The midwife as influencing factor in clinical decision-making

Exploration of the relationship between personal and professional factors and midwives' clinical decisions about childbirth interventions

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Contents

1

General introduction

Madeline* – a case study

Madeline is a client in our practice. A few weeks ago, she phoned to tell that she hadn't been able to sleep that night, because of irregular contractions. Madeline was 40 weeks pregnant with her third child and had given birth twice at home in a birthing pool. She asked if it was possible to get a check-up because she would like to know if she already had some cervical dilatation or not. If possible, she would like to have her membranes swept in the hope that labour would start.

On checking, she was two centimetres dilated, the baby was in good condition, and her membranes were swept as she had requested. An hour or three later, Madeline called that her contractions came every 5 minutes. I visited Madeline at home and she was six centimetres dilatated. However, I was not really impressed with the contractions. They were irregular, and above all, they appeared not very strong. Madeline was very relaxed and chatted with everyone in the room. Of one thing she was determined, she wanted to give birth tonight and she was ready to jump into the birthing pool.

But what was I going to do? Was I facing ineffective uterine contractions? Should I rupture the membranes or go to the hospital? Should I prepare for an increased risk of severe blood loss? What do our regional protocols say about this situation, and who is the obstetrician on call tonight? Or was this situation still physiological and should I just be present and wait for stronger contractions?

**Madeline is a fictitious name and this case study has been edited to hide her identity.*

Practice variation in maternity care

Clinical variation in interventions, such as diagnoses, treatments, and drug prescriptions, appears in a wide range of acute and chronic care specialities, both in primary care and in hospital settings. A systematic review of variation in medical practice variation in OECD countries, including 836 published studies, described variation between regions and hospitals, with differences in physician practices for same conditions (1). Practice variation in maternity care has also been described, with variation in rates of caesarean section and induction of labour as being the most commonly reported (2). Remarkably is the variation of the same interventions between different countries. In 2017, for example, 21.4% of all births in the Netherlands were induced, while America had a rate of induction of labour of 25.7% and Australia 33.0% (3–5).

With the aim of gaining an understanding of variation in childbirth interventions, research has focused on increasing rates of interventions and variation between countries (1–5). Beside variation between countries, there also appears to be variation in childbirth interventions within countries. Practice variation in Dutch maternity care was described in 2014 based on data from the national perinatal register (6). Analysis of these data showed that the rates of interventions, such as caesarean section, instrumental birth, and induction of labour varied widely between different hospitals. For example, there was little variation between hospitals in the rates of planned caesarean sections, but there was much variation in the rates of unplanned caesarean sections. Hospitals with a low rate of unplanned caesarean sections had a rate of around 4.8%, while the highest rates were around 21%. A similar variation was found between hospitals for induction of labour. Practice variation has also been described in primary midwifery practices, with variations in intrapartum referral rates from 9.7% to 63.7% (7).

Warranted versus unwarranted variation

Interventions in childbirth are in certain circumstances useful to prevent perinatal morbidity and mortality (1). Some practice variation in childbirth interventions is to be expected as care is adapted to medical conditions or the woman's preferences. However, large variations in care of fairly homogenous populations may indicate insufficient quality of care. Underuse of interventions can lead to preventable morbidity and mortality, while overuse of interventions during maternity care can result in medicalisation of physiological pregnancy and childbirth (1,2). The use of unnecessary interventions can harm women - physically and psychologically - and their newborns, and increase health care costs (3). Variations that reflect under- or overuse of interventions may be unwarranted.

Several researchers have tried to define warranted and unwarranted variation (8–10). Sutherland and Levesque have designed an analytical framework that identifies elements associated with warranted and unwarranted variation (8). These elements can be used to assess whether the variation is warranted or unwarranted and include the categories: evidence, capacity, and agency. These elements are interrelated and highly sensitive to context, such as patients living in lower socio-economic status areas are often reported to have worse outcomes than patients living in higher socio-economic status areas. This makes assessment difficult and requires nuance and reflexivity. Because the elements cannot be separated from the context, warranted and unwarranted variation cannot be explained by only using quantitative data sets (8).

Causes of unwarranted variation are 1) lack of evidence-based care (evidence); 2) differences in the availability of healthcare resources (capacity); and/or 3) care providers offering care based on the beliefs and personal interests (agency) (8). In other words, when variation cannot be explained by medical

conditions, population characteristics or patient preferences and occurs despite strong evidence-based recommendations, it is defined as unwarranted (9,11). Unwarranted variation is a problem because it contributes to inequalities in the availability and use of health services. As a result, interventions in childbirth may be used inappropriately, with interventions used too little and too late on the one hand, and interventions used too much and too soon on the other hand (1).

Explaining practice variation

Practice variation can be explained by a sociological model that describes factors that interact with practice variation at macro-, meso-, and micro-level (12) (Figure 1).

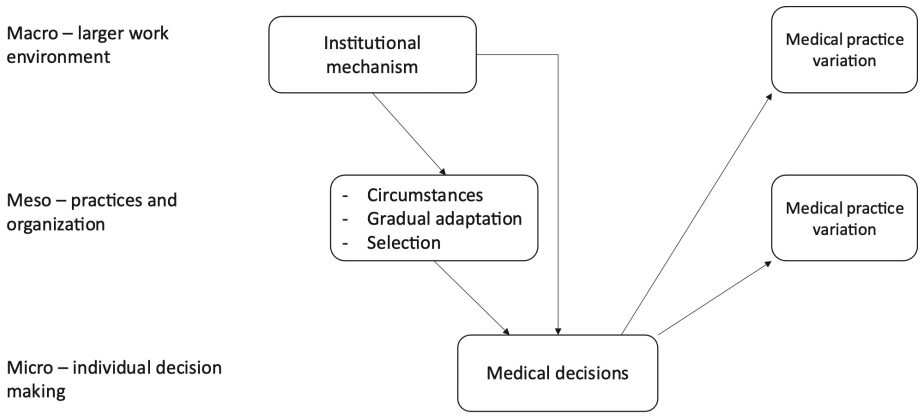

Figure 1. Theoretical model for the explanation of medical practice variation (de Jong et al, 2015)

Although the model describes mechanisms on different levels, these levels are not isolated but are interrelated with each other. Organisational arrangements at meso-level can, for example, influence individual choices made at micro-level. We will provide further insight into practice variation in maternity care by describing the factors at the different levels of the sociological framework. Within this description we will also link elements of Sutherland's analytical framework about warranted and unwarranted practice variation (8).

Practice variation in maternity care: macro-level

The organisation of maternity care in the Netherlands is based on the principle that pregnancy, childbirth, and postpartum care are physiological processes. If risk factors are present, they are identified in time to be monitored and to prevent or treat the pathology they may cause (13). Emphasis is placed on early prevention. Uncomplicated pregnancies of healthy women are cared for by community midwives. Community midwives are autonomous

health professionals, usually working in independent practices. They attend home births, uncomplicated hospital births and births in birth centres, and are capable to make autonomous decisions together with the woman about childbirth interventions or the intervention of referral to obstetrician-led care (14). Indications for referral from midwife-led to obstetrician-led care are described in the obstetric indication list of 2003 and multidisciplinary guidelines (15). Midwives are allowed to perform certain interventions, such as artificial rupture of membranes or episiotomies, while other interventions are restricted to obstetrician-led care. There hospital-based midwives and obstetricians provide care for women with specific risk factors or complications and more childbirth interventions are available, such as augmentation of labour, analgesia, and instrumental birth (14).

The organisational context can be the basis of practice variation through organisational structures, regulations, population characteristics or resource constraints that influence clinical decision-making (8). The organisation of maternity care in the Netherlands differs from other high-income countries because of the division between midwife-led and obstetrician-led care. This may contribute to practice variation at the macro level: the high rate of home births in the Netherlands compared to rates in other countries (16).

In this thesis, we focus on mechanisms that can help explain practice variation at the meso and micro level. We will therefore explain the mechanisms at these levels in more detail.

Practice variation in maternity care: meso-level

In the Netherlands, community midwives, hospital-based midwives, obstetricians, and other disciplines such as paediatricians and maternity care assistants collaborate regionally in maternity care networks (MCNs) (17,18). An MCN is usually situated around one hospital and the midwifery practices in the same region. The number of professionals involved varies from about 30 to 120, depending on the number of births and the level of urbanisation in the region. Professionals in an MCN are collectively responsible for the quality of maternity care in that region and are expected to continually evaluate perinatal outcomes and women's experiences in order to improve the quality and efficiency of their care (18). Collaboration in MCNs has intensified over time and has stimulated the development of regional protocols within the networks (18). In general, protocols are more context-specific and describe the 'who', and 'how' of medical practice provided in a given region, while national guidelines describe the 'what' and 'when' based on available evidence.

The quality of collaboration between the different disciplines in an MCN is an important issue in relation to practice variation at the meso-level. Good collaboration encourages to make joint agreements and to reflect on care between healthcare professionals in the same midwifery practice or MCN (8,19). However, multidisciplinary collaboration also comes with challenges.

Regional care should be designed as integrated care for pregnant women, respecting patient preferences and the specific expertise and autonomy of different healthcare professionals (13). Collaboration in MCNs can be challenging because professionals with different expertise and paradigms need to align (20). Particularly between the disciplines of community midwives and obstetricians, there are examples of each discipline having concerns about the other's professional perspective on birth and its impact on birth outcomes. Midwives have concerns about the medicalisation of childbirth, while obstetricians have expressed concerns that an overemphasis on physiological childbirth might overlook risks to mothers and their newborns (21).

Another challenge is to ensure equality between the different disciplines. Relationships between midwives and obstetricians seem to be influenced by the history of maternity care. Historically, the midwifery profession has been predominantly female and has fewer years of training than obstetricians (22). This hierarchy is also reflected in the experienced collaboration between midwives and obstetricians in MCNs. Midwives perceive an imbalance of power in their professional relationship with obstetricians and are cautious about collaborating with obstetricians (23–25).

International research has shown that the culture of maternity units has an influence on the intervention rates (26–28). Individual professionals working in the same maternity unit have comparable intervention rates, but the intervention rates between maternity units differ. Evidence suggests that intervention rates in Dutch maternity care are influenced by the culture of a midwifery practice or an MCN (7). Healthcare professionals' birth beliefs are a factor that contributes to attitudes and clinical decisions about interventions, and are therefore part of the culture (29). However, it is unclear how these beliefs influence clinical decision making on interventions. Hospital protocols in other disciplines have shown that hospital culture is reflected in recommendations for treatment or interventions (19,30). It is possible that a similar mechanism applies to maternity care, with regional culture reflected in regional protocols formulated by MCNs.

Practice variation in maternity care: micro-level

The third level of the sociological model on practice variation - the micro level - describes the interaction between the woman and the maternity care professional to achieve individual decision-making (12). At this level, the professional applies their theoretical knowledge and professional experience to individual situations. Preferably, the values and preferences of the individual woman are explored through shared decision-making, creating a conversation about clinical characteristics and woman's preferences. Decision-making at the micro-level appears to be influenced by the attitude of the healthcare professional (29). To study attitudes, intentions, and other factors that influence behaviour theories on human behaviour are used. Underlying reasons why

healthcare professionals show certain behaviour can be explored with the Attitude, Social Norms, Self-efficacy (ASE) model (31–34).

According to the ASE-model, individual experiences, beliefs, and values influence a person's attitude, which subsequently, together with social norms and self-efficacy, shapes the intention to perform a specific behaviour (Figure 2). Factors described as 'knowledge and skills' and 'barriers and facilitators' interact with a person's intentions until they translate in actual behaviour, such as the use of an intervention. For example, organisational factors in the professional environment, such as workload and volume targets, influence individual decision-making (behaviour) (19). In this example, we see that factors at the meso-level (professional environment) influence the micro-level (individual healthcare professional).

A closer look at the midwife's role as a healthcare professional in decision-making shows the influence of factors such as workload, setting (home or hospital), and regional protocols (35–37). In addition, more individual factors based on experience, beliefs, and values influence a midwife's decision-making. Their attitudes to physiology, woman-centredness, and shared decision-making, as well as individual risk perception, have an influence (35,36). A midwife's risk perception appears to be influenced by the social or medical model (38,39). Midwives who believe that pregnancy and birth are largely normal and healthy processes, think according to the social model. This model is characterised by the involvement of the pregnant woman, a holistic approach, and the social context. In contrast, the medical model is characterised by more monitoring, risk-thinking, and higher rates of interventions.

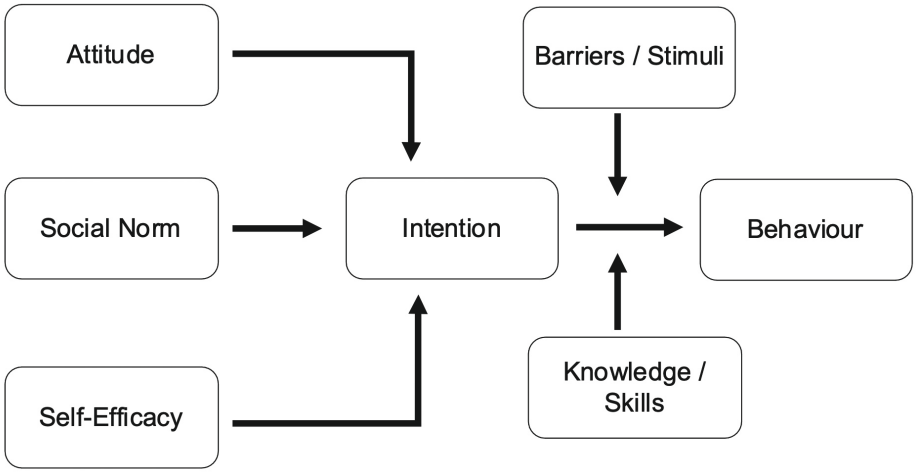

Figure 2. The ASE-model (33)

As individual decision-making in maternity care is achieved through interaction between the woman and the midwife, the woman is also a factor influencing practice variation (36,40). Woman's values and preferences influence the decision to perform interventions, and therefore influence with the clinical decisions of a midwife. Research on shared decision-making found that the introduction of shared decision-making increases the amount of different treatments. In other words, through the interaction with the woman variation within hospitals increased (41).

In the Netherlands, community midwives are professionals who make autonomous decisions about childbirth interventions or referrals to obstetrician-led care (13). Although Dutch midwifery educational programmes are similar and based on physiology, there is a wide variation in intrapartum referral rates between midwives and midwifery practices (7). Similar to previous research among physicians, it is likely that midwives' beliefs about treatment and clinical decisions also vary widely (42). However, it is not known how midwives' beliefs and other personal and professional factors influence clinical decision-making when deciding on the use of interventions or referrals.

Problem statement and knowledge gaps

Internationally, the interventions used in childbirth vary widely, and there is evidence to suggest that this applies to the Netherlands. Practice variation can be an indicator of unwarranted variation, which can lead to avoidable harm, inequalities in quality of care, and high costs. Regional variation in the Netherlands has not been studied extensively. Possible patterns in intervention rates can provide useful insights, for example whether all intervention rates are higher in certain regions or whether it is a selection of intervention rates that are higher or lower. Therefore, correlations between intervention rates in different regions, adjusted for population characteristics, should be investigated to better understand practice variation in the Netherlands.

Different mechanisms that influence practice variation can be understood by the sociological model of de Jong et al (12). To our knowledge, this model has not been used in maternity care. By using this model, we expect to gain knowledge about practice variation in maternity care at meso- and micro-level. As practice variation is a large topic, not all factors can be studied. For this thesis, we focused on the role of midwives and their clinical decisions about the use of interventions. There are indications that the use of interventions varies between midwives and we want to explore what causes this variation. Therefore, we explored how midwives' personal and professional factors influence their clinical decisions about interventions in childbirth and consequently influence practice variation in maternity care.

General aim and research questions

The general aim of this thesis is to generate more knowledge about how midwives' personal and professional factors are related to their clinical decisions about childbirth interventions. This can contribute to reducing unwarranted practice variation in maternity care.

The first research question aims to provide more background knowledge about the current regional variation within the Netherlands, after which the other research questions focus on the general aim. The findings of this thesis focus on two different levels for practising midwives: 1) the individual midwife (micro-level) 2) the midwife as part of the collaboration within midwifery practices or maternity care networks (meso-level). On the level of the micro-level, we want to explore how midwives' attitude, knowledge, and skills influence clinical decisions on the use of interventions. On the meso-level, we want to explore if differences in birth beliefs of maternity care professionals and regional protocols are a factor contributing to practice variation.

The following research questions are addressed in this thesis:

1. Which regional variations in childbirth intervention rates exist in the Netherlands, and how are these variations associated to maternal and perinatal outcomes? (meso-level)
2. What experiences, beliefs, and values influences midwives' attitudes toward childbirth interventions? (micro-level)
3. How do knowledge and skills influence clinical decision-making of midwives on the appropriate use of childbirth interventions? (micro-level)
4. Can the Birth Beliefs Scale be used to measure beliefs towards the nature of birth (medical or natural) among maternity care professionals? (micro and meso-level)
5. What is the variation in regional protocols with regard to recommendations on induction of labour, and do regional protocols contribute to practice variation? (meso-level)

Outline of this thesis

Following the general introduction to the thesis, chapter 2 describes the regional variation of commonly used childbirth interventions in obstetrician-led care in the Netherlands, and how these variations were correlated both to each other and to maternal and perinatal outcomes, adjusted for population characteristics. (Q1)

In chapter 3, regional variations and correlations in the Netherlands were also described, but in this chapter for childbirth interventions that are used in both midwife-led and obstetrician-led care. (Q1)

Chapter 4 presents the findings of individual interviews with community midwives working in the Netherlands in order to explore different attitudes toward childbirth interventions. (Q2)

Chapter 5 reports the outcomes of our follow-up study in which we explored how knowledge and skills influence midwives' clinical decision-making on the appropriate use of childbirth interventions. (Q3)

Chapter 6 describes the validation of the Birth Beliefs Scale for maternity care professionals. In addition, we have compared the birth beliefs of maternity care professionals working in different maternity care networks. (Q4)

Chapter 7 provides the results of a document analysis on variation in regional protocols as one of the factors contributing to practice variations. (Q5)

In chapter 8, we discuss the main findings of the studies contained within this thesis and we reflect on the methodological strengths and limitations of those studies. We interpret the findings in a broader perspective and discuss the implications for practice and future research.

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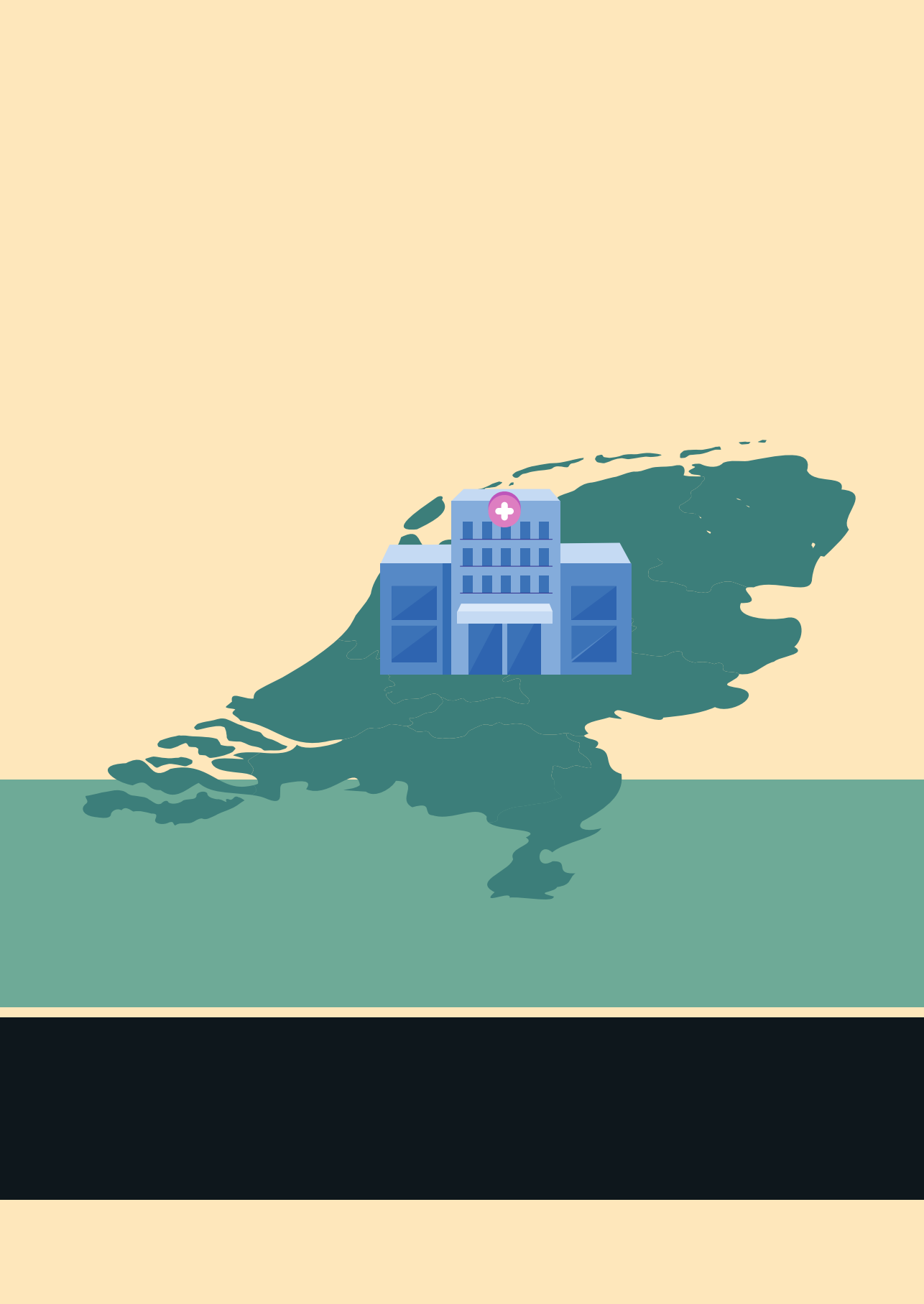

2

Regional variations in childbirth interventions in the Netherlands: a nationwide explorative study

Anna Seijmonsbergen-Schermers, Lianne Zondag, Marianne Nieuwenhuijze, Thomas van den Akker, Corine Verhoeven, Caroline Geerts, François Schellevis, Ank de Jonge

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Abstract

Background
Although interventions in childbirth are important in order to prevent neonatal and maternal morbidity and mortality, non-indicated use may cause avoidable harm. Regional variations in intervention rates, which cannot be explained by maternal characteristics, may indicate over- and underuse. The aim of this study is to explore regional variations in childbirth interventions in the Netherlands and their associations with interventions and adverse outcomes, controlled for maternal characteristics.

Methods
Childbirth intervention rates were compared between twelve Dutch regions, using data from the national perinatal birth register for 2010-2013. All single childbirths from 37 weeks' gestation onwards were included. Primary outcomes were induction and augmentation of labour, pain medication, instrumental birth, caesarean section (prelabour, intrapartum) and paediatric involvement. Secondary outcomes were adverse neonatal and maternal outcomes. Multivariable logistic regression analyses were used to adjust for maternal characteristics. Associations were expressed in Spearman's rank correlation coefficients.

Results
Most variation was found for type of pain medication and paediatric involvement. Epidural analgesia rates varied from between 12-38% (nulliparous) and from between 5-14% (multiparous women). These rates were negatively correlated with rates of other pharmacological pain relief, which varied from between 15-43% (nulliparous) and from between 10-27% (multiparous). Rates of paediatric involvement varied from between 37-60% (nulliparous) and from between 26-43% (multiparous). For instrumental vaginal births, rates varied from between 16-19% (nulliparous) and from between 3-4% (multiparous). For intrapartum caesarean section, the variation was 13-15% and 5-6%, respectively. A positive correlation was found between intervention rates in midwife-led and obstetrician-led care at the onset of labour within the same region. Adverse neonatal and maternal outcomes were not lower in regions with higher intervention rates. Higher augmentation of labour rates correlated with higher rates of severe postpartum haemorrhage.

Conclusions
Most variation was found for type of pain medication and paediatric involvement, and least for instrumental vaginal births and intrapartum caesarean sections. Care providers and policy makers should critically audit remarkable variations, since these may be unwarranted. Limited variation for some interventions may indicate consensus for their use. Further research should focus on variations in evidence-based interventions and indications for the use of interventions in childbirth.

Introduction

The rates of interventions in childbirth vary worldwide (1-4) and have fluctuated over the years (1, 4-7). Induction of labour and caesarean section (CS) rates have shown a steady increase since the 1970s (1, 4, 6, 8, 9), which raised concerns (10). Interventions in childbirth are important in order to prevent neonatal and maternal morbidity and mortality. However, use without a medical indication may cause avoidable harm (2, 11-14). The World Health Organization (WHO) recommends limited use of interventions during childbirth (15). Induction and augmentation of labour should only be performed on medical indication (16, 17). However, there are concerns about poor adherence to this recommendation in a significant number of women with uncomplicated pregnancies (16-19). Epidural analgesia is the most effective method for pain medication during labour (20), but is associated with a higher risk of instrumental birth, oxytocin use, maternal fever, urinary retention and complications, such as post-dural puncture headache (20, 21). The decision for pain medication is ultimately based on women's choice. There is some evidence that continuous support of labour might reduce the need for pain medication (22). Furthermore, the WHO states that CS rates higher than ten percent at population level are not associated with reductions in maternal, neonatal and infant mortality rates (23).

Variations in intervention rates between high-income countries may be explained by culture and history, differences in population characteristics, maternity care systems, and national guidelines (12, 15, 24-26). Clinical guidelines have been used for a long time to harmonise and rationalise the use of interventions within countries, and to improve outcomes (27, 28). Nevertheless, studies comparing regions within countries like England, Ireland, Canada and Germany, have found substantial variations in rates of induction of labour, epidural analgesia, continuous fetal electronic monitoring, episiotomy, instrumental birth, and CS (29-33). Additionally, Dutch studies have reported variations in rates between hospitals, of induction and augmentation of labour, administration of sedation and analgesics, episiotomy, instrumental birth, and CS (34, 35). Regional variations in intervention rates, which cannot be explained by maternal characteristics, may indicate over- and underuse (36). This is especially true in a relatively small country without regional differences in the maternity healthcare system.

The aim of this study was therefore to explore which regional variations in intervention rates in childbirth exist, and how these variations are associated both to each other, and to adverse neonatal and maternal outcomes. These are explored for single childbirths from 37 weeks of gestation onwards in midwife- or obstetrician-led care in the Netherlands, and controlled for maternal characteristics.

Methods

Data collection

For this nationwide study, we used consolidated data of the years 2010 to 2013 from Perined, the national perinatal register that includes data from almost all births in the Netherlands. Perined aims to improve the quality of perinatal care through providing data for research and audits on adverse outcomes. The Perined register includes data from: primary midwife-led care (the national perinatal database 1); secondary obstetrician-led care (the national perinatal database 2); paediatric care (the national neonatal register); and primary midwifery care by general practitioners (the national perinatal database h). The data are routinely recorded by the care providers and combined into the Perined register via a validated linkage method (37, 38). More than 98% of all midwifery practices and obstetric hospital units record their births in this combined database (39). All single childbirths from 37 weeks' gestation onwards were included. Exclusion criteria were missing data on: postal code; parity; or from the national perinatal database 1, covering midwife-led care, but where the woman was referred to obstetrician-led care, covered by the national database 2.

In the Netherlands, low-risk women in primary midwife-led care are cared for by independent midwives who attend home births, low-risk hospital births, and births in alongside and free-standing birth centres. The Dutch Birth Centre Study showed that health outcomes, experiences, and costs for low-risk women are similar for planned birth in a birth centre and planned birth in a hospital, both supervised by a primary care midwife (40, 41). When risks for adverse outcomes increase or complications arise, women are referred to obstetrician-led care. Interventions in childbirth such as induction and augmentation of labour, pain medication, instrumental birth, and CS, are only available in an obstetrician-led care setting (42, 43). Intrapartum interventions may be used for women in midwife-led care at the onset of labour after referral to obstetrician-led care. Therefore, intervention rates are not comparable for women who are in midwife-led care and women who are in obstetrician-led care at the onset of labour.

The VU University Medical Center confirmed that ethical approval was not required for this study according to the Dutch legislation (reference WC2016-055; http://www.ccmo.nl/en/your-research-does-it-fall-under-the-wmo).

Interventions

Births were attributed to one of the twelve Dutch administrative provinces (further referred to as 'regions') according to the residential postal code of the mother. All low-risk women have access to all types of birth settings, but not all types are present in all regions (44). We adjusted for this by using the residential postal code of the mother.

The following interventions were examined as the primary outcomes: induction of labour; augmentation after a spontaneous onset of labour; intrapartum oxytocin use; epidural analgesia; other pharmacological pain relief; instrumental vaginal birth; CS (prelabour, intrapartum); and involvement of a paediatrician in the first 24 hours after birth. Births from 42 weeks onwards were not excluded, because they may explain variation in particularly induction of labour rates, and they may reflect different policies between regions. Artificial rupture of membranes before a spontaneous onset of labour was defined as induction of labour, and administration of oxytocin to stimulate uterine contractions after spontaneously ruptured membranes as augmentation. A CS after spontaneously ruptured membranes was defined as intrapartum CS. Intrapartum oxytocin includes the use of oxytocin for induction or for augmentation of labour, but not oxytocin use in the third stage of labour. Women with a prelabour CS were excluded from the analyses on pain medication. Women with an intrapartum CS and an epidural, are classified as epidural analgesia for labour pain, since epidural analgesia is generally not used for caesarean sections without prior epidural analgesia for labour pain. In Perined 'other pharmacological pain relief' is specified as: sedatives; non-opioid analgesics; and opioid analgesics without further details. The most common opioid analgesics are pethidine injections, sometimes combined with a sedative such as promethazine, and patient-controlled remifentanil (45). In some births, epidural analgesia and other pharmacological methods for pain medication were both used, and therefore, the percentages could not be added up (45).

Neonatal and maternal outcomes

The secondary neonatal and maternal outcomes were: antepartum and intrapartum stillbirth; neonatal mortality; Apgar score below 7 at 5 minutes; third or fourth degree perineal tear among vaginal births; and postpartum haemorrhage (PPH) of 1000 ml or more. Antepartum stillbirths with births beyond 37 weeks were included, since this may influence intervention rates. Neonatal mortality was defined as neonatal death up to 7 days. Antepartum and intrapartum stillbirths were excluded from the analyses on Apgar score. Women who gave birth by CS were excluded from the analyses on third or fourth degree perineal tear.

Maternal and neonatal characteristics

The following maternal and neonatal characteristics were included as independent variables or potential confounders (29, 30, 32, 46-49): parity (nulliparous, multiparous); care setting at the onset of labour (midwife-led, obstetrician-led), maternal age (<20, 20-24, 25-29, 30-34, 35-39, ≥40 years); ethnic background (Dutch, non-Dutch); degree of urbanisation (urban, intermediate, rural); socioeconomic status (high, medium, low); gestational age (37+0 - 37+6, 38+0 - 40+6, 41+0 - 41+6, ≥42 weeks); and birth weight (<2.3rd, <10th, >90th, >97.7th percentile). Ethnic background was reported by the care provider and was defined as Dutch or non-Dutch, because of

inconsistencies in recording non-Dutch subgroups. The degree of urbanisation was based on the four digits of the residential postal code of the mother. For 2,500 or more addresses/km^2, the degree of urbanisation was categorized as urban, and for less than 500 addresses/km^2 as rural. Socioeconomic status [SES] was based on a proxy measure indicated by the Netherlands Institute for Social Research (SCP), which includes education, employment, and level of income of the residential postal code area (Statistics Netherlands; https://bronnen.zorggegevens.nl/Bron?naam=Sociaal-Economische-Status-per-postcodegebied). SES was classified as high, medium and low, based on the 25 and 75 percentile cut-off points.

Data analysis

The baseline characteristics were described in percentages per region. The variation in interventions was analysed overall, and in subgroups according to the care setting. Stratification by parity was applied for the crude rates. Univariable analyses were performed to gain insight in the variations of intervention rates and childbirth outcomes in the twelve regions. All interventions and childbirth outcomes mentioned above were included in the univariable analyses. The percentages of missing data were low, namely from between 0.0 to 2.5% for baseline characteristics, from between 0.0 to 0.8% for interventions, from between 0.0 to 0.1% for neonatal outcomes, and from between 1.4 to 2.7% for maternal outcomes. Therefore, cases with missing data were excluded.

Multivariable logistic regression analyses were conducted for all births and stratified by the care setting, with adjustments for: parity; maternal age; ethnic background; socioeconomic position; and the degree of urbanisation. The results of the multivariable analyses were illustrated in figures with maps and boxplots with adjusted odds ratios (ORs) and 99% confidence intervals (CIs). The weighted overall intervention rate was taken as the reference. This weighted rate was the overall intervention rate, with the intervention rate of the region weighted for the number of women in each region. A confidence interval of 99% was chosen to limits chance findings due to multiple testing in a large dataset. Outcome variables were dichotomised and dummy variables were created to account for potential confounders in the multivariable logistic regression analyses. An important topic of this study, was to explore whether the variation of one intervention was associated with the variation of another intervention. Instead of exploring associations with eyeballing only, we quantified these associations by calculating Spearman's rank correlation coefficients. These were calculated to demonstrate the associations of regional adjusted ORs between interventions in different care settings, and between interventions and childbirth outcomes. Correlation coefficients were calculated for the adjusted ORs of the regions, but only for outcomes that varied significantly between the regions. Since the sample size for all calculated correlations was the same, namely 12 regions, all correlations with $\rho \geq 0.57$ or ≤ -0.57 corresponded with a p-value of 0.05. Although the limits

for clinically significant correlations are arbitrary, we considered a correlation of $\rho \geq 0.60$ or ≤ -0.60 as strong (50), and only these correlations were discussed in the text and indicated in bold in the tables. Statistical analyses were performed using SPSS Statistics 22 (SPSS Inc, Chicago, IL, USA). First, overall results and remarkable associations between subgroups of women or between interventions were described. Second, results for each intervention were described, starting with those that showed most variation.

Results

Baseline characteristics

Figure 1 shows the number of births eligible for inclusion in this study and table 1 describes the maternal and neonatal characteristics. Of the 276,701 births in nulliparous women, 153,091 were in midwife-led care at the onset of labour, 121,612 in obstetrician-led care, and for the remainder, the care setting was unknown. For births in multiparous women, these numbers were 174,918 and 161,286 respectively. In the regions, the proportion of mothers younger than 20 years of age ranged from between 0.8% to 2.2%, and of 40 years or older from between 2.4% to 4.5%. The lowest proportion of mothers with a non-Dutch ethnicity was 9.3% and the highest 34.6%. In three regions, there were no urban areas, whereas in all regions there were mothers living in rural areas, with a range of between 11.1% and 48.5%. Proportions of mothers with a low socioeconomic status varied from between 24.1% to 59.2%. Regions with the lowest number of births after 42 weeks (varying from between 0.8% to 2.5%), had higher numbers of births at 37-38 weeks (varying from between 5.8% to 9.2%), and vice versa. We found a similar pattern for birth weight below the 2.3rd, 10th or above the 90th or 97.7th percentile, with rates varying from between 1.4% to 2.1% for birth weight below the 2.3rd percentile, and from between 2.3% to 3.5% for birth weight above the 97.7th.

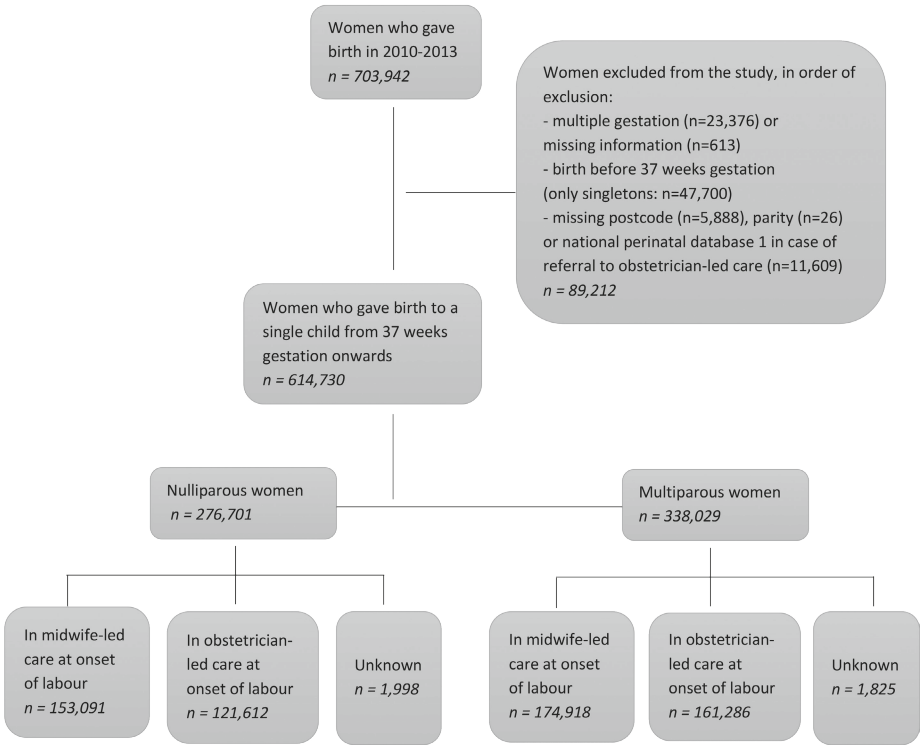

Figure 1. Study population

Results on the national level

The greatest variation was found for the type of pain medication and whether a paediatrician was involved within 24 hours after birth, followed by variation in augmentation after a spontaneous onset of labour. Less variation was found for induction of labour and prelabour CSs, and least for instrumental vaginal births and intrapartum CSs (figures 2-7). Similar variation in intervention rates was found for births in midwife-led care compared to those in obstetrician-led care at the onset of labour in the same region (table 5). The adverse neonatal and maternal outcomes were not lower in regions with higher intervention rates (table 8).

