Midwifery 124 (2023) 103744

Contents lists available at ScienceDirect

Midwifery

journal homepage: www.elsevier.com/locate/midw

Type of deliveries supported by Dutch clinical midwives

H.W. Harmsen van der Vliet–Torij[a,*], L.C.M. Bertens[b], L. Burgos Ochoa[b], M.J.B.M. Gouman[a], A.G. Posthumus[b], E.A.P. Steegers[b]

[a] Research Centre Innovations in Care, Rotterdam University of Applied Sciences, Rochussenstraat 198, Rotterdam 3015 EK, the Netherlands
[b] Department of Obstetrics and Gynaecology, Erasmus University Medical Centre, PO Box 2040, Rotterdam 3000 CA, the Netherlands

ARTICLE INFO

Article history:
Received 18 March 2022
Revised 4 April 2023
Accepted 23 May 2023

Keywords:
Midwife
Clinical midwife
The Netherlands
Latent class analysis
Childbirth
Delivery

ABSTRACT

Objective: The number of clinical midwives in the Netherlands has substantially increased over the last twenty years, but their role in obstetric care is not clearly defined. Our aim was to identify the type of deliveries that are usually supported by clinical midwives and whether these changed over time.
Design, setting, and participants: National data from the Netherlands Perinatal Registry from the years 2000 to 2016 (n = 2.999.411 deliveries) were used to divide all deliveries into classes using latent class analyses based on delivery characteristics. In the primary analyses, the identified classes, type of hospital, and year of cohort were used to predict deliveries supported by a clinical midwife. In secondary analyses, the same analyses were repeated where the classes were replaced by individual level characteristics of deliveries and stratified by referral during birth.
Measurements and findings: The latent class analyses identified three classes: I. referral during birth; II. Induction of labour; and III. Planned caesarian section. The primary analyses indicated that women in both class I and II were frequently supported by clinical midwives and those in the third class almost never. Therefore, only data from deliveries assigned to class I and II were used in the secondary analyses. The secondary analyses showed that clinical midwives supported deliveries with a great variety in characteristics, such as pain relief and preterm birth. Although the frequency of clinical midwives being involved in the second stage of labour increased over the years, we did not find noticeable changes in their involvement.
Key conclusion and implications for practice: Clinical midwives care for women with various types of deliveries with varying degrees of pathology and complexity during second stage of labour. Additional training, taking previously acquired skills and competences into account, is necessary to deal with this complexity for which clinical midwives are not always trained.

Introduction

In the Netherlands, obstetric care is organized into tiers: community based primary care, hospital based secondary care, and hospital based tertiary care. Primary care is provided by community midwives who independently supervise low risk, uncomplicated pregnancies and deliveries. Emerging risks that occur during primary care are referred to a hospital where high risk pregnancies and deliveries are cared for. In the hospital setting, pregnant women and women in labour are cared for by obstetricians, obstetricians in training, and clinical midwives (Cronie et al., 2012; Wiegers and Hukkelhoven, 2010; KNOV, 2014; Page, 2001; Posthumus et al., 2016).

Clinical midwives have had the same initial training as community midwives, but they work in a different setting and are supervised by obstetricians. The complexity and pathology of pregnancies and deliveries in this setting, the hospital, is higher than in the community setting. Although not mandatory, additional courses and training for clinical midwives are available to deal with this increased complexity in care. The number of clinical midwives in Dutch hospitals has increased significantly during the last decennia, from 185 in 1996 to 1083 in 2018 (NIVEL, 2006, 2020), but their position is not clear and there is insufficient insight into their role in Dutch hospitals. To date, little research has been performed into the type of deliveries that are typically cared for by a clinical midwife and whether this has changed during the last decennia.

The objective of this study was to identify the types of deliveries that are usually supported by clinical midwives, using registry data from the Dutch national birth registry. Type of hospital and

* Corresponding author.
E-mail address: h.w.torij@hr.nl (H.W. Harmsen van der Vliet–Torij).

https://doi.org/10.1016/j.midw.2023.103744

time (years in cohorts) were included to identify their potential impact on this. The outcomes of this study can help to further develop the profession of clinical midwife and to adequately deploy clinical midwives.

Methods

A registry-based study was conducted, using data from the national birth registry to identify the different types of deliveries using latent class analyses (LCA). Next, the identified types of deliveries were used to assess which types are most often supported by clinical midwives.

Data source

National registry data from the Netherlands Perinatal Registry between 2000 and 2016

(n = 2 999 411) were used for the analyses. The registry covers over 97% of all deliveries in the Netherlands and includes routinely collected data on pregnancy, delivery, and neonatal outcomes (Perined, 2021). The study was approved by the board of the Netherlands Perinatal Registry (project number 15.29).

Main outcome

The main outcome of this study were births in which the clinical midwife supports the second stage of labour. For the analyses, the outcome was dichotomized into a clinical midwife versus any other obstetric professional.

