician-led care, such as previous preterm birth and chronic disease.

Another possible type of bias is the bias due to inexact matching which we reduced by using nearest-neighbor matching. Nearest-neighbor matching selects a control with the smallest distance to the case in terms of propensity score. Our p-values after matching indicate successful propensity matching; the variables in both groups were equally distributed, as could be seen in the plots. Because of the low prevalence of the mortality outcome, we could not perform a full match because that would lead to the exclusion of cases if a full match was unavailable. Furthermore, variables such as fetal gender and birthweight can be considered post-birth variables, and therefore not predictors, but can also be determined or estimated in pregnancy with ultrasound. We chose to include birthweight class (in 6 categories) because the goal is to account for the covariates that predict receiving the treatment (starting birth in obstetrician-led care), and suspected intrauterine growth restriction is an indication for referral to obstetrician-led care. However, additional analyses in which we excluded these 2 variables did not significantly alter our findings.

The midwife-led care group was nearly 4 times the size of the obstetrician-led care group, so to maintain adequate group sizes after matching, the obstetrician-led care group formed the treatment group. Women who had comparable risk of starting birth in obstetrician-led care were selected from within the midwife-led care group. This resulted in the selection of a relatively high-risk population within the midwife-led care group. We do not expect this to influence our final conclusions: even in this relatively high-risk group in midwife-led care, no increase in poor outcomes was seen, with lower intervention rates.

We were unable to perform subgroup analyses for intended place of birth, because of limitations in the validity of the coding of intended place of birth in midwifery units in the PAN database, as well as a 13% prevalence of unknown planned place of birth.

Besides intrapartum and neonatal mortality, other important outcomes such as perinatal morbidity, maternal outcomes and parent's experiences should be taken into account when evaluating birth outcomes of low-risk women. A new set of indicators registering these items is currently under evaluation in the Netherlands (ICHOM).[18] In this study timeframe, we were only able to use Apgar score, which is an outcome measure with a subjective component.[19] Therefore, whether perinatal morbidity differs between the 2 groups should be further evaluated. Furthermore, our study does not allow for conclusions regarding prelabor outcomes, including antenatal stillbirth.

The results of this study, based on recent data, a larger study group and proper adjustment methods, differ from those of previous publications regarding intrapartum and neonatal mortality in low-risk and high-risk women in the Netherlands. These studies performed in the Amsterdam en Utrecht region of the Netherlands, as discussed in our introduction, suggested increased risk intrapartum and neonatal mortality in the midwife-led care group.[3,11] Although our previous Amsterdam study showed perinatal mortality rates of 0.75‰ and 0.19‰ for midwife-led and obstetrician-led care, respectively,[11] the current study showed ranges between 0.49‰ and 0.44‰ for both groups, which suggests an improvement for the midwife-led group but a poorer outcome for the obstetrician-led care group.

It is possible that variations in methodology (adjustment for confounding, classification differences) as well as a power issue (regional vs national data) in the previous studies contributed to this difference. Also, the difference in time period could explain some differences. Both regional studies were performed before 2009, whereas our current study reported on deliveries performed between 2010 and 2012. In this period, many things have changed in Dutch perinatal health care. Over the last 2 decades antepartum and intrapartum referral rates from midwife-led to obstetrician-led care have increased.[20] Perinatal mortality rates in the Netherlands, both preterm and at term, have decreased over time.[12,21] This was observed for stillbirths and for neonatal death, with a steady decline of the perinatal mortality risk at term (including antepartum mortality) of 3.8‰ in 2001, to 2.8‰ in 2008, 1.9‰ in 2014 and 1.6‰ in 2017.[12,22] Among the main changes implemented in the Dutch obstetric system over the last decade are the installation of the Foundation Perinatal Audit in the Netherlands (PAN, 2010), the introduction of a routine structural anomaly scan at 20 weeks (January 2007), introduction of therapeutic neonatal hypothermia for perinatal asphyxia (2009), and the active treatment of extremely premature (born at 24-26 weeks) babies (2010).[23] Furthermore, in 2010 the College for Perinatal Care (CPZ) was founded, aspiring and facilitating the development of an integrative obstetric network, with a central position for the wishes and needs of the pregnant woman. Goals for 2022 include further professionalization of the obstetric networks including a healthy financial structure and improving digital data exchange. Despite these ongoing changes and aspirations for the future, the current Dutch situation continues to show a distinct division in midwife-led and obstetrician-led care. We therefore expect that our conclusions remain relevant.

Comparing our data with international literature, is challenging because of variation in maternity systems worldwide, and because most of the available studies[24-32] focus on planned place of birth rather than line of care at birth. The largest study in the UK, the Birthplace in England concluded that in nulliparous women, the proportion of women with a poor perinatal outcome (a composite including intrapartum stillbirth, early neonatal death, neonatal encephalopathy, meconium aspiration syndrome, and specified birth-related injuries including brachial plexus injury) was higher for planned home births (9.3‰, 6.5‰-13.1‰) compared with births planned in obstetric units (5.3‰, 3.9‰-7.3‰, adjusted OR 1.75, 95% CI 1.07-2.86) but not for midwifery unit settings. Interventions during labor were substantially lower in all non-obstetric unit settings, with intrapartum cesarean section rates of 11.1% in obstetric units and 2.8% in intended home births (OR 0.31, 95% CI 0.23-0.41).[33] This was partly in line with our study, which showed lower intrapartum cesarean section rates for women starting labor in midwife-led care (2.6% vs 8.2% in obstetrician-led care) and other studies comparing intervention rates in midwife-led vs obstetrician-led care.[6,33-35]

In contrast to the Birthplace study and the study by Evers et al[2], our subgroup analysis by parity showed no significant difference in mortality risk for nulliparous and multiparous women.

5 | CONCLUSION

This propensity score matched cohort study suggests comparable intrapartum and neonatal mortality risk for low-risk term women starting labor in midwifery-led and obstetrician-led care in the Netherlands, with significantly fewer neonates with low Apgar scores and lower instrumental delivery and cesarean section rates in the midwife-led care group. In countries with an integrated maternity system, low-risk term women might benefit from reduced intervention rates during delivery in midwife-led care.

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CONFLICT OF INTEREST

None.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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