Table 1. Maternal and neonatal characteristics of women by region

	GR	FR	DR	OV	FL	GD	UT	NH	ZH	ZL	NB	LB
Total *n*	19,441	22,568	15,875	42,869	17,461	71,286	52,893	105,948	139,573	11,327	84,187	31,302
Parity, %												
Nulliparous	45.8	42.4	42.7	42.1	41.4	43.4	44.7	46.8	45.7	42.8	45.8	47.2
Multiparous	54.2	57.6	57.3	57.9	58.6	56.6	55.3	53.2	54.3	57.2	54.2	52.8
Maternal age, %												
<20 years	1.9	1.5	1.6	1.2	2.2	1.2	0.8	1.0	1.5	1.6	1.0	1.6
20-24 years	12.4	11.5	11.6	10.0	13.9	10.0	7.5	8.4	11.7	15.2	8.7	10.6
25-29 years	31.2	34.8	35.4	33.4	33.9	31.6	26.7	26.2	30.3	33.9	31.5	32.2
30-34 years	35.4	35.1	34.2	38.0	32.3	37.5	40.6	38.2	35.6	33.1	39.8	37.8
35-39 years	16.1	14.5	14.7	14.9	14.6	16.6	20.9	21.6	17.4	13.6	16.5	15.2
≥40 years	2.9	2.7	2.5	2.4	3.0	3.1	3.6	4.5	3.5	2.7	2.5	2.7
Ethnic background, %												
Dutch	85.7	90.7	89.9	86.2	65.4	85.6	77.5	67.1	65.4	87.2	80.1	82.7
Non-Dutch	14.3	9.3	10.1	13.8	34.6	14.4	22.5	32.9	34.6	12.8	19.9	17.3
Urbanisation, %												
Urban	18.0	4.6	0.0	2.9	0.0	3.8	23.0	39.8	41.7	0.0	9.0	2.5
Intermediate	49.2	47.0	53.6	71.3	72.5	71.4	59.6	49.1	45.0	53.3	70.0	69.7
Rural	32.9	48.5	46.4	25.9	27.5	24.8	17.4	11.1	13.3	46.7	21.0	27.8
Socioeconomic status, %												
High (p ≥75)	9.3	11.8	19.4	16.9	39.2	19.1	35.7	23.5	25.5	7.4	20.0	8.7
Medium (p 25-75)	31.5	34.8	40.5	51.4	36.8	56.0	38.8	39.0	39.1	60.3	55.8	58.4
Low (p ≤25)	59.2	53.4	40.0	31.7	24.1	24.9	25.4	37.5	35.4	32.2	24.1	32.9
Gestational age (weeks), %												
37+0 - 37+6	8.7	8.3	9.2	8.6	8.4	6.7	5.8	6.6	7.6	6.5	7.3	8.8
38+0 - 40+6	71.5	71.7	72.5	72.1	73.1	71.6	71.2	72.2	72.8	71.6	72.4	73.9
41+0 - 41+6	17.9	18.1	16.9	17.4	16.9	19.3	20.7	19.0	18.3	19.4	18.5	16.5
≥42	1.8	1.9	1.4	1.8	1.6	2.3	2.3	2.2	1.4	2.5	1.8	0.8
Birth weight, %												
<2,3rd percentile	1.7	1.4	1.4	1.5	1.8	1.6	1.7	1.8	1.9	2.0	2.0	2.1
<10th percentile	8.0	6.8	7.3	7.4	9.5	7.8	7.9	8.4	8.9	8.8	9.3	9.7
>90th percentile	11.3	12.9	11.9	11.0	9.8	11.2	10.6	10.3	9.7	10.0	9.0	9.0
>97,7th percentile	3.0	3.5	3.4	2.9	2.4	3.0	2.7	2.7	2.5	2.4	2.3	2.4

Percentage of missing data: 0.0% for maternal age, 0.4% for ethnic background, 1.1% for urbanisation, 2.5% for socioeconomic status, 0.2% for birth weight.

Regional variations

Table 2 describes the intervention rates by region in subgroups stratified by parity, and table 4 the crude and adjusted ORs with confidence intervals, on which figures 2-7 are based. Most variation was found for the type of pain medication during labour (figures 2a and 2b), with epidural analgesia rates varying from between 12.3% to 37.5% in nulliparous and from between 4.6% to 13.8% in multiparous women, and rates of other pharmacological pain relief varying from between 14.8% to 43.0% in nulliparous and from between 9.8% to 26.8% in multiparous women without prelabour CS (table 2). The variation of pain medication was similar for women in midwife-led compared to those in obstetrician-led care within the same region, with ρ = 0.97 (table 5), but rates were lower for women in midwife-led care. Generally, lower rates of other pharmacological pain relief were found in regions with higher rates of epidural analgesia, and vice versa. The correlation coefficient was ρ = - 0.61 for women in midwife-led care and ρ = - 0.68 in obstetrician-led care (table 6). There were no significant correlations between the use of pain medication and augmentation of labour, intrapartum oxytocin use, instrumental vaginal birth, intrapartum CS, or spontaneous vaginal birth (table 7). As can be seen from figure 3, considerable variation was found for the involvement of a paediatrician in the first 24 hours after birth, with rates varying from between 36.9% to 60.3% for nulliparous and from between 25.6% to 42.7% for multiparous women (table 2).

Figure 4 shows maps with variations of spontaneous birth rates, CS rates, and rates of intrapartum oxytocin between regions. Rates of intrapartum oxytocin, used for induction or augmentation of labour, were found of between 55.1% and 66.5% for nulliparous and of between 39.7% and 51.7% for multiparous women (table 2), and varied significantly across regions (figure 4c). Rates of augmentation after a spontaneous onset of labour varied across regions from between 33.5% to 48.4% for nulliparous and from between 12.4% to 22.6% for multiparous women (table 2). Instrumental vaginal birth rates were lower (ρ = - 0.61) and spontaneous vaginal birth rates were higher (ρ = 0.66; table 7) in regions where rates of augmentation of labour were higher. Variations in augmentation of labour are shown in figure 5.

Less variation was found for induction of labour, instrumental vaginal birth, and prelabour and intrapartum CS. Rates of prelabour CS were found of between 3.6% and 5.8% for all nulliparous and of between 5.8% and 9.8% for all multiparous women, and induction of labour rates of between 18.0% and 26.2% for all nulliparous and of between 16.6% and 25.4% for all multiparous women (table 2). Figure 6 illustrates the ORs of prelabour CS and induction of labour. Regions with higher rates of prelabour CS had higher rates of intrapartum CS as well (ρ = 0.67), and lower rates of spontaneous vaginal births (ρ = - 0.62; table 7).

Compared to the other interventions, least variation was found for intrapartum CS and instrumental vaginal birth for women without prelabour CS (figures 7a and b). Intrapartum CS rates varied from between 12.7% to 15.4% (nulliparous women) and from between 5.3% to 6.4% (multiparous women), and instrumental birth rates varied from between 16.2% to 19.4% (nulliparous women) and from between 3.1% to 4.2% (multiparous women) (table 2). For midwife-led care, regions with higher intrapartum CS rates had higher instrumental birth rates as well ($\rho = 0.60$), but this correlation was not significant in obstetrician-led care at the onset labour ($\rho = 0.45$; table 6). For all nulliparous women, a variation of spontaneous vaginal birth rates was found of between 62.4% and 67.4%, and for multiparous women, of between 81.7% and 86.1% (table 2).

Table 2. Childbirth intervention rates by region total, and in subgroups by setting, stratified by parity (percentages)

Nulliparous women, total and by care setting at the onset of labour *(abbreviated as 'midwife' or 'obstetrician')*													
	Total	**GR**	**FR**	**DR**	**OV**	**FL**	**GD**	**UT**	**NH**	**ZH**	**ZL**	**NB**	**LB**
Total *n*													
All women	**276,701**	8,901	9,564	6,785	18,051	7,233	30,961	23,662	49,582	63,785	4,853	38,544	14,780
Midwife	**153,091**	4,827	5,701	3,550	10,292	3,979	18,559	14,293	29,280	32,817	2,695	20,2019	6,879
Obstetrician	**121,612**	4,045	3,831	3,217	7,648	3,230	12,247	9,266	19,663	30,283	2,140	18,198	7,844
Induction of labour, %													
All women	**21.2**	24.8	20.7	26.2	23.3	20.8	18.6	18.0	19.1	23.0	22.4	21.4	24.4
Obstetrician	**48.2**	54.6	52.2	55.1	54.3	46.9	47.0	46.1	47.6	48.0	51.2	45.5	46.3
Augmentation after spontaneous onset of labour, %													
All women	**42.9**	40.7	38.0	41.5	36.2	48.4	44.3	45.9	43.7	42.1	33.5	45.6	42.2
Midwife	**39.1**	37.9	34.8	37.5	32.7	43.3	41.2	43.4	40.3	37.1	29.5	41.8	37.6
Obstetrician	**54.5**	49.9	51.5	53.9	48.9	62.6	55.1	54.7	55.6	54.9	47.1	56.0	52.0
Intrapartum oxytocin use, %													
All women	**62.2**	62.4	61.7	63.3	59.0	66.5	64.3	65.6	63.4	62.4	55.1	59.9	58.0
Obstetrician	**61.6**	64.6	64.4	67.5	60.9	69.5	63.2	63.7	62.1	60.9	56.5	58.7	58.4
Epidural, %													
All women without prelabour CS	**27.4**	25.4	20.1	12.3	27.7	13.7	27.6	31.0	22.3	27.3	19.1	37.5	36.4
Midwife	**19.8**	19.5	14.2	7.9	19.8	8.7	20.9	24.4	16.0	17.9	13.0	28.8	26.2
Obstetrician without prelabour CS	**38.1**	33.1	30.0	17.7	39.3	20.1	38.7	42.4	32.6	38.5	27.7	48.4	46.3
Other pharmacological pain relief, %													
All women without prelabour CS	**21.6**	20.1	20.6	38.2	16.2	43.0	17.6	14.8	24.6	22.3	25.6	17.2	27.9
Midwife	**17.7**	14.7	16.5	30.0	13.0	35.4	14.8	13.1	21.2	17.6	19.0	14.8	20.9
Obstetrician without prelabour CS	**27.1**	27.1	27.6	48.0	20.8	53.1	22.0	17.7	29.8	28.0	34.8	20.1	34.7
Spontaneous vaginal birth, %													
All women	**65.2**	62.4	64.0	66.0	64.1	64.6	67.4	66.8	64.6	64.1	66.2	66.2	64.9
Midwife	**74.3**	72.0	72.7	74.5	73.1	71.8	75.6	75.2	73.2	74.3	75.9	75.7	75.8
Obstetrician	**53.6**	51.2	51.2	56.6	51.9	55.9	54.9	53.9	51.8	53.0	53.9	55.4	55.4
Instrumental vaginal birth, %													
All women (without prelabour CS)	**17.9**	19.3	17.8	17.5	19.4	18.5	17.1	17.2	18.3	19.1	17.0	16.2	16.6
Midwife	**17.0**	18.5	17.1	17.7	18.3	18.5	16.4	16.3	17.5	17.3	15.6	15.9	15.9
Obstetrician (without prelabour CS)	**19.2**	20.2	18.9	17.4	21.1	18.5	18.2	18.7	19.7	21.1	18.9	16.5	17.3

Table 2. Childbirth intervention rates by region total, and in subgroups by setting, stratified by parity (percentages) (continued)

Nulliparous women, total and by care setting at the onset of labour *(abbreviated as 'midwife' or 'obstetrician')*													
	Total	**GR**	**FR**	**DR**	**OV**	**FL**	**GD**	**UT**	**NH**	**ZH**	**ZL**	**NB**	**LB**
Caesarean Section, %													
All women	**17.8**	19.3	19.0	17.2	17.4	17.6	16.3	16.7	17.9	17.7	17.6	18.5	19.4
Prelabour CS, %													
All women	**4.5**	4.6	4.7	4.1	4.4	3.6	4.1	4.2	4.3	4.4	4.6	5.2	5.8
Obstetrician	**10.2**	10.0	11.5	8.6	10.2	7.9	10.2	10.6	10.7	9.2	10.4	11.1	10.8
Intrapartum CS, %													
All women (without prelabour CS)	**13.9**	15.4	15.1	13.7	13.6	14.6	12.7	13.1	14.2	13.9	13.7	14.0	14.4
Midwife	**8.6**	9.6	10.2	7.7	8.5	9.7	7.9	8.5	9.3	8.4	8.5	8.3	8.2
Obstetrician (without prelabour CS)	**21.2**	23.0	23.3	20.9	21.2	21.0	20.7	21.1	22.3	20.5	21.0	21.2	20.6
Involvement paediatrician <24 hours, %													
All women	**50.4**	59.6	49.9	51.1	47.7	48.3	55.9	60.0	36.9	50.8	46.9	53.0	60.3
Midwife	**38.1**	45.6	37.9	37.2	34.8	38.1	43.4	49.0	26.9	36.5	32.5	42.5	47.0
Obstetrician	**65.8**	76.3	67.6	66.5	64.8	60.8	74.7	76.9	51.6	66.4	65.6	64.5	71.9
Total *n*													
All women	**338,029**	10,540	13,004	9,090	24,818	10,228	40,325	29,231	56,366	75,788	6,474	45,643	16,522
Midwife	**174,918**	5,186	7,200	4,334	13,630	4,963	22,842	16,308	30,470	37,206	3,373	21,821	7,585
Obstetrician	**161,286**	5,331	5,765	4,735	11,070	5,246	17,324	12,812	25,414	37,940	3,082	23,705	8,862
Induction of labour, %													
All women	**19.7**	23.8	19.0	25.4	20.2	22.2	17.7	16.6	18.0	21.1	20.6	20.1	21.2
Obstetrician	**41.1**	47.0	43.0	48.8	44.8	43.3	41.1	37.6	39.4	41.7	43.3	38.8	39.7
Augmentation after spontaneous onset of labour, %													
All women	**17.3**	14.5	14.8	18.0	14.0	22.6	17.2	16.1	17.9	18.4	12.4	18.8	16.6
Midwife	**11.2**	8.8	9.5	12.0	8.6	14.2	11.3	11.5	12.1	11.6	7.1	11.7	10.1
Obstetrician	**33.2**	29.3	32.5	33.2	30.9	41.3	34.3	29.4	34.6	33.9	27.2	33.8	30.2
Intrapartum oxytocin use, %													
All women	**44.7**	47.0	47.6	51.7	44.5	51.7	46.3	43.4	45.4	45.6	41.4	40.1	39.7
Obstetrician	**45.8**	50.3	50.0	54.2	46.6	54.3	47.8	43.9	45.8	45.9	42.9	41.0	41.5

Table 2. Childbirth intervention rates by region total, and in subgroups by setting, stratified by parity (percentages) (continued)

Nulliparous women, total and by care setting at the onset of labour *(abbreviated as 'midwife' or 'obstetrician')*													
	Total	**GR**	**FR**	**DR**	**OV**	**FL**	**GD**	**UT**	**NH**	**ZH**	**ZL**	**NB**	**LB**
Epidural, %													
All women without prelabour CS	**9.6**	8.9	7.0	4.6	8.4	4.9	9.3	10.4	8.0	9.7	7.6	13.8	13.8
Midwife	**3.0**	2.7	2.0	0.8	2.2	1.6	3.0	4.2	2.6	2.6	2.3	4.8	4.3
Obstetrician without prelabour CS	**18.1**	16.0	14.5	8.6	17.5	8.6	18.7	19.9	15.8	18.1	14.7	23.8	23.6
Other pharmacological pain relief, %													
All women without prelabour CS	**14.5**	12.4	14.3	22.9	11.7	26.8	11.2	9.8	14.5	15.1	14.4	15.0	19.9
Midwife	**6.6**	5.0	5.6	9.5	5.2	12.6	5.3	5.1	7.2	6.5	4.7	7.9	8.4
Obstetrician without prelabour CS	**24.6**	20.8	27.3	37.3	21.3	42.5	20.0	17.0	25.0	25.1	26.8	23.0	31.7
Spontaneous vaginal birth, %													
All women	**83.7**	82.9	82.5	83.8	83.6	84.9	86.1	84.2	82.8	83.4	83.9	83.6	81.7
Midwife	**96.9**	96.6	96.2	97.3	96.6	96.9	97.2	97.1	96.8	96.8	97.1	96.9	97.1
Obstetrician	**69.3**	69.7	65.2	71.5	67.5	73.6	71.5	67.9	66.0	70.1	69.4	71.1	68.6
Instrumental vaginal birth, %													
All women (without prelabour CS)	**3.5**	3.7	4.1	3.5	4.2	3.1	3.3	3.1	3.1	3.8	3.7	3.1	3.5
Midwife	**1.8**	1.7	2.1	1.7	2.2	1.6	1.6	1.7	1.6	1.9	1.8	1.7	1.7
Obstetrician (without prelabour CS)	**5.7**	6.0	7.0	5.5	7.2	4.8	5.9	5.3	5.4	6.0	6.1	4.6	5.4
Caesarean Section, %													
All women	**13.2**	13.7	13.8	13.0	12.6	12.2	10.8	12.9	14.3	13.2	12.7	13.6	15.2
Prelabour CS, %													
All women	**7.8**	7.9	7.8	7.7	7.7	7.2	5.8	8.0	8.5	7.9	7.7	8.2	9.8
Obstetrician	**16.4**	15.6	17.6	14.7	17.1	14.0	13.4	18.2	18.8	15.6	16.3	15.9	18.0
Intrapartum CS, %													
All women (without prelabour CS)	**5.8**	6.2	6.4	5.7	5.3	5.4	5.3	5.4	6.3	5.8	5.4	5.9	6.0
Midwife	**1.3**	1.7	1.6	1.0	1.2	1.5	1.2	1.2	1.5	1.4	1.1	1.4	1.1
Obstetrician (without prelabour CS)	**11.6**	11.4	13.8	10.7	11.4	9.6	11.5	11.8	13.4	11.0	11.2	10.9	11.0

Table 2. Childbirth intervention rates by region total, and in subgroups by setting, stratified by parity (percentages) (continued)

Nulliparous women, total and by care setting at the onset of labour *(abbreviated as 'midwife' or 'obstetrician')*													
	Total	**GR**	**FR**	**DR**	**OV**	**FL**	**GD**	**UT**	**NH**	**ZH**	**ZL**	**NB**	**LB**
Involvement paediatrician <24 hours, %													
All women	**35.6**	41.1	34.5	36.3	33.9	34.0	37.8	41.9	25.6	37.0	36.0	37.0	42.7
Midwife	**14.6**	16.6	14.2	13.7	13.1	14.8	16.4	19.6	9.2	14.4	11.7	16.8	19.2
Obstetrician	**58.2**	65.0	59.9	57.0	59.3	52.0	66.1	70.2	45.2	59.1	62.7	55.5	62.7

Percentage of missing data: 0.6 for midwife- or obstetrician-led care, 0.7% for spontaneous vaginal birth, 0.7% for instrumental birth, 0.7% for caesarean section, 0.8% for induction of labour, 0.6% for augmentation of labour, 0.0% for oxytocin use, 0.4% for epidural and other pharmacological pain relief, 0.3% for involvement paediatrician <24 hours.

Table 3. Neonatal and maternal outcomes by region (percentages, crude and adjusted* ORs, compared to weighted mean, with 99% CIs

	Total	GR	FR	DR	OV
	614,661	19,441	22,568	15,875	42,860
Antepartum and intrapartum stillbirth, *n (%)*	**717 (0.12)**	23 (0.12)	32 (0.14)	17 (0.11)	42 (0.10)
Crude OR [99% CI]		1.02 [0.61-1.69]	1.22 [0.79-1.88]	0.92 [0.51-1.65]	0.84 [0.57-1.24]
aOR* [99% CI]		1.04 [0.62-1.73]	1.26 [0.81-1.97]	0.93 [0.51-1.71]	0.90 [0.61-1.33]
Neonatal mortality up to 7 days, *n (%)*	**471 (0.08)**	14 (0.07)	13 (0.06)	12 (0.08)	29 (0.07)
Crude OR [99% CI]		0.93 [0.49-1.78]	0.75 [0.38-1.46]	0.98 [0.49-1.97]	0.88 [0.55-1.39]
aOR* [99% CI]		0.93 [0.48-1.79]	0.76 [0.39-1.51]	1.06 [0.52-2.14]	0.83 [0.51-1.36]
Apgar score below 7 at 5 minutes#, *n (%)*	**6410 (1.00)**	291 (1.5)	280 (1.2)	132 (0.8)	354 (0.8)
Crude OR [99% CI]		1.53 [1.32-1.77]	1.26 [1.09-1.46]	0.84 [0.68-1.04]	0.84 [0.73-0.96]
aOR* [99% CI]		1.47 [1.26-1.71]	1.28 [1.10-1.49]	0.90 [0.73-1.12]	0.85 [0.74-0.98]
3rd and 4th degree perineal tear for vaginal births, %	**14065 (2.76)**	432 (2.68)	528 (2.84)	423 (3.15)	1061 (2.95)
Crude OR [99% CI]		0.99 [0.88-1.12]	1.05 [0.94-1.17]	1.17 [1.04-1.32]	1.10 [1.01-1.19]
aOR* [99% CI]		1.00 [0.88-1.12]	1.09 [0.98-1.22]	1.17 [1.03-1.33]	1.10 [1.01-1.91]
Postpartum haemorrhages ≥1000 ml, %	**35868 (6.00)**	1088 (5.62)	1147 (5.17)	977 (6.19)	2283 (5.41)
Crude OR [99% CI]		0.99 [0.91-1.06]	0.90 [0.84-0.97]	1.09 [1.01-1.18]	0.95 [0.90-0.998]
aOR* [99% CI]		0.99 [0.92-1.07]	0.92 [0.85-0.99]	1.11 [1.02-1.21]	0.94 [0.89-0.995]

*Odds ratios, adjusted for parity, maternal age, ethnic background, socioeconomic status and urbanisation
#Antepartum and intrapartum stillbirth cases are excluded for analyses of Apgar score below 7 at 5 minutes.
Percentage of missing data: 0.0% for antepartum and intrapartum stillbirth, 0.1% for neonatal mortality, 0.1% for Apgar score below 7 at 5 minutes, 1.4% for 3rd and 4th degree perineal tear, 2.7% for postpartum haemorrhages >1000 ml.

FL	GD	UT	NH	ZH	ZL	NB	LB
17,461	71,284	52,886	105,944	139,567	11,327	84,147	31,301
27 (0.15)	97 (0.14)	62 (0.12)	126 (0.12)	159 (0.11)	11 (0.10)	88 (0.10)	33 (0.11)
1.33 [0.83-2.13]	1.17 [0.89-1.53]	1.01 [0.73-1.39]	1.02 [0.80-1.31]	0.98 [0.78-1.23]	0.83 [0.41-1.71]	0.90 [0.68-1.19]	0.90 [0.59-1.39]
1.41 [0.86-2.32]	1.13 [0.85-1.50]	1.07 [0.76-1.50]	0.97 [0.74-1.27]	0.97 [0.75-1.25]	0.75 [0.35-1.61]	0.85 [0.63-1.14]	0.89 [0.58-1.37]
14 (0.08)	72 (0.10)	42 (0.08)	85 (0.08)	98 (0.07)	12 (0.11)	52 (0.06)	28 (0.09)
1.04 [0.54-1.99]	1.31 [0.95-1.80]	1.03 [0.69-1.53]	1.04 [0.77-1.40]	0.91 [0.68-1.21]	1.37 [0.68-2.76]	0.80 [0.56-1.15]	1.16 [0.72-1.86]
1.04 [0.52-2.11]	1.34 [0.97-1.86]	1.02 [0.67-1.57]	1.01 [0.73-1.40]	0.92 [0.67-1.27]	1.38 [0.68-2.79]	0.80 [0.56-1.16]	1.08 [0.67-1.76]
163 (0.9)	715 (1.0)	460 (0.9)	1136 (1.1)	1735 (1.2)	83 (0.7)	777 (0.9)	284 (0.9)
0.95 [0.78-1.14]	1.02 [0.92-1.12]	0.88 [0.78-0.99]	1.09 [1.00-1.18]	1.26 [1.17-1.36]	0.74 [0.57-0.96]	0.94 [0.85-1.03]	0.92 [0.79-1.07]
0.96 [0.78-1.18]	1.05 [0.95-1.17]	0.88 [0.78-0.997]	0.99 [0.90-1.08]	1.18 [1.09-1.28]	0.78 [0.60-1.02]	0.94 [0.85-1.03]	0.92 [0.79-1.07]
369 (2.49)	1638 (2.68)	1369 (3.07)	2741 (3.13)	2725 (2.38)	173 (1.83)	1919 (2.79)	687 (2.73)
0.92 [0.81-1.04]	0.99 [0.93-1.06]	1.14 [1.06-1.23]	1.16 [1.10-1.23]	0.88 [0.83-0.93]	0.67 [0.56-0.81]	1.03 [0.97-1.10]	1.01 [0.92-1.11]
0.96 [0.83-1.10]	0.99 [0.92-1.06]	1.09 [1.01-1.18]	1.15 [1.08-1.22]	0.88 [0.82-0.93]	0.70 [0.58-0.84]	1.01 [0.95-1.08]	1.01 [0.92-1.11]
1041 (5.99)	4610 (6.53)	3054 (5.85)	6155 (6.03)	7832 (5.79)	411 (3.72)	5430 (6.88)	1840 (5.95)
1.05 [0.97-1.14]	1.16 [1.11-1.20]	1.03 [0.98-1.08]	1.06 [1.02-1.10]	1.02 [0.98-1.05]	0.64 [0.57-0.72]	1.22 [1.17-1.27]	1.05 [0.99-1.11]
1.09 [0.998-1.18]	1.14 [1.09-1.19]	0.98 [0.93-1.03]	1.04 [0.99-1.08]	1.02 [0.99-1.06]	0.66 [0.58-0.74]	1.20 [1.15-1.25]	1.04 [0.98-1.10]

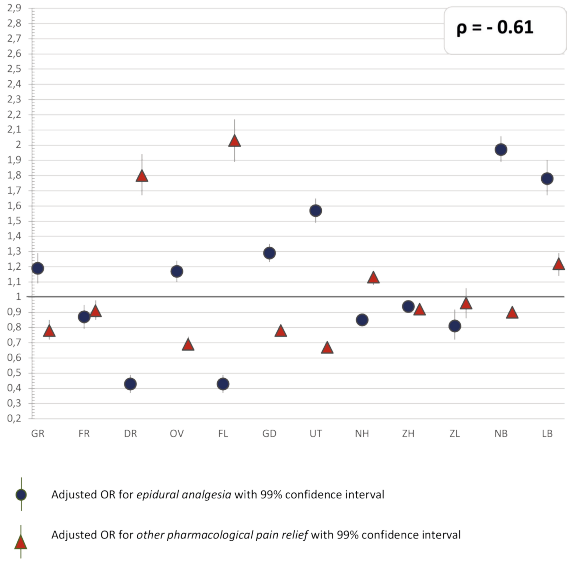

Figure 2a. Regional variation of epidural analgesia and other pharmacological pain relief for women in midwife-led care
The reference category (OR of 1.0) is the weighted overall rate of the country.
ρ (rho) is the coefficient between the two point markers in the figure (epidural analgesia and other pharmacological pain relief), which corresponds with the correlation coefficient described in table 6.

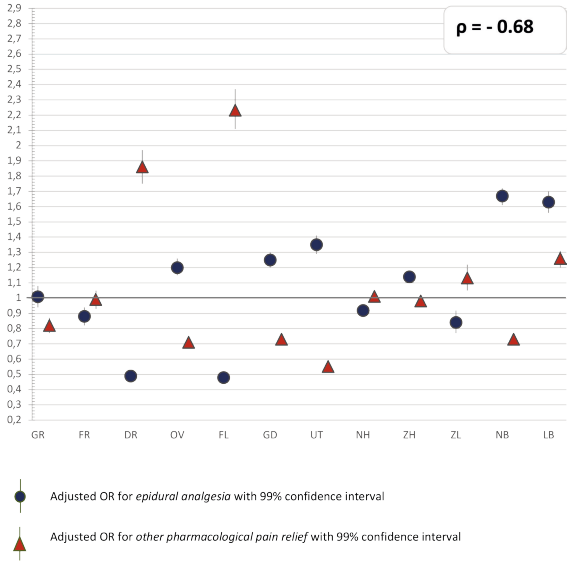

Figure 2b. Regional variation of epidural analgesia and other pharmacological pain relief for women in obstetrician-led care
The reference category (OR of 1.0) is the weighted overall rate of the country.
ρ (rho) is the coefficient between the two point markers in the figure (epidural analgesia and other pharmacological pain relief), which corresponds with the correlation coefficient described in table 6.

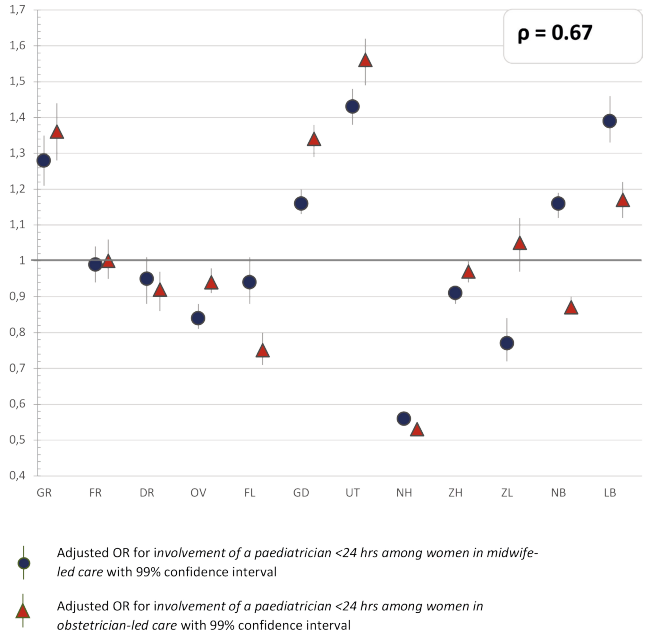

Figure 3. Regional variation of paediatric involvement for women in midwife-led care and obstetrician-led care
The reference category (OR of 1.0) is the weighted overall rate of the country.
ρ (rho) is the coefficient between the two point markers in the figure (paediatric involvement for women in midwife-led versus obstetrician-led care), which corresponds with the correlation coefficient described in table 5.

Neonatal and maternal outcomes

The results of the multivariable analyses for the childbirth outcomes are described in table 3. The overall incidence of antepartum and intrapartum stillbirth was 0.12% and of neonatal mortality up to 7 days 0.08%, but the adjusted ORs did not vary significantly between regions (table 3; not shown in figures). Correlation coefficients were therefore not calculated for these outcomes. The incidence of Apgar score below 7 at 5 minutes varied significantly across regions from between 0.7% to 1.5%. For third and fourth degree perineal tear, incidences varied from between 1.8% to 3.2% and for PPH from between 3.7% to 6.9%. The only intervention and adverse outcome that were significantly correlated, were augmentation of labour after a spontaneous onset of labour and PPH (ρ = 0.87; table 8).

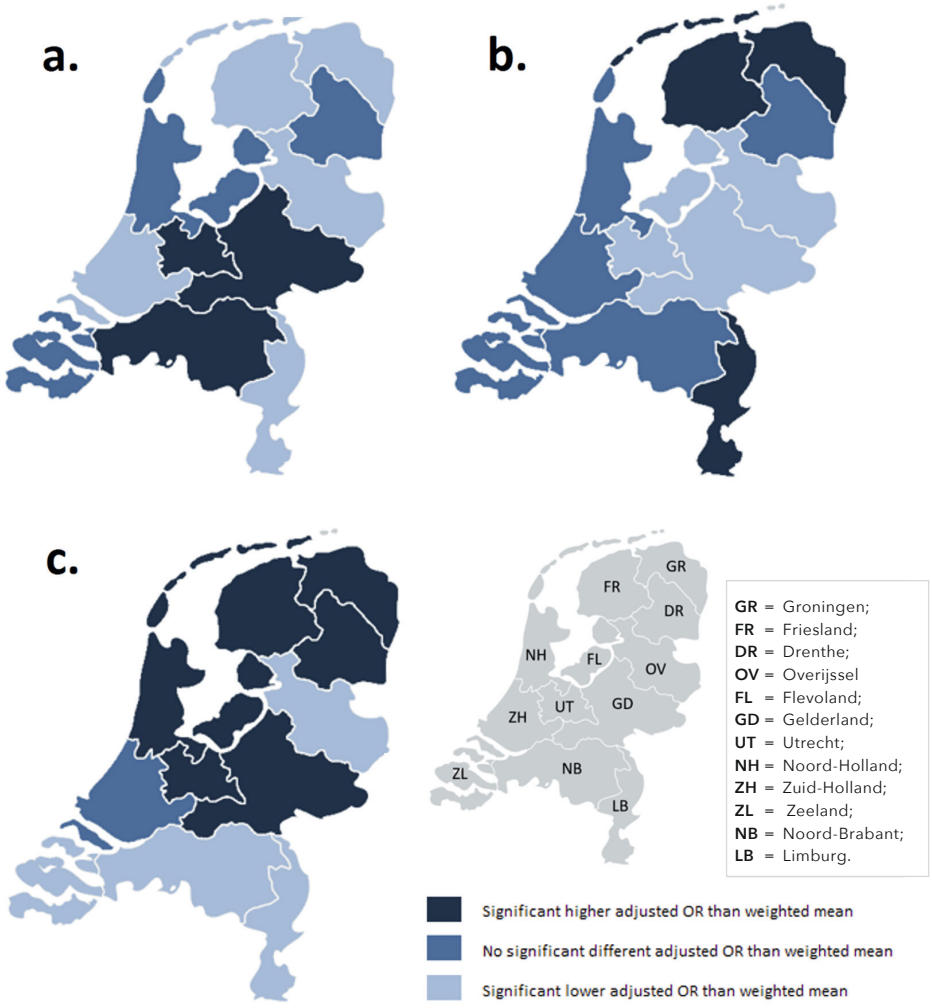

Figure 4. Significant differences in adjusted* OR between regions in incidences of:
a. spontaneous births
b. caesarean sections
c. intrapartum oxytocin use
*Adjusted for parity, maternal age, ethnic background, socioeconomic status and urbanisation

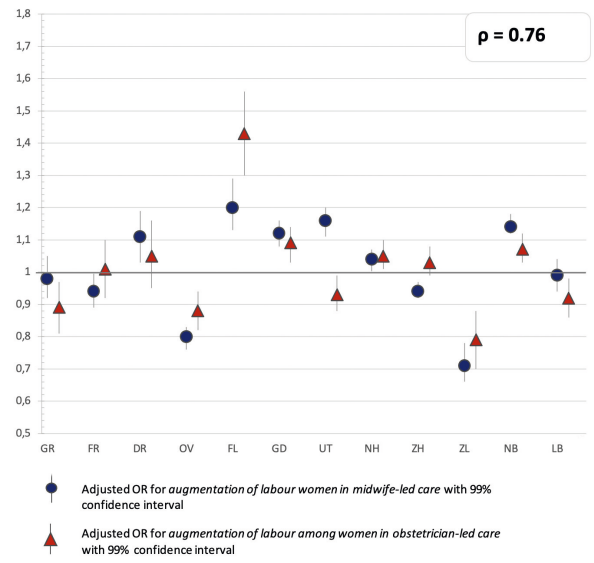

Figure 5. Regional variation of augmentation of labour after spontaneous onset for women in midwife-led care and obstetrician-led care
The reference category (OR of 1.0) is the weighted overall rate of the country.
ρ (rho) is the coefficient between the two point markers in the figure (augmentation of labour for women in midwife-led care versus obstetrician-led care), which corresponds with the correlation described in table 5.

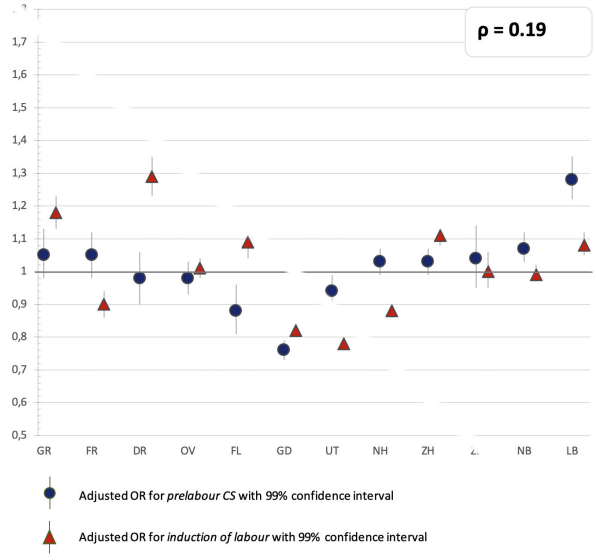

Figure 6. Regional variation of prelabour CS and induction of labour for all women
The reference category (OR of 1.0) is the weighted overall rate of the country.
ρ (rho) is the coefficient between the two point markers in the figure (prelabour CS and induction of labour), which corresponds with the correlation described in table 7.

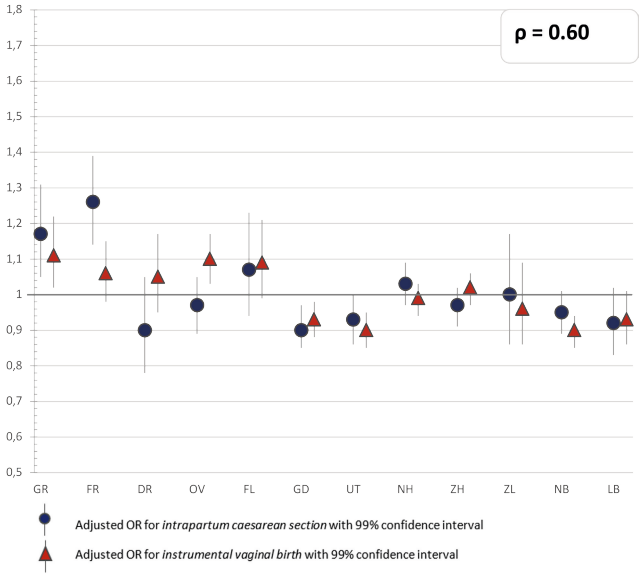

Figure 7a. Regional variation of intrapartum CS and instrumental birth for women in midwife-led care
The reference category (OR of 1.0) is the weighted overall rate of the country.
ρ (rho) is the coefficient between the two point markers in the figure (intrapartum CS and instrumental birth), which corresponds with the correlation described in table 6.