Determinants

Type of hospital: categorical variable indicating the type of hospital as secondary non-teaching hospitals, secondary teaching hospitals (where an obstetrician in training is available), and tertiary hospitals (where an obstetrician in training is available and where care is provided for complex pathology with a risk for severe maternal, foetal, or neonatal morbidity). Tertiary hospitals were used as the reference category.

Cohort years: Data was available for analyses from the years 2000 up to 2016. For the analyses these years were categorized into three cohorts: 2000–2005 (reference), 2006–2011, and 2012–2016.

The following variables were also used within the latent class analysis: *Maternal age; Gestational age; Parity; Singleton / multiple pregnancy; Perinatal mortality; Pain relief; Oxytocin administration; Ethnicity, based on the caregiver's opinion; Congenital anomalies; Referral from first to second or third tier during birth; foetal position; Induction of labour*.

Additionally, for the baseline table, *end of birth; Sex; Birth weight; APGAR score at 5 min; Maternal death; Post-partum complications; Episiotomy;* And *perineal tears* were also included. An overview of the determinants referred to in this Methods section, including the categories per variable, is tabulated in Table 1.

In the registry data that we used, no information is available as to whether incidents occurring during birth and referral during birth actually happened during the first stage or the second stage of labour.

Missing data

Cases with missing information about the obstetric professional supporting the second stage of labour (the outcome variable) were

Table 1
Determinants used in the study.

Variable	Categories
Maternal age	≤19
	20 – 35 (REF)
	≥36
Gestational age	22 – 31+6
	32 – 36+6
	37 – 41+6
	≥42
Parity	Nulliparous (REF)
	Multiparous
Singleton / multiple pregnancy	Singleton pregnancies (REF)
	Multiple pregnancies
Perinatal Mortality	No (REF)
	Antepartum
	Other
(end of) Birth*	Spontaneous
	Assisted
	Unplanned Caesarian
	Planned Caesarian
Pain relief	None (REF)
	Sedatives, Analgesics
	Epidural
	General anaesthesia and other pain relief
Oxytocin administration	No (REF)
	Yes
	In combination with induction
Ethnicity	Western (REF)
	Non-Western
Congenital anomalies	No (REF)
	Yes
Referral during birth	No (REF)
	yes
foetal position	cephalic (ref)
	Breech
	Other or unknown
Induction of labour	No (REF)
	Yes
Sex*	Male
	Female
Birth weight*	< 1500 gs
	1500 – 2499
	2500 – 3999
	> 4000 gs
APGAR score at 5 min*	0 – 6
	7 – 10
Maternal death*	No
	Yes
Post partum*	No complications
	HPP and / or MPV
	Other complications
Episiotomy*	No
	Yes
Perineal tears*	No
	Second-degree
	Third-degree and fourth -degree tear
Type of hospital	Secondary, non- teaching hospital
	Secondary, teaching hospital
	Tertiary, academic hospital (REF)
Cohort in years	2000 – 2005 (REF)
	2006 – 2011
	2012 - 2016
Second stage of labour supported by clinical midwife (main outcome)	Clinical midwife
	Other obstetric professional

* Variables that were not included in the latent class analysesREF: Category that is used as the reference category.

excluded from the analyses. In the latent class analysis, missing data ranged from <0.1% for maternal age, gestational age, parity, singleton/multiple pregnancy, and induction of labour to 1.2% for ethnicity. Since the data come from the national registry, consisting of routinely collected care data, missingness at random could not be assumed, and therefore no data was imputed. For the LCA and multivariate regression analyses, cases with missing data were omitted.

Latent class analyses

Latent class analysis (LCA) was performed on the data of all available deliveries. LCA is a statistical technique to identify mutually exclusive, and exhaustive groups of people (latent classes) based on observed variables (Collins and Lanza, 2009). These classes, as categories of a latent variable, cannot be measured directly but indirectly through the patterns in the responses of the indicator items. The deliveries that were assigned to the same group resembled each other based on a set of demographic, maternal, and pregnancy characteristics. In the final analyses, these identified groups were used as determinant in the multivariable logistic regression analyses with clinical midwives supporting the second stage of labour as outcome.

To relate the identified latent classes to a distal outcome (clinical midwife supporting the second stage of labour) a classify-analyse approach is required. Using a classify-analyse approach to estimate associations between the latent class variable and other observed variable is known to produce attenuated estimates (Bray et al., 2015; Vermunt, 2010). To circumvent this limitation, the classify-analyse approach proposed by Bray et al. was used (Bray et al., 2015). This approach follows four steps (Bray et al., 2015): (1) determine the optimal number of latent classes by fitting and comparing several models without covariates; (2) re-fit the selected latent class model adding other variables of interest (distal outcome and regression covariates) included as covariates in the LCA to produce posterior probabilities; (3) assign individuals to latent classes, using maximum-probability assignment; and (4) treat class membership as observed to perform the desired analysis.