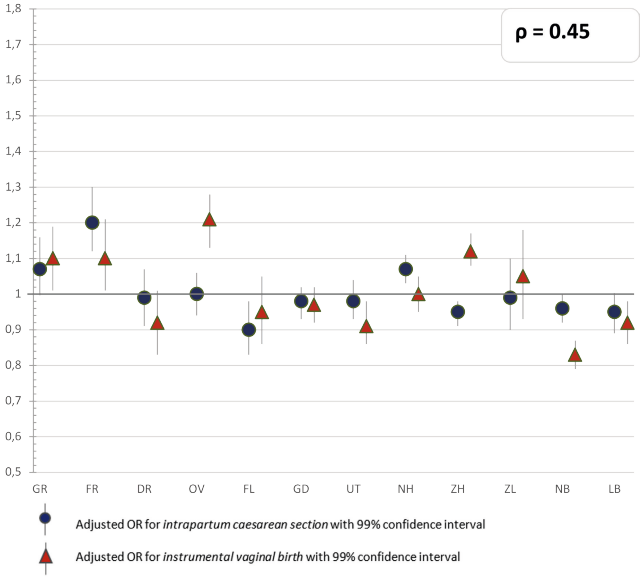

Figure 7b. Regional variation of intrapartum CS and instrumental birth for women in obstetrician-led care
The reference category (OR of 1.0) is the weighted overall rate of the country.
ρ (rho) is the coefficient between the two point markers in the figure (intrapartum CS and instrumental birth), which corresponds with the correlation described in table 6.

Discussion

In this nationwide study, most interregional variation was found for the different types of pain medication (epidural analgesia or other pharmacological pain relief), and for the involvement of a paediatrician in the first 24 hours after birth. Less variation was found for prelabour CS, augmentation and induction of labour, and least for instrumental vaginal birth and intrapartum CS rates. Regions with higher rates of one intervention did not have higher rates of all other interventions. Interventions that were correlated, were epidural analgesia and other pharmacological pain relief (negatively), augmentation of labour and instrumental vaginal birth (negatively), intrapartum CS and prelabour CS (positively), and for women in midwife-led care at the onset of labour, intrapartum CS and instrumental vaginal birth (positively). Regional variation was similar for women in midwife-led compared to those in obstetrician-led care within the same region. PPH occurred more often in regions where rates of augmentation of labour were higher. Antepartum and neonatal mortality rates did not vary significantly. Regions with higher intervention rates did not have lower rates of adverse neonatal and maternal outcomes, or vice versa.

Limitations and strengths

This study is based on routinely collected data. Reporting bias is an issue in any register dataset, particularly for subjective outcomes, such as Apgar score and blood loss. Pitfalls in the use of these register-based data are described in a recent article of De Jonge et al. (44). Misclassification is expected to be similar across regions and it is unlikely that it accounts for any of the variations. Another limitation is the absence or incompleteness of some variables in the dataset, such as maternal body mass index, congenital disorders, and obstetric history of low birth weight or previous CS. However, it is unlikely that this explains all variations observed, because adjustments for maternal characteristics did not lead to considerable changes in regional variation. Besides, it does not explain the large variation in pain medication and involvement of a paediatrician. On the other hand, regional variations in subgroups of different ethnic backgrounds could explain some of the variations. Secondly, regions with higher rates of referrals from midwife-led to obstetrician-led care, may have more low- or medium-risk women in obstetrician-led care, which might be reflected by lower intervention rates in obstetrician-led care, and higher rates in midwife-led care. However, our results showed strong positive correlations between intervention rates in midwife-led and obstetrician-led care within the same region. Last, by calculating correlation coefficients between regional adjusted ORs, it was not possible to account for the confidence intervals of the ORs. Therefore, these calculated correlations are only a rough indicator of relevant and significant correlations between variables. Besides, in case of minor variation in ORs, a Spearman's rank correlation coefficient readily becomes insignificant, since it is based on ranking of the twelve regions. The Spearman's rank correlation coefficients should be interpreted with caution, also because of multiple testing.

To our knowledge, this is the first study investigating regional variations of multiple interventions in childbirth in the Netherlands. A major strength of this study is its inclusion of almost all births in the Netherlands between 2010 and 2013. As stated in a Lancet series on Midwifery, available data strongly suggest an urgent need for more research to assess the appropriate use of interventions in childbirth (10). This study contributes to this need. Because the results were described separately for women in midwife- and obstetrician-led care at the onset labour, it has become clearer in which subgroups variations in interventions are more prevalent. Another strength of this explorative study is the comparison of groups of births based on the mothers' residential postal codes rather than her place of birth. Presence of a tertiary academic hospital in a region has had limited impact on results in this way, since in all regions both low- and high risk women are represented, women have access to all types of birth settings, while not all types are present in all regions, and confounders are more equally distributed than between hospitals (44). However, other confounders, such as distance to a hospital, may still have influenced the outcomes.

Multilevel analyses were not performed, since the aim of this study was to explore regional variations that are not explained by maternal characteristics but may be explained by variations between care professionals and/or care settings (midwifery practices, hospitals).

Interpretation and further research

The results from previous studies on regional variations in perinatal mortality and PPH in the Netherlands were not completely consistent with our results, probably due to older data and different samples (49, 51). It is not possible to establish causal relationship in our study, for instance between augmentation of labour and severe PPH. However, the results are consistent with findings from previous studies that showed an association between oxytocin use during labour and severe PPH (52, 53). Other studies showed greater variations between regions within a country than our study (29, 31-33, 54, 55). Although variation in for instance augmentation of labour appears limited, an additional 10,300 nulliparous women would receive oxytocin for augmentation each year if the highest regional rate would become the national rate, compared to the lowest rate. Even in case of limited variation in intervention rates, crude numbers show that variation might nonetheless be unwarranted. An aim of evidence-based practice is to minimize unwarranted variation in the use of interventions (56, 57). However, it is still unknown what would be the best rate for augmentation of labour and for other interventions. Regions with higher rates of augmentation of labour had on one hand higher rates of PPH, but on the other hand lower instrumental vaginal birth rates. Whether there is a causal relationship between these variables, needs to be investigated in further research. Generally, the optimal rate is the lowest rate with comparable neonatal and maternal outcomes. In our study adverse neonatal and maternal outcomes were not lower in regions with higher intervention rates. However,

achieving a low intervention rate should not be an aim in itself (10, 57). It is not possible to identify the optimal rate of interventions based on this study. An essential element in improving quality of care, is that care providers critically audit remarkably high and low rates (10, 58). This study intends to contribute to this debate. Following national guidelines and using the recommendations of the WHO might help in achieving the optimal use of interventions (15-17, 23, 58).

On the other hand, differences in regional guidelines and in adherence to national guidelines may explain a part of the large variation in type of pain medication and involvement of a paediatrician. Use of epidural analgesia for women with a single fetus in cephalic position after 37 weeks' gestation, has almost tripled between 2000 and 2009 in the Netherlands (from 7.7% to 21.9%) (59). In 2008, a multidisciplinary guideline on pain medication was published, in which adequate pain relief upon request for all women during labour was advised, with epidural analgesia as the most effective method for pain relief. Two randomized controlled trials showed that women were more satisfied with epidural analgesia compared to patient-controlled remifentanil (60, 61), but access to pain medication should not be at the expense of continuous support, which can reduce the need for pain medication (22). The large variation in rates of pain medication suggests different degrees of implementation of evidence and national guidelines, leading to disparity in accessibility to pain medication. Furthermore, the absence of a national guideline on when a paediatrician needs to be involved after birth and differences in accessibility may explain a part of the large variation in the rates of paediatric involvement, leading to differences in care and costs. Further research is required to examine which medical and non-medical factors may explain the large variations in pain medication and involvement of a paediatrician.

Clinical practice is influenced by characteristics of the care provider, such as age, educational background, perceptions of risks, and views on childbirth (62-66). Culture within the work environment may encourage care providers to take similar decisions, and variations are therefore not merely individual (67). Differences in perceptions and attitudes may result in differences in local practice and guidelines. The fact that variations were found between regions, even after adjustments for maternal characteristics, suggests that there may be cultural differences between regions, reflected in differences in the views of care providers on childbirth (63, 68, 69). The large variation, in particular for pain medication and involvement of a paediatrician, cannot be explained by clinical variations only. Similarities in variations in interventions that were found between women in midwife-led and obstetrician-led care, suggest similar practice by midwives and obstetricians within regions. These similarities existed in interventions with minor variation as well as in those with considerable variation. The results of this study call for implementation of evidence-based interventions, and for investigation into indications for the use of interventions in childbirth (10). The Robson Classification System

could be used to explore subgroups of women that account for the greatest variation (70). Limited variation in some of the interventions in our study may indicate consensus about its use. However, variations may be greater between midwifery practices, hospitals, collaborations or care providers, than between regions where variations between organisations and practitioners will have been averaged. In further research, variations within the regions should therefore be investigated.

Conclusions

The greatest variation was found for the type of pain medication and the involvement of a paediatrician, and the least for instrumental vaginal birth and intrapartum CS rates. The rates of adverse outcomes were not lower in regions with higher intervention rates. Care providers should critically audit remarkable variations, since these may be unwarranted. Variation may be explained to some extent by a difference in the degree of implementation of national guidelines between regions. Further research should therefore focus on variations in evidence-based interventions and indications for the use of interventions in childbirth.

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Supplementary tables

Additional file 1. Table 4. Crude and adjusted* ORs of childbirth interventions by region, compared to the weighted mean, with 99% CIs

	GR	FR	DR	OV	FL
Total *n*	19,441	22,568	15,875	42,869	17,461
Induction of labour					
Crude OR [99% CI]	1.20 [1.16-1.25]	0.92 [0.89-0.96]	1.30 [1.25-1.36]	1.03 [1.001-1.06]	1.04 [0.99-1.08]
aOR* [99% CI]	1.18 [1.13-1.23]	0.90 [0.86-0.94]	1.29 [1.23-1.35]	1.01 [0.98-1.04]	1.09 [1.04-1.15]
Augmentation of labour after spontaneous onset					
Crude OR [99% CI]	0.94 [0.90-0.99]	0.85 [0.81-0.89]	1.02 [0.97-1.07]	0.79 [0.76-0.81]	1.31 [1.25-1.37]
aOR* [99% CI]	0.95 [0.90-0.996]	0.92 [0.88-0.97]	1.10 [1.04-1.17]	0.80 [0.77-0.83]	1.30 [1.24-1.37]
Intrapartum oxytocin use					
Crude OR [99% CI]	1.05 [1.01-1.10]	1.03 [0.99-1.08]	1.16 [1.11-1.21]	0.92 [0.89-0.95]	1.22 [1.17-1.28]
aOR* [99% CI]	1.06 [1.01-1.10]	1.05 [1.01-1.10]	1.19 [1.13-1.25]	0.92 [0.89-0.95]	1.24 [1.19-1.30]
Epidural *(women without prelabour CS)*					
Crude OR [99% CI]	1.08 [1.03-1.14]	0.79 [0.75-0.83]	0.48 [0.44-0.51]	1.09 [1.06-1.13]	0.52 [0.49-0.56]
aOR* [99% CI]	1.08 [1.03-1.14]	0.84 [0.80-0.89]	0.50 [0.46-0.54]	1.15 [1.11-1.19]	0.48 [0.45-0.52]
Other pharmacological pain relief *(women without prelabour CS)*					
Crude OR [99% CI]	0.82 [0.79-0.87]	0.89 [0.86-0.93]	1.81 [1.73-1.89]	0.69 [0.66-0.71]	2.19 [2.11-2.28]
aOR* [99% CI]	0.82 [0.78-0.86]	0.93 [0.89-0.97]	1.87 [1.78-1.95]	0.69 [0.67-0.72]	2.14 [2.05-2.23]
Spontaneous vaginal birth					
Crude OR [99% CI]	0.90 [0.87-0.94]	0.96 [0.92-0.995]	1.04 [0.996-1.09]	0.99 [0.97-1.02]	1.06 [1.01-1.11]
aOR* [99% CI]	0.89 [0.85-0.93]	0.90 [0.87-0.94]	1.00 [0.95-1.05]	0.97 [0.94-0.999]	1.03 [0.98-1.08]
Instrumental vaginal birth *(women without prelabour CS)*					
Crude OR [99% CI]	1.11 [1.05-1.18]	1.00 [0.95-1.06]	0.96 [0.90-1.03]	1.09 [1.04-1.13]	0.97 [0.91-1.03]
aOR* [99% CI]	1.11 [1.05-1.18]	1.07 [1.004-1.13]	1.00 [0.93-1.07]	1.14 [1.09-1.19]	1.03 [0.96-1.11]
Caesarean Section					
Crude OR [99% CI]	1.08 [1.03-1.13]	1.06 [1.02-1.11]	0.97 [0.92-1.02]	0.95 [0.92-0.99]	0.94 [0.89-0.99]
aOR* [99% CI]	1.10 [1.05-1.15]	1.11 [1.06-1.16]	1.01 [0.95-1.07]	0.96 [0.93-0.998]	0.94 [0.89-0.995]

GD	UT	NH	ZH	ZL	NB	LB
71,286	52,893	105,948	139,573	11,327	84,187	31,302
0.83 [0.81-0.85]	0.78 [0.76-0.80]	0.85 [0.83-0.87]	1.06 [1.04-1.08]	1.02 [0.97-1.08]	0.98 [0.96-1.004]	1.10 [1.07-1.14]
0.82 [0.80-0.84]	0.78 [0.76-0.80]	0.88 [0.86-0.90]	1.11 [1.08-1.13]	1.00 [0.95-1.06]	0.99 [0.97-1.02]	1.08 [1.05-1.12]
1.06 [1.03-1.08]	1.09 [1.06-1.12]	1.12 [1.10-1.15]	1.07 [1.05-1.09]	0.71 [0.66-0.76]	1.17 [1.14-1.20]	1.04 [1.01-1.08]
1.09 [1.06-1.12]	1.05 [1.02-1.09]	1.00 [0.98-1.03]	0.99 [0.97-1.01]	0.74 [0.69-0.79]	1.16 [1.13-1.19]	1.02 [0.98-1.06]
1.07 [1.05-1.10]	1.05 [1.02-1.08]	1.05 [1.03-1.07]	1.02 [1.002-1.04]	0.80 [0.76-0.85]	0.87 [0.85-0.89]	0.84 [0.81-0.87]
1.07 [1.04-1.10]	1.05 [1.02-1.08]	1.04 [1.02-1.06]	1.02 [0.998-1.04]	0.79 [0.75-0.84]	0.86 [0.85-0.88]	0.82 [0.79-0.84]
1.16 [1.13-1.19]	1.35 [1.31-1.39]	0.95 [0.93-0.98]	1.20 [1.17-1.22]	0.80 [0.74-0.85]	1.75 [1.71-1.80]	1.73 [1.67-1.79]
1.19 [1.16-1.23]	1.35 [1.30-1.39]	0.86 [0.83-0.88]	1.09 [1.06-1.12]	0.84 [0.78-0.90]	1.80 [1.76-1.85]	1.77 [1.71-1.83]
0.72 [0.70-0.74]	0.60 [0.58-0.62]	1.04 [1.02-1.06]	1.00 [0.98-1.02]	1.04 [0.98-1.10]	0.82 [0.80-0.84]	1.31 [1.27-1.36]
0.73 [0.71-0.75]	0.58 [0.56-0.60]	1.03 [1.001-1.05]	0.97 [0.95-0.99]	1.06 [1.001-1.13]	0.82 [0.80-0.84]	1.30 [1.26-1.35]
1.15 [1.12-1.18]	1.06 [1.03-1.08]	0.94 [0.92-0.96]	0.96 [0.94-0.97]	1.05 [0.99-1.11]	1.01 [0.99-1.03]	0.92 [0.89-0.94]
1.17 [1.14-1.20]	1.12 [1.09-1.16]	1.01 [0.99-1.03]	0.97 [0.95-0.99]	0.99 0.94-1.05]	1.05 [1.02-1.07]	0.94 [0.91-0.98]
0.93 [0.90-0.97]	0.95 [0.92-0.99]	1.05 [1.02-1.08]	1.10 [1.08 [1.13]	0.95 [0.88-1.03]	0.91 [0.88-0.94]	0.99 [0.94-1.04]
0.93 [0.90-0.97]	0.89 [0.85-0.93]	0.98 [0.95-1.01]	1.08 [1.05-1.11]	1.01 [0.93-1.10]	0.87 [0.84-0.90]	0.94 [0.90-0.99]
0.85 [0.82-0.87]	0.96 [0.93-0.99]	1.06 [1.04-1.09]	1.00 [0.98-1.02]	0.97 [0.91-1.04]	1.05 [1.02-1.08]	1.16 [1.11-1.20]
0.84 [0.81-0.86]	0.91 [0.88-0.94]	1.00 [0.98-1.03]	1.00 [0.98-1.03]	1.01 [0.95-1.08]	1.03 [0.999-1.05]	1.13 [1.09-1.18]

	GR	FR	DR	OV	FL
Prelabour CS					
Crude OR [99% CI]	1.01 [0.94-1.09]	1.03 [0.96-1.10]	0.97 [0.90-1.05]	1.00 [0.95-1.05]	0.89 [0.82-0.96]
aOR* [99% CI]	1.05 [0.98-1.13]	1.05 [0.98-1.12]	0.98 [0.90-1.06]	0.98 [0.93-1.03]	0.88 [0.81-0.96]
Intrapartum CS *(women without prelabour CS)*					
Crude OR [99% CI]	1.12 [1.06-1.19]	1.08 [1.02-1.14]	0.97 [0.90-1.04]	0.93 [0.89-0.97]	0.98 [0.92-1.04]
aOR* [99% CI]	1.13 [1.06-1.20]	1.15 [1.08-1.22]	1.03 [0.96-1.11]	0.95 [0.91-1.00]	0.99 [0.92-1.06]
Involvement paediatrician <24 hrs					
Crude OR [99% CI]	1.30 [1.25-1.34]	0.92 [0.89-0.95]	0.98 [0.84-1.02]	0.87 [0.84-0.89]	0.88 [0.84-0.91]
aOR* [99% CI]	1.30 [1.26-1.35]	0.95 [0.92-0.98]	1.01 [0.97-1.05]	0.88 [0.85-0.90]	0.89 [0.86-0.93]
Women in midwife-led care at onset of labour, n = 328,009					
Total *n*	10,013	12,901	7,884	23,922	8,942
Augmentation of labour after spontaneous onset					
Crude OR [99% CI]	0.98 [0.93-1.04]	0.86 [0.82-0.91]	1.02 [0.95-1.08]	0.78 [0.74-0.81]	1.24 [1.17-1.31]
aOR* [99% CI]	0.98 [0.92-1.05]	0.94 [0.89-0.995]	1.11 [1.03-1.19]	0.80 [0.76-0.83]	1.20 [1.13-1.29]
Epidural					
Crude OR [99% CI]	1.18 [1.09-1.28]	0.79 [0.73-0.86]	0.41 [0.36-0.47]	1.07 [1.01-1.13]	0.49 [0.44-0.55]
aOR* [99% CI]	1.19 [1.09-1.29]	0.87 [0.79-0.95]	0.43 [0.37-0.49]	1.17 [1.10-1.24]	0.43 [0.37-0.49]
Other pharmacological pain relief					
Crude OR [99% CI]	0.77 [0.71-0.84]	0.85 [0.79-0.91]	1.68 [1.56-1.80]	0.67 [0.64-0.71]	2.14 [2.01-2.28]
aOR* [99% CI]	0.78 [0.72-0.85]	0.91 [0.85-0.98]	1.80 [1.67-1.94]	0.69 [0.65-0.74]	2.03 [1.89-2.17]
Instrumental vaginal birth					
Crude OR [99% CI]	1.13 [1.04-1.22]	0.99 [0.92-1.07]	1.01 [0.92-1.11]	1.04 [0.98-1.10]	1.04 [0.95-1.14]
aOR* [99% CI]	1.11 [1.02-1.22]	1.06 [0.98-1.15]	1.05 [0.95-1.17]	1.10 [1.03-1.17]	1.09 [0.99-1.21]
Intrapartum CS					
Crude OR [99% CI]	1.18 [1.06-1.31]	1.16 [1.05-1.27]	0.85 [0.74-0.97]	0.92 [0.85-0.99]	1.10 [0.97-1.23]
aOR* [99% CI]	1.17 [1.05-1.31]	1.26 [1.14-1.39]	0.90 [0.78-1.05]	0.97 [0.89-1.05]	1.07 [0.94-1.23]
Involvement paediatrician <24 hrs					
Crude OR [99% CI]	1.26 [1.19-1.33]	0.94 [0.89-0.98]	0.92 [0.86-0.98]	0.83 [0.80-0.86]	0.96 [0.91-1.02]
aOR* [99% CI]	1.28 [1.21-1.35]	0.99 [0.94-1.04]	0.95 [0.88-1.01]	0.84 [0.81-0.88]	0.94 [0.88-1.01]

GD	UT	NH	ZH	ZL	NB	LB
0.79 [0.75-0.82]	0.99 [0.95-1.04]	1.04 [1.01-1.08]	0.99 [0.96-1.02]	1.01 [0.92-1.11]	1.09 [1.05-1.13]	1.27 [1.20-1.34]
0.76 [0.73-0.79]	0.94 [0.90-0.99]	1.03 [0.99-1.07]	1.03 [0.99-1.07]	1.04 [0.95-1.14]	1.07 [1.03-1.12]	1.28 [1.22-1.35]
0.90 [0.86-0.93]	0.93 [0.90-0.97]	1.07 [1.04-1.10]	1.01 [0.98-1.04]	0.95 [0.88-1.03]	1.02 [0.99-1.06]	1.07 [1.02-1.12]
0.90 [0.87-0.94]	0.90 [0.86-0.94]	0.99 [0.96-1.02]	0.98 [0.95-1.01]	1.00 [0.92-1.08]	0.99 [0.96-1.03]	1.03 [0.98-1.08]
1.11 [1.09-1.13]	1.32 [1.29-1.35]	0.59 [0.58-0.60]	1.01 [0.995-1.03]	0.91 [0.87-0.95]	1.06 [1.04-1.08]	1.37 [1.33-1.41]
1.11 [1.09-1.13]	1.28 [1.25-1.31]	0.55 [0.54-0.56]	0.99 [0.97-1.004]	0.93 [0.89-0.98]	1.05 [1.03-1.07]	1.36 [1.32-1.40]
41,401	30,601	59,750	70,023	6,068	42,040	14,464
1.08 [1.05-1.12]	1.19 [1.15-1.23]	1.16 [1.13-1.19]	1.02 [0.99-1.05]	0.68 [0.63-0.74]	1.18 [1.14-1.21]	1.00 [0.95-1.05]
1.12 [1.08-1.16]	1.16 [1.11-1.20]	1.04 [1.003-1.07]	0.94 [0.92-0.97]	0.71 [0.66-0.78]	1.14 [1.12-1.18]	0.99 [0.94-1.04]
1.21 [1.16-1.27]	1.56 [1.49-1.63]	1.01 [0.97-1.05]	1.07 [1.03-1.11]	0.75 [0.67-0.85]	1.92 [1.84-2.00]	1.68 [1.59-1.79]
1.29 [1.23-1.35]	1.57 [1.49-1.65]	0.85 [0.81-0.89]	0.94 [0.90-0.98]	0.81 [0.72-0.92]	1.97 [1.89-2.06]	1.78 [1.67-1.90]
0.76 [0.73-0.80]	0.70 [0.67-0.74]	1.20 [1.16-1.24]	0.98 [0.95-1.01]	0.91 [0.83-1.01]	0.92 [0.88-0.95]	1.21 [1.14-1.28]
0.78 [0.74-0.81]	0.67 [0.63-0.71]	1.13 [1.08-1.17]	0.92 [0.88-0.95]	0.96 [0.86-1.06]	0.90 [0.87-0.94]	1.22 [1.14-1.29]
0.93 [0.89-0.98]	0.97 [0.92-1.02]	1.07 [1.03-1.12]	1.04 [0.997-1.08]	0.89 [0.80-1.001]	0.96 [0.92-1.01]	0.96 [0.89-1.04]
0.93 [0.88-0.98]	0.90 [0.85-0.95]	0.99 [0.94-1.03]	1.02 [0.97-1.06]	0.96 [0.86-1.09]	0.90 [0.85-0.94]	0.93 [0.86-1.01]
0.89 [0.84-0.95]	0.97 [0.91-1.04]	1.15 [1.09-1.21]	0.99 [0.94-1.04]	0.93 [0.80-1.08]	1.00 [0.94-1.07]	0.95 [0.86-1.05]
0.90 [0.85-0.97]	0.93 [0.86-0.998]	1.03 [0.97-1.09]	0.97 [0.91-1.02]	1.00 [0.86-1.17]	0.95 [0.89-1.01]	0.92 [0.83-1.02]
1.14 [1.11-1.17]	1.43 [1.38-1.48]	0.62 [0.61-0.64]	0.94 [0.92-0.97]	0.75 [0.70-0.81]	1.18 [1.15-1.22]	1.37 [1.31-1.43]
1.16 [1.13-1.20]	1.43 [1.38-1.48]	0.56 [0.55-0.58]	0.91 [0.88-0.93]	0.77 [0.72-0.84]	1.16 [1.12-1.19]	1.39 [1.33-1.46]

	GR	FR	DR	OV	FL
Women in obstetrician-led care at onset of labour					
Total *n*	9,376	9,596	7,952	18,718	8,476
Induction of labour					
Crude OR [99% CI]	1.22 [1.16-1.28]	1.05 [1.002-1.11]	1.27 [1.20-1.34]	1.14 [1.10-1.19]	0.97 [0.92-1.03]
aOR* [99% CI]	1.18 [1.12-1.24]	1.00 [0.95-1.05]	1.22 [1.15-1.29]	1.11 [1.07-1.15]	1.03 [0.97-1.09]
Augmentation of labour after spontaneous onset					
Crude OR [99% CI]	0.87 [0.80-0.95]	0.94 [0.87-1.02]	1.02 [0.93-1.11]	0.87 [0.82-0.93]	1.41 [1.30-1.53]
aOR* [99% CI]	0.89 [0.81-0.97]	1.01 [0.92-1.10]	1.05 [0.95-1.16]	0.88 [0.82-0.94]	1.43 [1.30-1.56]
Intrapartum oxytocin use					
Crude OR [99% CI]	1.13 [1.07-1.18]	1.09 [1.04-1.15]	1.28 [1.21-1.35]	0.95 [0.92-0.99]	1.31 [1.24-1.38]
aOR* [99% CI]	1.12 [1.07-1.18]	1.11 [1.05-1.17]	1.29 [1.22-1.37]	0.94 [0.91-0.98]	1.34 [1.26-1.42]
Epidural *(women without prelabour CS)*					
Crude OR [99% CI]	1.01 [0.95-1.07]	0.84 [0.79-0.90]	0.48 [0.44-0.52]	1.16 [1.11-1.21]	0.51 [0.47-0.55]
aOR* [99% CI]	1.01 [0.94-1.08]	0.88 [0.82-0.94]	0.49 [0.45-0.53]	1.20 [1.15-1.26]	0.48 [0.44-0.52]
Other pharmacological pain relief *(women without prelabour CS)*					
Crude OR [99% CI]	0.83 [0.78-0.89]	0.98 [0.92-1.04]	1.87 [1.77-1.98]	0.71 [0.68-0.75]	2.28 [2.16-2.41]
aOR* [99% CI]	0.82 [0.77-0.87]	0.99 [0.93-1.05]	1.86 [1.75-1.97]	0.71 [0.68-0.75]	2.23 [2.11-2.37]
Instrumental vaginal birth *(women without prelabour CS)*					
Crude OR [99% CI]	1.09 [1.001-1.18]	1.05 [0.97-1.14]	0.91 [0.82-0.99]	1.17 [1.10-1.24]	0.88 [0.80-0.97]
aOR* [99% CI]	1.10 [1.01-1.19]	1.10 [1.01-1.21]	0.92 [0.83-1.01]	1.21 [1.13-1.28]	0.95 [0.86-1.05]
Prelabour CS					
Crude OR [99% CI]	0.96 [0.90-1.04]	1.14 [1.06-1.22]	0.88 [0.81-0.96]	1.06 [1.003-1.12]	0.84 [0.77-0.91]
aOR* [99% CI]	1.01 [0.93-1.09]	1.14 [1.06-1.23]	0.87 [0.80-0.95]	1.04 [0.99-1.10]	0.82 [0.75-0.90]
Intrapartum CS *(women without prelabour CS)*					
Crude OR [99% CI]	1.06 [0.99-1.14]	1.15 [1.07-1.23]	0.94 [0.87-1.02]	0.99 [0.94-1.04]	0.88 [0.81-0.95]
aOR* [99% CI]	1.07 [0.996-1.16]	1.20 [1.12-1.30]	0.99 [0.91-1.07]	1.00 [0.94-1.06]	0.90 [0.83-0.98]
Involvement paediatrician <24 hours					
Crude OR [99% CI]	1.36 [1.28-1.43]	0.99 [0.94-1.05]	0.91 [0.86-0.96]	0.94 [0.90-0.97]	0.72 [0.69-0.76]
aOR* [99% CI]	1.36 [1.28-1.44]	1.00 [0.95-1.06]	0.92 [0.86-0.97]	0.94 [0.91-0.98]	0.75 [0.71-0.80]

*Odds ratios, adjusted for parity, maternal age, ethnic background, socioeconomic status and urbanisation

GD	UT	NH	ZH	ZL	NB	LB
29,571	22,078	45,077	68,223	5,222	41,903	16,706
0.93 [0.90-0.96]	0.84 [0.81-0.87]	0.91 [0.88-0.93]	0.97 [0.94-0.99]	1.05 [0.98-1.12]	0.86 [0.84-0.88]	0.90 [0.87-0.94]
0.91 [0.88-0.94]	0.87 [0.84-0.90]	0.99 [0.96-1.02]	1.05 [1.02-1.07]	1.00 [0.93-1.07]	0.87 [0.84-0.89]	0.87 [0.83-0.90]
1.06 [1.01-1.11]	0.95 [0.90-0.998]	1.11 [1.06-1.15]	1.09 [1.05-1.13]	0.77 [0.69-0.86]	1.08 [1.04-1.13]	0.97 [0.91-1.03]
1.09 [1.03-1.14]	0.93 [0.88-0.99]	1.05 [1.01-1.10]	1.03 [0.99-1.08]	0.79 [0.70-0.88]	1.07 [1.03-1.12]	0.92 [0.86-0.98]
1.02 [0.99-1.06]	0.95 [0.91-0.98]	0.97 [0.95-0.999]	0.96 [0.94-0.98]	0.82 [0.76-0.87]	0.82 [0.80-0.84]	0.85 [0.81-0.88]
1.03 [0.99-1.06]	0.96 [0.93-0.996]	0.99 [0.97-1.02]	0.97 [0.94-0.99]	0.80 [0.75-0.85]	0.82 [0.79-0.84]	0.81 [0.78-0.84]
1.22 [1.18-1.26]	1.32 [1.27-1.38]	0.97 [0.94-1.002]	1.23 [1.19-1.26]	0.82 [0.75-0.90]	1.63 [1.58-1.68]	1.64 [1.57-1.71]
1.25 [1.20-1.30]	1.35 [1.29-1.41]	0.92 [0.89-0.95]	1.14 [1.11-1.18]	0.84 [0.77-0.92]	1.67 [1.61-1.72]	1.63 [1.56-1.70]
0.72 [0.70-0.75]	0.56 [0.53-0.58]	0.97 [0.94-1.00]	0.98 [0.95-1.001]	1.14 [1.06-1.23]	0.73 [0.70-0.75]	1.27 [1.22-1.33]
0.73 [0.71-0.76]	0.55 [0.53-0.58]	1.01 [0.97-1.04]	0.98 [0.95-1.01]	1.13 [1.05-1.22]	0.73 [0.71-0.76]	1.26 [1.20-1.31]
0.96 [0.92-1.02]	0.97 [0.92-1.03]	1.05 [1.004-1.10]	1.15 [1.11-1.19]	1.01 [0.90-1.13]	0.85 [0.81-0.89]	0.98 [0.92-1.04]
0.97 [0.92-1.02]	0.91 [0.86-0.98]	1.00 [0.95-1.05]	1.12 [1.08-1.17]	1.05 [0.93-1.18]	0.83 [0.79-0.87]	0.92 [0.86-0.98]
0.87 [0.83-0.91]	1.12 [1.07-1.18]	1.15 [1.11-1.19]	0.93 [0.90-0.96]	1.02 [0.93-1.12]	1.02 [0.98-1.06]	1.09 [1.03-1.15]
0.84 [0.80-0.88]	1.07 [1.02-1.13]	1.15 [1.11-1.20]	0.98 [0.94-1.02]	1.04 [0.94-1.14]	1.00 [0.96-1.04]	1.11 [1.05-1.18]
0.97 [0.93-1.02]	1.01 [0.96-1.06]	1.13 [1.09-1.17]	0.97 [0.94-1.00]	0.97 [0.88-1.07]	0.98 [0.94-1.02]	0.99 [0.94-1.05]
0.98 [0.93-1.02]	0.98 [0.93-1.04]	1.07 [1.03-1.11]	0.95 [0.91-0.98]	0.99 [0.90-1.10]	0.96 [0.92-0.998]	0.95 [0.89-1.003]
1.34 [1.30-1.39]	1.58 [1.52-1.64]	0.54 [0.53-0.55]	0.98 [0.96-1.001]	1.04 [0.97-1.12]	0.88 [0.85-0.90]	1.19 [1.14-1.24]
1.34 [1.29-1.38]	1.56 [1.49-1.62]	0.53 [0.51-0.54]	0.97 [0.94-0.999]	1.05 [0.97-1.12]	0.87 [0.85-0.90]	1.17 [1.12-1.22]

Additional file 2. Correlations within and between interventions and obstetric outcomes tested with Spearman's rho (two-tailed significance level)

All correlations are based on adjusted OR's of the intervention rates of the region (adjusted for parity, maternal age, ethnic background, socioeconomic status and urbanisation). The correlations are therefore on region level and not on individual women level.

A p-value of 0.05 corresponds with a correlation of $\rho \geq 0.57$ or ≤ -0.57 (95% confidence intervals 0.001-0.86).

Since the sample size for all measured correlations is the same, namely 12 regions, the correlation is significant at the same value of ρ for all measured correlations. Correlations with $\rho \geq 0.60$ or ≤ -0.60 are indicated in bold type, since they are considered strong.

Table 5. Correlations within interventions among women in midwife-led and interventions among women in obstetrician-led care at onset of labour

		Interventions among women in midwife-led care at onset of labour					
		Augmentation after spontaneous onset of labour	***Epidural****	***Other pharmacological pain relief****	***Instrumental vaginal birth****	***Intrapartum CS****	***Involvement paediatrician <24 hours***
Interventions among women in obstetrician-led care at onset of labour	*Augmentation after spontaneous onset of labour*	ρ = 0.76					
	*Epidural**		ρ = 0.97				
	*Other pharmaco-logical pain relief**			ρ = 0.97			
	*Instrumental vaginal birth**				ρ = 0.70		
	*Intrapartum CS**					ρ = 0.43	
	Involvement paediatrician <24 hours						ρ = 0.67

*Measured in a group of women without prelabour CS.

Table 6. Correlations between interventions in subgroups of women in midwife- or obstetrician-led care at onset of labour

		Interventions among women in midwife-led care at onset of labour		Interventions among women in obstetrician-led care at onset of labour	
		Epidural	*Instrumental vaginal birth*	*Epidural**	*Instrumental vaginal birth**
Interventions among women in midwife-led care at onset of labour	*Other pharmacological pain relief*	ρ = - 0.61			
	Intrapartum CS		ρ = 0.60		
Interventions among women in obstetrician-led care at onset of labour	*Other pharmacological pain relief**			ρ = - 0.68	
	*Intrapartum CS**				ρ = 0.45

*Measured in a group of women without prelabour CS.

Table 7. Correlations between interventions

	Induction of labour	*Augmentation after spontaneous onset of labour*	*Intrapartum oxytocin use*	*Epidural**	*Other pharmacological pain relief**	*Instrumental vaginal birth**	*Prelabour CS*	*Involvement paediatrician <24 hrs*
Induction of labour		ρ = 0.01		ρ = - 0.39	ρ = 0.55	ρ = 0.56		ρ = 0.07
Augmentation after spontaneous onset of labour				ρ = 0.10	ρ = 0.24	ρ = - 0.61		ρ = 0.25
Intrapartum oxytocin use				ρ = - 0.49	ρ = 0.10	ρ = 0.09		ρ = 0.03
Epidural*					ρ = - 0.61	ρ = - 0.50		ρ = 0.56
Other pharmacological pain relief*						ρ = 0.08		ρ = - 0.22
Instrumental vaginal birth*								ρ = - 0.39
Prelabour CS	ρ = 0.19							ρ = 0.28
Intrapartum CS*	ρ = 0.48	ρ = - 0.23	ρ = - 0.02	ρ = - 0.42	ρ = 0.52	ρ = 0.29	ρ = 0.67	ρ = 0.12
Spontaneous vaginal birth	ρ = - 0.54	ρ = 0.66	ρ = 0.25	ρ = 0.20	ρ = - 0.18	ρ = - 0.72	ρ = - 0.62	ρ = - 0.06

*Measured in a group of women without prelabour CS.

Table 8. Correlations between interventions and obstetric outcomes

		Obstetric outcomes		
		Apgar score below 7 at 5 minutes	*3rd and 4th degree perineal tear for vaginal births*	*Postpartum haemorrhages ≥1000 ml*
Interventions among all women	*Induction of labour*	ρ = 0.11	ρ = - 0.12	ρ = 0.09
	Augmentation after spontaneous onset of labour	ρ = 0.05	ρ = 0.09	ρ = 0.87
	Intrapartum oxytocin use	ρ = 0.41	ρ = 0.16	ρ = 0.35
	*Epidural**	ρ = - 0.10	ρ = 0.02	ρ = 0.22
	*Other pharmacological pain relief**	ρ = - 0.04	ρ = - 0.14	ρ = 0.20
	Spontaneous vaginal birth	ρ = - 0.29	ρ = 0.00	ρ = 0.55
	*Instrumental vaginal birth**	ρ = 0.24	ρ = - 0.11	ρ = - 0.55
	Caesarean section	ρ = 0.20	ρ = 0.09	ρ = 0.16
	Involvement paediatrician <24 hours	ρ = 0.17	ρ = - 0.13	ρ = 0.24

*Measured in a group of women without prelabour CS.

3

Regional variations in childbirth interventions and their correlations with adverse outcomes, birthplace and care provider: a nationwide explorative study

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Abstract

Background
Variations in childbirth interventions may indicate inappropriate use. Most variation studies are limited by the lack of adjustments for maternal characteristics and do not investigate variations in adverse outcomes. This study aims to explore regional variations in the Netherlands and their correlations with referral rates, birthplace, interventions, and adverse outcomes, adjusted for maternal characteristics.

Methods
In this nationwide retrospective cohort study, using a national data register, intervention rates were analysed between twelve regions among single childbirths after 37 weeks' gestation in 2010-2013 (n=614,730). These were adjusted for maternal characteristics using multivariable logistic regression. Primary outcomes were intrapartum referral, birthplace, and interventions used in midwife- and obstetrician-led care. Correlations both between primary outcomes and between adverse outcomes were calculated with Spearman's rank correlations.

Findings
Intrapartum referral rates varied between 55-68% (nulliparous) and 20-32% (multiparous women), with a negative correlation with receiving midwife-led care at the onset of labour in two-thirds of the regions. Regions with higher referral rates had higher rates of severe postpartum haemorrhages. Rates of home birth varied between 6-16% (nulliparous) and 16-31% (multiparous), and was negatively correlated with episiotomy and postpartum oxytocin rates. Among midwife-led births, episiotomy rates varied between 14-42% (nulliparous) and 3-13% (multiparous) and in obstetrician-led births from 46-67% and 14-28% respectively. Rates of postpartum oxytocin varied between 59-88% (nulliparous) and 50-85% (multiparous) and artificial rupture of membranes between 43-52% and 54-61% respectively. A north-south gradient was visible with regard to birthplace, episiotomy, and oxytocin.

Conclusions
Our study suggests that attitudes towards interventions vary, independent of maternal characteristics. Care providers and policy makers need to be aware of reducing unwarranted variation in birthplace, episiotomy and the postpartum use of oxytocin. Further research is needed to identify explanations and explore ways to reduce unwarranted intervention rates.

Introduction

Rates of interventions during childbirth have been studied worldwide and large variations between countries have been reported (1). Interventions during childbirth can be crucial in order to prevent neonatal and maternal morbidity and mortality (2) and, therefore, underuse of healthcare services can be an important cause of preventable morbidity and mortality. On the other hand, use without a medical indication may cause avoidable harm, given the risk of adverse effects related to interventions (3-5).

Worldwide, rates of most interventions and referrals during childbirth have increased (1, 6, 7), episiotomy being the exception (1, 8). The rate of home births varies worldwide and is low in most high-income countries. For instance, in 2017, the rate of home births was 1% in the USA (9), 0.3% in Australia (10), and 2% in England and Wales (11). The rate of referrals depends on the maternity care system in a country. Alliman et al. (2016) showed a range of intrapartum referral rates from birth centres to hospitals of between 12% and 37% (12), and Blix et al. (2014) a referral rate range from home to hospital of between 10% and 32% (13). Episiotomy rates vary largely, from 5% in Denmark, to 75% in Cyprus (14).

In the Netherlands, a variation in intrapartum referral rates among midwifery practices has been shown of between 10% and 64% (15). Since the late twentieth century, referrals during pregnancy and labour have increased continuously. Where in 1999 more than 60% of women received midwife-led care at the onset of labour, this number has decreased to 51% in 2015 (15, 16). The rate of home births has historically been high in the Netherlands. However, the rate of home births declined from 23% in 2000 to 13% in 2015 (15, 16). Episiotomy rates declined from 23% in 2005 to 13% in 2015 in the Netherlands.

Variations in the use of interventions between countries may be explained by differences in maternal and perinatal characteristics and perinatal healthcare systems (18). For example, parity, maternal age, ethnicity, and birthweight are associated with the use of episiotomy (19). However, since these factors are likely to be more similar within a specific country, less variation may be expected within a country than between countries (20). If variations persist after adjustment for maternal characteristics, then this may indicate that variations are unwarranted and it may indicate inappropriate use (20, 21). While on one hand characteristics can be associated with interventions, on the other hand interventions can be associated with improved or worsened neonatal and maternal outcomes (2-5). Therefore, intervention rates should be investigated in view of adverse outcomes. Similar neonatal and maternal outcomes between regions together with variations in interventions, is another indicator of unwarranted variation (20, 21).

A first step in addressing possible inappropriate use of interventions is to examine regional variations of intrapartum interventions within a country (20). Regional variation would not be expected in a relatively small country such as the Netherlands without regional differences in the maternity healthcare system. In the Dutch maternity care system, low-risk women start antenatal care in midwife-led primary care. Midwives refer women to obstetrician-led care when risks of adverse outcomes increase or complications arise. Interventions such as episiotomy, artificial rupture of membranes (AROM), and postpartum administration of oxytocin are used in both midwife-led and obstetrician-led care settings (22). Box 1 cites the description of the maternity care system in the Netherlands from our previous publication on regional variations in the Netherlands (23).

Box 1: The maternity care system in the Netherlands (23)

In the Netherlands, there are no regional differences in the maternity healthcare system. Low-risk women start antenatal care in midwife-led primary care. These women are cared for by independent midwives who attend home births, low-risk hospital births, and births in alongside and free-standing birth centres. The Dutch Birth Centre Study showed that health outcomes, experiences, and costs for low-risk women are similar for planned birth in a birth centre and planned birth in a hospital, both supervised by a primary care midwife (24, 25). Midwives refer women to obstetrician-led care when risks of adverse outcomes increase or complications arise. Criteria for referral from midwife-led to obstetrician-led care have been laid out in the obstetric indication list of 2003. Interventions in childbirth such as induction and augmentation of labour, pain medication, instrumental birth, and CS, are only available in an obstetrician-led care setting (22, 25). These intrapartum interventions may be used for women in midwife-led care at the onset of labour after referral to obstetrician-led care. Interventions such as episiotomy, artificial rupture of membranes (AROM), and postpartum administration of oxytocin are used in both midwife-led and obstetrician-led care settings (22). The Steering Committee 'Pregnancy and birth' recommended in 2009 more integration in maternity care between midwife-led and obstetrician-led care, which led to several regional initiatives to change the organisation of care, but there was not one uniform, national model (27).

The decreased rate of midwife-led births in the Netherlands corresponded with an increased use of interventions on the national level (15, 28). A previous article described regional variations in rates of induction and augmentation of labour, pain medication, caesarean section, and involvement of paediatrician in the first 24 h after birth (23). Little information is available as to how regional variations in rates of referral, place of birth, and interventions during childbirth, relate to each other, nor how they might relate to adverse neonatal

and maternal outcomes. Knowledge on these correlation will give insight into underlying processes of variations in childbirth interventions, place of birth, and referral, and will help care providers and policy makers to know which variation is large and likely unwarranted and should therefore be the focus of changes in practices and policies with the ultimate aim to improve the quality of maternity care. This article focuses on rates of referral, place of birth, and interventions that are used in both primary midwife-led, and secondary obstetrician-led care. The first aim of this study was to explore which regional variations in intrapartum rates of referral, place of birth, and use of intrapartum interventions, exist for women who gave birth in the Netherlands between 2010 and 2013. Secondly, we aimed to investigate how these variations are correlated to each other. Thirdly, we examined the association between variations, and adverse neonatal and maternal outcomes, adjusted for maternal characteristics.

Methods

Data collection

The methods of this explorative study have been described previously in more detail (23). For this nationwide study, we used data on single births after 37 weeks of gestation. We focused on single births because multiple pregnancies are associated with much higher risks of adverse outcomes and therefore medical interventions are often justified. These data originated from the national register, "Perined", covering the years 2010 up to 2013 and including 98% of all births in the Netherlands after 24 weeks of gestation (29). Patient records were excluded when data were missing on: postal codes or parity; or when data were missing from the midwifery database of women that received both midwife- and obstetrician-led care. The pitfalls in the use of data based on the national register have been described in a recently published article (30).

Selection of variables

We used the twelve Dutch administrative provinces as regions. A record of a birth was allocated to a region on the basis of the mother's residential postal code. All women, in all regions, have access to all types of birth settings and therefore, these regions were comparable.

Care processes

The following primary outcome variables concerning maternity care processes were examined: the number of women receiving midwife-led care at the onset of their pregnancy, at the onset of labour, and at the time of birth; intrapartum referral to obstetrician-led care, and the planned, and actual place of birth (home, hospital and birth centre midwife-led, hospital obstetrician-led). The onset of labour was defined as the onset of active uterine contractions or rupture of membranes. Intrapartum referral to an obstetrician-led care setting was defined as a referral after the onset of labour and before birth. The planned

place of birth was defined as that at the onset of labour. Therefore, women who were referred, during pregnancy and before labour, to obstetrician-led care could not have a birth planned in midwife-led care.

Interventions
The following primary outcome variables concerning interventions were examined: the rates of episiotomy in vaginal births; AROM, and postpartum administration of oxytocin. Data about AROM and postpartum administration of oxytocin were only available in the midwifery part of the perinatal database and were therefore not described for the obstetrician-led care group.

Adverse outcomes
Secondary neonatal and maternal outcomes were: antepartum and intrapartum stillbirth; neonatal mortality up to seven days; Apgar score below seven at five minutes; third or fourth degree perineal tear among vaginal births; and postpartum haemorrhages (PPH) of more than 1,000 ml.

Data analysis
The differences between primary outcomes per region were analysed initially as a whole and then in subgroups of women in midwife-led or in obstetrician-led care, at the onset of labour and at the time of birth. Crude rates were given separately for nulliparous and multiparous women since rates of interventions are not comparable for these groups. The analyses were conducted on the level of the women, with the region as independent variable, and the primary or secondary outcome as dependent variable. In the logistic regression analyses, the overall rate of the outcome we investigated, weighted for the number of women per region, was considered as a reference. Univariable analyses were conducted in order to gain insight into the variations in the rates of primary and secondary outcomes among the twelve regions. These were followed by multivariable logistic regression analyses with adjustments for: maternal age (<40 years, 40 years or older); ethnic background (Dutch, non-Dutch); socioeconomic position (low, medium or high) - based on postal code and education, employment and level of income; and the degree of urbanisation (rural, intermediate or urban) - based on women's residential postal code (Statistics Netherlands). A confidence interval of 99% was chosen to account for multiple testing within a large dataset. The aim of these analyses was to explore differences between the regions, which are not explained by maternal characteristics, but may be explained by variations between care professionals and/or care settings such as midwifery practices and hospitals. Therefore, we did not perform multilevel analyses.

Figures with maps of the regions and boxplots with adjusted odds ratios (ORs) and confidence intervals were used to visualise the results. To test whether variables with a significant regional variation correlated with each other, a Spearman's rank correlation coefficient was calculated. Correlations in the 12 regions with rho ≥ 0.57 or ≤ - 0.57 corresponded with a p-value of 0.05, and

a correlation of rho ≥ 0.60 or ≤ - 0.60 was considered strong (31). Statistical analyses were performed using SPSS Statistics 22 (SPSS Inc, Chicago, IL, USA).

Results

Overall variation

The total number of women in this study was 614,730. The number of women in midwife- or obstetrician-led care at the onset of labour and at the time of birth, for nulliparous and multiparous women separately, are presented in fig 1. Maternal characteristics have previously been published (1). Fig 2 shows that the largest regional variations for the use of episiotomy and postpartum administration of oxytocin, were found in women who received midwife-led care at the time of birth. Adjustments for maternal age, ethnic background, socioeconomic position and the degree of urbanisation did not lead to substantial changes in regional variation. Therefore, we have shown the adjusted ORs only in the supplementary tables. Lower rates of episiotomy and postpartum administration of oxytocin were found in regions where home births were more common (rho = - 0.60 and - 0.79, respectively; S4 Table).

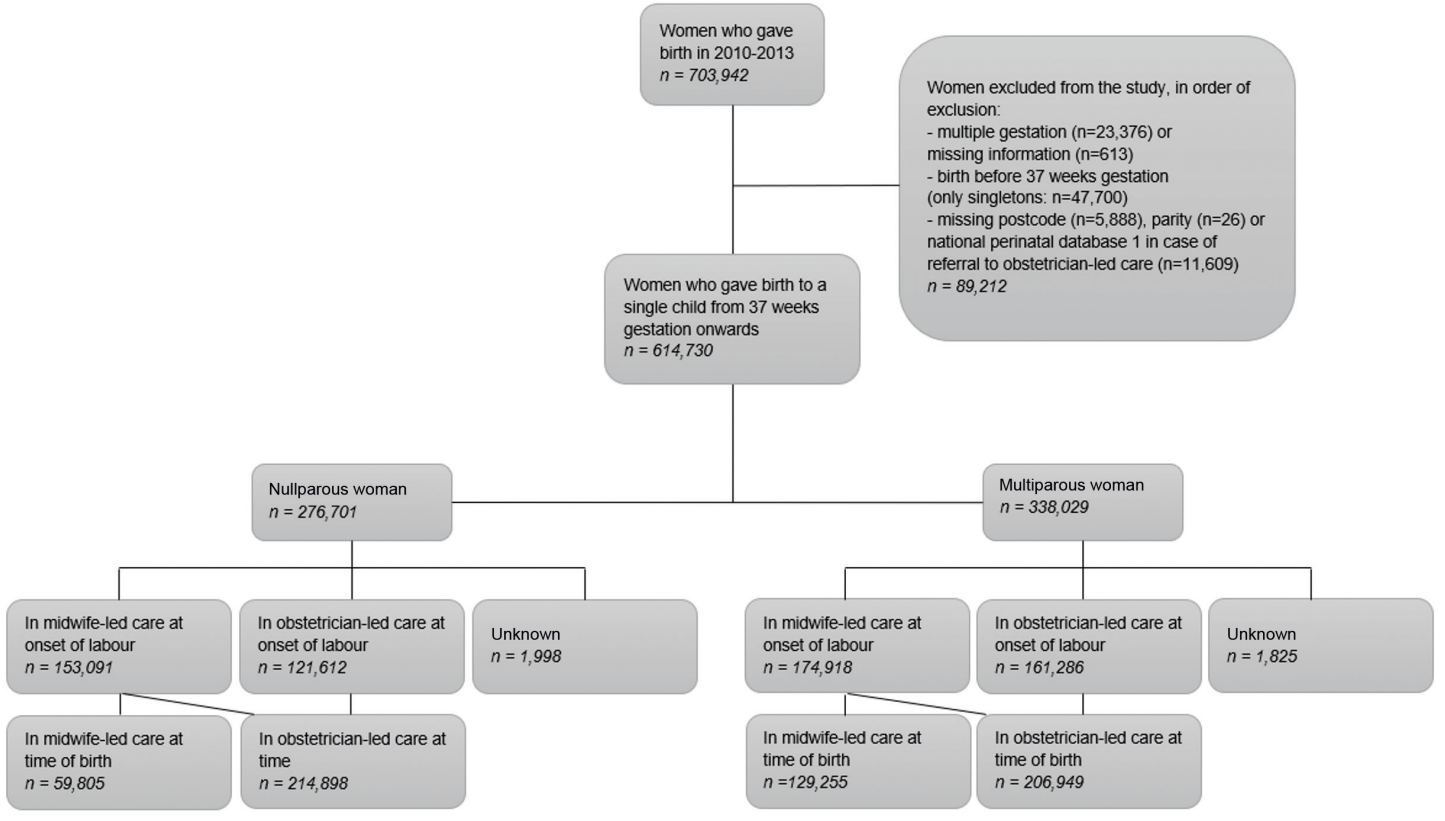

Figure 1. Study population

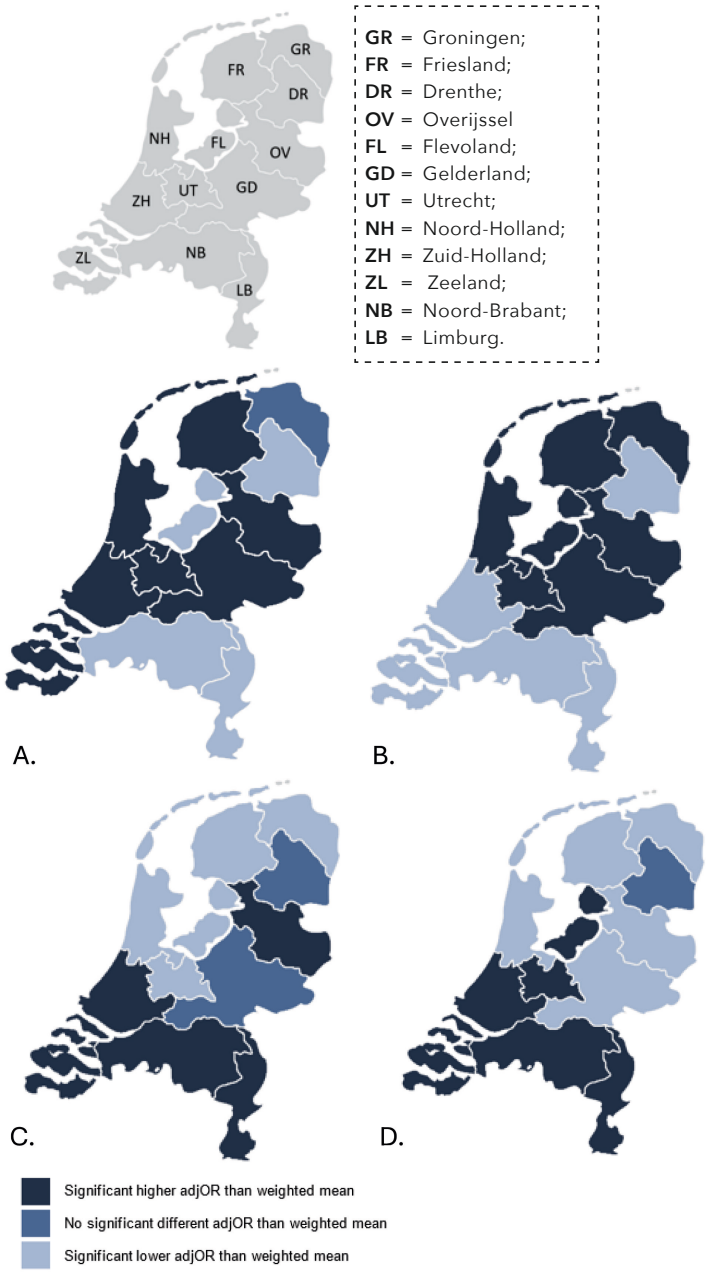

Figure 2. Interregional variation in adjusted* odds ratio (OR) of number of:
a. women in midwife-led care at time of birth
b. actual home births
c. episiotomy
d. oxytocin postpartum among women in midwife-led care
* Adjusted for parity, maternal age, ethnic background, socioeconomic position and urbanisation

Variations in referral and place of birth

Table 1 shows the rates of the primary outcomes for each region. In nulliparous women, variations in regions were found of between 84% and 93% for being in midwife-led care at the onset of pregnancy, of between 47% and 61% at the onset of labour, and of between 17% and 26% at the time of birth. These rates were similar for multiparous women, with the exception that there were higher levels for women receiving midwife-led care at the time of birth, with a variation of between 33% and 43%. Correlations are shown in S4 and S5 Tables, which are available in the supplementary material. In regions with more women in midwife-led care at the onset of labour, there were more births in midwife-led care (rho = 0.84) and more home births (rho = 0.69; S4 Table).

Adjusted ORs of variations in the rates of primary outcomes can be found in S3 Tables. Adverse neonatal and maternal outcomes have been described in a previous article (23). A visualisation of the adjusted ORs is provided in figs 2 to 7. Fig 3 shows that in eight regions the number of women in midwife-led care at the onset of labour was negatively correlated with intrapartum referral rates to obstetrician-led care, but the overall correlation was not significant (rho = - 0.40; S4 Table). Rates of intrapartum referrals from midwife-led to obstetrician-led care varied from between 55% to 68% for nulliparous and from between 20% to 32% for multiparous women (table 1). The correlations are shown in S5 Table. In regions where referral rates were higher, rates of PPH were higher as well (rho = 0.74; S5 Table).

Rates of planned home births varied from between 7% to 30% among nulliparous and from between 11% to 32% among multiparous women. For actual home birth, rates varied from between 6% to 16% among nulliparous and from between 16% to 31% among multiparous women (table 1). Planned and actual home birth were strongly correlated with each other (rho = 0.98; S4 Table).

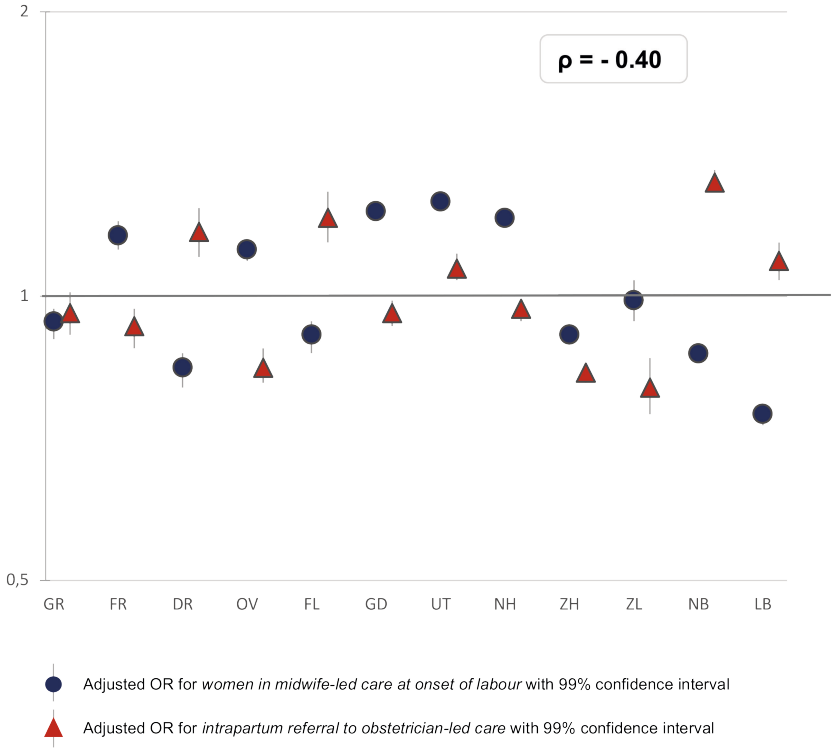

Figure 3. Interregional variation in midwife-led care at onset of labour and intrapartum referral* to obstetrician-led care
* Referral to obstetrician-led care during labour: only women in midwife-led care at the onset of labour are shown. The reference category (OR of 1.0) is the weighted overall rate of the country.

Table 1. Primary outcomes: process of care and intervention rates by region

All nulliparous women													
	Total	**GR**	**FR**	**DR**	**OV**	**FL**	**GD**	**UT**	**NH**	**ZH**	**ZL**	**NB**	**LB**
Total *n*	**276,701**	8,901	9,564	6,785	18,051	7,233	30,961	23,662	49,582	63,785	4,853	38,544	14,780
Women in midwife-led care, %													
At onset of pregnancy	**88.5**	90.4	92.5	90.6	90.0	90.5	91.2	92.4	89.9	83.6	89.5	89.1	83.7
At onset of labour	**55.7**	54.4	59.8	52.5	57.4	55.2	60.2	60.7	59.8	52.0	55.7	52.6	46.7
At time of birth	**21.8**	21.7	25.6	19.1	24.8	17.8	23.8	21.9	23.0	22.6	25.1	17.2	17.4
Planned place of birth, %													
Home	**16.7**	17.8	30.1	19.1	26.2	16.7	24.5	16.3	15.1	12.4	6.8	15.0	10.5
Hospital/birth centre midwife-led	**30.0**	33.5	26.1	30.5	25.2	34.1	28.4	35.2	33.9	29.9	30.5	26.4	25.7
Hospital obstetrician-led	**44.2**	45.6	40.2	47.5	42.6	44.8	39.7	39.3	39.9	47.8	44.2	47.3	53.2
Other/unknown	**9.1**	3.1	3.6	2.8	5.9	4.4	7.4	9.3	11.1	9.9	18.5	11.3	10.5
Actual place of birth*, %													
Home	**9.8**	11.3	15.8	10.3	14.0	9.3	14.4	9.6	10.1	7.4	5.5	7.7	7.3
Hospital/birth centre midwife-led	**10.9**	10.0	9.5	8.7	10.3	8.4	8.9	11.5	11.6	13.5	18.9	8.6	9.7
Hospital obstetrician-led	**79.2**	78.6	74.7	81.1	75.7	82.3	76.7	78.9	78.3	79.1	75.6	83.7	83.1
Episiotomy in vaginal births, %	**47.4**	42.1	44.4	49.2	52.0	39.1	47.4	43.2	38.9	49.4	59.9	54.7	55.7
All multiparous women													
	Total	**GR**	**FR**	**DR**	**OV**	**FL**	**GD**	**UT**	**NH**	**ZH**	**ZL**	**NB**	**LB**
Total *n*	**338,029**	10,540	13,004	9,090	24,818	10,228	40,325	29,231	56,366	75,788	6,474	45,643	16,522
Women in midwife-led care, %													
At onset of pregnancy	**84.1**	84.8	88.6	83.6	86.8	83.3	87.0	88.1	84.9	79.7	84.4	84.2	79.2
At onset of labour	**52.0**	49.3	55.5	47.8	55.2	48.6	56.9	56.0	54.5	49.5	52.3	47.9	46.1
At time of birth	**38.4**	37.9	42.7	34.9	42.6	33.5	43.0	40.7	39.9	37.2	41.9	32.8	33.9
Planned place of birth, %													
Home	**20.5**	21.1	32.0	22.1	29.4	19.4	28.6	20.4	19.3	16.5	10.8	17.4	13.5
Hospital/birth centre midwife-led	**23.7**	24.9	19.4	23.6	19.6	24.0	21.9	27.9	26.5	24.1	26.0	22.2	21.4
Hospital obstetrician-led	**47.9**	50.7	44.5	52.2	44.8	51.4	43.1	44.0	45.3	50.3	47.7	52.0	53.8
Other/unknown	**7.9**	3.3	4.1	2.1	6.2	5.2	6.4	7.7	8.9	9.1	15.5	8.3	11.3

Table 1. Primary outcomes: process of care and intervention rates by region (continued)

Actual place of birth*, %													
Home	**21.4**	22.7	30.5	20.6	28.8	21.0	29.3	21.6	20.7	17.4	15.9	17.3	17.3
Hospital/birth centre midwife-led	**16.0**	14.9	11.7	14.2	13.3	12.3	13.2	18.2	17.6	18.0	25.5	14.2	16.1
Hospital obstetrician-led	**62.7**	62.4	57.8	65.2	57.9	66.7	57.5	60.2	61.7	64.6	58.6	68.5	66.6
Episiotomy in vaginal births, %	**14.8**	11.9	13.4	15.1	16.6	9.9	15.3	12.4	10.4	14.8	20.2	19.8	20.6
Midwife-led care at onset of labour													
	Total	**GR**	**FR**	**DR**	**OV**	**FL**	**GD**	**UT**	**NH**	**ZH**	**ZL**	**NB**	**LB**
Total *n*	**328,009**	10,013	12,901	7,884	23,922	8,942	41,401	30,601	59,750	70,023	6,068	42,040	14,464
Intrapartum transfer to obstetrician-led care, %													
nulliparous	**60.9**	60.2	57.1	63.5	56.8	67.7	60.5	63.9	61.5	56.6	54.9	67.2	62.8
multiparous	**26.1**	23.1	23.0	26.9	22.8	31.1	24.4	27.3	26.8	24.8	19.7	31.6	26.5
AROM, %													
nulliparous	**46.9**	45.3	49.5	47.9	47.3	51.6	46.8	44.4	46.9	48.1	50.0	46.1	43.3
multiparous	**57.3**	53.9	56.3	60.1	59.1	58.2	56.8	55.3	55.4	58.9	61.0	58.7	55.1
Midwife-led care at time of birth													
	Total	**GR**	**FR**	**DR**	**OV**	**FL**	**GD**	**UT**	**NH**	**ZH**	**ZL**	**NB**	**LB**
Total *n*	**189,060**	5,912	7,985	4,461	14,962	4,706	24,600	17,014	33,578	42,223	3,922	21,557	8,140
Postpartum administration of oxytocin, %													
nulliparous	**76.0**	59.0	71.6	74.1	69.9	76.7	68.8	80.3	73.2	80.7	88.2	81.4	85.3
multiparous	**69.1**	50.3	61.6	70.1	60.0	72.9	61.8	72.4	66.7	73.5	84.6	77.0	80.3
Episiotomy, %													
nulliparous	**23.4**	17.0	19.4	25.9	32.9	13.8	23.4	19.1	14.4	26.2	41.7	28.1	31.6
multiparous	**7.0**	4.8	5.7	7.2	9.5	3.4	7.3	5.3	4.0	6.8	12.5	10.5	9.7

Table 1. Primary outcomes: process of care and intervention rates by region (continued)

Obstetrician-led care at time of birth													
	Total	**GR**	**FR**	**DR**	**OV**	**FL**	**GD**	**UT**	**NH**	**ZH**	**ZL**	**NB**	**LB**
Total *n*	**421,847**	13,477	14,512	11,375	27,678	12,712	46,372	35,665	71,249	96,023	7,368	62,386	23,030
Episiotomy in vaginal births, %													
nulliparous	**55.7**	50.8	55.4	56.0	59.7	45.7	56.5	51.4	48.2	57.3	67.4	61.6	61.9
multiparous	**20.9**	17.3	20.6	20.4	23.3	13.9	22.6	18.5	15.9	20.4	27.2	25.5	27.8

GR=Groningen; FR=Friesland; DR=Drenthe; OV=Overijssel; FL=Flevoland; GD=Gelderland; UT=Utrecht; NH=Noord-Holland; ZH=Zuid-Holland; NB=Noord-Brabant; LB=Limburg. These regions are the twelve provinces in the Netherlands.
Percentage of missing data: 0.0% for women in midwife-led care at onset of pregnancy, 0.6% for women in midwife-led care at onset of labour, 0.6% for women in midwife-led care at time of birth, 0.4% for planned place of birth, 0.6% for actual place of birth, 0.0% for transfer to obstetrician-led care during labour, 3.8% for artificial rupture of membranes, 4.2% for episiotomy, 3.7% for oxytocin postpartum.
* Due to some missing values in the actual place of birth variable, the rates of actual home birth and midwife-led birth in a hospital or birth centre do not add up to the total rate of women in midwife-led care at time of birth.

Variations in childbirth interventions

There was a considerable north-south divide with regard to the place of birth, episiotomy and postpartum administration of oxytocin. Rates of home births were higher in the north of the country than in the south (fig 2), and were negatively correlated with episiotomy (rho = - 0.60; S4 Table).

Rates of postpartum administration of oxytocin among women in midwife-led care at the time of birth varied from between 59% to 88% among nulliparous women and from between 50% to 85% among multiparous women (table 1). Overall, among women in midwife-led care, the correlation of actual home birth and postpartum administration of oxytocin was rho = - 0.79 (fig 4). In regions where midwives more frequently administer oxytocin postpartum, overall rates of PPH were not lower (rho = 0.08; S5 Table).

For episiotomy, a variation of between 39% and 60% was found in nulliparous women, and of between 10% and 21% among multiparous women. Variation was greatest for women receiving midwife-led care at the time of birth, with rates varying from between 14% to 42% among nulliparous women and from between 3% to 13% among multiparous women. Among women receiving obstetrician-led care, rates varied from between 46% to 67% among nulliparous women and from between 14% to 28% among multiparous (table 1). There was a strong correlation between episiotomy rates in midwife-led and in obstetrician-led care settings within the same region (rho = 0.96, fig 5). The correlation between the adjusted ORs of actual home birth and episiotomy was rho = - 0.60 (S4 Table). We did not find a correlation between the adjusted ORs of episiotomy and third or fourth degree perineal tear in vaginal births (rho = - 0.20; S5 Table and figs 6a and 6b).

Least variation was found for AROM among women receiving midwife-led care at the onset of labour (fig 7). Here rates varied from between 43% to 52% among nulliparous women and from between 54% to 61% among multiparous (table 1). Except for the positive correlation between intrapartum referral and PPH (rho = 0.74), correlations with other adverse outcomes were not statistically significant.

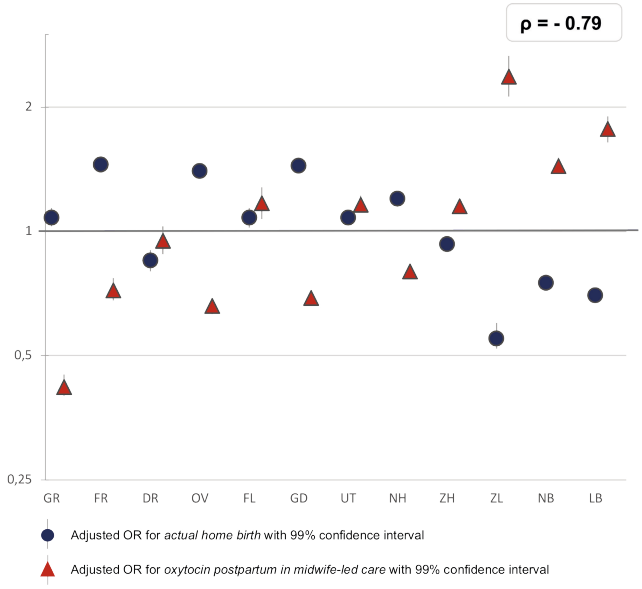

Figure 4. Interregional variation in actual home birth and oxytocin postpartum in midwife-led care
The reference category (OR of 1.0) is the weighted overall rate of the country.

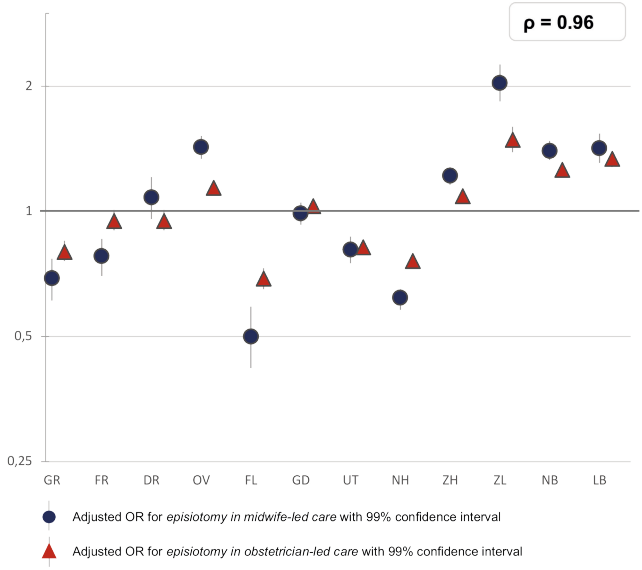

Figure 5. Interregional variation in episiotomy in vaginal births at the time of birth
The reference category (OR of 1.0) is the weighted overall rate of the country.

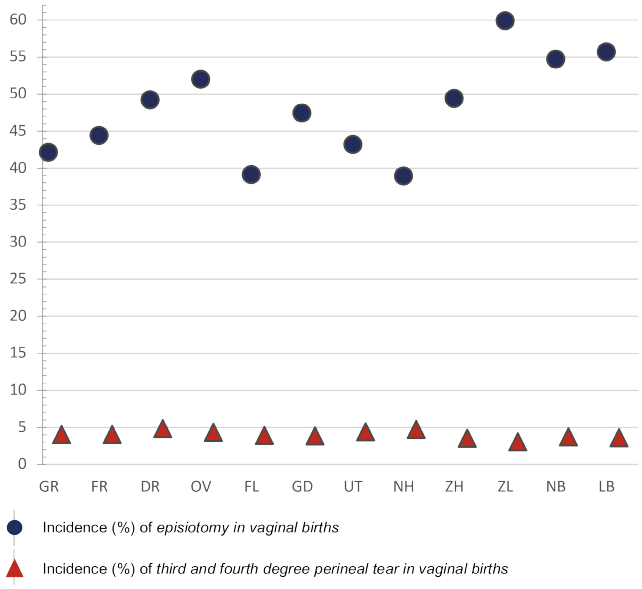

Fig 6A. Crude incidences of episiotomy and 3rd/4th degree perineal tear for nulliparous women with vaginal births
Correlation between adjusted ORs of episiotomy and of 3rd/4th degree perineal tear among all women is rho = - 0.20

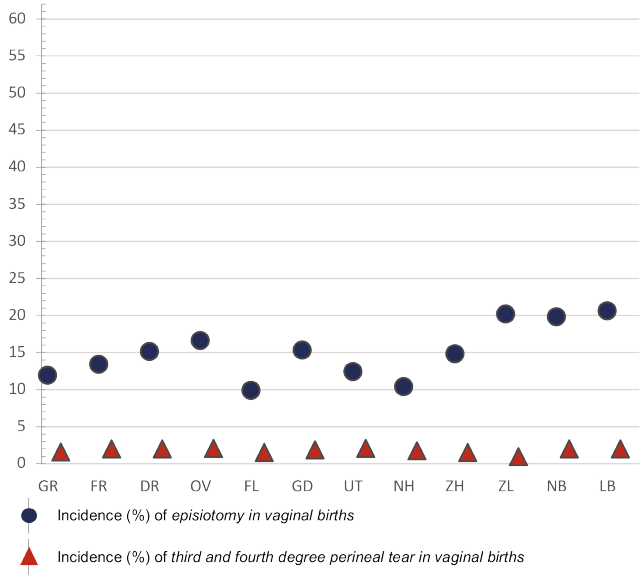

Fig 6B. Crude incidences of episiotomy and 3rd/4th degree perineal tear for multiparous women with vaginal births
Correlation between adjusted ORs of episiotomy and of 3rd/4th degree perineal tear among all women is rho = - 0.20

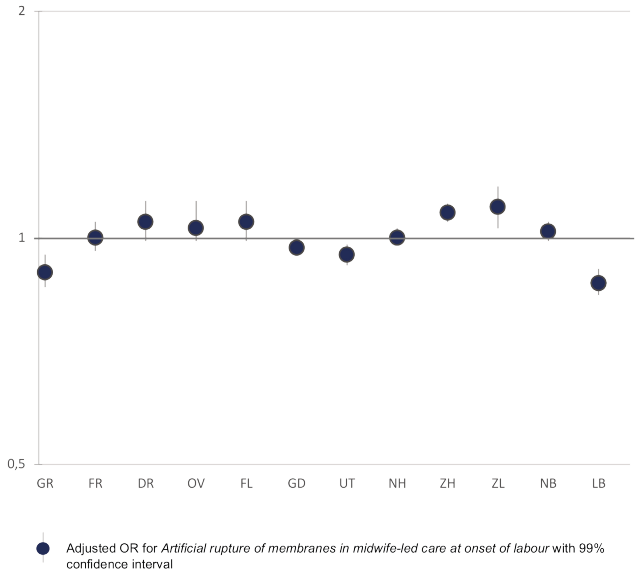

Fig 7. Interregional variation in Artificial rupture of membranes in midwife-led care at onset of labour

Discussion

This study is a first step towards understanding the appropriate use of interventions in childbirth, as was recommended in a Lancet series on Midwifery (2). Most variation was found in the use of episiotomy and postpartum administration of oxytocin in women receiving midwife-led care at the time of birth. These intervention can be applied in both home and hospital births, but lower rates were found in regions with more home births. Although there was a correlation between episiotomy use in midwife-led care and episiotomy use in obstetrician-led care, the variation between regions in episiotomy rates was greater for women receiving midwife-led care. A finding we believe to be significant was the negative correlation that was found in two-thirds of the regions between the number of women in midwife-led care at the onset of labour and intrapartum referral rates. The only correlation that we found with adverse neonatal and maternal outcomes was between intrapartum referral and PPH; there were higher rates of PPH in regions with more intrapartum referrals, which did not include referrals after birth. Significantly, in our study, no correlation was found between the regional adjusted ORs for episiotomy, and third or fourth degree rupture.