The previous described characteristics were used to estimate the number and composition of groups (see description of the determinants for the used definition and transformations). Next to the study (distal) outcome, type of hospital and the cohorts were also added as covariates in the LCA.

Statistical analyses

Descriptive analyses were used to describe the entire cohort and to describe the cohort per class identified by the LCA procedure. Multivariable logistic regression models were fitted with the classes identified by the LCA as main determinants and the midwife supporting the second stage of labour as outcome. Within one of the identified classes, clinical midwives played almost no role in supporting the second stage of labour, while in the two other classes, the number of deliveries supported by clinical midwives was very similar. Therefore, the primary analyses were not performed and only the secondary analyses were performed, relating the individual level characteristics to the second stage of labour supported by a clinical midwife. In line with the LCA findings, deliveries ending in a caesarian section were excluded from these analyses. Furthermore, the analyses were performed stratified by referral during birth.

The LCA were performed in R 3.6.3 using package using the R package poLCA (Linzer and Lewis, 2011). The other analyses were performed using the Statistical Package of Social Sciences version 25.0 for Windows (IBM Corp., Armonk, NY, USA). A p-value < 0.05 was considered statistically significant.

Results

From the total set of 2 999 411 women, 909 982 cases were excluded because the place of birth was not in the hospital. Subsequently, 156 285 cases were excluded because data about the professional who supported the second stage of labour were not available. In total, 1 933 144 cases were included of which 646 842 (33.5%) were from the cohort 2000 – 2005, 694 241 (35.9%) from cohort 2006 – 2011, and 592 061 (30.6%) from cohort 2012 – 2016. In a latent class analysis, only classes can be made with complete cases. In 3.2% ($n = 61\ 162$) of the dataset no class could be assigned, because there was a missing somewhere on one of the variables used for the analysis. From the latent class analysis, 1 100 665 (56.9%) were assigned to class I, 501 139 (25.9%) to class II, and 270 178 (14%) to class III (Fig. 1).

Table 2 shows the baseline characteristics of our study population and the three identified groups from the LCA. Class I was characterized by women who were referred during birth (Referral group), class II by women with induction of labour (Induction group), and class III was characterized by women with a planned caesarian (Caesarian group). The groups came from secondary non-teaching hospitals (38.3%, $n = 740\ 406$), secondary teaching hospitals (51.4%, $n = 994\ 401$), and tertiary hospitals (10.3%, $n = 198\ 337$).

Within the caesarian group, clinical midwives played almost no role in supporting the second stage of labour (<0.1%, $n = 112$). Furthermore, within class I and II, the number of deliveries supported by clinical midwives was almost similar. Therefore, the planned logistic regression analyses with classes as main determinants were dropped. In the logistic regression analyses using the individual level determinants, deliveries ending in caesarian sections were excluded because of the LCA findings, and separate models were fitted for deliveries starting in the hospital (non-referred) and deliveries referred to the hospital during birth (referred).

Table 3 shows the results of these multivariable logistic regression analyses. In the model for the women who were referred during birth, ethnicity showed no statistically significant association and was therefore removed from the final model. In the non-referred group, all associations were significant. The odds that a clinical midwife supported the second stage of labour was in the same direction for most variables in both groups but differed between both groups for pain relief with sedatives/analgesics (referred group OR 0.74 95%CI 0.73–0.75; non-referred group OR 1.10 95%CI 1.09–1.11;), and term birth (referred group OR 0.84 95%CI 0.82–0.86; non-referred group OR 1.31 95%CI 1.29–1.34). Adding the type of hospital (Table 4) did not yield other results, except that when giving birth in a tertiary hospital, the odds of a clinical midwife supporting the second stage of labour was higher than when giving birth in a secondary non-teaching hospital.

Discussion

Key results

Based on our analyses, there is not one type of delivery that is specifically supported by a clinical midwife. The largest class that was identified by the LCA was characterized by women who were referred during birth and, in this group, clinical midwives also play an important role. Clinical midwives are almost never involved in caesarean sections. In the secondary analyses we stratified for referral during birth. A large part of the non-referred group concerns induction of labour of women already in secondary hospital care. Overall, in the group of women who are not referred during birth,

Table 2
Baseline table.