Limitations and strengths

A limitation of this study is the absence, or low quality of other relevant data in the register such as the maternal body mass index, congenital disorders, and history of obstetric complications. However, adjustments for maternal

age, ethnic background, socioeconomic position and degree of urbanisation did not lead to considerable changes in ORs. Therefore, it is unlikely that regional variation in underlying morbidity, including variation in indications for interventions, would explain entirely the variations observed. Reporting bias is an issue for datasets based on national registers (30) but we have no indication that misclassifications are different across regions. The number of missing values was very low; there were no outcome variables with more than 1.5% of values missing, and no characteristic variables with more than 2.5% of values missing.
Additionally, the correlation coefficients calculated are only a crude indicator of the relevant and significant correlations between variables, since it was not possible to account for confidence intervals by calculating Spearman's correlation coefficients of adjusted ORs.

A major strength of this study was access to data of the total population of women in the Netherlands who gave birth in the four-year study period. Furthermore, we were able to differentiate between outcomes for women receiving midwife-led and obstetrician-led care, at the onset of labour and at the time of birth. In this manner, the distinction could be made between groups of women at a low and those at a higher risk of complications. This makes confounding by indication less likely. While not all twelve regions have a university hospital, the analyses were based on the women's residential postal code instead of the postal code of the place of birth, thus the presence or absence of a university hospital in a region will have had a limited influence on the results. However, other confounders, such as distance to a hospital, may have had an influence upon the outcomes and may explain, in part, some variations. Correlations which were investigated in this study cannot be interpreted as causal relationships. Further research is needed to examine whether causality exists for the associations found.

Interpretation and further research

Interpretation in view of previous literature

Previous studies on regional variations in other countries, showed a variety in intervention rates across studies. When focusing on the subjects of our study, we found lower rates and less variation in rates of AROM, and, similar to our results, large variations in episiotomy rates. Studies were found on regional variations in episiotomy and AROM in Brazil, Ireland, Canada, and France, but there is a lack of literature on regional variations in care processes. A Brazilian study, including 23,940 women, found rates of AROM varying from between 32% to 48%, and episiotomy rates varying from 49% to 69% across five regions, although variation in episiotomy rates was only significantly different in the region with the highest incidence (32). The episiotomy rate in a study in Ireland, including 323,588 births, varied from between 19% to 27% across four regions, and the rate of AROM varied from between 5% to 9% (33). A study on variation across 13 regions in Canada, including 8,244

women, found varying episiotomy rates of between 5% to 24% (34). A variation of between 1% and 34% was found for episiotomy rates in non-instrumental births across many regions in France, in a study including national data (35).

A result in our study which we believe to be significant is the north-south divide within the country. In northern regions, rates of home births were higher and rates of episiotomy in the total population and postpartum oxytocin administration in midwife-led care were lower. It is unlikely that this can be entirely explained by the different risk profiles of low-risk women giving birth at home, compared to low-risk women giving birth in a hospital or a birth centre. Fewer intrapartum referrals to obstetrician-led care might be expected in regions with fewer women in midwife-led care at the onset of labour because women with higher risks may already have been referred earlier during their pregnancy. Yet, our results showed the opposite for two-thirds of all regions. These findings may be explained by regional policies oriented towards obstetrician-led care, or by the preferences of women which may require more referrals. In regions with higher referral rates, PPH rates were higher as well, which may be explained by the association that was found between the augmentation of labour and PPH in our previous publication (23). Offerhaus et al. (2015) described a similar correlation (15). Previous studies showed non-urgent referrals, such as meconium-stained amniotic fluid, need for pain medication and/or delay in progress of first stage of labour, being the main reasons for intrapartum referrals in the Netherlands (15, 36). Our findings of varying rates of intrapartum referral, which may be correlated with higher PPH rates requires further investigation, before any conclusions in terms of policy with regard to augmentation of labour may be drawn.

Several important bodies, such as the WHO, and the series on Caesarean section and Midwifery in the Lancet, have called for action to reduce the inappropriate use of medical interventions in maternity care. Large regional variation that is not explained by differences in maternal characteristics may be unwarranted. There is a lack of literature on regional variations in interventions, related to place of birth and other care processes. It is important to give more insight in the existing variation to care providers and policy makers, to motivate for reflection on their practice policies, on remarkable high or low rates, and on possible causes of variation. This study is therefore an important step in the reduction of unwarranted variation.

Possible explanations of variations in referrals and interventions

Many studies have investigated midwives' and obstetricians' perceptions of risk and uncertainty surrounding clinical practice behaviours. They showed that perceived higher risk or uncertainty is associated with higher rates of interventions (37-39) and intrapartum referrals (40). Care providers' perceptions of risk or uncertainty may also have an impact upon the preferences of childbearing women. Perceptions among care providers may vary due to differences in education - in particular between different countries

- underlying social history and various developments in attitudes towards interventions during childbirth over time and culture (37, 38, 41). Variations are not merely individual, since care providers are influenced by the culture of their working environment (42). Similar variations in rates of episiotomy between women in midwife-led care versus those in obstetrician-led care, within the same region, may be explained by a number of factors including: the impact of regional guidelines; comparable attitudes towards interventions during childbirth; and the influence different care providers have upon each other with regard to which care strategies are preferred within a region (37, 38, 42). Considerable variation between regions with regard to rates of intrapartum referrals, episiotomy and postpartum administration of oxytocin, particularly in midwife-led care, may indicate lack of national consensus about indications for these practices. Further research into the factors which may influence the clinical practice behaviours mentioned above is needed to identify the underlying causes, attitudes towards interventions during childbirth, and the perception of risk (41).

Episiotomy

The routine use of episiotomy is not recommended in recent literature (43) or by the World Health Organization (WHO) (44), because it can lead to physical problems such as a lower pelvic floor muscle strength, dyspareunia and perineal pain (3). The WHO recommends restricting episiotomy in normal labour to a rate of ten per cent (44), but there are no national guidelines on indications for episiotomy in the Netherlands. An episiotomy rate of 60% for all nulliparous women, found in one of the regions, suggests that this intervention is not performed in a restrictive manner (43). Since rates of adverse neonatal and maternal outcomes in regions with high episiotomy rates were not lower, such major variation might indicate that episiotomy has been overused in some regions. This warrants further investigation. In our study, a correlation between the regional adjusted ORs for episiotomy, and third or fourth degree perineal tears was not found. In addition, regional variation in performing an episiotomy was considerably larger than the variation in severe perineal tears. An episiotomy is often performed to prevent severe perineal tears (43, 45). However, literature supports other methods to reduce the rate of third or fourth degree tears which do not have adverse effects (46-48).

Artificial rupture of membranes

AROM may reduce the length of time of labour (4) and it might, therefore, decrease the need for augmentation of labour with oxytocin (4). On the other hand, some concerns about possible adverse effects have been suggested (4, 49). The WHO states there should be a valid reason for the artificial rupturing of the membranes in normal labour (44), but there are no national guidelines on indications for AROM in the Netherlands. The average incidence of AROM in our study (47% for nulliparous and 57% for multiparous women in midwife-led care at the onset of labour) was relatively high compared to for instance Germany, where the incidence is 34% and 42% respectively (50). However,

its variation was limited, suggesting a consensus in the use of AROM among midwives. More research is needed to investigate appropriate rates of AROM (4, 44).

Postpartum administration of oxytocin

The large regional variation of postpartum oxytocin among low-risk women, that was found in our study, suggests a lack of a national consensus in midwife-led care. As described by the WHO, the administration of oxytocin seems beneficial for reducing the risk of PPH (44, 51). Our study suggests underuse of oxytocin in the Netherlands in some regions. This may be explained by some midwives, particularly in regions with low rates, not being convinced of the benefits of routine oxytocin for low-risk women (52), and they may be concerned about potential side effects that have been highlighted in literature (5). As has been argued before (5), we recommend further research into the use of routine administration of postpartum oxytocin among low-risk women and to develop a national guideline on this issue.

Conclusions

High rates and large variations were found for intrapartum referral, indicating differences in risk perception between care providers. A correlation was found between intrapartum referral and PPH. More research is required into factors influencing care providers' decision to refer a woman during labour. Higher rates in the use of episiotomy in the total population and postpartum administration of oxytocin in midwife-led care were found in regions with fewer home births. These were not accompanied by better maternal and neonatal outcomes. It seems that existing evidence for restricted use of episiotomy has not been implemented in clinical practice in the Netherlands and large variations in rates of episiotomy and postpartum administration of oxytocin suggest lack of national consensus with regard to these practices. In the short-term, care providers should reflect on their episiotomy practice and restrict the use of episiotomy to evidence-based indications. In the longer-term, policy makers in midwife-led and obstetrician-led care at the national level should achieve consensus on indications for episiotomy and postpartum administration of oxytocin. Further research is needed to identify the reasons for these differences in intervention rates, to explore ways of reducing possibly avoidable interventions, and acquiring evidence-based consensus on the use of interventions.

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Supplementary tables S3, S4 and S5

S3 Table. Multivariable logistic regression of process of care and intervention rates by region, adjusted* OR [99% CI]

All women					
	GR	**FR**	**DR**	**OV**	**FL**
Total *n*	19,441	22,568	15,875	42,869	17,461
Women in midwife-led care at onset of labour	0.94 [0.90-0.97]	1.16 [1.12-1.20]	0.84 [0.80-0.87]	1.12 [1.09-1.15]	0.91 [0.87-0.94]
Women in midwife-led care at time of birth	0.98 [0.94-1.01]	1.15 [1.11-1.19]	0.81 [0.77-0.85]	1.20 [1.17-1.23]	0.83 [0.79-0.87]
Planned home birth	1.05 [1.001-1.10]	1.74 [1.67-1.81]	0.98 [0.93-1.03]	1.59 [1.54-1.63]	1.10 [1.04-1.16]
Actual home birth	1.08 [1.03-1.14]	1.45 [1.39-1.51]	0.85 [0.80-0.90]	1.40 [1.36-1.45]	1.08 [1.02-1.14]
Episiotomy in vaginal births	0.79 [0.75-0.83]	0.87 [0.83-0.91]	1.03 [0.98-1.08]	1.14 [1.10-1.18]	0.70 [0.67-0.74]
Women in midwife-led care at onset of labour					
	GR	**FR**	**DR**	**OV**	**FL**
Total *n*	10,013	12,901	7,884	23,922	8,942
Intrapartum referral to obstetrician-led care	0.96 [0.91-1.01]	0.93 [0.88-0.97]	1.17 [1.10-1.24]	0.84 [0.81-0.88]	1.21 [1.14-1.29]
Artificial rupture of membranes	0.90 [0.86-0.95]	1.00 [0.96-1.05]	1.05 [0.99-1.12]	1.03 [0.99-1.12]	1.05 [0.99-1.12]
Women in midwife-led care at time of birth					
	GR	**FR**	**DR**	**OV**	**FL**
Total *n*	5,912	7,985	4,461	14,962	4,706
Oxytocin postpartum	0.42 [0.40-0.45]	0.72 [0.68-0.77]	0.95 [0.88-1.03]	0.66 [0.63-0.69]	1.17 [1.07-1.28]
Episiotomy	0.69 [0.61-0.77]	0.78 [0.70-0.86]	1.08 [0.96-1.21]	1.43 [1.34-1.52]	0.50 [0.42-0.59]
Women in obstetrician-led care at time of birth					
	GR	**FR**	**DR**	**OV**	**FL**
Total *n*	13,477	14,512	11,375	27,678	12,712
Episiotomy in vaginal births	0.80 [0.76-0.85]	0.95 [0.90-1.01]	0.95 [0.90-1.01]	1.14 [1.10-1.19]	0.69 [0.65-0.73]

*odds ratios, adjusted for parity, maternal age, ethnic background, socioeconomic position and urbanisation.

GD	UT	NH	ZH	ZL	NB	LB
71,286	52,893	105,948	139,573	11,327	84,187	31,302
1.23 [1.20-1.25]	1.26 [1.23-1.29]	1.21 [1.19-1.23]	0.91 [0.89-0.93]	0.99 [0.94-1.04]	0.87 [0.85-0.89]	0.75 [0.73-0.77]
1.19 [1.16-1.21]	1.12 [1.10-1.15]	1.16 [1.14-1.19]	1.05 [1.03-1.07]	1.12 [1.06-1.17]	0.77 [0.76-0.79]	0.79 [0.77-0.82]
1.51 [1.48-1.55]	1.13 [1.10-1.17]	1.18 [1.15-1.21]	0.96 [0.93-0.98]	0.36 [0.33-0.39]	0.84 [0.82-0.86]	0.56 [0.53-0.58]
1.44 [1.41-1.48]	1.08 [1.04-1.12]	1.20 [1.17-1.23]	0.93 [0.90-0.95]	0.55 [0.52-0.60]	0.75 [0.72-0.77]	0.70 [0.67-0.73]
0.98 [0.95-1.002]	0.81 [0.78-0.83]	0.71 [0.69-0.73]	1.10 [1.07-1.12]	1.54 [1.45-1.63]	1.35 [1.31-1.38]	1.40 [1.35-1.45]

GD	UT	NH	ZH	ZL	NB	LB
41,401	30,601	59,750	70,023	6,068	42,040	14,464
0.96 [0.93-0.99]	1.07 [1.04-1.11]	0.97 [0.94-0.99]	0.83 [0.81-0.85]	0.80 [0.75-0.86]	1.32 [1.29-1.36]	1.09 [1.04-1.14]
0.97 [0.95-1.00]	0.95 [0.92-0.98]	1.00 [0.98-1.03]	1.08 [1.05-1.11]	1.10 [1.03-1.17]	1.02 [0.99-1.05]	0.87 [0.84-0.91]

GD	UT	NH	ZH	ZL	NB	LB
24,600	17,014	33,578	42,223	3,922	21,557	8,140
0.69 [0.67-0.72]	1.16 [1.11-1.22]	0.80 [0.78-0.83]	1.15 [1.10-1.19]	2.37 [2.12-2.66]	1.44 [1.38-1.51]	1.77 [1.64-1.90]
0.99 [0.93-1.05]	0.81 [0.75-0.87]	0.62 [0.58-0.65]	1.22 [1.16-1.28]	2.04 [1.84-2.26]	1.40 [1.33-1.48]	1.42 [1.31-1.54]

GD	UT	NH	ZH	ZL	NB	LB
46,372	35,665	71,249	96,023	7,368	62,386	23,030
1.03 [0.99-1.06]	0.82 [0.79-0.85]	0.76 [0.74-0.78]	1.09 [1.06-1.12]	1.49 [1.39-1.60]	1.26 [1.23-1.30]	1.34 [1.28-1.39]

S4 Table. Correlations between process of care variables and interventions

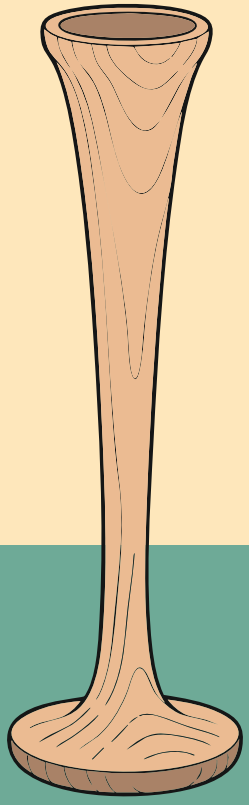
	Women in midwife-led care at onset of labour	*Intrapartum referral to obstetrician-led care*	*Planned home birth*	*Actual home birth*	*Episiotomy in midwife-led care at time of birth*	*Episiotomy in all births*	*Oxytocin postpartum*
Women in midwife-led care at time of birth	**rho = 0.84**	**rho = - 0.66**	**rho = 0.73**	**rho = 0.73**	rho = - 0.06	rho = - 0.20	rho = - 0.57
Intrapartum referral to obstetrician-led care	rho = - 0.40		rho = - 0.15	rho = - 0.21	rho = - 0.33	rho = - 0.26	rho = 0.28
Planned home	**rho = 0.69**			**rho = 0.98**	rho = - 0.48	rho = - 0.57	**rho = - 0.75**
Actual home birth	**rho = 0.69**				rho = - 0.53	**rho = - 0.60**	**rho = - 0.79**
Episiotomy in midwife-led care at time of birth	rho = - 0.31						rho = 0.37
Episiotomy in obstetrician-led care at time of birth		rho = - 0.31			**rho = 0.96**		
Artificial rupture of membranes	rho = - 0.21	rho = - 0.27	rho = - 0.24	rho = - 0.27	rho = 0.28		rho = 0.29

All correlations are based on adjusted ORs of the intervention rates (adjusted for parity, maternal age, ethnic background, socioeconomic position and urbanisation).
A p-value of 0.05 corresponds with a correlation of rho ≥ 0.57 or ≤ - 0.57 (95% confidence intervals 0.001-0.86).
Since the sample size for all measured correlations is the same, namely 12 regions, the correlation is significant at the same value of rho for all measured correlations. Correlations with rho ≥ 0.60 or ≤ - 0.60 are indicated in bold type since they are considered strong.

S5 Table. Correlations between process of care variables or interventions, with obstetric outcomes

Process of care and interventions in subgroups of:		Obstetric outcomes for women in the same subgroup as the process of care or intervention subgroups		
		Apgar score below 7 at 5 minutes	***3rd and 4th degree perineal tear for vaginal births***	***Postpartum haemorrhages ≥1000 ml***
all women	*Women in midwife-led care at onset of labour*	rho = 0.07	rho = 0.11	rho = - 0.37
	Women in midwife-led care at time of birth	rho = 0.01	rho = 0.14	rho = - 0.46
	Planned home birth	rho = 0.30	rho = 0.45	rho = - 0.15
	Actual home birth	rho = 0.46	rho = 0.32	rho = - 0.12
	Episiotomy in vaginal births among all women	rho = - 0.52	rho = - 0.20	rho = - 0.12
women in midwife-led care at onset of labour	*Intrapartum referral to obstetrician-led care*	rho = - 0.05	rho = 0.32	**rho = 0.74**
	Artificial rupture of membranes	rho = - 0.31	rho = - 0.28	rho = - 0.10
women in midwife-led care at time of birth	*Oxytocin postpartum*	rho = - 0.50	rho = - 0.36	rho = 0.08

All correlations are based on adjusted ORs of the intervention rates (adjusted for parity, maternal age, ethnic background, socioeconomic position and urbanisation).
Correlations for still birth and mortality are not calculated since these were not significantly different between the regions.
A p-value of 0.05 corresponds with a correlation of rho ≥ 0.57 or ≤ - 0.57 (95% confidence intervals 0.001-0.86).
Since the sample size for all measured correlations is the same, namely 12 regions, the correlation is significant at the same value of rho for all measured correlations. Correlations with rho ≥ 0.60 or ≤ - 0.60 are indicated in bold type since they are considered strong.



4

Experiences, beliefs, and values influencing midwives' attitude towards the use of childbirth interventions

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Abstract

Background
Intervention rates in perinatal care vary between and within countries, without populations' characteristics as a full explanation. Research suggests that one factor in this variation might be the attitude of perinatal healthcare providers. Systematic knowledge on the background of midwives' attitudes and how this influences the use of interventions is limited.

Aim
To explore experiences, beliefs, and values that influence midwives' attitude towards interventions in perinatal care.

Methods
A qualitative study using in-depth interviews with primary care midwives (n=20) in the Netherlands. The interviews were performed in June 2019 and combined a narrative approach with a semi-structured interview guide. Inductive content analysis was applied.

Findings
We identified two main themes: attitude towards interventions and influences on midwives' attitudes. The midwives in our study described their attitude towards interventions either as one oriented towards wait and see or as one oriented towards check and control. Care based on wait and see displayed a more supportive style of behavior, and care based on check and control appeared to display a more directive style of behavior. In the theme influence on midwives' attitudes three subthemes emerged: experiences in collaboration, trust and fear, and woman centeredness.

Conclusion
Midwives with a wait and see attitude seem to have a more restricted approach towards interventions compared to midwives with a check and control attitude. Midwives need to be aware how their experiences, beliefs, and values shape their attitude towards use of interventions. This awareness could be a first step towards the reduction of unwarranted interventions.

Introduction

The rates of childbirth interventions have shown a steady increase in the last decades (1). For example, in 2000 a caesarean birth was performed on 12.1% of all births worldwide. This number almost doubled in 2015, where the caesarean birth rate was 21.1% (2). Interventions during pregnancy, childbirth, and the postpartum period can prevent both perinatal morbidity and mortality. Inadequate access to timely childbirth interventions jeopardizes positive birth outcomes (3). Conversely, medicalization of normal antenatal, natal, and postnatal care by using unnecessary interventions has negative consequences and seems an even larger problem worldwide (3,4). Childbirth interventions have the potential to harm women, physically and mentally, and their newborns, and therefore unnecessary use should be avoided (5,6). In addition, overuse of childbirth interventions leads to higher health costs (7).

Worldwide, the Netherlands is known for its low intervention rates and high rates of home births. In this country, childbirth has long been defined as a physiologic process where the woman can choose to give birth at home or in a hospital under the care of a midwife (8). Dutch midwives are supposed to be the guardians of physiology and advocate for non-intervention in physiologic childbirth (9). Two thirds of the midwives work in community group practices with 2-5 midwives as independent health professionals paid by insurance companies. They provide antenatal, natal and postnatal care to healthy women registered in this practice, who can choose to give birth with their midwife at home or in the hospital (10). Dutch primary care midwives are an integrated part of the Dutch perinatal care system and collaborate with one or more hospitals in their region (10). The other third of the midwives are employed by hospitals and take care of women with complicated pregnancies or births under the supervision of obstetricians. Almost 90% of pregnant women start antenatal care in midwife-led primary care (11). Midwives refer women to obstetrician-led care when risks of adverse outcomes increase or complications arise (12). Criteria for referral are described in the obstetric indication list of 2003, however, every primary care midwife has the autonomy to refer to obstetrician-led care at any point in care. In addition, primary care midwives can make autonomous decisions together with the woman to perform certain childbirth interventions such as artificial rupture of membranes, episiotomy, and postpartum administration of oxytocin.

During the past decades, a rise in childbirth interventions has been described in the Netherlands (13). Additionally, large variations in childbirth interventions are described between regions in the Netherlands and between Dutch primary midwifery practices, without differences in neonatal or maternal outcomes (12-14). These variations cannot be explained by variation in populations' characteristics and it remains unclear why a group of autonomous midwives in the same small country shows such a wide variation in use of childbirth interventions (12,13). Previous research showed a positive correlation between

intervention rates in midwife-led care and obstetrician-led care within the same region (15). This suggests that culture in the work environment influences care providers within the same region towards comparable use of interventions, and that variations are not merely individual. The wide variation between referral rates among Dutch midwives support the theory that the attitude towards use of interventions differ between midwives (13). Furthermore, fundamental differences between midwives in their willingness to support the physiology of pregnancy and childbirth are known to result in different individual attitudes towards childbirth interventions (16).

According to the theory of planned behavior, individual experiences, beliefs, and values influence a person's attitude, which subsequently, together with social influences and self-efficacy, shapes the intention to perform a specific behavior (17,18). Therefore, the midwife's attitude is an interacting factor in the use of interventions. However, systematic studies on the background of midwives' attitudes and how this influences the use of interventions in perinatal care are limited. The purpose of this study was to explore deeper and identify the experiences, beliefs, and values that shape midwives' attitudes, and how these factors influence their clinical decision-making when deciding to use interventions. These findings can direct further research into deeper understanding of the factors that influence practice variation in the use of interventions.

Methods

Study design

We conducted a qualitative study using in-depth interviews that combined a narrative approach with a semi-structured question route to indicate relevant topics (Table 1). In accordance with the narrative approach, we invited the participating midwives to elaborate and share stories about situations during pregnancy, birth, and the postpartum period where decisions were made on the use of interventions. At start of the interview, midwives described their definition of a childbirth intervention. The narrative approach made it possible to explore which experiences, beliefs, and values of the midwives were important during their clinical decision-making (19). Using a semi-structured interview helped to ensure that all relevant topics were explored. Although acknowledging that not all individuals in perinatal care refer to themselves as women, we have chosen to use 'women' and feminine prepositions.

Setting and participants

Based on data from the Dutch national register Perined, we selected midwifery practices varying in rates of homebirth, episiotomy, and referral during pregnancy or birth. In total, we invited midwives from 56 practices for an interview. Twenty-two primary care midwives accepted the invitation and we interviewed twenty midwives in June 2019. We excluded one midwife because a colleague from the same practice was already interviewed, and one midwife

because no suitable date could be found. The reason for the non-response of the 34 remaining practices is unknown.

Table 1. Interview guide

What do you think is the definition of a medical intervention in midwifery care?
Please describe a situation during maternity care (pregnancy, birth or postpartum) in which many interventions were performed.
Please describe a situation during maternity care (pregnancy, birth or postpartum) in which few interventions were performed.
When do you experience the need to perform a medical intervention?
Which factors influence whether or not a medical intervention is performed?
How do you involve clients in the performance of interventions?
How do you evaluate the use of interventions in midwifery care?

Data collection

Before the interviews, we distributed a short questionnaire to collect the participants' demographic characteristics and usage of childbirth interventions in their midwifery practice. Interviews were face-to-face conversations at a safe setting chosen by the participant. The interviews were conducted by four interviewers who had a midwifery background, but no personal relationships with the participants. We audio-recorded and transcribed the interviews verbatim for analysis. The transcribed interviews were sent to the participants for participant validation, however, no adjustments were requested. The anonymized and encrypted transcripts, together with field notes, were stored safely and locked, solely accessible to the research team.

Rigor and reflectivity

We used several strategies to ensure methodological rigor (20). The first two interviews of each interviewer were observed by a colleague interviewer to ensure consistency and quality. After the first four interviews, the research team made small adjustments to the interview guide to strengthen the narrative approach through peer debriefing. Field notes were kept from each interview to achieve data triangulation. Throughout the study, we reflected on the analytic process as a group to arrive at consensus through investigator triangulation. We used the standards for reporting qualitative research (SRQR) as guidance for writing the current article (21).

Ethical considerations

According to the *Act governing research involving human subjects* in The Netherlands (WMO), formal ethical approval by a research ethics committee is only required for medical research where participants are subject to interventions or procedures or are required to follow specific, research-related rules of behavior (22). None of these apply to this research. All the midwives gave informed consent and were aware of their rights.

Data analysis
Subsequently, we performed an inductive content analysis (23,24) using the online software program *Dedoose* version 8.3.17. The first and last author developed a preliminary coding scheme based on the data of three, randomly chosen interviews and the structure of the Attitude, Social influence, Self-Efficacy model (17,18). The final coding scheme emerged during further analysis based on consensus. We grouped the codes into subthemes and themes by examining the commonalities, differences, and relationships within and among the interviews. After eleven interviews, we reached saturation on the level of themes and subthemes, but we analyzed two additional interviews for confirmation. We read the remaining seven interviews to check whether any codes or themes had been missed, and confirmed the stated themes. During the analysis, a theory emerged on midwifery styles towards interventions and was supported by the themes and subthemes (23).

Findings

All participating midwives worked in primary care in the Netherlands and they varied in age, place of education, years of experience, and midwifery practice characteristics (see Table 2). Five midwives were educated in Belgium, Switzerland or the United Kingdom, reflecting the overall educational background of midwives in the Netherlands (25).

The following two main themes were evident in the data: attitude towards interventions and influences on midwives' attitudes. Within the theme influences on midwives' attitudes we found three subthemes: experiences in collaboration, trust and fear, and woman centeredness. Finally, an emerging theory on midwifery styles towards childbirth interventions is presented.

Table 2. Characteristics of participants (n = 20)

Characteristic	Value
Age, mean (range), y	42.8 (24-60)
Work experience,mean (range), y	16.4 (2-30)
Place of education, n	
The Netherlands – North	4
The Netherlands – South	4
The Netherlands – Amsterdam	3
The Netherlands – Rotterdam	4
Abroad (Belgium, UK, Switzerland)	5
Size of midwifery practice[a]	
Small	6
Medium	9
Large	5
Location	
North	5
East	4
Central	4
West	3
South	4

[a]Size of the midwifery practice is based on the number of annually completed cases. The definition of a case is provision of complete care during pregnancy, labor, and postpartum period. Size is divided in: small (<80 completed cases), medium (80-300 completed cases), and large (>300 completed cases).

Attitude towards interventions

All midwives in our study agreed that pregnancy and childbirth are physiologic processes. Midwives told us about supervising the progress of labor and monitoring the condition of the mother, partner, and child as being their specific responsibility. Some midwives in our study did not only define medical procedures as interventions, but also included psychosocial aspects like being present and various forms of coaching as part of their definition of an intervention.

> *Everything what influences the natural behavior of the woman giving birth … In case a woman needs some encouragement, such as "you can do this, it's going well'. This is also an intervention for me. (Midwife 12)*

Talking about interventions, some midwives in our study seemed to have a more wait and see approach towards the provided care in pregnancy, childbirth, and the postpartum period. These midwives expressed how they preferred to be present in the background, meaning to be somewhere in the

house or in the corner of the room, and only interfering when invited by the woman and her partner.

> *. . . which is a birth where the healthcare providers are invisible, where a woman can determine her own posture, determine her own coping strategy and have as little interference as possible. (Midwife 12)*

Midwives with a more wait and see approach described that they use guidelines as a tool in clinical decision-making. Other midwives in our study explained they considered it important to follow the national guidelines or local protocols in all or nearly all circumstances. These midwives seemed to have a more 'check and control' approach. They felt that by strictly following the national guidelines or local protocols the best possible physical outcomes could be guaranteed. These midwives emphasized that interventions helped them to obtain additional information about possible pathology, which gave them a feeling of certainty and safety. In the quote, an example of the check and control approach is given. However, it should be noted that an oral glucose tolerance test (OGTT) is not standard care for all women in the Netherlands, it is only indicated and offered when women have specific risk factors.

> *I agree that if someone is really overweight or has diabetes in the family, it's good to perform an OGTT. It gives me the feeling of "I have checked it, so that is good" . . . That also provides a bit of control, a bit of certainty. (Midwife 17)*

The differences in attitude towards the use of interventions between midwives with a wait and see approach and midwives with a check and control approach became most clear when midwives talked about prevention of pathology, indications for ultrasound scans, and their belief that they need to advocate for non-intervention in physiologic childbirth. In their stories, the midwives expressed a variation in the application of interventions like artificially rupture of membranes, vaginal examinations, or administration of oxytocin postpartum.

Influences on midwives' attitudes

When describing the background of their attitude towards interventions, the midwives in our study mentioned different experiences, beliefs, and values, such as experiences in collaboration, trust and fear, and woman-centeredness.

Experiences in collaboration

In all interviews, midwives discussed how collaboration with other healthcare providers influenced their attitude towards the use of interventions. Regarding collaboration with providers of obstetrician-led care, midwives with a 'check and control' approach repeatedly mentioned that they wanted to satisfy the obstetrician, and seemed to be influenced by the perceived hierarchy.

These midwives described that they performed more interventions then recommended in the national standard due to this feeling of authority.

I sometimes think: "what does the obstetrician think about it [care management]?". That is on my mind when I don't achieve a certain result within a certain time. (Midwife 7)

Other midwives experienced local protocols as restrictive and they often felt obligated to follow them, as this was mutually agreed at a local level. They felt internally conflicted between conforming to the local agreements, and their view on how much value the intervention added. Midwives in our study did not mention any internal conflict about the national guidelines, only about the local protocols.

The standard offering of OGTT for risk factors is something I feel compelled to do because those are the agreements. But, I'd rather not do it because I don't support this regional management. I feel compelled from the outside . . . (Midwife 9)

In our study, most midwives strived for collaboration based on equality with obstetric care providers. Nevertheless, midwives reported experiencing a difficult relationship with obstetricians and hospital-based midwives due to the different perceptions over what constituted the minimum necessary care for low-risk women. Midwives described how they succeed in defending their physiologic statements in regional collaboration sessions. As a result, the regional protocol included fewer mandatory interventions than had been requested by obstetrician-led care providers.

In our region, the postpartum hemorrhage protocol stagnated for a long time. In the end, we managed to cancel the obligation to administer oxytocin by default. So yes, we fight . . . it feels now and then a bit like fighting, but that ultimately helps to ensure that you don't have to justify yourself for everything every time. (Midwife 10)

Trust and fear

Trust and fear seemed to be important factors in directing midwives' attitudes towards the use of interventions. Midwives in our study mentioned that their experiences influenced their fear for complications. They described how experiencing uncomplicated situations boosted their trust in physiologic childbirth, and made them feel more restrained towards the use of interventions.

I certainly feared upright births in my early years. After the baby was born, the blood clattered down and I wanted to administer oxytocin right away. After a while, you get used to the noise and you can estimate the blood loss better, and you hold off administering oxytocin. (Midwife 14)

However, more often, midwives talked about the emotions they felt after an obstetric emergency such as a postpartum hemorrhage or fetal distress. They described feeling helpless and afraid when these situations happened, and feeling uncertain and unsafe during subsequent births. The described feelings were mostly related to childbirth and rarely to a situation occurring in pregnancy, such as fetal growth restriction.

After that case [neonate with asphyxia], when I noticed a little dip in the fetal heartbeat, I immediately thought "oh no, not again". (Midwife 3)

It appeared that midwives could react in two ways to these stressful experiences. One group became more defensive and felt they needed to do more interventions, and also performed more interventions than they had in previous pregnancies or births. This group practiced the check and control approach to feel more certain and safe. The other group of midwives reflected on having feelings of uncertainty and fear that an obstetric emergency or complication would reoccur. They suggested that they needed to regain confidence, but were aware of this response and the impact it might have on the use of interventions. As described in the following quote, these midwives were conscious not to perform more interventions in later situations.

Afterwards, all midwives in my practice wanted to check blood when a woman had a little itching [after a fetal death caused by cholestasis]. But it was just one case, and we cannot implement a new treatment based on one case. (Midwife 11)

Besides fear for complications, perinatal mortality or morbidity, midwives spoke about their fear for a legal complaint or claim.

Woman-centeredness

Most midwives in our study talked about woman-centered care in relation to their attitude towards the use of interventions. They talked about how woman-centered care was part of their daily practice and about the difficulties they encountered in providing this care. They highly valued the wishes of the woman, and strived to meet these wishes as best as possible. When the woman had other preferences than her midwife concerning the obstetric management, midwives with a more wait and see approach told us they would support the woman in her choice. Other midwives expressed difficulties supporting the woman's care wishes when these wishes differed from their own preferred management. They expressed their dilemma between values as

woman-centeredness and safety. For example, in a critical situation, they did not ask for informed consent before they acted because obtaining informed consent felt as losing time.

We explain [in the pregnancy]: "… if you have a lot of blood loss we will administer oxytocin". They will agree to it. During birth, you also need to obtain informed consent. I find that difficult. Sometimes I just want to administer it. (Midwife 15)

Midwives who told us about their difficulties with supporting a woman's preference when it differed from the national guidelines and local protocols, were more inclined to persuade the woman to follow the midwife's healthcare management plan. This often included more interventions. Midwives gave examples of situations in which they persuaded or overruled the woman. In their stories, the midwife appeared to be the main subject instead of the woman.

I look at what the patient wants. If I find it medically responsible, they can do anything they want to. But if things are not going in the right direction, I will put a stop to it. I try to explain why, and usually, they listen. (Midwife 20)

All midwives mentioned that workload sometimes influenced the extent to which they provided woman-centered care and influenced their use of a particular intervention. Notably, midwives with a more wait and see approach described changing their work circumstances to be able to provide care from this approach. They choose to work in smaller teams or in shorter shifts, or even stopped working in a group practice and started working in caseload midwifery to create more time for each woman and experienced a lower workload. Midwives with a more check and control approach talked about the Dutch perinatal care system and the consequences of this system for the workload of a primary care midwife as an entrepreneur.

The supportive and directive style

From the analysis, two attitudes emerged that influenced midwives' approach towards perinatal care: a wait and see attitude and a check and control attitude. In the three subthemes, the midwives in our study described what experiences, beliefs, and values influenced their attitude. We summarized this in figure 1.

Midwives with a wait and see attitude described a more restricted approach towards interventions than midwives with a more check and control attitude. They described childbirth as a physiologic process that only needs an intervention when pathology occurs or at woman's request. Experiences of uncomplicated births reinforced trust in the physiologic childbirth. Midwives with this attitude emphasized the importance of collaborating with healthcare

providers in obstetrician-led care on an equal base. It seemed that care based on a wait and see attitude resulted in a more supportive style of behavior.