Variable	Category	Cohort (including missings 3.2%)	56,9% (class I) $N = 1.100.665$	25.9% (class II) $N = 501.139$	14.0% (class III) $N = 270.178$
Maternal age	≤19	29.079 (1.5%)	19.926 (1.8%)	6.685 (1.3%)	1.698 (0.6%)
	20 – 35	1.591.042 (82.3%)	925.508 (84.1%)	410.412 (81.9%)	207.367 (76.8%)
	≥36	312.874 (16.2%)	155.231 (14.1%)	84.042 (16.8%)	61.113 (22.6%)
	Missing	149 (<0.1%)	none	none	none
Gestational age	22 – 31+6	39.862 (2.1%)	16.883 (1.5%)	7.599 (1.5%)	11.786 (4.4%)
	32 – 36+6	174.217 (9.0%)	98.108 (8.9%)	25.879 (5.2%)	42.774 (15.8%)
	37 – 41+6	1.629.943 (84.3%)	960.244 (87.2%)	409.185 (81.7%)	212.435 (78.6%)
	≥42	88.771 (4.6%)	25.430 (2.3%)	58.476 (11.7%)	3.183 (1.2%)
	Missing	351 (<0.1%)	none	none	none
Parity	Nulliparous	1.016.586 (52.6%)	634.707 (57.7%)	240.312 (48.0%)	112.375 (41.6%)
	Missing	47 (<0.1%)	none	none	none
Singleton / multiple pregnancy	Multiple pregnancies	52.226 (2.7%)	15.988 (1.5%)	15.863 (3.2%)	15.379 (5.7%)
	Missing	1 (<0.1%)	none	none	none
Perinatal Mortality	No	1.905.679 (98.6%)	1.090.701 (99.1%)	488.970 (97.6%)	267.130 (98.9%)
	Antepartum	14.012 (0.7%)	3.671 (0.3%)	8.649 (1.7%)	390 (0.1%)
	Other	13.453 (0.7%)	6.293 (0.6%)	3.520 (0.7%)	2.658 (1.0%)
(end of) Birth	Spontaneous	1.181.820 (61.1%)	793.393 (72.1%)	358.637 (71.6%)	–
	Assisted	284.234 (14.7%)	216.889 (19.7%)	61.768 (12.3%)	–
	Unplanned Caesarian	250.665 (13.0%)	90.380 (8.2%)	80.734 (16.1%)	67.824 (25.1%)
	Planned Caesarian	216.298 (11.2%)	3 (<0.1%)	–	202.354 (74.9%)
	Missing	127 (<0.1%)	none	none	none
Pain relief	None	891.843 (46.1%)	651.031 (59.1%)	217.749 (43.5%)	7.310 (2.7%)
	Sedatives, Analgesics	397.880 (20.6%)	256.986 (23.3%)	131.094 (26.2%)	1.898 (0.7%)
	Epidural	597.268 (30.9%)	190.318 (17.3%)	145.841 (29.1%)	237.901 (88.1%)
	General anaesthesia and other pain relief	34.217 (1.8%)	2330 (0.2%)	6.455 (1.3%)	23.069 (8.5%)
	Missing	11.936 (0.6%)	none	none	none
Oxytocin administration	No	1.172.845 (60.7%)	611.825 (55.6%)	273.449 (54.6%)	253.990 (94.0%)
	Yes	515.389 (26.7%)	488.840 (44.4%)	–	16.188 (6.0%)
	In combination with induction	232.585 (12.0%)	-	227.690 (45.4%)	–
	Missing	12.325 (0.6%)	none	none	none
Non Western ethnicity		321.016 (16.6%)	194.673 (17.7%)	77.454 (15.5%)	42.015 (15.6%)
	Missing	22.596 (1.2%)	none	none	none
Congenital anomalies (yes)		62.297 (3.2%)	30.281 (2.8%)	18.210 (3.6%)	11.075 (4.1%)
referral during birth		622.717 (32.2%)	600.148 (54.5%)	3 (<0.1%)	7.295 (2.7%)
foetal position	cephalic	1.761.627 (91.1%)	1.069.310 (97.2%)	487.962 (97.4%)	167.217 (61.9%)
	Breech	147.975 (7.7%)	30.832 (2.8%)	12.606 (2.5%)	101.745 (37.7%)
	Other or unknown	2.707 (0.1%)	523 (<0.1%)	571 (0.1%)	1.216 (0.5%)
	Missing	20.835 (1.1%)	none	none	none
Induction of labour		516.033 (26.7%)	none (0.0%)	501.139 (100%)	858 (0.3%)
	Missing	800 (<0.1%)	none	none	none
Sex	Boy	1.008.157 (52.2%)	578.017 (52.5%)	260.051 (51.9%)	138.054 (51.1%)
	Girl	924.686 (47.8%)	522.573 (47.5%)	240.961 (48.1%)	132.107 (48.9%)
Birth weight	< 1500 gs	38.207 (2.0%)	13.278 (1.2%)	8.221 (1.6%)	13.030 (4.8%)
	1500 – 2499	144.402 (7.5%)	64.278 (5.8%)	37.306 (7.4%)	36.314 (13.4%)
	2500 – 3999	1.483.713 (76.8%)	873.999 (79.4%)	374.740 (74.8%)	190.612 (70.6%)
	> 4000 gs	266.369 (13.8%)	148.885 (13.5%)	80.737 (16.1%)	30.187 (11.2%)
	Missing	453 (<0.1%)	225 (<0.1%)	135 (<0.1%)	35 (<0.1%)
APGAR score at 5 min	0 – 6	53.851 (2.8%)	22.709 (2.1%)	18.726 (3.7%)	8.785 (3.3%)
	7 – 10	1.878.259 (97.2%)	1.077.541 (97.9%)	482.114 (96.2%)	261.158 (96.7%)
	Missing	1.034 (0.1%)	415 (<0.1%)	299 (0.1%)	235 (0.1%)
Maternal death		153 (<0.1%)	42 (<0.1%)	38 (<0.1%)	64 (<0,1%)
Post partum	No complications	1.701.534 (88.0%)	970.233 (88.1%)	437.645 (87.3%)	244.783 (90.6%)
	HPP and / or MPV	150.942 (7.8%)	82.092 (7.5%)	44.224 (8.8%)	18.744 (6.9%)
	Other complications	15.904 (0.8%)	7.184 (0.7%)	3.859 (0.8%)	1.392 (0.5%)
	Missing	64.764 (3.4%)	41.156 (3.7%)	15.411 (3.1%)	5.259 (1.9%)
Episiotomy (yes)		591.043 (30.6%)	436.448 (39.7%)	140.867 (28.1%)	509 (0.2%)
Perineal tears	No	859.120 (44.4%)	346.270 (31.5%)	209.356 (41.8%)	268.917 (99.5%)
	Second-degree	477.169 (24.7%)	317.314 (28.8%)	148.089 (29.6%)	202 (0.1%)
	Third-degree and fourth -degree tear	38.158 (2.0%)	27.974 (2.5%)	9.337 (1.9%)	7 (<0.1%)
	Missing	558.697 (28.9%)	409.107 (37.2%)	134.357 (26.8%)	1.052 (0.4%)
Type of hospital	Secondary, non- teaching hospital	740.406 (38.3%)	418.389 (38.0%)	199.760 (39.9%)	103.990 (38.5%)
	Secondary, teaching hospital	994.401 (51.4%)	575.248 (52.3%)	253.193 (50.5%)	131.078 (48.5%)
	Tertiary, academic hospital	198.337 (10.3%)	107.028 (9.7%)	48.186 (9.6%)	35.110 (13.0%)
Cohort in years	2000 – 2005	646.842 (33.5%)	387.169 (35.2%)	151.487 (30.2%)	94.142 (34.8%)
	2006 – 2011	694.241 (35.9%)	406.696 (37.0%)	176.198 (35.2%)	94.139 (34.8%)
	2012 - 2016	592.061 (30.6%)	306.800 (27.9%)	173.454 (34.6%)	81.897 (30.3%)
Second stage of labour supported by clinical midwife		524.311 (27.1%)	347.714 (31.6%)	164.420 (32.8%)	112 (<0.1%)

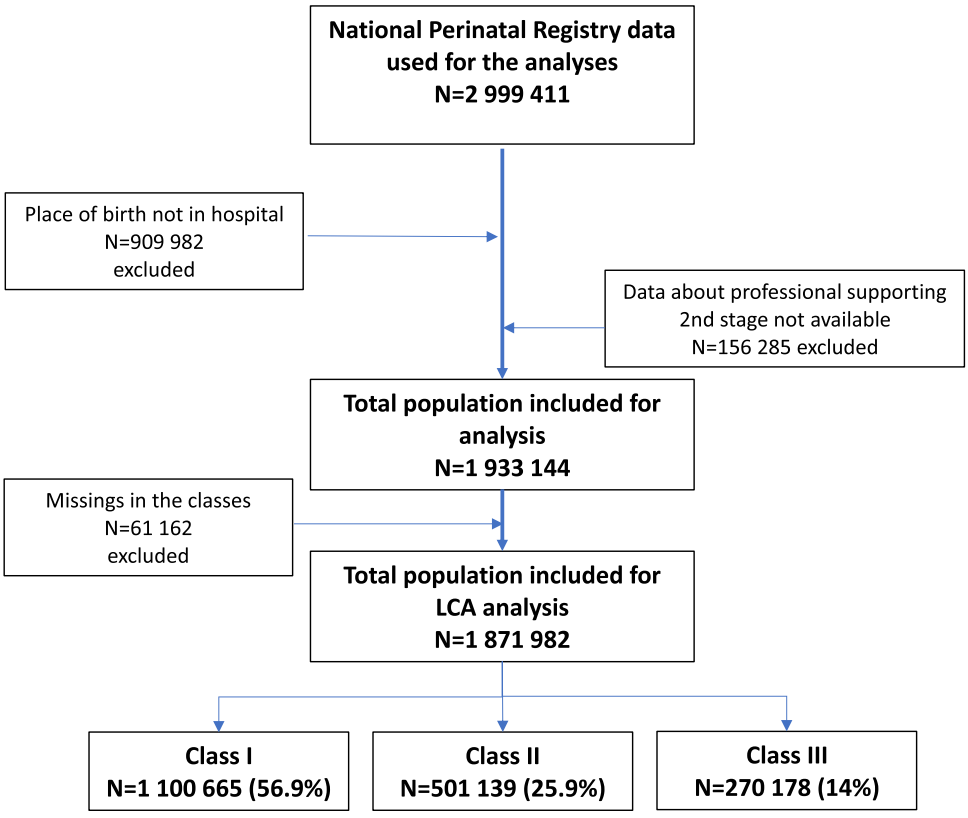

Fig. 1. Flowchart of the population for analysis.

term birth and women who receive pain relief are more often supported by a clinical midwife during the second stage of labour. It is remarkable that in tertiary hospitals, where less, and more complicated, deliveries take place, more deliveries are supported by clinical midwives than in secondary non-teaching hospitals. Although the frequency of clinical midwives being involved in the second stage of labour increased over time, we did not find noticeable changes in the associations over time.