Midwives with a check and control attitude towards perinatal care tended to use more interventions compared with midwives with a more wait and see attitude. These midwives also indicated pregnancy, childbirth, and the postpartum period as physiologic processes. However, they relied on national guidelines and local protocols for reassurance about the process and indications for performing interventions. These midwives seemed to be more affected by authority in the collaboration with obstetric care providers and the interaction with the woman. Care based on a 'check and control' attitude seemed to result in a more directive style of behavior.

The two emerged attitudes towards the use of interventions do not translate into a definitive distinction of each midwife's individual style of behavior. In our analysis, participants showed a tendency towards a stronger orientation to the wait and see attitude combined with a more supportive style of behavior or to the check and control attitude combined with a more directive style. Still, certain circumstances could elicit midwives to use the other style of behavior.

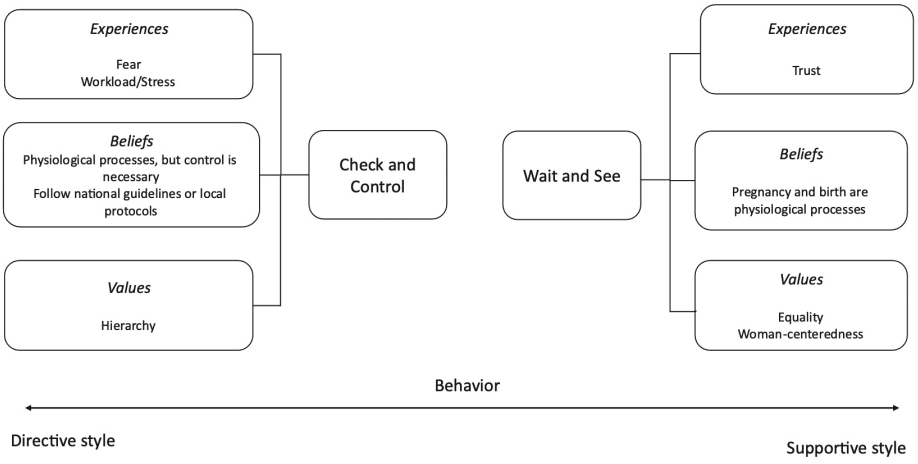

Figure 1. Experiences, beliefs, and values underpinning the attitudes and behavior towards use of interventions.

Discussion

Midwives' attitude towards interventions presented itself in an attitude oriented towards wait and see and an attitude orientated towards check and control. Coping with experiences of complications or complaints, and values on collaboration with women or health care providers in obstetrician-led care influenced midwives' attitude. It appears that midwives with a wait and see attitude have a more restricted approach to interventions compared to midwives with a check and control attitude. The care of midwives based on a wait and see attitude suggested a more supportive style of behavior, where care based on a check and control attitude suggested a more directive style of behavior.

Two paradigms

The wait and see and check and control attitudes match the sociological framework of the social and medical model of care (26). In practice, a whole range of combinations of the two ways of operating can be seen (26). In accordance with the social model, midwives with a wait and see attitude focus on normality of childbirth, social support, and an active involvement of the individual woman. In accordance with the paradigm of trust (27), these midwives build a relationship with the woman through open communication and equality. The midwife-woman relationship is the vehicle through which trust is built, personalized care is provided, and contributes to a woman's feeling of empowerment.

In contrast, the medical model of care focuses on risk and ways for risk reduction, whereby women are less involved in their care (26). Midwives with a check and control attitude also believe that normal childbirth requires medical control to guarantee safety and apply interventions at the earliest sign of pathology, like in the medical model. This attitude is more influenced by the paradigm of risk (28). In the last century, midwifery care has become more technologically oriented and the number of hospital births has grown, creating an increasing reliance on standardized procedures and a prominent place for risk management (26,29,30). As such, the standardization of care by guidelines, and audits of healthcare provision have brought about a shift in focus, away from the trust in the normality of childbirth and professional autonomy (30,31).

Perinatal care in the United States of America is more influenced by the paradigm of risk, resulting in a care system that more strongly believes birth is an event with a high potential of pathology (32). Most midwives work in a hospital setting, where the autonomy of a midwife differs greatly between hospitals. In the Netherlands, primary care midwives work in collaboration with hospitals but can make autonomous decisions about certain, nationally regulated childbirth interventions, eg, external version of a breech (10,14,15). On the other hand, certain interventions, such as an epidural, are only

accessible in obstetric-led care and women are referred if wanting or needing one (10,15). Still, our study shows that the attitude towards childbirth interventions is influenced by various factors even though the midwife has the autonomy to make her own decisions together with the woman. These findings can make midwives from both countries aware of the significant influence of their attitude on the way they practice midwifery. Influencing factors on the attitude did not depend on the work setting of the midwife, whereby the results of this study probably also apply to midwives working in a hospital.

Changes in Dutch midwifery care

According to social science, different responses to risk are seen depending on the perception of an individual or group (33). Childbirth in the Netherlands has long been defined as a physiologic process under the care of a midwife (8). Educational programs in the Netherlands still teach student midwives the basic attitude that pregnancy and childbirth are physiologic processes needing minimal interventions (34). However, studies on referral rates among Dutch midwives show a movement towards medicalization of midwifery care in the Netherlands (14). It appears, that some midwives can better retain their basic physiologic attitude compared to colleagues. For example, this study provided insight into different coping mechanisms of midwives according to fear of complications resulting in variation in application of interventions.

In recent years, there has been a call in the Netherlands to provide more woman-centered care and the term 'watchful attendance' has been introduced (35). Watchful attendance is a combination of continuous support, clinical assessment, and responsiveness (35). Midwives perform regular clinical checks integrated into the whole dynamic of care. Many benefits of care with watchful attendance have been described (36), however, midwives' motivation and individual skills are of great influence whether and how this care is provided (35,37). In addition, discussion continues that the current official workload is too high to effectuate woman-centered care in all its aspects (38). The number of midwives per 100,000 women in the Netherlands is only 31.1, making it one of the five western countries with the lowest number of midwives (39). In our study, midwives who wanted to provide woman-centered care made changes in their practice towards working in smaller teams or started working as a case load midwife, expecting a reduction in salary.

Limitations and strengths

Our sample of twenty midwives resulted in a wide variety of participants and information about experiences, beliefs, and values. This study included only midwives working in primary care, so its results cannot be generalized to those working in the hospital setting. Several steps were taken to minimize bias, such as using an interview guide, member checks, and interviewing the midwives by people unknown to them. The researchers were aware they had preconceived ideas, knowledge, and understanding that possibly influenced

the execution and outcomes of the study. To ensure that interpretations were valid and grounded in reality, the researchers engaged in continuous self-reflection, and the first, second, and last author collaborated in the analysis. Further research should give insight into which knowledge, skills, barriers, and support interacts with intentions to perform a certain behavior, to convert an intention to actual behavior.

Recommendations for practice

For appropriate use of interventions during pregnancy, birth, and the postpartum period midwives should learn to balance between the two attitudes and corresponding styles of care. Awareness of their underlying personal experiences, beliefs, and values can provide midwives insight into their attitude towards interventions. If they feel supported by a broader movement towards watchful attendance, this could be a first step towards behavioral change and the reduction of unwarranted interventions.

Conclusion

All midwives in our study had the intention to only perform interventions when appropriate. It seems that midwives with a more wait and see attitude have a more restricted approach towards interventions compared to midwives with a more check and control attitude.

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Knowledge and skills used for clinical decision-making on childbirth interventions: a qualitative study among midwives in the Netherlands

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Abstract

Introduction
Appropriate use of interventions in maternity care is a worldwide issue. Midwifery-led models of care are associated with more efficient use of resources, fewer medical interventions, and improved outcomes. However, the use of interventions varies considerably between midwives. The aim of this study was to explore how knowledge and skills influence clinical decision-making of midwives on the appropriate use of childbirth interventions.

Methods
A qualitative study using in-depth interviews with 20 primary care midwives was performed in June 2019. Participants clinical experience varied in the use of interventions. The interviews combined a narrative approach with a semi-structured question route. Data were analyzed using deductive content analysis.

Results
'Knowledge', *'Critical thinking skills'*, and *'Communication skills'* influenced midwives' clinical decision-making towards childbirth interventions. Midwives obtained their knowledge through the formal education program and extended their knowledge by reflecting on experiences and evidence. Midwives who utilize low rates of interventions as part of their clinical practice seem to have a higher level of reflective skills, including reflection-in-action. These midwives used a more balanced communication style with instrumental and affective communication skills in interaction with women, and have more skills to engage in discussions during collaboration with other professionals, and thus personalizing their care.

Conclusions
Midwives who utilize low rates of interventions as part of their clinical practice seemed to have the knowledge and skills of a reflective practitioner, leading to more personalized care compared to standardized care as defined in protocols. Learning through reflectivity, critical thinking skills, and instrumental and affective communication skills need to be stimulated and trained to pursue appropriate, personalized use of interventions.

Introduction

The appropriate use of interventions in maternity care has attracted considerable international attention (1, 2). It appears that medicalisation of pregnancy and birth has negative consequences for women and babies, and results in higher health costs (2, 3). Therefore, medicalisation of maternity care has become a contentious issue worldwide. There is a growing body of evidence that care provided by midwives results in fewer medical interventions, and increased satisfaction with the birthing experience without differences in adverse perinatal outcomes (4). Regarding the appropriate use of interventions, using as little interventions as possible is not a purpose in itself, the purpose is to have the optimal balance between childbirth interventions and perinatal and maternal outcomes (3, 4, 5).

Midwifery care provided by primary care midwives in the Netherlands attracts attention internationally, because of the high number of homebirths and the autonomy of midwives (6). Two third of Dutch midwives work as independent healthcare professionals in primary care, and are able to make, together with women, autonomous decisions about childbirth interventions or referral to obstetrician-led care (7). Around 87% of the Dutch pregnant women start their prenatal care in primary midwifery care, however, during pregnancy and birth a large percentage of women is referred to obstetrician-led care (8). The referral percentage for nulliparous women is around 74% and 55% for multiparous women (8).

For a long time, the leading principle of maternity care in the Netherlands has been that pregnancy and birth are physiological and normal processes (9). Research exploring the background of midwives' attitudes towards childbirth also suggests a common belief among Dutch midwives that pregnancy and childbirth are physiological processes and unnecessary use of interventions should be avoided (10, 11). Despite the fact that midwives seem to have a joint intention to promote physiological childbirth, different behaviours are seen towards clinical decision-making, resulting in variations in use of childbirth interventions including variations in referrals from midwife-led care to obstetrician-led care (12, 13, 14).

Theories on human behaviour, such as the Attitude, Social norms, Self-efficacy model (ASE-model), are relevant for studying intention and factors influencing behaviour in human beings (15, 16). The ASE-model explains behaviour by linking attitude, social norms and self-efficacy with behavioural intention and actual behaviour. In addition to these three determinants of behavioural intention, factors such as 'knowledge and skills' and 'barriers and facilitators' also play a role in explaining behaviour. Earlier studies in the Netherlands on determinants of intention and behaviour towards clinical decision-making during childbirth, showed the influence of differences in midwives' risk perception, work-experience, workload, setting (home or hospital), interaction

with the woman, and regional protocols (10, 12, 13, 17). In addition, studies by Weltens et al. (2018) and Seijmonsbergen-Schermers et al. (2020) suggest that perspectives on birth as a physiological event differ between regions in the Netherlands.

In a previous study, we found that midwives with a 'wait and see' attitude seem to have a more restricted approach towards interventions compared to midwives with a 'check and control' attitude (11). However, studies on the influence of knowledge and skills on midwives' clinical decision-making are limited. Research on this subject is important because these are influenceable factors: knowledge and skills can be taught. This offers possibilities for behavioural change, contributing to appropriate use of interventions and improvement of the quality of midwifery care. Therefore, the objective of this study is to explore how knowledge and skills influence clinical decision-making of midwives towards the appropriate use of childbirth interventions.

Methods

2.1 Study design

This study was part of a larger qualitative study exploring factors that may explain variations between midwives in decision-making on childbirth interventions (11). We used in-depth interviews that combined a narrative approach with a semi-structured question route to indicate relevant topics (Box 1). In accordance with a narrative approach, we invited the participating midwives to elaborate and share their stories about situations during pregnancy, birth, and postpartum period where the use of interventions was an issue. The narrative approach made it possible to explore, from a broader perspective, how midwives used their knowledge and skills during clinical decision-making (18).

Box 1. ***Question route for interviews***

- What do you think is the definition of a medical intervention in midwifery care?
- Please describe a situation during maternity care (pregnancy, birth or postpartum) in which many interventions were performed.
- Please describe a situation during maternity care (pregnancy, birth or postpartum) in which few interventions were performed.
- Which factors influence whether or not a medical intervention is performed?

2.2 Setting

In the Netherlands, low-risk pregnant women can choose to give birth at home, in a birth centre, or in hospital under the supervision of their independent midwife. Women will not receive interventions such as epidural analgesia, augmentation, or continuous fetal monitoring while in primary midwife-led care. If a woman wants these interventions or if they become necessary, a referral to obstetrician-led care is indicated. Therefore, referral to obstetrician-led care is seen as an intervention in this study. Criteria for referral are described in the List of Obstetric Indications (9).

2.3 Participants

Participants were purposive sampled and included midwives from midwifery practices with either a low- or a high use of childbirth interventions in order to explore differences between these two groups. The definition of low- or high use of childbirth interventions is based on literature describing variations in childbirth interventions (14, 19). For the purpose of this study we used data from the Dutch national perinatal register Perined to identify midwifery practices with a high or a low intervention rate (https://www.perined.nl/). Practices in the group with a low intervention rate had a combination of three factors: low referral rate (<35th percentile), a high homebirth rate (>65th percentile), and a low episiotomy rate (<35th percentile). Practices considered as having a high use of interventions had the combination of: a high referral rate (>65th percentile), a low homebirth rate (<35th percentile) and a high episiotomy rate (>65th percentile).

We invited midwives from 46 midwifery practices, 23 for each category (low and high use of interventions), taking into account geographical locations and practice sizes to include various types of practices throughout the Netherlands. We intended to interview one midwife per practice. We send a reminder two weeks after the invitation.

2.4 Data collection

Before the interviews, we distributed a short questionnaire to collect the participants' demographic characteristics. The face-to-face interviews were conducted in June 2019 by four interviewers with a midwifery background, and without a personal relationship with the participants. It was unknown for the interviewers to which of the two categories the participant belonged. The first two interviews of each interviewer were observed by another member of the research team to ensure validity, consistency and enhance quality across each of the interviews. After the first four interviews, the research team made small adjustments to the semi-structured question route, in order to reinforce the narrative approach. The interviews were audio-recorded and transcribed verbatim for analysis. Each participant received a transcription of the interview for a member-check. We anonymized and encrypted the transcripts, together with field notes, the data were safely stored and only accessible for the research team.

2.5 Ethical considerations

According to the 'Act governing research involving human subjects' in The Netherlands (WMO), formal ethical approval by a research ethics committee is only required for medical research where participants are subject to interventions or procedures, or are required to follow specific, research-related rules of behaviour (20). None of these apply to this research. A self-assessment tool from the Medical Ethics committee of Maastricht University, The Netherlands, signalled our study as exempted from formal medical ethical review (21). Written consent was obtained from all participants before participating.

2.6 Data analysis

We analysed the data using deductive content analysis (22). The goal of this analysis process was to gain deeper knowledge about the aspects involved in clinical decision-making for the use of interventions in the two groups with a different use of interventions. We used the ASE-model (16) as a theoretical framework, focusing on determinants of knowledge and skills. Throughout data analysis, we found that in the communication skills a distinction could be made between instrumental and affective communication, as identified in theories on healthcare communication (23, 24). Instrumental communication is task-related behaviour and involves skills such as asking questions and providing information, while affective communication is socio-emotional behaviour and involves skills such as reflecting feelings and showing empathy and concern (24). We extended the theoretical framework using these findings complementary to the ASE-model.

The first author read and reread the complete transcripts of each interview to identify any descriptions related to the framework. The analysis process was open to identify any new themes that would emerge from the data. The second author conducted a dependability and conformability audit to check the analysis against accepted standards and examine the analysis process and records for accuracy. After nine interviews, we reached saturation on the level of themes and subthemes. We analysed the remaining nine interviews to check whether any codes or themes had been missed and any falsifying findings could be found, also confirming the stated themes. We used the online software program *Dedoose* version 8.3.17 and recorded the study's procedure in a logbook. The standards for reporting qualitative research (SRQR) gave guidance to the writing of the current article (25).

Results

In total, 22 midwives accepted the invitation for an interview. Two midwives were excluded. One midwife because a colleague from the same midwifery practice was already interviewed, and a second midwife because no suitable date or time could be planned. Thirteen midwives worked in a midwifery practice with a low use of interventions and seven in a midwifery practice

with a high use of childbirth interventions. The reasons for the non-response of the 24 remaining practices are unknown.

Participants varied in terms of years of midwifery experience, place of education, and practice characteristics including geographical location (Table 1).

We identified three main themes: (I) K*nowledge – learning through reflectivity*, (II) *Critical thinking skills – advanced knowledge in context,* and (III) C*ommunication skills – making your knowledge work*. An overview of the main themes and subthemes is given in Box 2.

Table 1. Characteristics of the participants: primary care midwives working in the Netherlands (N=20)

Characteristic	Number of participants with low use of interventions (n=13)	Number of participants with high use of interventions (n=7)
Years of working experience		
<10 years	2	2
10-20 years	5	2
20-30 years	3	3
>30 years	3	0
Place of midwifery training		
The Netherlands	12	4
Abroad (Belgium, UK, Switzerland)	1	3
Practice size[a]		
< 80	6	0
80-300	5	4
>300	1	3
Size of the midwifery team in the practice		
1-2	6	1
3-4	4	3
≥5	3	3

[a]Size of the midwifery practice in number of women receiving complete care (pregnancy, birth and postpartum) annually.

Box 2. Overview of main themes and subthemes

3.1 **Knowledge – learning from different sources**
3.1.1 Getting the basics
3.1.2 Deepening the knowledge base
3.1.2.1 *Learning through experience*
3.1.2.2 *Reflection on evidence*

3.2 **Critical thinking skills – advanced knowledge in context**

3.3 **Communication skills – making knowledge work**
3.3.1 Communication with women: giving and gaining background information
3.3.1.1 *Instrumental communication*
3.3.1.2 *Affective communication*
3.3.2 Communication with colleagues: the ability to speak up

3.1 Knowledge – learning from different sources

The midwives in our study described how their knowledge on the use of interventions developed from the basics towards a deeper understanding.

3.1.1 Getting the basics

Midwives from both high and low intervention groups elaborated how their use of interventions is first of all based on knowledge acquired during their midwifery training. Parameters for a physiological progress of pregnancy and birth were taught, which they used for the rest of their working life.

'They [educators] really taught me to act according to the physiology. They also taught me to show what you can do as a primary care midwife.' (Midwife 7)

In the Netherlands, half of the four-year midwifery education program consists of clinical placements in both primary care midwifery practices and hospital settings. Midwives from both groups reported that their clinical decision-making and use of interventions is strongly influenced by these placements, especially the final placement before graduation. Some midwives described how they replicate the clinical decision-making style of the midwifery practice where they had taken their final placement. Either because they believed this was the appropriate care to provide, or as habitual standard. Some participants mentioned the lack of specific experiences during their placements. For example, midwives questioned if knowledge about a topic such as the pros and cons of different birth places and how you discuss this

information with the woman and her partner, is sufficiently embedded in their study program.

'If you don't learn during your placement to discuss in an open way, and also mention the benefits of giving birth at home [….], you will hear that once during the study program, I hope, but it will not become normal in your way of working and giving information.' (Midwife 10)

3.1.2 Deepening the knowledge base

Midwives in our study described how, over time, experience and reflection deepened their knowledge.

3.1.2.1 Learning through experience

A second source of knowledge was knowledge acquired through practical experience by working as a midwife. Midwives in the study spoke about how their experiences with a cascade of interventions after administration of epidural analgesia, a fetal growth scan, or the diagnosis of gestational diabetes, deepens their understanding of the consequences of using interventions.

'Especially by epidural analgesia. An IV is placed, followed by a catheter, an electrode on the head of the baby, laying down in the bed; the hospital's "total package". It all causes a lot of misery…' (Midwife 2)

In particular, midwives from the group that utilize low rates of childbirth interventions as part of their clinical practice spoke about the added value of knowledge from experience. Because of this knowledge, they gained confidence in the natural process of birth, and became more restrained in using interventions. Most midwives from the group that utilize low rates of childbirth interventions as part of their clinical practice reported that their experiences create the possibility to tailor the use of interventions to the individual situation, instead of following standardized recommendations suggested by national guidelines or local protocols.

'The longer you work, the easier it becomes to feel free in decision-making, and to decide what is best in each situation.' (Midwife 12)

3.1.2.2 Reflection on evidence

Some midwives working in practices with a low use of childbirth interventions described situations in which they critically reflect on their own clinical decision-making. These midwives mentioned scientific literature they read and interpret to make clinical decisions regarding childbirth interventions in situations where no guideline or consensus exists.

'In our practice we say 'the less you do, the more beautiful the birth will be'. It's a kind of conscious choice […] It's also very clearly written in the Lancet series. A lot of midwives use amniotomy to accelerate labour, and then you think: 'why would you want to do that?' […] Eventually, it becomes evident that it does not help at all.' (Midwife 1)

In addition, midwives in the group that utilize low rates of interventions as part of their clinical practice described how they question assumptions and generate knowledge through reflection.

'Ultrasounds are absolutely interventions. Enormous interventions, based on which, care pathways can go in all directions. You should be very careful with the use of them. Not a standard thirty-week fetal growth scan […]. I also don't understand that colleagues go along with this. If you think about it carefully and read all the evidence about it.' (Midwife 10)

In contrast, none of the midwives in the group that utilize high use of childbirth interventions as part of their clinical practice gave examples of using scientific literature in their clinical decision-making process. They reported how they often align with local protocols and do not use national guidelines. They accommodated to the local agreement to use these protocols, which were different from the national guidelines, often leading to a more interventionist approach.

Overall, midwives described that the formal midwifery education program is an important source of knowledge. In addition, midwives with a low use of interventions clearly described how they have extended their knowledge, and the application of knowledge by reflecting on experiences and evidence. This extended knowledge through reflection influenced their clinical decision-making. In contrast, midwives with a high use of interventions did not mention this reflection, but described how they adhere to local protocols for their decision-making.

3.2 Critical thinking skills – advanced knowledge in context

All midwives felt competent to perform interventions, such as vaginal examination or amniotomy. A difference seemed to exist in the process leading up to the use of these interventions; a difference in the reflective process involving critical thinking skills to make well-founded decisions during midwifery care. Midwives who utilize low rates of interventions as part of their clinical practice spoke about how they continuously reflect on the ongoing situation and constantly ask themselves if it is necessary to intervene. Such reflective moments seem to contribute to less standardized application of interventions compared to the group midwives with a high use of childbirth interventions who did not mention reflective moments.

'During childbirth I try to say to myself: "hold back, you don't have to [artificial rupture the membranes]. The woman does not benefit from that. She will only have more severe contractions. That's of no benefit".' (Midwife 20)

Midwives who utilize high rates of interventions as part of their clinical practice described how they apply interventions to control the process of labour or because this is the standard procedure.

'We make a fetal growth scan at 30 weeks. That's more because it makes us feel safe. And because we know we detect more small babies. We just want to check it.' (Midwife 17)

Summarizing, midwives in the group that utilize low rates of interventions as part of their clinical practice seemed to use critical thinking skills for a reflective process where appropriate use of interventions is being pursued. They have a reflection moment in action, which makes them wait and evaluate whether an intervention is beneficial at that moment. Such moments were not described by midwives in the group that utilize high rates of interventions.

3.3 Communication skills – making knowledge work

In the interviews, midwives stated how the communication skills they use in their interaction with women are differed from the ones they use in their interaction with colleague healthcare professionals.

3.3.1 Communication with women: giving and gaining background information

In their communication with women, the midwives in our study use instrumental and affective communication.

3.3.1.1 Instrumental communication

All midwives in our study used instrumental communication to explain information to women. However, midwives who utilize low rates of interventions as part of their clinical practice explained that they communicate extensively about treatment options to facilitate women to make an informed choice. Some of them spoke about open communication, including conversations about uncertainties or their own professional experiences with specific interventions, such as induction of labour, ultrasound, and fetal monitoring. These midwives also expressed a broader view on childbirth interventions and the role of healthcare professionals in the application of interventions.

'In general, we find it easier to give more [interventions] than to give less [interventions]. Healthcare providers see more danger in not intervening than in intervening. I think it is my job to make this clear to the woman and her partner.' (Midwife 12)

Midwives who utilize high rates of interventions as part of their clinical practice seem to enact a different communication style regarding treatment options. They discussed about how they suggest a certain care pathway and ask the woman if she agrees with this plan. These midwives seem to provide only limited information about a selection of care options that fit in the care pathway, suggesting that they use an opt-out approach when outlining the treatment plan for pregnancy and birth.

'In case of a high maternal body mass index or someone who has used drugs, I assimilate the individual care pathway according to these risk factors. I always go through everything with the client and then say: "let's do fetal growth ultrasounds anyway, and an OGTT". That's what I explain.' (Midwife 17)

3.3.1.2. Affective communication

Midwives who utilize low rates of interventions as part of their clinical practice indicated also a range of affective communication skills they use when interacting with pregnant women. These midwives spoke about situations they had encountered where women had requested more or fewer interventions than suggested by the national guidelines or local protocols. They described how they took time to actively listen to these women and started a conversation to investigate the underlying motives for the request.

'Someone may say that she wants to give birth at home, even when it's preterm. But then I still know nothing. Is she traumatised? Would she like to experience this once? […] Actually, the conversation starts at that point. You need to know a lot more.' (Midwife 12)

In contrast, midwives who utilize high rates of interventions as part of their clinical practice seemed less inclined to investigate underlying motives in such situations, and described how they quickly shift to arranging practical matters or to refer to obstetrician-led care. They discussed situations where women requested fewer interventions then recommended in guidelines or local protocols, and how they usually do not grant such requests. If a woman requested more interventions, for example an induction of labour, they arranged a consultation in obstetrician-led care without exploring the woman's motives extensively.

'She was pregnant of her third child, an unplanned pregnancy, and she was anxious from the beginning. She asked for a planned caesarean. So, we have sent her to the obstetrician at an early stage of pregnancy.' (Midwife 8)

3.3.2. Communication with colleagues: the ability to speak up

Midwives who utilize low rates of interventions as part of their clinical practice seem to use more persuasive communication strategies during interaction

with other healthcare professionals, such as other midwives, residents and obstetricians. They described how, in discussions, they are comfortable to deal with resistance or disagreement from other healthcare professionals and are prepared to defend their point of view. These midwives saw it as their duty to be the advocate for the woman's wishes. They reported how it is necessary to be persistent in these discussions to achieve physiological care or the care the pregnant woman desires.

> *During multidisciplinary meetings we are transparent and open. We honestly say what we think and what we want. […] Always as the advocate of the woman. It is very important that you neatly organize the desired healthcare plan for her.' (Midwife 1)*

Some midwives who utilize high rates of interventions as part of their clinical practice described how they avoid discussion with healthcare professionals in the hospital, especially with obstetricians. Generally, they conformed to the wishes of the local obstetricians.

> *'If someone has an Hb [haemoglobin] of 5.9, then you don't have to do anything according to the national guidelines. But the obstetrician is not very happy when he gets someone on his operation table with an Hb of 5.9. […] So if it gets towards 6.0, we prescribe iron. Because we know the obstetrician doesn't like it, you know.' (Midwife 4)*

Overall, the results suggest that midwives who utilize low rates of interventions as part of their clinical practice explore women's options and considerations to a higher extent, using a communication style that balances instrumental and affective communication skills, compared to midwives who utilize high rates of interventions as part of their clinical practice. In addition, the narratives of the midwives suggest that midwives who utilize high rates of interventions are less skilled to engage in discussions with colleague healthcare professionals.

Discussion

In this qualitative study, we explored how knowledge and skills influence clinical decision-making towards the appropriate use of childbirth interventions. We found that the level of reflection seems to differ among midwives with either a low or high use of childbirth interventions. Midwives who utilize low rates of interventions as part of their clinical practice described how they reflect on previous experiences and the evidence that influence their clinical decision-making. In addition, they seem to use more critical thinking skills during reflective moments as well as a communication style that balances instrumental and affective communication skills in interaction with the woman resulting in more personalized care. This personalized approach to maternity care may help in the pursuit for an appropriate use instead of routine use of interventions and may reduce medicalization in childbirth.

Reflective practitioner

Our study suggests that the knowledge and skills of midwives who utilize low rates of interventions as part of their clinical practice resemble those of a reflective practitioner. A reflective practitioner is someone who 'lives' reflection as a way of 'being' rather than just 'doing' (26). Reflective practice is linked to the concept of learning through and from experiences, by actively analyzing and questioning choices and decisions. Individual healthcare practitioners who are aware of what they are doing and critically evaluate their own responses to situations are reflective practitioners. This reflectivity helps them to provide appropriate interventions, to the right person at the right time (26, 27). This also emerged in our study, where midwives with a higher tendency to reflect on provided care were less inclined to provide standardized care.

Reflection *on* practice is an important skill for a reflective practitioner, however, reflection *in* practice is also important. Lake and McInnes (2012) describe that critical thinking skills help midwives in their clinical judgment and clinical decision-making, and enable them to provide appropriate, woman-centred and evidence-based care (28). In our study, midwives who utilize low rates of interventions as part of their clinical practice described reflective moments in care, where they consciously consider different options for clinical decision-making. During this *reflection-in-action*, they used critical thinking skills to make a balanced decision whether the intervention is beneficial at that moment. Previous studies have shown that higher interventions rates do not automatically lead to better perinatal outcomes [30]. The reflective approach towards interventions can help in the pursuit for appropriate use of interventions.

Important elements of reflection *on* practice is the recognition of non-evidence based care, and to search and interpret evidence for clinical decision-making (30). These skills are crucial to practice physiological care with an appropriate use of interventions (30, 31). In our study, midwives who utilize high rates of interventions as part of their clinical practice did not describe using scientific literature in their clinical decision-making process. It is possible that they lack skills to assess evidence and to recognize non-evidence based care.

Another element of reflective practice are the skills to discuss and debate within the multidisciplinary setting of maternity care (30, 31): the ability to speak up and to persuasively communicate the wishes of women, and the advantages of a physiological birth. Midwives should be able to effectively communicate considerations in clinical decision-making, including available evidence with other healthcare professionals (6). These skills seems less present in the group with a more interventionist approach. When a midwife is less skilled to speak up and advocate the midwifery philosophy of care, the risk philosophy of obstetrician-led care will be predominant, making it more likely that a higher use of interventions will occur (32).

Reflection has been described as an important learning strategy for professionals to create awareness of their own skills and attitude on the actual performance (33). Probably, explication of reflective skills and training of these skills can enhance the reflectivity of midwives (34). The Optimality Index – Netherlands (OI-NL) is a tool that can support reflection on maternity care practices from a physiological perspective and facilitate optimal birth practices: maximal outcome with minimal intervention (30).

Effective communication: the balance between communications skills

Midwives who utilize high rates of interventions as part of their clinical practice seem mainly focused on the need to provide information by using instrumental communication, which fits with an informed consent approach. Midwives who utilize low rates of interventions as part of their clinical practice showed additional attention for women's need to feel known, by using more affective communication skills and gaining insight in women's knowledge and motives. Such a balance between both communication styles is needed to invest in an effective partnership between woman and midwife (24, 25), and is more in line with the model of shared decision-making (SDM) (35). However, an informed consent approach can unjustly be mistaken for SDM by care professionals, because they ask for assent but there is no dialogue as medium for the decision-making process (35). In our study, we observed that midwives, mainly in the group with a high use of interventions, used informed consent instead of offering relevant knowledge on various options and working together with the woman to establish choices that fit her circumstances. Applying SDM means that a midwife explains the various options and their evidence base. This makes clinical decision-making less dependent on personal beliefs of the individual midwife (35), and leads to more awareness about appropriate use of interventions instead of standardised use. Thomas et al. (2020) emphasises that major changes are necessary in educational structures and maternity care systems to promote critical reflexivity required for SDM (36). This supports our findings that these skills need further development for care providers to be fully competent.

Strengths and limitations

We used purposive sampling and included a diverse population of midwives in terms of years of midwifery experience, place of education, and midwifery practice characteristics. In total, seven midwives who utilize high rates of interventions as part of their clinical practice participated in this study and thirteen midwives who utilize low rates of interventions as part of their clinical practice participated. This unequal distribution of participants possibly might have influenced the results of this study, because midwives in the low intervention group already work as reflective practitioner. Factors such as teams size, and place of midwifery training might influence clinical decision-making, but was not investigated in this study. We reached data saturation in both groups. Attention was paid to the methodological rigor, with a reflective journal being kept by the first author and all key decisions

during data collection and analysis being peer reviewed by the second author. Complementary, we re-read the interviews after we finalized the findings, to falsify the results and limit bias.

A limitation of this study was that midwives could only be included based on the practice level of interventions, because the Perined database cannot be analysed on the level of individual midwives. Therefore, the assumption was made that individual midwives provide care in accordance with the level of childbirth interventions of the midwifery practice they work at. However, midwives are autonomous healthcare professionals and make individual decisions whether to perform an intervention or not. We cannot rule out that some misclassification took place. However, the interviewers were blinded for this classification, and we observed no signs of misclassification during the analysis of both groups.

Conclusions

The results of this study suggests that there are differences in knowledge and skills between primary care midwives, probably influencing clinical decision-making and the use of childbirth interventions. The knowledge and skills of a reflective practitioner seem to lead to more personalized care compared to standardized use of interventions as defined in protocols. This personalized care helps in the pursuit for appropriate use of childbirth interventions and may reduce medicalization in childbirth. Reflection on experiences and evidence, a balanced communication style with instrumental and affective communication skills, and the use of critical thinking skills during reflection-in-action need to be taught and trained to midwives to pursue an appropriate and personalized use of interventions.

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6

Validation of the Birth Beliefs Scale for maternity care professionals in the Netherlands

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Abstract

Objectives
To validate the Birth Beliefs Scale (BBS) for maternity care professionals by testing 1) content validity; 2) internal reliability; 3) known-group discriminant validity; and examine potential relationships between regions and birth beliefs.

Methods
First, content validity was tested. Before distribution of the questionnaire among maternity care professionals of six maternity care networks (MCN), adjustments in the statements were made whenever content validity was too low. Data was collected from November 2022 to March 2023. Statistical analysis were performed using Cronbach's alpha, ANOVA, and regression analysis.

Results
Based on the content validity-test, item 6 of the questionnaire was adjusted before distribution. In total, 199 maternity care professionals completed the questionnaire. A good internal reliability of the BBS was found. There was a significant difference between the different disciplines for the BBS-Med subscale ($p<0.001$), and the BBS-Nat subscale ($p<0.001$). For the BBS-Nat subscale, the factors work experience and MCN were significant in the regression analysis, with interaction on the association between BBS-Nat and discipline.

Conclusion
The BBS is a valid instrument to measure birth beliefs among maternity care professionals. The BBS can help to create awareness within professionals of their beliefs and may help to explain practice variation in childbirth.

Introduction

Practice variation in childbirth interventions is a topic often described, both between (1,2) and within countries (3,4). For example, a large variation in labour induction rates has been described between countries, with rates around five percent in low-income countries and percentages beyond seventy percent in Brazil and Iran (5). A study describing regional induction rates in the Netherlands calculated the lowest rates of induction of labour around 14% and the highest rates over 41% (6). Interventions in childbirth can be lifesaving for both mother and baby, but unnecessary interventions can cause harm to mother and baby, and increase health care costs (5). Practice variation can be essential to provide high quality care adapted to medical conditions or patient preferences. When variation cannot be explained by medical conditions or patients' preferences and occurs despite strong evidence-based recommendations, it is defined as unwarranted (7,8).

Practice variation can be explained by a sociological model that describes factors that interact with practice variation at macro-, meso-, and micro-level (9). Although the model explains mechanisms on different levels, these levels cannot be considered in isolation but are interrelated. At micro-level the interaction is described between the patient and the healthcare professional to achieve individual decision-making (9). In the process of clinical decision-making, the professional applies theoretical knowledge to, sometimes complex, individual situations. The values and preferences of the individual patient are explored through shared decision-making, creating a conversation about clinical characteristics and patient preferences. Decision-making at the micro-level appeared to be influenced by the attitude of the healthcare professional (10).

Previous research on the attitudes of maternity care professionals has shown that there are differences between disciplines in their attitudes to labour and birth. Obstetricians and other medical staff seemed to generally favour a more interventionist approach to birth, while midwives tended to favour a more physiological approach to birth (11,12). The attitude of a maternity care professionals can influence their patients' decision-making process about labour and birth. For example, women who receive midwifery care may hold views that are more positive towards natural vaginal childbirth and more negative towards technological birth.

Despite overall differences between the attitudes of different maternity care disciplines, there also appeared to be considerable areas of agreement (11). Research among Canadian maternity care professionals has shown that a significant group of obstetricians had attitudes toward maternity care similar to those of the majority of midwives, even on contentious issues (11). This similarity is a possible explanation for the variation in intervention rates between different maternity units and regions within countries (4,13). In

the Netherlands, large variations in interventions were found, but trends in intervention rates between midwifery and obstetric care were comparable in the same region (4). This observation might suggest that an individual maternity care professional's attitude is subject to regional culture. These circumstances at organizational level create practice variation at meso-level influencing individual decision-making (9).

Birth beliefs are an important factor in the attitude of maternity care professionals towards childbirth interventions, and there are indications that birth beliefs differ between maternity care professionals (10–12). We would like to investigate in a larger population whether birth beliefs are a possible factor explaining practice variation between the different regions in the Netherlands. A validated tool to assess birth beliefs is available for pregnant women but is not yet validated for maternity care professionals (14). Therefore, the aim of this study is to validate the Birth Beliefs Scale (BBS) for maternity care professionals.

The objectives of the current study are to:
1. evaluate the content validity of the BBS for maternity care professionals
2. evaluate the internal reliability of the BBS for maternity care professionals
3. evaluate the known-group discriminant validity of the BBS
4. examine the potential relationships between different regions in the Netherlands and birth beliefs

Methods

We performed a validation study to validate the Birth Beliefs Scale for maternity care professionals and explored if these birth beliefs contribute to regional practice variation.