Comparison with literature

The midwifery care system in the Netherlands, is different from systems in other countries. It is normal for women to deliver at home, community midwives work autonomously, and clinical midwives formally work under supervision of an obstetrician. In most other countries, homebirth is very scarce and the profession of clinical midwife is more commonplace. For example, in the UK, midwives work in hospitals as well as in communities, but most births occur in hospital. The majority of care before and after birth is in the community. Midwives are autonomous practitioners who provide care before, during, and after birth. Only in high-risk cases, doctors are present. Midwives work closely with a multidisciplinary team, including obstetricians. They most often have a specific role within a ward, clinical unit, or community care centre, where they can also specialize in areas such as neonatal care, fertility care, breast feeding consultancy and infant screening (NHS Professionals, 2023).

Another example is from Norway. Also here, most births occur in hospital and most routine antenatal care is provided in the community. Midwives work in both settings and in close collaboration with obstetricians and general practitioners. Unfortunately, home birth is not a mandatory part of the midwifery training. (Lukasse and Henriksen, 2019) In all hospitals, a midwife is present every delivery and he/she is the main care provider during normal birth, while an obstetrician is almost never involved. In high-risk women or when complications occur, the obstetrician is responsible (Blix et al., 2012).

It is therefore difficult to compare the Dutch system, and responsibilities of Dutch clinical midwives, to that of other midwifery care systems and midwives in other countries. Also, only few studies have tried to identify types of deliveries that are typically supported by clinical midwives. Thornton (2017) performed a study to assess the risk status and birth outcomes of women who were cared for by midwives in hospitals in the USA in 2014. Physicians supported much more deliveries than midwives, but, similar to our study results, clinical midwives also attended preterm births and were involved in labour induction (although less often than physicians). They were more likely than physicians to attend post term births. Thornton (2017) found that there was little difference in women's demographic profiles between deliveries attended by midwives and physicians. Moreover, midwives in hospitals cared safely for women with many high-risk conditions delivering spontaneously. This is comparable to our study, in which clinical midwives support women with various and sometimes severe pathology. Although the number of clinical midwives increased almost sixfold (NIVEL, 2006, 2020), noticeable changes in the associations between characteristics of women and the support of a clinical midwife during the second stage of labour over time were not found in our study. This suggests that the need for labour support by clinical midwives in hospitals increased.

It is interesting to study what this need for labour support can encompass. For example, pain relief is the most prevalent reason for referral during birth (19.8%) (Perined, 2016) and is also associated with a clinical midwife supporting the second stage of labour

Table 3
Associations between individual characteristics and second stage of labour supported by a clinical midwife, stratified for referral during birth.

		Model 2a (*not referred during birth)*		Model 2b (*referred during birth; excl ethnicity)*	
		OR	95% CI	OR	95% CI
Age (years)					
	≤ 19 [REF]				
	20–35	0.77	0.75 – 0.80	0.83	0.800 – 0.867
	≥ 36	1.15	1.13 – 1.16	1.14	1.118 – 1.159
Gestational age (weeks)					
	24–27+6 [REF]				
	28–31+6	3.48	3.16 – 3.84	2.87	2.04 – 4.04
	32–36+6	4.58	4.24 – 4.94	3.00	2.48 – 3.61
	37–41+6	1.31	1.29 – 1.34	0.84	0.82 – 0.86
	≥ 42	1.82	1.79 – 1.85	1.76	1.67 – 1.85
Parity					
	Nulliparous [REF]				
	Primiparous and multiparous	0.65	0.65 – 0.66	0.45	0.45 – 0.46
Singleton/multiple pregnancy					
	Singleton [REF]				
	Multiple	3.04	2.93 – 3.16	2.39	1.55 – 3.67
Perinatal mortality					
	No [REF]				
	Antepartum	0.84	0.79 – 0.89	1.20	1.02 – 1.42
	Other	1.92	1.75 – 2.11	1.96	1.67 – 2.32
Pain relief					
	No [REF]				
	Sedatives/analgesics	1.10	1.09 – 1.11	0.74	0.73 – 0.75
	Epidural	1.9	1.90 – 1.95	1.08	1.07 – 1.10
	General anaesthesia and other pain relief	104.45	81.21 – 134.35	69.66	48.03 – 101.03
Oxytocin administration					
	No [REF]				
	Yes	0.86	0.85 – 0.86	0.95	0.94 – 0.96
Ethnicity					
	Western [REF]				
	Non-Western	1.06	1.05 – 1.07		
Congenital anomalies					
	No [REF]				
	yes	0.87	0.85 – 0.89	0.88	0.85 – 0.92
foetal position					
	Cephalic [REF]				
	Breech	6.15	5.90 – 6.40	10.87	9.87 – 11.97
	Other or unknown	2.08	1.73 – 2.49	2.80	1.90 – 4.15
Induction of labour					
	No [REF]				
	Yes	0.79	0.78 – 0.79		

Model 2a: OR adjusted for not referred during birth; Model 2b: OR adjusted for referred during birth where ethnicity was removed from the final model as this showed no statistically significant association.

in our study. Dutch clinical midwives play an important role in referral during birth. Possibly, they have an important role in continuity in the delivery of midwifery care across tiers.

Strengths and limitations of the study

Our study has a few strengths and limitations that merit discussion. One of the strengths is that our analysis used data from the Netherlands Perinatal Registry which covers over 97% of all deliveries in the Netherlands. A large number of participants was included and a longer period of time (2000 – 2016) was investigated, in which we conducted analyses in three different time periods to see any changes over time. Also, a distinction between types of hospitals was made. This is relevant because the type of hospital influences the type of deliveries presented to clinical midwives.

We were unable to distinguish types of deliveries that were typically supported by clinical midwives during the second stage of labour. Apparently, clinical midwives support almost all types of vaginal deliveries. Multivariable logistic regression analyses showed differences between women's individual characteristics and clinical midwives supporting labour, but it cannot be distinguished whether this was planned or a coincidence. For example, clinical midwives' role in supporting induction of labour can also be explained by the higher association between women giving birth at term and clinical midwives supporting the second stage of labour in the non-referred group. A large part of this non-referred group concerns induction of labour.

It is probably not always certain whether a woman was rightly classified into the correct group. Because our data concern registration data, there is a chance that one care professional labels a delivery as referral during birth, while another would classify it as a referral antepartum, and vice versa.

Implications of findings

The results of our study show that clinical midwives support a broad range of deliveries that vary from low to highly complex. Additional training, in line with this variety in complexity in

Table 4
Associations between individual characteristics and second stage of labour supported by a clinical midwife, stratified for referral during birth, including the effect of the type of hospital.

		Model 3a *(not referred during birth)*		Model 3b *(referred during birth)*	
		OR	95% CI	OR	95% CI
Type of hospital					
	Tertiary hospital [REF]				
	Secondary teaching hospital	1.62	1.60 – 1.64	1.60	1.56 – 1.63
	Secondary non-teaching hospital	0.68	0.67 – 0.69	0.76	0.74 – 0.78
Age (years)					
	≤ 19 [REF]				
	20–35	0.77	0.74 – 0.79	0.82	0.79 – 0.86
	≥ 36	1.12	1.10 – 1.13	1.12	1.10 – 1.14
Gestational age (weeks)					
	24–27+6 [REF]				
	28–31+6	3.56	3.23 – 3.93	2.94	2.08 – 4.15
	32–36+6	4.62	4.28 – 4.98	3.11	2.57 – 3.76
	37–41+6	1.34	1.32 – 1.36	0.85	0.82 – 0.87
	≥ 42	1.84	1.81 – 1.88	1.79	1.70 – 1.88
Parity					
	Nulliparous [REF]				
	Primiparous and multiparous	0.66	0.65 – 0.66	0.44	0.44 – 0.45
Singleton/multiple pregnancy					
	Singleton [REF]				
	Multiple	3.14	3.02 – 3.26	2.73	1.76 – 4.26
Perinatal mortality					
	No [REF]				
	Antepartum	0.84	0.79 – 0.89	1.26	1.06 – 1.50
	Other	1.98	1.80 – 2.18	2.06	1.74 – 2.43
Pain relief					
	No [REF]				
	Sedatives/analgesics	1.14	1.13 – 1.16	0.76	0.75 – 0.77
	Epidural	1.91	1.89 – 1.93	1.03	1.02 – 1.05
	General anaesthesia and other pain relief	110.37	85.80 – 141.98	74.68	51.13 – 109.06
Oxytocin administration					
	No [REF]				
	Yes	0.83	0.82 - 0.84	0.94	0.93 – 0.95
Ethnicity					
	Western [REF]				
	Non-Western	0.96	0.95 – 0.97	0.93	0.91 – 0.94
Congenital anomalies					
	No [REF]				
	yes	0.88	0.86 – 0.90	0.89	0.86 – 0.93
foetal position					
	Cephalic [REF]				
	Breech	6.66	6.39 – 6.93	11.99	10.88 – 13.22
	Other or unknown	2.23	1.86 – 2.68	2.98	2.10 – 4.42
Induction of labour					
	No [REF]				
	Yes	0.81	0.80 – 0.82		

Model 3a: OR adjusted for not referred during birth and type of hospital; Model 3b: OR adjusted for referred during birth and type of hospital.

clinical practice and considering previously acquired skills and competencies, is needed to make sure all clinical midwives are adequately equipped to provide this care. In the Netherlands, the position of clinical midwives is not formally recognised. Besides necessary skills and competencies, a formal position is required to assure the quality of care that clinical midwives provide.