BOX 1– maternity care in the Netherlands

The Dutch maternity care system is equal in all regions in the country. Low-risk women start their antenatal care in midwife-led settings, which is provided by community midwives. Community midwives are qualified to provide antenatal, natal, and postnatal care and are independent healthcare professionals able to make, together with the woman, autonomous decisions about childbirth interventions or referral to obstetric-led care. Indications for a referral from midwife-led to obstetrician-led care are described in the 2003 List of Obstetric Indications. In obstetrician-led care, hospital-based midwives and obstetricians provide care after referral and can provide childbirth interventions such as augmentation of labour, analgesia, and instrumental birth.

Community midwives, obstetricians, and other disciplines such as paediatricians and maternity care assistants collaborate regionally in maternity care networks (MCNs). An MCN is usually based around a hospital and the midwifery practices in the same region. The number of professionals involved varies from about 30 to 120, depending on the number of births and the level of urbanisation in the region.

Setting

This study is part of the VALID study that describes practice variation in induction of labour (IOL) between Maternity Care Networks (MCNs) in the Netherlands (6) (see Box 1). Hereby different mechanisms are explored that influence the decision-making process on IOL. Six MCNs are selected for this study (see Figure 1). Three networks have a high percentage of IOL, and three networks have a low percentage of IOL, categorised based on data of the Dutch national database Perined (6). We focussed on MCNs from the low and high group to explore different mechanisms that influence the IOL rate. The MCNs with a moderate IOL rate are seen as reference group. The Medical Ethical Committee of Zuyderland-Zuyd University confirmed that ethical approval was not required for the VALID study according to the Dutch legislation and regulations (reference METCCZ20210008).

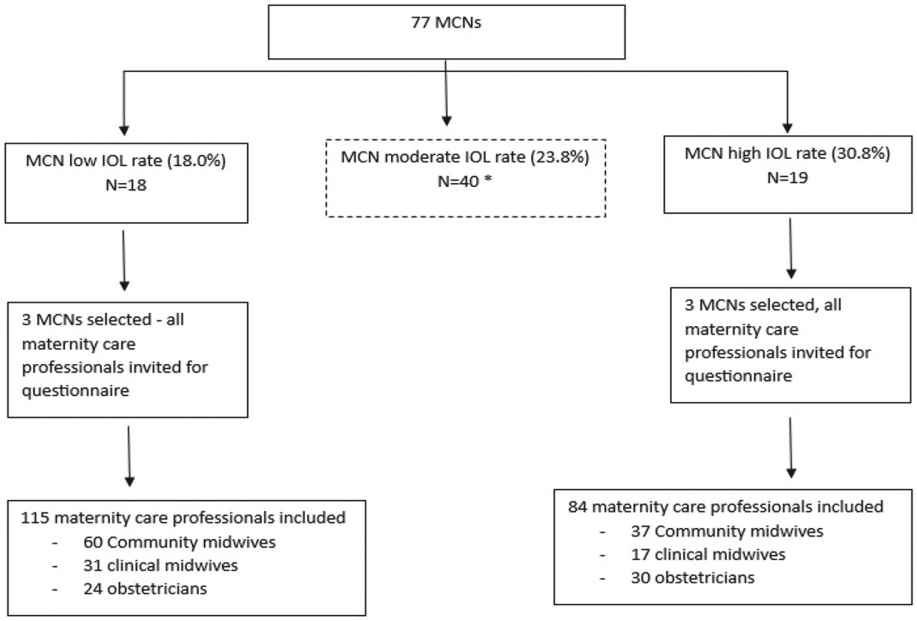

Figure 1. Flowchart of the study population

Data collection

This validation study has a three-step approach in testing: 1) content validity 2) internal reliability 3) discriminant validity. We determined the content validity by examining the BBS by an expert panel (15). Based on the method of Polit and Beck (2006), all the experts scored each item of the BBS on relevance (15). We calculated the content validity per item (I-CVI) and the scale validity (S-CVI) with the scores of the experts. In case, the I-CVI or S-CVI were too low, adjustments in the statements were made before the questionnaire was distributed among the maternity care professionals of the six MCNs.

The BBS exists of two subscales: five statements on birth as a natural process (BBS-Nat) and six statements on birth as a medical process (BBS-Med). Each statement is rated on a 5-point Likert scale ranging from 1= "completely disagree" to 5= "completely agree". Scores for each subscale are derived by calculating the mean scores of the responses, resulting in scores between 1 and 5. A higher score indicates stronger beliefs about birth as a natural (BBS-Nat) or as a medical (BBS-Med) process.

The BBS was validated and the structure of the instrument was examined using factor analysis. This study confirms that the BBS measures the concept of beliefs about birth as a medical process (BBS-Med) and beliefs about birth as a natural process (BBS-Nat) (14). As a result, no adjustments have been made to the statements of the BBS. The statements of the BBS were previously

translated into Dutch by a bilingual researcher and was used in several studies (16,17).

The BBS is distributed among maternity care professionals of the six MCNs as part of a larger questionnaire about perceptions, beliefs, self-efficacy, and shared decision-making on IOL. The questionnaire included validated tools, questions that have been used in previous studies, and additional questions about professionals' characteristics. All midwives and obstetricians working in each of the six MCNs were eligible to participate and were invited to fill out an online questionnaire. Data collection was from November 2022 to March 2023. We aimed to achieve the highest possible response by sending four reminders (after 2, 4, 6, and 8 weeks). Unfinished questionnaires were not included. The questionnaires were saved anonymously on a secured hard drive of Zuyd University, only accessible for the researchers of the VALID-study. Derived data supporting the findings of this study are available from the corresponding author (DCZ) on request.

Data analysis

Statistical analyses for internal reliability and discriminant validity were performed, using data from the questionnaires completed by the maternity care professionals. Professionals' background variables were described in terms of frequencies and percentages for categorical variables and means and standard deviations for continuous variables. Subsequently, internal reliability was tested using Cronbach's alpha, with $\alpha > 0.70$ as the cut-off for acceptable internal reliability (18).

To validate the BBS for maternity care professionals, this study first investigated whether the BBS discriminated between community midwives, hospital-based midwives, and obstetricians (including trainees) on the two subscales (19). We expected midwives to have higher scores on natural beliefs and lower scores on medical beliefs compared to obstetricians (11,12). We expected hospital-based midwives to score in between these two groups (20). Known-group discriminant validity was tested using ANOVA with post-hoc Bonferroni correction (21). The six MCNs were divided in two groups: the three MCNs with a high percentage of IOL (MCN with a high percentage IOL) and the three MCNs with a low percentage of IOL (MCN with a low percentage IOL). Once discriminant validity was confirmed, potential relationships between type of MCN, years of work experience, place of training, and birth beliefs were explored using regression analysis. Place of training was divided in training inland and abroad. P-values of <0.05 were considered statistically significant (21). Data were analysed using SPSS Statistics© version 29.0.

Findings

Evaluation of the content validity of the BBS

Content validity was determined by the examination of the BBS by an expert panel consisting of researchers (n=2), community midwives (n=3), hospital-based midwives (n=2), obstetrician (n=1), midwifery lecturer (n=1), and student midwife (n=1) (15). The content validity per item (I-CVI) and the scale validity (S-CVI) were calculated based on the scores of the experts. The calculated I-CVI score was 0.78 or higher for all items except item 6 (I-CVI = 0.30).

Scale validity can be calculated in two different ways: 1) count how many of the same items scored a 3 or more from the different experts, and divide this by the total number of items; 2) count for each item how many experts give an item a score of 3 or more. Add these totals and divide by the number of items rated (= number of experts * number of items). A good score for the S-CVI should be 0.90 or higher. The S-CVI calculated using method 1 was 0.91, while the S-CVI calculated using method 2 was 0.86. Based on the S-CVI score of 0.86, which is <0.90, adjusting item 6 would improve the I-CVI for this item and the S-CVI. Therefore, item 6 was adjusted before the questionnaire was distributed.

Basic characteristics

The questionnaire was completed by 199 maternity care professionals (Table 1). The response rate varied from 45 to 75% between the different MCNs. A total of 97 community midwives, 48 hospital-based midwives, and 54 obstetricians completed the questionnaire. The majority of the professionals were female (n=187, 94.0%), with a higher proportion of male professionals in the obstetrician group (16.7%). The mean number of years of work experience was comparable in the different groups (14,5 years, SD 9.1). Overall, 15.6% of the professionals was trained abroad. In the group of hospital-based midwives, a higher percentage of professionals was trained abroad, mostly in Belgium (37.5%).

Table 1. Basic characteristics maternity care professionals (n=119)

	All professionals (n=199)	Community midwives (n=97)	Hospital-based midwives (n=48)	Obstetricians (n=54)
Gender				
- male (n, %)	11 (5.5%)	1 (1.0%)	1 (2.1%)	9 (16.7%)
- female (n, %)	187 (94.0%)	96 (99.0%)	46 (95.8%)	45 (83.3%)
- unknown (n, %)	1 (0.5%)	0 (0.0%)	1 (2.1%)	0 (0.0%)
Work experience (years) – mean (SD)	14,5 (9.1)	14,6 (9.8)	14,9 (8.8)	14,05 (8.0)
Education				
- the Netherlands (n, %)	168 (84.4%)	84 (86.6%)	30 (62.5%)	54 (100%)
- Abroad (n, %)	31 (15.6%)	13 (13.4%)	18 (37.5%)	0 (0%)
MCN high % IOL (n, %)	84 (57.8%)	37 (38.1%)	17 (35.4%)	30 (55.6%)
MCN low % IOL (n, %)	115 (42.2%)	60 (61.9%)	31 (64.6%)	24 (44.4%)

Evaluation of the internal reliability of the BSS

Internal consistency was analysed for each of the BBS subscales (Table 2). Cronbach's α for the BBS-Med was 0.74 and for the BBS-Nat 0.76. All item-to-total correlations were greater than 0.38, indicating a good internal reliability of the BBS for maternity care professionals.

Table 2. Internal consistency for the BBS subscales

	N=199
BBS-Med	
Cronbach's α	α = 0.74
Item-to-total correlation	r's = .51-.83
BBS-Nat	
Cronbach's α	α = 0.76
Item-to-total correlation	r's = .63-.77

Evaluation of known-group discriminant validity of the BBS

Table 3 shows the BBS scores by discipline. The mean score for the BBS-Med subscale was 2.72 (SD 0.63). On this subscale obstetricians had the highest score (M 3.22, SD 0.52), followed by hospital-based midwives (M 2.92, SD 0.53), and community midwives had the lowest score (M 2.72, SD 0.63). For the BBS-Nat subscale, the mean score was 3.89 (SD 0.60), with an inverse scoring pattern. The group of community midwives had the highest scores (M 4.24, SD 0.39), followed by hospital-based midwives (M 3.94, SD 0.46), and obstetricians had the lowest scores (M 3.21, SD 0.42). Each discipline showed variation in scores on both subscales, but we saw no outliers for any discipline.

Table 3. BBS-scores by discipline (n=199)

	Total group (n=199)			Community midwives (n=97)			Hospital-based midwives (n=48)			Obstetricians (n=54)		
	M	*SD*	*min-max*	*M*	*SD*	*min-max*	*M*	*SD*	*min-max*	*M*	*SD*	*min-max*
BBS-Med	2.72	0.63	1.17-4.17	2.35	0.48	1.17-3.50	2.92	0.53	1.50-3.83	3.22	0.52	2.00-4.17
BBS-Nat	3.89	0.60	2.00-5.00	4.24	0.39	3.40-5.00	3.94	0.46	2.60-4.80	3.21	0.42	2.00-4.20

The difference between the disciplines was statistical significant using one-way ANOVA for the BBS-Med subscale (F 55.367, p<0.001), and for the BBS-Nat subscale (F 107.676, P<0.001). The Bonferroni post hoc test showed that there was a significant difference between all groups on both the BBS-Med and BBS-Nat.

Examine the potential relationship between different regions in the Netherlands and birth beliefs

Using regression analysis, the impact of the type of MCN (high or low IOL rate) on the association between disciplines and BBS scores was examined. Subsequently, association with work experience and place of training was examined. The variable *years of work experience* was visually inspected for linearity with the BBS-Med and BBS-Nat subscales and was included as a continuous variable (21). For the BBS-Med subscale, MCN, work experience, and place of training were not significant in the regression models. For the BBS-Nat subscale, the factors MCN and work experience were significant in the regression analysis, with interaction on the association between BBS-Nat and discipline. Place of training was not significant in the regression analysis for BBS-Nat.

We made final regression models stratified by type of MCN to estimate the association between discipline and BBS-Nat score, controlling for work experience. The highest BBS-Nat score was estimated for community midwives in MCNs with a high IOL rate, and the lowest for obstetricians in MCNs with a high IOL rate. It was notable that years of work experience had a small decreasing effect on the BBS-Nat score for community midwives and on the contrary a small increasing effect for hospital-based midwives and obstetricians (Box 2 and Supplementary tables).

Box 2. Estimates based on the regression model for different disciplines

MCN with a low % IOL
BBS-Nat community midwife = 4,281 + (-0,006*years of work experience)
BBS-Nat hospital-based midwife = 4,098 + (0,014*years of work experience)
BBS-Nat obstetrician = 3,225 + (0,01*years of work experience)

MCN with a high % IOL
BBS-Nat community midwife = 4,449 + (-0,009*years of work experience)
BBS-Nat hospital-based midwife = 3,760 + (0,022*years of work experience)
BBS-Nat obstetrician = 2,956 + (0,009*years of work experience)

Discussion

The findings from the current study indicate that the BBS in this Dutch translation is a valid instrument for measuring birth beliefs among maternity care professionals. In addition to a good score on content validity and internal reliability, the known-group discriminant validity testing revealed statistical significant differences as a function of the discipline of maternity care professional (community midwives, hospital-based midwives, obstetricians) on BBS-Natural and BBS-Medical subscales. Significant associations were found between years of work experience, discipline, and type of MCN with the BBS-Natural subscale. None of the investigated factors other than discipline had a significant association with the BBS-Medical subscale.

This states the Birth Beliefs Scale as a valid instrument for examining birth beliefs among professionals and could make maternity care professionals aware of their own beliefs and attitudes. Subsequently, this can help to achieve an appropriate balance between patient preferences and the professional beliefs in shared decision-making and can decrease unwarranted practice variation.

Comparison between different disciplines
This study confirmed our hypothesis that birth beliefs differ between maternity care professionals, and this is consistent with the findings of previous studies (11,12). Differences in birth beliefs between maternity care professionals may be the result of the paradigm that influences the way they act. A higher score on the BBS-Med subscale for obstetricians suggests a more medical, interventionist approach where childbirth is seen as a medical condition with treatable risks, whereas a higher score on the BBS-Nat subscale for midwives fits with the midwifery philosophy that childbirth is a physiological, natural process (22).

An interesting finding is the difference between community and hospital-based midwives. Our results showed that hospital-based midwives' scores on the BBS-Nat and the BBS-Med subscales were intermediate between the scores of community midwives and obstetricians, being a distinct group. All midwives educated in the Netherlands follow the same bachelor program, regardless of their later choice of workplace (23). Our findings suggest that beliefs are influenced by the work setting. This is consistent with previous research showing that healthcare professionals adapt their practice to their colleagues and local circumstances, also including managerial demands (24–26). More specifically for maternity care, Thompson et al (20) described the hospital culture as a barrier to practices that promote physiological birth. The influence of the hospital culture can be an explanation for the BBS-professional scores of hospital-based midwives. When community midwives make the transition to work as hospital-based midwives, their beliefs may be influenced by this culture and a higher incidence of pathology, creating a distinct group with intermediate BBS-professional scores. Another explanation can be that not all student midwives have the same beliefs at the end of their midwifery training, as described by Feijen- de Jong et al (23). It is possible that student midwives with beliefs more supportive of a medical approach are more inclined to choose to work in a hospital setting.

Association of beliefs with type of MCN and work experience

In our study, we found clear differences between the different disciplines of professionals, and only small effects on the BBS-Nat subscale for the two types of MCN. Therefore, we cannot conclude that professional's birth beliefs contribute to regional practice variation. Previous research has shown that variation in intervention rates appears to be dependent on regional culture (4,13). Since beliefs are a factor in the attitudes of maternity care professionals, but not the only factor to actual behaviour toward childbirth interventions, the 11-item BBS is probably limited to discriminate between differences in regional culture (10). An instrument that also considers other influencing factors, such as communication skills and collaboration, would probably be more appropriate to measure differences in regional culture (27).

According to years of work experience, there was a small decrease in BBS-Nat score with more years of work experience for community midwives in both types of MCNs. A small increase in BBS-Nat score was seen in both types of MCNs for hospital-based midwives and obstetricians with more years of work experience. As a result, total scores on the BBS-Nat of the different disciplines were less divergent when years of work experience increased. An Australian study among midwives and obstetricians also found an influence of years of work experience on the beliefs and attitudes of maternity care professionals, but was inconclusive about whether there was an effect on medical or natural beliefs about childbirth (12). Further research is needed to investigate the association between beliefs and work experience.

Strengths and limitations

Our study shows that the BBS is a valid instrument to examine birth beliefs of maternity care professionals quantitatively and is easy to use as it consists of only eleven items. A strength of this validation study is that it was conducted within the Dutch maternity care system with its distinction between low-risk midwifery-led care and high-risk obstetric-led care. This offers an interesting opportunity for testing discriminant validity. Another strength in testing the validity of the BBS is that we first tested the content validity of the BBS before distributing the questionnaire. During data collection, attention was paid to population variance and geographical spread. Different perspectives were provided by the international and interdisciplinary nature of the research team. A limitation of the study was that few potential confounders were included in the questionnaires. This number of variables were realistic for a validation study of this type, however, future studies using the BBS for professionals would benefit from confirming our findings in a larger population with more demographic characteristics.

Conclusion

Our study highlights variation in maternity professionals' birth beliefs and contributes to the growing body of evidence that variation in the beliefs and attitudes of professionals contributes to practice variation in maternity care (10–13,27,28). The BBS is a valid instrument for examining professionals' birth beliefs and can make maternity care professionals aware of their own beliefs and attitudes. This awareness can help to achieve an appropriate balance between patient preferences and the professional beliefs in shared decision-making and can decrease unwarranted practice variation.

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7

Practice variation in induction of labor: a critical document analysis on the contribution of regional protocols

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Abstract

Rationale
Despite national guidelines with recommendations on induction of labor (IOL), large variation in the use of this intervention exists between regions in the Netherlands. Guidelines are translated into protocols, which give a contextual description of medical practice provided in a given region. Possibly, protocols developed by regional multidisciplinary maternity care networks (MCNs) contribute to the regional variation in IOL.

Aims and objectives
The aim of this study was to assess the variation between regional protocols and national guidelines regarding recommendations on IOL and the extent to which this contributes to practice variation.

Method
We performed a systematic document analysis using the Ready materials, Extract data, Analyze, Distil (READ) approach. National guidelines (n=4) and regional protocols (n=18) from six MCNs on topics linked to IOL were assessed between October 2021 and April 2022. An analytical framework was used to extract data for the comparison of regional protocols.

Results
Some MCNs followed all the recommendations of national guidelines in their regional protocols, others developed their own recommendations, and for some this varied per topic. When developing their own recommendations, MCNs with a high percentage of IOL added additional risk factors and stricter cut-off values. In contrast, MCNs with a low percentage of IOL added more care options for continuing midwife-led care. No clear relationship was observed between the Appraisal of Guidelines for Research & Evaluation (AGREE) scores of the national guidelines and the extent to which regional protocols complied with the recommendations.

Conclusion
The translation of national guidelines to regional protocols seemed arbitrary and not very systematic. To reduce unwarranted practice variation in the use of IOL, guidance is needed to better align regional protocols with national guidelines, while including appropriate contextual factors and allowing women's preferences. Additionally, healthcare providers should be trained in practicing evidence-based medicine instead of using evidence.

Introduction

Practice variation in health care is gaining attention as a topic in research. Variation in medical practice has been described since the 1930s and variations are seen in diagnoses, contact frequencies, referral rates to more specialized care, and the number of interventions (1). Variation in itself is not remarkable, because medical conditions and patients' preferences vary. If variation cannot be explained by medical conditions or patient preferences, and there are compelling evidence-based recommendations, practice variation is unwarranted (2,3). Unwarranted practice variation is potentially harmful because it can lead to underuse or overuse of interventions, unequal access to good quality care, and higher healthcare costs (2,4).

To understand the causes of medical practice variation, a sociological model of practice variation has been developed (1,5). This model distinguishes three levels 1) micro-level: mechanisms that influence the interaction and decision-making process between the healthcare provider and the patient, such as the provider's attitude and self-efficacy and the patient's attitude and preferences, 2) meso-level: mechanisms that influence practices and organizations, such as regional protocols and regional culture, and 3) macro-level: mechanisms at the (inter)national levels, such as national guidelines and health care systems. Limiting practice variation was one of the reasons why health professionals began to develop clinical practice guidelines. The first guidelines included recommendations based on expert consensus (6,7). Later, evidence-based medicine (EBM) was introduced as a counter-movement to authority-based medicine (8). In EBM, a clinical decision for each individual patient is made by integrating clinical expertise with the best available evidence and the patient preferences (8). The AGREE Collaboration recognized the importance of high-quality evidence-based guidelines internationally and developed the AGREE instrument to assess the quality of clinical practice guidelines (9). A systematic literature search is the basis of a guideline, this combined with clinical expertise, patient preferences, and consideration of cost-effectiveness, results in recommendations for optimal care for patients and care providers (10,11).

Until recently, guidelines for maternity care in the Netherlands were mainly developed monodisciplinary by the professional organizations of obstetricians, midwives, and pediatricians separately (12). More and more, these guidelines are being developed on a multidisciplinary basis using standardized procedures described by the Dutch Federation of medical specialists (12). Multidisciplinary guideline development is important because several disciplines are involved in maternity care and often provide care for the same pregnant woman (Box 1). Regionally, primary care midwives, obstetricians, and other disciplines such as pediatricians and maternity care assistants collaborate in maternity care networks (MCNs) (13,14). Collaboration in MCNs has intensified over the last decade and has stimulated the development of

regional protocols within MCNs (14). In general, protocols are more context-specific than guidelines and describe the 'who', 'what', 'when', and 'how' of medical practice provided in a given region.

Box 1 – maternity care in the Netherlands

In the Netherlands, primary care midwives provide care to women with a low-risk pregnancy as independent healthcare professionals and are able to make autonomous decisions with the woman about childbirth interventions or referral to obstetrician-led care (37). Indications for a referral from midwife-led to obstetrician-led care are described in the obstetric indication list of 2003 and in national multidisciplinary guidelines (38). In obstetrician-led care, hospital-based midwives and obstetricians provide care after referral and can provide childbirth interventions such as augmentation of labor, analgesia, and instrumental birth (37).

Primary care midwives, obstetricians, and other disciplines such as pediatricians and maternity care assistants collaborate regionally in maternity care networks (MCNs) (13, 14). An MCN is usually situated around one hospital and the midwifery practices in the same region. The number of professionals involved varies from about 30 to 120, depending on the number of births and the level of urbanization in the region. Professionals in an MCN are collectively responsible for the quality of maternity care in that region and are expected to continually evaluate perinatal outcomes and women's experiences in order to improve the quality and efficiency of their care (14).

Previous research on regional protocols for perinatal care in Dutch hospitals showed a lack of standardization (15–17). Not all hospitals had protocols on similar topics, and there was a wide variation in developmental methodology and content. It seemed unclear to health professionals what the purpose and content of a protocol should be and how to formulate recommendations that reflect the quality of the supporting evidence (15,17). There is also no clarity on how regional protocols relate to national guidelines. Development of clinical practice guidelines was started to reduce practice variation and methodological clarity exists on how to develop them in accordance with the AGREE recommendations, however, no guidance exists on the development procedure or content of regional protocols. The lack of guidance makes it possible that regional protocols are a potential factor for practice variation.

In this study, we focused on guidelines and protocols with recommendations on induction of labor (IOL). IOL is an intervention in perinatal care that is used for various indications (18). Despite national guidelines recommending situations in which IOL is appropriate care, there are large regional differences in the use of this intervention in the Netherlands, with percentages ranging

from 14.3% to 41.1% (19). Because IOL is a major intervention during pregnancy with the potential for harm, it should only be performed on medical indication (20). In situations complicated by pre-eclampsia of diabetes mellitus, the benefits of IOL for mother and child outweigh the harms. However, IOL is also associated with less favourable outcomes such as the risk of uterine hyperstimulation and rupture, fetal distress, and more unplanned caesarean sections (20). This study focused on variation in regional protocols as one of the factors that may contribute to practice variation at the meso-level of the sociological model of practice variation. The purpose of this study was to analyze variation between regional protocols, and variation between regional protocols and national guidelines regarding recommendations for IOL. Additionally, we explored the extent to which national guidelines were used in regional protocols and whether this was related to the quality of the national guidelines.

Methods

2.1 Design

We conducted a critical document analysis to gain insight into and understanding of the regional protocols and national guidelines. We used the READ approach as a systematic qualitative description approach (21). The READ (Ready materials, Extract data, Analyze data, Distil) approach provides a step-by-step guide to document analysis in health policy research, extracting insight from documents, while ensuring rigor in the analysis. The READ approach can be adapted to different purposes and types of research and is useful for understanding policy content at regional, national, or global level.

2.2 Setting

This study was part of the larger VALID study, which describes practice variation in IOL between MCNs in the Netherlands and explores the different mechanisms that influence the decision-making process about IOL. The aim was to select a total of six MCNs for the VALID study, three MCNs with a high percentage of IOL and three MCNs with a low percentage of IOL In the Netherlands, the Perined database includes data from medical records of almost all births (19). For the VALID-study, the records with a relatively low risk for severe pregnancy complications in the years 2016-2018 were selected. IOL rates in these groups were calculated per MCN with case-mix correction for available socio-demographic factors. The six MCNs with the highest percentage of IOL and the six VSVs with the lowest percentage of IOL were approached for participation. In both groups, at least three MCNs were willing to participate, with the final selection taking into account geographical distribution. Both groups also included an MCN situated around an academic hospital.

2.3 National guidelines

2.3.1 Search and selection

In October 2021, we searched for relevant national guidelines in the Dutch guideline database and on the websites of the Dutch associations of obstetricians and midwives. Relevant guidelines were all national guidelines on maternity care related issues that described specific recommendations for IOL in common situations. From this selection, the following four topics were identified: 1) the management of shoulder dystocia (including recommendations for suspected macrosomia or large for gestational age infants), 2) reduced fetal movement, 3) elective induction of labor, and 4) late term pregnancy (≥41 weeks) (Table 1).

Table 1. Subject, authorization parties, and publication date of the included national guidelines

Subject	Authorization parties	Publication date
Shoulder dystocia	Dutch association of obstetricians	17-09-2008
Reduced fetal movements	Dutch association of obstetricians Dutch association of midwives	12-2013
Elective induction of labour	Dutch association of obstetricians	15-4-2020
Late term pregnancy (≥41 weeks pregnancy)	Dutch association of obstetricians Dutch association of midwives Dutch association of paediatricians Client organizations	15-2-2021

2.3.2. Quality assessment

The quality of the national guidelines was assessed using the AGREE II instrument (22). This instrument consists of two overall items and 23 items divided into six domains (Box 2), which assess the quality and development process of the guidelines. Each item, except the two overall items, is scored on a 7-point scale (1 - strongly disagree to 7 - strongly agree). A sum score and percentage is calculated for each domain. One of the overall items asks whether the guideline can be used in practice (yes – no) and the other item asks for a numerical quality score. Each guideline was scored independently by three of the authors, individual scores were compared and consensus was reached after discussion. In addition, we extracted the recommendations for IOL from each of the four guidelines.

Box 2: Six domains of AGREE II

Domain 1: Scope and purpose
Domain 2: Stakeholder involvement
Domain 3: Rigor of development
Domain 4: Clarity of presentation
Domain 5: Applicability
Domain 6: Editorial independence

2.4 Regional protocols

2.4.1. Search and selection

Regional protocols from the six participating MCNs were collected for in-depth content analysis and assessment. They were collected between 1 October 2021 and 15 April 2022 from the MCN websites and by contacting the MCNs. Regional protocols were eligible if they described recommended care related to IOL for the topics shoulder dystocia, large-for-gestational-age or macrosomia, reduced fetal movements, elective induction of labor, or late term pregnancy (≥41 weeks).

2.4.2. Analytical framework

Because the AGREE II instrument was developed specifically for guidelines, it contains elements that are applicable to national guidelines. Regional protocols have a different structure and include different elements, which makes the AGREE II instrument not suitable for analyzing regional protocols. An analytical framework (S1 Appendix. Analytical framework for analyzing regional protocols.) was developed for this study, based on the domains of the AGREE II instrument (22) and complemented with items for critical document analysis (21). A first version was pilot tested on the regional protocols for late term pregnancy and adjusted for data extraction to meet the purpose of this study. The analytical framework consisted of questions about the development procedure such as scope and target population. Other questions focused on the content of the regional protocols, with questions about relevant recommendations, supporting evidence for the recommendations, clarity of presentation, applicability, and general impression. The first author answered the questions of the analytical framework for each protocol based on the information given in the protocol. Subsequently, the second author monitored the answers given and these were discussed together for the final assessment.

2.5 Analysis

The collected data resulted in an extensive dataset, which we analyzed by systematically answering the questions of the analytical framework for each MCN and reasoning what effect the described care might have on IOL rates. The different MCNs were then compared to see if the outcomes differed and if there was a relationship between the outcomes of the analysis and whether the MCN had a high or low IOL rate. In accordance with the READ method, we also took a holistic view of all documents to see what variation there was within and between the documents (21). The scores of the AGREE II instrument were compared with the recommendations of the regional protocols to see if there was a relationship between the score and the extent to which national guidelines were used in the regional protocols. To increase the validity of our findings, we discussed them in detail with the research team and checked them in the original data before drawing conclusions.

2.6 Ethics

According to the 'Act governing research involving human subjects' in The Netherlands (WMO), formal ethical approval by a research ethics committee is only required for medical research where participants are subject to interventions or procedures, or are required to follow specific, research related rules of behavior (23). Because this research is a document analysis, none of these apply. As the focus of the study was on regional protocols and national guidelines, there was no need for anonymization of documents and no written consent was required.

Results

3.1 Quality assessment national guidelines

In the Netherlands, a standardized method for developing multidisciplinary national guidelines was introduced in 2012. Emphasis was put on an extensive literature review and reporting all individuals and stakeholders involved in the development procedure (12). The AGREE II domain scores of the analyzed guidelines reflected this process of standardization: the newest guideline (late term pregnancy; 2021) showed the highest scores and the eldest guideline (shoulder dystocia; 2008) had the lowest scores (Table 2). The second newest guideline 'Elective induction of labor' (2020) had a remarkably low score on '*Stakeholder involvement*' (domain 2). The development process of this guideline was monodisciplinary, three other disciplines were only involved in the external review and authorization of the final version.

Table 2. Quality assessment of four national guidelines based on the AGREE II instrument

Guideline (year of publication)	D1	D2	D3	D4	D5	D6	Quality score (0-7)	Use
Shoulder dystocia (2008)	7.4%	11.1%	23.6%	57.4%	5.6%	0.0%	2.33	No
Reduced fetal movements (2013)	96.3%	64.8%	41.0%	81.5%	30.6%	0.0%	4.57	Yes
Elective induction of labor (2020)	68.5%	25.9%	66.0%	85.2%	33.3%	44.4%	3.67	No
Late term pregnancy (≥41 weeks pregnancy) (2021)	61.1%	66.7%	80.6%	94.4%	33.3%	100%	5.33	Yes

Based on domain scores:
D1 = Domain 1: Scope and purpose
D2 = Domain 2: Stakeholder involvement
D3 = Domain 3: Rigor of development
D4 = Domain 4: Clarity of presentation
D5 = Domain 5: Applicability
D6 = Domain 6: Editorial independence
Overall items:
Quality score = numerical score of the guideline rated by the reviewing authors
Use = verdict of the reviewing authors if they recognize the guideline as appropriate for use in clinical practice

The overall scores showed the highest scores for the guidelines on late term pregnancy (5.33) and reduced fetal movements (4.57). All reviewing authors recognized both guidelines as appropriate for use in clinical practice, according to the question in the AGREE II instrument. In contrast, the guidelines on elective induction of labor and shoulder dystocia had low overall scores (resp. 3.67 and 2.33) and were not recognized by the reviewing authors as appropriate for use in clinical practice.

3.2 General impression regional protocols

The purpose of all regional protocols was to describe maternal and perinatal care in the MCN, including primary midwife-led care and secondary obstetrician-led care. Not every MCN had a regional protocol for all four selected topics. None of the MCNs had a protocol for elective induction of labor, and for the topics late term pregnancy and macrosomia two or three protocols were identified in one MCN. In total, 18 regional protocols were identified in the six participating MCNs describing the recommended care for (prevention of) shoulder dystocia, large-for-gestational-age or macrosomia (n=6), reduced fetal movements (n=5), and late term pregnancy (≥41 weeks) (n=7) (Table 3).

Table 3. Amount of regional protocols per subject (n=18)

Subject	MCN 1	MCN 2	MCN 3	MCN 4	MCN 5	MCN 6
Shoulder dystocia	1	1	0	1	0	3
Reduced fetal movements	0	1	1	1	1	1
Elective induction of labor	0	0	0	0	0	0
Late term pregnancy (≥41weeks)	1	2	1	2	0	1

A large variation was seen in document types. Documents varied from short and staccato protocols of one page describing what to do, to extensive protocols of ten pages describing not only recommended care, but also providing background, flowcharts, and recommendations for counseling. The documents were named differently, such as protocol, guideline, or care pathway. Three of the six MCNs consequently described authors, version number, and revision date in the document, while the other three MCNs did not.

Some regional protocols described the full range of perinatal care in the specific situation, including a description of what should be done in the event of a referral from midwife-led care to obstetrician-led care for all professionals involved. Others focused separately on recommended midwife-led primary care or obstetrician-led secondary care.

3.3. Development procedure regional protocols

Five of the six MCNs described a comparable development procedure. Their regional protocols were developed by a multidisciplinary panel of healthcare providers. Subsequently, a draft version was presented for feedback to their colleagues. In four out of five MCNs, all colleagues were consulted to approve the final protocol. In one other MCN approval was done by a specially mandated committee. The sixth MCN described a different procedure. A mandated multidisciplinary workgroup formulated specific statements on care based on a review of national and international guidelines and other relevant literature. The other care professionals in this MCN were subsequently asked to react to these statements, and based on these reactions the final recommendations were formulated by the working group and published. None of the MCNs described the participation of women in the development procedure of a regional protocol.

3.4 Recommendations in regional protocols

We observed variations between MCNs in the use of national guidelines in their protocols. However, we did not observe a clear relationship between the extent to which national guidelines were used in regional protocols and the overall AGREE II score of the national guidelines. Two MCNs used the national guidelines as the main source for their protocols and included recommendations from the national guideline in their regional protocols (Table 4). The protocols of these two MCNs followed the national guidelines quite precisely. One of these MCNs belonged to the high IOL group and the other to the low IOL group. Two other MCNs, also one high and one low IOL MCN, developed regional protocols and formulated recommendations based on self-collected evidence, such as data from the Dutch national perinatal register, individual studies, documents from the Dutch Association of Midwives, and international and national guidelines. The last two MCNs used both these strategies for developing protocols, depending on the topic.

Self-developed recommendations varied in several ways. Based on the variation in these recommendations, a possible relationship between the regional protocols and a high or low percentage of IOL appeared. Firstly, protocols from MCNs with a high percentage of IOLs described additional risk factors compared to national guidelines, often expanding the group eligible for IOLs. Factors such as advanced maternal age, smoking, or maternal body mass index >40 kg/m^2 were described as indicators to induce labor at 41 weeks gestation instead of considering expectant management. Secondly, cut-off values or definitions were defined differently in MCNs compared to national guidelines. For example, some protocols of MCNs with a high percentage of IOL recommended IOL in cases of suspected fetal macrosomia, based on a specific and rather strict cut-off value at the fetal growth scan (f.e. the 75th percentile). Other MCNs with a low percentage of IOL stated no specific cut-off value at the growth scan for the management of suspected fetal macrosomia and indicated continuing midwife-led care until referral

was considered necessary by the primary care midwife. Thirdly, additional care options were described compared to care described in the national guidelines. Examples in MCNs with a low percentage of IOLs were the option of artificial rupture of membranes in midwife-led care to induce labor and the option of antenatal cardiotocography for fetal assessment in midwife-led care in cases of reduced fetal movements instead of cardiotocography in obstetrician-led care. These options create opportunities for more continuity of care and potentially fewer referrals for IOL in obstetrician-led care. Extra diagnostic tests such as ultrasound or oral glucose testing were described as additional options in MCNs with a higher percentage of IOL, potentially leading to more situations in which IOL is recommended. Self-developed recommendations had mostly no references to scientific literature and were not explained with considerations of care providers.

Table 4. Are the recommendations in the existing regional protocols in line with the national guideline?

Subject*	MCN 1 – high % IOL	MCN 2 – high % IOL	MCN 3 – high % IOL	MCN 4 – low % IOL	MCN 5 – low % IOL	MCN 6 – low % IOL
Shoulder dystocia *AGREE overall score: 2.33*	No	Yes	Yes#	No	Yes#	No
Reduced fetal movements *AGREE overall score: 4.57*	No protocol available	Yes	No	No	Yes	No
Late term pregnancy *AGREE overall score: 5.33*	No	Yes – recommendations in line with the old guideline 2007	No	Yes	Yes# – recommendations in line with the old guideline 2007	No

* no regional protocols present on the subject 'Elective induction of labor
# For this MCN no regional protocol existed, they referenced to the national guideline

3.5 Other observations

Regional protocols varied in the way they described different care options for women and the involvement of women in the final decision about care options, including IOL. Some regional protocols did not mention women in their protocols, and other regional protocols, all from MCNs with low percentages of IOL, described women as the final decision maker. These protocols explicitly described that woman's preferences should be explored and that the woman should be allowed to decide on treatment.