Conclusion

During the last twenty years, the number of deliveries supported by clinical midwives increased. Clinical midwives care for women with various types of deliveries with varying complexity during the second stage of labour. As expected, they are almost never involved in caesarean sections. In order to further reduce maternal and perinatal mortality and morbidity, the role of Dutch clinical midwives should be better defined. Our observations emphasize the importance of adequate training for clinical midwives.

Funding sources

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRediT authorship contribution statement

H.W. Harmsen van der Vliet–Torij: Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft, Project administration. **L.C.M. Bertens:** Conceptualization, Methodology, Formal analysis, Investigation, Writing – review & editing, Supervision. **L. Burgos Ochoa:** Methodology, Formal analysis, Investigation, Writing – review & editing. **M.J.B.M. Gouman:** Conceptualization, Methodology, Writing – review & editing, Supervision. **A.G. Posthumus:** Conceptualization, Methodology, Writing – review & editing, Supervision. **E.A.P. Steegers:** Conceptualization, Methodology, Writing – review & editing, Supervision.

Ethical Approval

Not applicable.

Acknowledgments

We would like to thank Perined (www.perined.nl) for their permission to use the registry data.

References

Blix, E., Schaumburg Huitfeldt, A., Øian, P., Straume, B., Kumle, M., 2012. Outcomes of planned home births and planned hospital births in low-risk women in Norway between 1990 and 2007: a retrospective cohort study. Sex. Reprod. Healthc. 3 (4), 147–153. doi:10.1016/j.srhc.2012.10.001.

Bray, B.C., Lanza, S.T., Tan, X., 2015. Eliminating bias in classify-analyze approaches for latent class analysis. Struct. Eq. Model. Multidiscip. J. 22 (1), 1–11.

Collins, L.M., Lanza, S.T., 2009. Latent Class and Latent Transition Analysis: With Applications in the Social, Behavioral, and Health Sciences. John Wiley & Sons.

Cronie, D., Rijnders, M., Buitendijk, S., 2012. Diversity in the scope and practice of hospital-based midwives in the Netherlands. J. Midwifery Womens Health 57 (5), 469–475 Volpp.

KNOV, 2014. Verloskundige indicatielijst. Geraadpleegd op. 28 december 2016 http://www.knov.nl/fms/file/knov.nl/knov_downloads/769/file/Verloskundig%20Vademecum%202003.pdf?download_category=richtlijnenpraktijkkaarten .

Linzer, D.A., Lewis, J.B., 2011. poLCA: an R package for polytomous variable latent class analysis. J. Stat. Softw. 42 (10), 1–29.

Lukasse, M., Hendriksen, L., 2019. Norwegian midwives' perceptions of their practice environment: a mixed methods study. Nurs. Open 6 (4), 1559–1570. doi:10.1002/nop2.358, Vol.

NHS Professionals (2023). *Working as a* midwife. NHS professionals. Retrieved March 19th, 2023, from https://www.nhsprofessionals.nhs.uk/en/nhsp-international/midwifery

NIVEL, 2006. Cijfers Uit De Registratie Van Verloskundigen. Peiling 2006. NIVEL, Utrecht.

NIVEL, 2020. Cijfers Uit De Registratie Van Verloskundigen. Peiling 2018. NIVEL, Utrecht.

Page, L., 2001. Human resources for maternity care: the present system in Brazil, Japan, North America, Western Europe and New Zealand. Int. J. Gyneco. Obstetr. 75 (S1), S81–S88 Vol.

Perined, 2016. Perinatale Zorg in Nederland, 2015. Perined, Utrecht.

Perined, 2021. Perinatale Zorg in Nederland Anno 2020: Duiding Door Landelijke Perinatale Audit En Registratie. Perined, Utrecht.

Posthumus, A.G., Birnie, E., van Veen, M.J., Poeran, J., Steegers, E.A.P., Bonsel, G.J., 2016. An antenatal prediction model for adverse birth outcomes in an urban population: the contribution of medical and non-medical risks. Midwifery 38, 78–86 Vol.

Thornton, P., 2017. Characteristics of spontaneous births attended by midwives and physicians in US Hospitals in 2014. J. Midwifery Women's Health 62, 531–537 Vol.

Vermunt, J.K., 2010. Latent class modeling with covariates: two improved three-step approaches. Political Anal. 18 (4), 450–469.

Wiegers, T.A., Hukkelhoven, C.W.P.M., 2010. The role of hospital midwives in the Netherlands. BMC Pregnancy Childbirth 10, 80.