The provision of information was most frequently described in protocols on reduced fetal movements. Protocols from MCNs with high and low percentages of IOL were equally likely to mention 'personalized care' and 'treatment based on counseling', without further specification of the content of this care. Recommendations for counseling were regularly described in protocols for late term pregnancy and large-for-gestational age. However, the protocols were limited in their specifications.

We observed differences in the writing style used in the MCNs. In one MCN, a prescriptive writing style was observed, including strict cut-off values for interventions and prescriptive instructions on what to do if a woman requested care different from the regional protocol.

Discussion

In this critical document analysis, we found a large variation between regional protocols, which suggests that regional protocols may contribute to the current practice variation in IOL in the Netherlands. Some MCNs followed the recommendations of the national guidelines for all topics, other MCNs developed their own recommendations, and some MCNs used both these strategies depending on the topic. When developing their own recommendations, MCNs added additional risk factors, care options, and specific cut-off values. It appears that MCNs with a low percentage of IOL were more likely to describe additional options where women could stay in midwife-led primary care and to describe the involvement of women in decision-making. MCNs with a high percentage of IOL seemed to describe more indications for interventions such as ultrasound or fetal monitoring, and more indications or stricter cut-off values for IOL compared with MCNS with a low percentage of IOL. Causality could not be proven on the basis of this study, but these results suggest that regional protocols from regions with a high percentage of IOL indicate more situations in which IOL is recommended. Both groups were equally likely to mention 'personalized care' and 'treatment based on counseling'. No clear relationship was observed between the AGREE scores of the national guidelines and the extent to which the regional protocols complied with national recommendations.

National guidelines and regional protocols

Several sources of unwarranted practice variation have been described in the literature. One of the most important sources of unwarranted variation appears to be misinterpretation or misapplication of relevant clinical evidence (24). One strategy to minimize this type of unwarranted variation is the development of national guidelines (12,25). National guideline development provides an opportunity to ensure that sufficient knowledge and resources are available. Guideline development is a specialized task that requires experts who have the time to conduct a systematic analysis of the literature and formulate evidence-based recommendations (26). According to our study, national guidelines do not always seem to reflect current professional practice. Several national guidelines were out of date and do not support healthcare providers with the latest evidence and current issues. Regional protocols do not appear to adequately compensate for these shortcomings. Therefore, national associations need to ensure that guidelines are regularly reviewed to determine whether they are still up-to-date or need to be revised (12). In this way, guidelines can truly be the evidence base for clinical decision-making.

Our analysis confirms previous research that there is great variation between regional protocols (15,17). We found that evidence from national guidelines is not always incorporated into regional protocols, and some MCNs redo the guideline development process to develop a regional protocol. Considering this, there is a need for clarity in Dutch maternity care about the relationship between national guidelines and regional protocols, and about the content of regional protocols. Ultimately, a national guideline is the leading document that provides the systematic literature analysis and evidence-based recommendations on when certain care is needed. Guidelines should also describe where the evidence is less strong and where there is room for women's preferences. As a result, guidelines give direction to regional protocols, leaving only context-specific factors such as 'who' and 'how ' to be specified (26). This can avoid random use of evidence in regional protocols and allows for women's preferences, potentially reducing regional practice variation between MCNs. If recommendations in regional protocols do differ from those in the national guideline or, for example, if different cut-off values are used, this should be justified in the protocol.

The risk of over-standardization

Regional protocols provide an opportunity for a concrete description of medical practice provided in a particular region. This standardization in protocols can help to reduce healthcare provider subjectivity, bias, and uncertainty, thereby reducing unwarranted practice variation (26,27). However, while protocols should facilitate evidence-based practice, they should not promote undesirable standardization of care. Evidence-based practice combines knowledge of the patient's clinical condition, with the scientific literature, and the patient's individual preferences. The risk of undesirable standardization is that these factors are not sufficiently taken into account (27). National guidelines can provide the scientific literature for regional protocols,

and professional expertise is important in addition to knowledge of the client's clinical condition and previous practices. Healthcare providers need to be aware of their directing role in medical practice performed. It appears healthcare providers also need support in interpreting evidence and in shared decision-making (28,29). For healthcare providers, guidelines and guideline developers represent a new authority that makes evidence available for use and makes recommendations that must be followed. As a result, healthcare providers become 'evidence users', rather than reviewing and applying the available evidence themselves and developing a (self)critical attitude (30).
Too much standardization in regional protocols through additional risk factors and strict cut-off values may result in different management of certain obstetric problems in neighboring MCNs with similar populations. This can also be a reason for practice variation between different MCNs. Research has shown that the clinical decision-making of healthcare providers is influenced by several factors, such as geographical and organizational factors (1,31). Over-standardization of protocols can make it difficult to align protocols across regions. It can also lead to confusion among healthcare professionals providing care in different regions, possibly leading to more unwarranted practice variation.

Patient preferences
One factor in good evidence-based practice is whether patient's individual preferences are taken into account (12,26). Shared decision-making is fundamental to maternity care and is a collaborative process between the healthcare professional and the patient to make healthcare decisions using respectful communication (26,32). Our analysis showed that the role of women's choice in clinical decision-making was not always described in regional protocols. Counseling seemed to be described in cases where there is a lack of good evidence, or where the available evidence gives room for equivalent care options. Regions with a lower percentage of IOL appeared to be more likely to describe women having a choice or making the final decision. This may indicate that these regions are more attentive towards involving women in the decision-making process. Previous research has shown that most women receiving maternity care prefer physiological labor and birth (33). Increasing women's involvement in clinical decision-making could therefore lead to less medicalization. Following patients' preferences is a source of justified variation and appears to reduce practice variation between hospitals and simultaneously increase variation within hospitals (34). Women's preferences should be described as a factor to be considered in clinical decision-making as a standard in regional protocols. Attention should also be given to evaluating how these preferences are managed in practice and whether healthcare professionals have sufficient skills to support women's active participation and involvement in maternity care.

Strengths and limitations

This study is an exploration of regional protocols based on four topics for IOL in six MCNs. Although this is a relatively small sample, we saw a large variation in regional protocols. It is likely that protocols on other topics show similar variation. At the time of the analysis, some national guidelines had recently been published or were under revision. It is possible that these national guidelines have been partially implemented in the regional protocols, but this could not be traced due to the limited use of references to the evidence base in the regional protocols. As we did not observe the actual implementation of the regional protocols in practice, we cannot conclude to what extent clinical decision-making is in line with the regional protocols. However, the differences in recommendations in the regional protocols and the apparent relationship with high and low percentage of IOL in MCNs makes it plausible that the regional protocols are a contributing factor to practice variation.

Several techniques have been used to enhance qualitative rigor, such as the use of a systematic method, peer debriefing, and the use of multiple researchers in the study (investor triangulation). Data triangulation was achieved by searching for documents on websites, online databases, and requests to the MCN (35,36).

Conclusion

Overall, this study shows that there is variation in regional protocols, which can lead to unwanted standardization and unwarranted practice variation. There is a need for guidance on the development and content of regional protocols. In order to better align regional protocols with national guidelines, while adequately describing contextual factors, and making room for women's preferences and professional expertise. Healthcare providers should be trained in the use of evidence and in shared decision-making to become evidence-based practitioners. At the national level, there is a need to work on up-to-date guidelines and to communicate the relationship between national guidelines and regional protocols. Furthermore, research is needed into other mechanisms that contribute to practice variation.

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Supplementary

Analytical Framework

Analytical framework for analyzing regional protocols

Subject	Questions
Content regional protocol	1) What indicates that the regional protocol contributes to more or fewer inductions of labor (IOL) compared to the recommendations in national guidelines? a. What other interventions are described that may influence the number of IOL? Are any preventive interventions described that may affect more or less midwife led care? b. What (scientific) basis is there for these recommendations? (national guideline, additional literature research, other?)
Women's involvement	2) What is described about women's involvement in clinical decision-making?
National guideline vs regional protocol	3) What is the quality of the national guideline according to the AGREE assessment? Is there a relationship between the quality of the national guideline (AGREE) and the existence of variation between regional protocols?
Development procedure	Questions at Maternity Care Network (MCN) level: 4) What is the process to develop regional protocols/work arrangements? Issues to consider: a. Does the regional protocol describe only midwife-led care, obstetrician-led care, or complete integrated care? b. How were the different disciplines involved in developing and approving the regional protocol? Points of interest: role of the primary care midwives, clinical midwives, obstetricians, junior doctors. Which disciplines are represented? c. How is the implementation of the regional protocol supported? What is the follow-up process like? (review, accessibility)
Overall impression	What is your overall impression of this regional protocol/work arrangement at maternity care of this MCN? Points of interest: - Manner and responsible caregiver for counselling - How does this regional protocol affects cooperation? - Is there difference between the rationale (background/ substantiation) in the protocol and the work arrangements of the protocol? - Does the regional protocol fit with an MCN with a high or low group for IOL for low-risk pregnancies?

8

General discussion

General discussion

Practice variation is known for various childbirth interventions in maternity care. A number of factors such as organisational structures, regulations and population characteristics have been shown in research as potential explanations for this variation (1–4). This thesis contributes to further insight into a number of these factors. It describes exploratory research on the variation in childbirth interventions in the Netherlands and generates further knowledge about how personal and professional factors are related to midwives' clinical decisions about the use of childbirth interventions. We performed a variety of studies to answer five research questions. In this final chapter, the main findings of this PhD project are presented. Followed by a reflection on these findings, consideration of the methodological strengths and limitations, discussion about implications for practice and suggestions for further research.

Main findings

Two chapters of this thesis present a comprehensive overview of existing regional variation in the Netherlands. We found major regional variation for most childbirth interventions, which persisted after adjusting for population characteristics (Chapter 2 and 3). Perinatal mortality and morbidity rates did not vary significantly between regions. This practice variation can be an indicator of unwarranted variation, potentially leading to avoidable harm, inequalities in quality of care, and higher costs. Within the same region, intervention rates in midwife-led and obstetrician-led care were positively correlated, showing similar higher or lower use of different interventions, such as episiotomy and artificial rupture of membranes.

Practice variation in maternity care is a topic involving different mechanisms at micro-, meso- and macrolevel. In this thesis, we focused on studying how personal and professional factors influence midwives' clinical-decisions about the use of interventions in childbirth. We chose to focus on primary care midwives working in the Netherlands, because as autonomous professionals they make clinical decisions about the use of childbirth interventions on a day-to-day basis, including referrals to obstetrician-led care. Factors at the micro-level of the individual midwife and at the meso-level of collaboration in a maternity care network were examined. Insights from our studies can help to develop effective strategies to improve clinical decision-making and possibly contribute to reducing unwarranted practice variation in maternity care.

At the micro level, we focussed on attitudes, knowledge and skills of the individual midwife, working in primary midwife-led care, using the ASE-model. The ASE-model explains behaviour by linking attitude, social norms and self-efficacy with behavioural intention and actual behaviour. Two distinct attitudes towards interventions were identified (Chapter 4). Midwives with an attitude oriented to 'wait and see', who displayed a more supportive style of behaviour

toward the use of interventions, and midwives with an attitude orientated to 'check and control', who displayed a more directive style of behaviour toward the use of interventions. Midwives' attitudes were shaped by their experiences of collaboration with other healthcare professionals, their trust and fear in the process of pregnancy and birth, and their views on woman-centeredness. Midwives showed a tendency towards either one of these attitudes, however, certain circumstances such as client preferences or recent cases could elicit midwives to use the other style of behaviour. It appeared that midwives with a 'wait and see' attitude showed more skills of a reflective practitioner compared to midwives with a 'check and control' attitude (Chapter 5). Midwives with an attitude orientated to 'wait and see' demonstrated a higher level of reflective skills, used a more balanced communication style in interaction with women, and have more skills to engage in discussions during collaboration with other professionals, thereby personalising their care. This personalised approach to maternity care could help to promote appropriate rather than routine use of interventions and may contribute to reduce the medicalisation of childbirth.

The positive correlation between intervention rates in midwife-led care and obstetrician-led care within the same region (Chapters 2 and 3), suggests that variations are not merely individual. Therefore, we explored two factors at meso-level that potentially contribute to practice variation.

First, we performed a systematic document analysis of regional protocols of maternity care networks (MCNs), advising on use of induction of labour as a childbirth intervention for various complications during pregnancy (Chapter 7). As previous research on protocols for perinatal care in Dutch hospitals showed a lack of standardization (4), regional protocols of MCNs can be one of the factors on meso-level that contribute to practice variation. Our analysis showed a large variation of recommendations in regional protocols, which suggests that regional protocols may contribute to the current practice variation in induction of labour in the Netherlands. We observed MCNs that adhered to the recommendations set in national guidelines in their regional protocols, other MCNs developed their own recommendations, and for some MCNs this varied per topic. When formulating their own recommendations, regions with a high percentage of induction of labour added additional risk factors and stricter cut-off values for use of induction as an intervention. Conversely, regions with a low percentage of induction of labour offered more opportunities to continue midwife-led care. Additionally, in regions with a low percentage of induction of labour, protocols described more often that woman's preferences should be explored and that the woman is the final decision-maker in using the intervention.

Secondly, we evaluated if the Birth Beliefs Scale can be used to measure beliefs about birth among maternity care professionals (Chapter 6). The Birth Beliefs Scale has been validated for pregnant women (5). We explored if this scale can also be used for maternity care professionals to assess their beliefs,

so that in future research the relationship between professionals' beliefs about birth and the use of interventions can be explored. Our validation study showed that the Birth Beliefs Scale is a valid instrument to measure birth beliefs among maternity care professionals. Natural and medical birth beliefs differed between community midwives, hospital-based midwives, and obstetricians. Community midwives had the highest scores on the natural birth beliefs scale, followed by hospital-based midwives, and obstetricians showed the lowest score. For the medical birth beliefs scale an inverse scoring pattern was seen, with the highest score for obstetricians, followed by hospital-based midwives and the lowest scores for community midwives. These differences in birth beliefs were seen between maternity care professionals in all MCNs, however, beliefs did not explain practice variation between MCNs.

Reflection on the findings

In our nationwide studies, we found major regional variation for use of most childbirth interventions after correction for population characteristics, without significant differences in regional perinatal morbidity and mortality rates (Chapters 2 and 3). Some practice variation in childbirth interventions is to be expected when care is adapted to medical conditions or to woman's preferences (2,6). However, the large regional variation we observed can indicate unwarranted variation in Dutch maternity care. Sutherland and Levesque designed a framework which can be used to assess whether the variation is warranted or unwarranted (2). According to this framework causes of unwarranted variation can be found in 1) lack of evidence-based care (evidence); 2) differences in the availability of healthcare resources (capacity); and/or 3) care providers offering care based on the beliefs and personal interests (agency) (2). When variation cannot be explained by medical conditions, population characteristics or patient preferences and occurs despite strong evidence-based recommendations, it is defined as unwarranted (7,8). In other words, when patients conditions or preferences are considered in the process of clinical decision-making, variation can occur, but is warranted.

We reflect on the findings of this thesis using part of the framework described by Sutherland and Levesque (2). In line with the *first cause* of the framework, we discuss how evidence-based care is part of midwifery care in the development of guidelines and regional protocols, and how regional collaboration affects evidence based care. The second cause of the framework, reflection on differences in the availability of healthcare resources (capacity), was not part of our studies and goes beyond the scope of this thesis. It can be subject for future research. In line with the *third cause* of the framework 'agency', we explore how reflective practice can help to gain insight into midwives' beliefs and attitudes and the influence on their clinical decisions about the use of interventions. Woman-centredness was found in our study (chapter 4) to be part of midwives' attitudes and also to influence clinical decision-

making, we therefore discuss how woman-centredness might influence the use of interventions.

Evidence in guidelines and protocols (cause 1)
The development and utilisation of healthcare guidelines is beneficial when practice variation is the consequence of subjectivity, bias, and uncertainty. In that case, guidelines can indicate what care is the best for a specific group (9). Ultimately, a national guideline is the leading document that provides evidence and recommendations for care based on an up-to-date systematic literature analyses of available evidence: the 'what' and 'when'. (10,11). However, good quality of care is more than what is proven in studies. A guideline should therefore provide room for patients' preferences and the expertise and experiences of the healthcare professional (12). The use of such a guideline is likely to result in warranted practice variation, as patients have different preferences and taking these into account in clinical decision making will result in different treatments. As described in the report 'No evidence without context – About the illusion of evidence-based practice in healthcare', guidelines should give direction to regional protocols, leaving the specific implementation to that region, with description of the 'who' and 'how' (9).

National guidelines and regional protocols provide an opportunity for the detailed description of medical practice based on evidence, however, they should not promote undesirable standardisation of care (9). Some MCNs in our research had the tendency to add additional risk factors and stricter cut-off values in their regional protocols providing more indications for interventions compared to the national guidelines. These additional risk factors and stricter cut-off values were recommendations that did not become evident after a systematic exploration of the literature by the guideline or protocol developers. Based on these findings, there seems to be a need for maternity care professionals to have a better understanding of the differences between national guidelines and regional protocols. By making these differences clearer, professionals are likely to better understand the scientific rationale for recommendations. Hopefully, they will be more inclined to use the recommendations of the national guidelines during clinical decision-making, rather than describing additional risk factors and stricter cut-off values, without good scientific evidence.

As the latter will limit the scope for patient preferences and healthcare professional expertise and experiences, resulting in strict, standardised protocols. Too much standardisation in regional protocols can decrease the existing room for patients' preferences and other contextual factors, such as living circumstances of women and the structure of healthcare practices. Offering care in accordance with these protocols will make it more difficult to personalise care and possibly increase unwarranted interventions (13–15).

Effect of regional collaboration on evidence based care (cause 1 and 3)
As regional protocols are developed within the interdisciplinary collaboration of an MCN, protocols are influenced by this collaboration (11,13,16,17). Collaboration in MCNs is known to be challenging, because maternity care professionals with different expertise and paradigms need to align (11). Differences in professional paradigms were also reflected in our study exploring the birth beliefs of different disciplines of maternity care professionals. Beliefs about the nature of birth are part of the attitudes of healthcare professionals that influence clinical decision-making. In the development of a regional protocol, these differences in attitudes between disciplines play a role, requiring a collaborative approach based on equality to ensure the creation of a regional protocol that is acceptable to all disciplines. It is therefore essential that professionals have the skills to engage in constructive dialogue and debate in a multidisciplinary setting (18–20).

There are different views on the influence of individual care professionals on the culture of shared work environments, such as MCNs (14,16,21). Some researchers have argued that professionals prefer a certain approach in their work based on their education and professional socialisation, resulting in (self)selection of professionals in shared work environments. This means that professionals with the same training or same preferences will collaborate together (21). Other researchers have argued that the circumstances in which professionals work have a profound influence on their approach to their work. They stated that healthcare professionals cannot make their decisions autonomously, because they are influenced by collegial norms (22).

According to Dutch maternity care, community midwives are autonomous working healthcare professionals, capable to make autonomous decisions together with the women about childbirth interventions or referral to obstetrician-led care (23). The midwives interviewed for this thesis, mentioned that they are autonomous working professionals providing care within the shared work environment of a midwifery practice and an MCN. Still, some of these midwives mentioned that they adapted their care to avoid criticism from colleagues or because of a feeling of hierarchy towards obstetricians. These midwives seem more sensitive to feelings of hierarchy and the belief that it is correct to follow regional protocols.

Reflective practice: insight into midwife's practices (cause 3)
Midwife-led care is indicated by the World Health Organization as the most appropriate care for women with uncomplicated pregnancies, making the midwife the most suitable professional to be the lead carer for these women (24–26). Care by midwives shows a reduction in interventions rates and an improvement in women's satisfaction with the care they received (26). In the Netherlands, midwives appoint that they 'guard physiology', meaning that they prevent unnecessary interventions and provide care that stimulates a physiological process (27). However, current trends of medicalisation in Dutch

midwifery care, such as increasing rates of referral to obstetrician-led care, require a critical evaluation of the statement that Dutch midwives 'guard physiology'. Midwives need to reflect on their clinical decision-making and whether it is influenced by their personal values and beliefs (28). Reflective practice has been used in midwifery education for several decades. However, there are different interpretations of the concept of reflective practice and it is known to be prone to oversimplification in practice settings (29,30). The Model of Holistic Reflection for the Bachelor of Midwifery program has been developed as an educational tool to support midwifery students to require reflective and critical thinking skills (31). Embedding this model into Dutch educational programs will help student midwives to develop into critically reflective and reflexive practitioners, who demonstrate self-awareness and the ability to discuss.

Midwives can be helped to understand their own practice through the use of reflection on action during peer review meetings with colleagues, which helps to make sense of their experiences and identify patterns in practice (30). Nevertheless, midwives need to go beyond reflection on action and should also include reflection in action as part of their practice (32). This makes reflective practice an active process of doing rather than just thinking, offering the opportunity to change actions as they unfold. Genuine reflection is challenging because it requires time, effort and a willingness to question your actions, underlying beliefs and values (33). Reflective models, such as the Model of Holistic Reflection, can promote deeper reflection instead of an uncritical and descriptive cause-and-effect analysis of experience also for graduated midwives (31). Overall, it seems that midwives with a more wait and see attitude are more likely to have the skills of a reflective practitioner. This enables them to provide more personalised care and the use of childbirth interventions appropriate for that situation.

Because midwifery practice is dynamic, and the effectiveness and application of interventions depend on the context, midwives need critical thinking skills to examine this (9,29,30). The context of midwifery practice depends on a number of factors, including the preferences of the patient, the expertise and experience of the midwife, and the regional setting. The balance will therefore vary from one individual situation to another. Context-based care consequently introduces greater uncertainty for the healthcare professional, as each decision requires a new weighing of elements (9). It seems that familiarity with and accurate interpretation of the scientific literature and guidelines enables them to contextualise the literature and deviate from established protocols. This results in a more nuanced approach that is responsive to patient preferences, addresses uncertainty, and consequently reduces unwarranted interventions.

Woman-centredness during clinical decision-making (cause 3)
Part of woman-centredness in maternity care is shared decision-making. Research has shown that the use of shared decision-making helps patients to take an active role in the decision-making process, which contributes to more positive experiences of their care. Decisions will then be made based on patient's preferences, healthcare professionals' expertise, the organisation of care and the best available evidence. When patients have an active role in the decision-making, different treatments are preferred compared to those with medical professionals' judgement only (34,35).

Up to now, most studies have explored the influence of shared decision-making on variation within hospitals and general practitioners practices (16,36). A comparable influence on practice variation in maternity care is likely when midwives use shared-decision making. Especially when uncertainty exist about the evidence on what is the best options, it creates room for women's preferences. Variation within a midwifery practice is likely to increase when women's preferences are taken into account using shared decision-making (15). If variation increases based on women's preferences, within the boundaries of accepted care, this is not considered unwarranted variation. However, if this variation is caused by preferences of the midwife, it is considered to be unwarranted variation. As it seems that women informed through shared decision-making prefer more conservative options, another effect of shared decision-making may be a reduction in interventions during childbirth (15,37).

In our interviews, participants described differences in communication skills. Midwives with a wait and see attitude seemed to use more communication skills that facilitated shared decision- making. Besides the use of instrumental communication to explain treatment options, these midwives showed additional attention to women's need to feel known, by using more affective communication skills and gaining insight into women's knowledge and motives (Chapter 5). The balance between instrumental and affective communication skills is necessary to invest in an effective partnership between woman and midwife and is in the line with the shared decision-making model (38–40). Shared decision-making means that a midwife explains the various options and their evidence base as well as exploring women's preferences and what she knows. This makes clinical decision-making less dependent on the personal beliefs of the individual midwife (38), and leads to more awareness about appropriate use of interventions instead of standardised use. In practice, an informed consent approach can unjustly be mistaken for shared decision-making, because professionals ask for consent but there is no dialogue as a medium for the decision-making process (38). Research by Thomas et al. proposes changes in health education to develop the skills needed to be fully competent in shared decision-making (41). They suggest that education should, among other things, include teaching methods that involve more dialogue and the creation of moments of dissonance.

Reflection on the methodological strengths and limitations of this thesis
A strength of this thesis is that used the sociological model for explaining practice variation by de Jonge et al (14) (Chapter 1: figure 1), which provides knowledge about factors interacting on micro and meso-level for midwives. The use of this model has ensured a broader view on factors influencing practice variation, also investigating the role of midwives within the interdisciplinary collaboration of MCNs. On meso-level, we gained knowledge about the influence of regional protocols and differences in maternity care professionals' birth beliefs. In the document analysis, we focused on protocols with recommendations on induction of labour. However, we expect that the findings of this study are also applicable to other topics in maternity care. Due to time and resources limitations, we were unable to investigate other factors that have been identified to influence medical practice variation, including staff capacity, the structure of collaboration and the effective application of protocols (2,11,14).

In our qualitative studies, we used the ASE-model to investigate which factors influence individual midwives' intention to use interventions or not (42–44). We gained in-depth knowledge of the experiences, beliefs and values that underpin their attitudes, and how knowledge and skills influence midwives' intentions to come to actual behaviour. The ASE-model is internationally used in behavioural science studies and known as the Theory of Planned Behaviour. Over time, this theory has been replaced by The Reasoned Action Approach, which provides a more integrative framework for predicting human behaviour (44). As in our studies, multiple factors such as context and time are taken into account, making the outcomes of our studies more in line with the Reasoned Action Approach. Considering multiple factors is a strength because it gives more in-depth insight into the underlying motivations that influence midwives' decisions to perform or refrain from performing childbirth interventions. The results of our studies allow us to formulate hypotheses about the influence of specific factors on the decision to use interventions. However, it is not possible to describe the precise effect on intervention rates, as we did not investigate actual behaviour.

We identified knowledge and skills that (future) midwives need to become reflective practitioners with the aim to reduce unwarranted interventions. However, we did not study the actual interaction between midwives and women during decision-making. Patient involvement in shared decision-making represents another potential element that affects practice variation in maternity care (36). Therefore, research is needed to investigate the interaction with women during decision-making and the impact on practice variation in maternity care.

Implications for practice
Given what we and others have learned regarding the influence of personal and professional factors on midwives' clinical decisions about the use of childbirth

interventions, it appears that there should be more focus on midwives as reflective practitioners. The skills of a reflective practitioner will probably help to provide more personalised care, which can help in the appropriate use of interventions and can contribute to reduce unwarranted practice variation in maternity care. In order to raise awareness among midwives about their role in the use of interventions, the findings of this thesis will be disseminated with the help of the Dutch Association of Midwives (KNOV) and the Dutch Master in Midwifery. Midwives can be trained to provide personalised care and integration of this training in the current quality register will be explored.

For student midwives, education in critical thinking skills and an advanced level of interpretation of the scientific literature need to be part of the bachelor curriculum (45). Models such as the Model of Holistic Reflection can be used to embed reflection in the educational programme. Midwives with a Master's degree can add value to the midwifery profession, for example by using their advanced competencies in the development of national guidelines or regional protocols. In addition, they can act as role models for practice or mentors for bachelor midwives.

It is necessary that the Dutch Associations of Midwives and of Obstetricians as well as the federation of MCNs anticipate on the need for clarity on the difference between national guidelines and regional protocols. Both national guidelines and regional protocols should allow room for patient's preferences and the expertise and experiences of the healthcare professional, avoiding undesirable standardisation. The professional associations can contribute to supporting MCNs in the development of regional protocols through the federation of MCNs, as the development of regional protocols occurs in MCNs and this organisation is affiliated to almost all networks.

Implications for future research

This thesis contributes knowledge about how personal and professional factors relate to midwives' clinical decisions about childbirth interventions. We have focused on a number of factors on micro- and meso-level, but predicting human behaviour is complex and depends on different elements of an integrative framework. Future research should therefore focus on more factors, such as social norms, barriers and stimuli that influence midwives in their process to come from intention to actual behaviour. Research is also needed on possible factors influencing attitudes. For example, years of work experience have been described as both stimulating and inhibiting factor in the provision of personalised and low-intervention care (46–48). Our studies were also ambiguous about whether years of work experience had a stimulating or an inhibiting effect on beliefs towards the use of interventions.

Research is needed to investigate the influence of contextual factors and culture in MCNs during the process of developing regional protocols and execution of care. In light of the conclusions reached in this thesis, it is our

hope that MCNs will be provided with the necessary support to develop context-based protocols that align with national guidelines. Instruments or implementation strategies to support MCNs in the development of regional protocols should be the subject of further research and development. The development and implementation of a training program to obtain the knowledge and skills of a reflective practitioner is an interesting and relevant topic for implementation research.

Final conclusion

We have shown that midwives' attitudes, knowledge and skills differ and are influencing factors on practice variation at the micro-level. More attention for the skills as a reflective practitioner could contribute to a more personalised approach in clinical decision-making towards childbirth interventions. At the meso-level, midwives can use these skills in the context of MCNs for effective interdisciplinary collaboration and the development of regional protocols. Together with guidance on how to translate national guidelines into regional protocols. This can provide opportunities for more personalised care and a reduction of unwarranted practice variation.

We have shown that midwives have an important role in clinical-decision making and can make a difference in the use of interventions, and therefore to women's experiences of childbirth. Finding a balance between too little too late and too much too soon, requires a midwife that finds a balance between evidence, expertise and women's preferences in order to proves personalised care with appropriate interventions.

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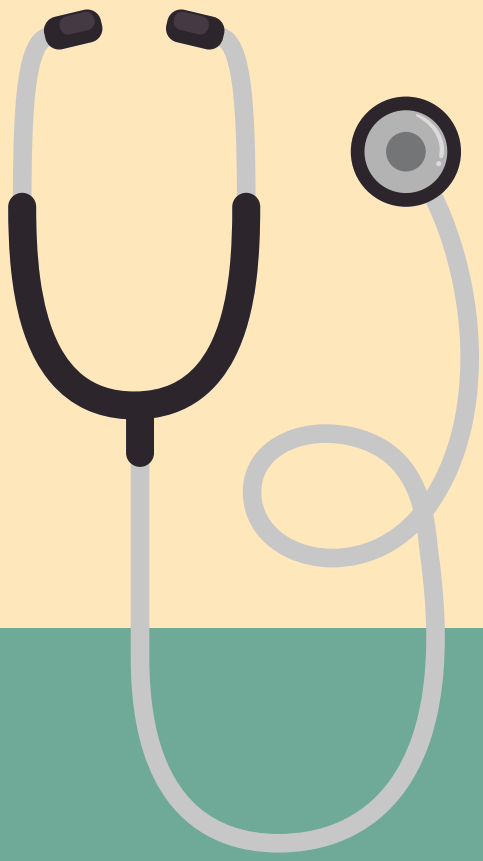

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Summary

Summary

Chapter 1 | Introduction
Internationally, the interventions used in childbirth vary widely, and there is evidence to suggest that this is also the case in the Netherlands. Interventions in childbirth are useful in certain circumstances to prevent perinatal morbidity and mortality. Some practice variation in childbirth interventions is to be expected, as care is adapted to medical conditions or the woman's preferences. However, practice variation can also be an indicator of unwarranted variation, which can lead to avoidable harm, inequalities in quality of care, and high costs.

Practice variation can be explained by a sociological model that describes factors that interact with practice variation at macro-, meso-, and micro-level. In this thesis, we focus on mechanisms in maternity care that can help explain practice variation at the meso and micro level.

The meso-level, refers to regional collaboration in maternity care networks (MCNs), where community midwives, hospital-based midwives, obstetricians, and other disciplines such as paediatricians and maternity care assistants are collectively responsible for the quality of maternity care in that region. Collaboration in MCNs can be challenging because professionals with different expertise and paradigms need to align and should agree on recommendations in regional protocols.

The micro-level describes the interaction between the woman and the maternity care professional to achieve individual decision-making. Decision-making at the micro-level appears to be influenced by the attitude of the healthcare professional. There are indications that the use of interventions varies between midwives and we want to explore what causes this variation. Therefore, the general aim of this thesis is to generate more knowledge about how midwives' personal and professional factors are related to their clinical decisions about childbirth interventions. This can contribute to reducing unwarranted practice variation in maternity care.

Chapter 2
In this chapter we explored regional variations in childbirth interventions performed in obstetrician-led care in the Netherlands and their associations with interventions and adverse outcomes, controlled for population characteristics.

We performed a register-based study and analyzed data from the Dutch national perinatal register (Perined) from 2010 to 2013, including all singleton births from 37 weeks of gestation onwards. The following interventions were examined: induction and augmentation of labor, pain medication, instrumental vaginal birth, cesarean section, and pediatric involvement after

birth. We compared data across twelve regions and controlled for maternal characteristics such as age, parity, ethnicity, socioeconomic status, and degree of urbanization.

We found the largest variations for the type of pain medication and whether a paediatrician was involved within 24 hours after birth, followed by variation in augmentation after a spontaneous onset of labour. Less variation was found for induction of labour and prelabour caesarean sections, and least for instrumental vaginal births and intrapartum caesarean sections. We found similar variation in intervention rates for births in midwife-led care compared to those in obstetrician-led care at the onset of labour in the same region. This correlation suggests that regional medical culture and practices influence decision-making in midwife-led and obstetrician-led care. Higher of lower intervention rates did not lead to differences in rates of adverse neonatal and maternal outcomes.

The study highlights the need for critical evaluation of regional differences in childbirth interventions in the Netherlands. Major variations may indicate unwarranted interventions. Variation may be explained to some extent by a difference in the degree of implementation of national guidelines between regions. Further research should therefore focus on variations in evidence based interventions and indications for the use of interventions in childbirth.

Chapter 3
In this nationwide retrospective cohort study, we explored variations in childbirth interventions that are used in both midwife- and obstetrician-led care, and in referral rates, place of birth, and care provider. We analysed variations in childbirth interventions across twelve Dutch regions using a national data registry of 614,730 singleton births after 37 weeks' of gestation (2010–2013). We adjusted for maternal maternal characteristics using multivariable logistic regression.

Intrapartum referral rates varied widely for primiparae (55 to 68%) and multiparae (20 to 32%). We found higher rates of postpartum haemorrhage in regions with higher rates of intrapartum referral. Large variations were found in the use of episiotomy and postpartum oxytocin administration. In regions with more home births, an episiotomy was placed less and postpartum oxytocin was administered less often. Remarkable was a north-south division: northern regions had higher rates of home birth and lower rates of interventions (episiotomy and oxytocin use) than southern regions. Adjustment for maternal characteristics did not change the variations in childbirth interventions, suggesting differences in healthcare professional attitudes towards interventions.

The findings highlight the role of the healthcare professional in decisions about the use of interventions. In addition, policy makers and healthcare

professionals should be made aware of the unwarranted variation in childbirth interventions.

Chapter 4
In this descriptive, qualitative study, we used in-depth interviews to explore experiences, beliefs, and values that shape midwives' attitudes toward the use of childbirth interventions. We conducted the interviews (n=20) in June 2019 and used inductive content analysis.

We identified two main themes: (1) attitudes toward interventions, and (2) influences on midwives' attitudes. Midwives in our study described their attitudes toward interventions as oriented to either wait and see or check and control. Care based on wait and see displayed a more supportive style of behaviour, and care based on check and control appeared to display a more directive style of behaviour. Collaboration with other healthcare providers, trust and fear in the process of pregnancy and childbirth, and beliefs about woman-centeredness influenced the attitude of midwives.

We learnt that all midwives in our study had the intention to perform interventions only when appropriate. However, midwives with a wait and see attitude seemed to have a more restrictive approach toward interventions compared with midwives with a check and control attitude. Midwives need to be aware of how their experiences, beliefs, and values shape their attitudes toward the use of interventions. This awareness could be a first step toward the reduction of unwarranted interventions.

Chapter 5
In this chapter, we explored how knowledge and skills influence midwives' clinical decision-making about the appropriate use of childbirth interventions. We interviewed 20 community midwives in June 2019. Participants' clinical experience varied in the use of interventions. The interviews had a narrative approach and we analysed the data using deductive content analysis.

We identified that knowledge, critical thinking skills, and communication skills influenced midwives' clinical decisions about childbirth interventions. Midwives obtained their knowledge through the formal education program and expand their knowledge through reflection on experiences and scientific evidence. Midwives with a low use of interventions seemed to have a higher level of reflective skills, including reflection-in-action. These midwives used a more balanced communication style with instrumental and affective communication skills in interaction with women. They offered women a range of options, encourage shared decision-making, and actively explore patients' preferences. Additionally, these midwives had more skills to engage in discussions during collaboration with other professionals. On the other hand, midwives with a high use of interventions tend to use more directive communication, presenting interventions as standard procedures rather than

optional choices. Midwives with reflective skills, critical thinking skills, and the skills to discuss about care seem to make more personalised decisions about interventions rather than following standardised procedures.

We concluded from these findings that midwives with a low use of interventions seemed to have the knowledge and skills of a reflective practitioner, leading to more personalised care compared to standardised care as defined in protocols. Learning through reflectivity, critical thinking skills, and instrumental and affective communication skills, need to be stimulated and trained to pursue appropriate, personalised use of interventions.

Chapter 6
We analyzed variation between regional protocols, and variation between regional protocols and national guidelines regarding recommendations for induction of labour (IOL). Additionally, we explored the extent to which national guidelines were used in regional protocols and whether this was related to the quality of the national guidelines. The research explored how regional maternity care networks (MCNs) translate national guidelines into protocols and how these variations may contribute to practice variation.

Using a systematic document analysis, we compared four national guidelines with eighteen regional protocols from six different MCNs. The study applied the READ approach (*Ready materials, Extract data, Analyze, Distil*) to analyze the content of these protocols. Additionally, the AGREE II instrument was used to assess the quality of national guidelines, while a analytical framework was developed to evaluate regional protocols.

Our analysis showed a large variation of recommendations in regional protocols, which suggests that regional protocols may contribute to the current practice variation in IOL in the Netherlands. We observed MCNs that adhered to the recommendations set in national guidelines in their regional protocols, other MCNs developed their own recommendations, and for some MCNs this varied per topic. When formulating their own recommendations, regions with a high percentage of IOL added additional risk factors and stricter cut-off values for use of induction as an intervention. Conversely, regions with a low percentage of IOL offered more opportunities to continue midwife-led care. Additionally, in regions with a low percentage of IOL, protocols described more often that woman's preferences should be explored and that the woman is the final decision-maker in using the intervention.

This study illustrates that the translation of national guidelines to regional protocols seemed arbitrary and not very systematic. There seems to be a need for guidance to help healthcare professionals translate national guidelines into regional protocols, while including appropriate contextual factors and allowing women's preferences to ensure that protocols do not lead to over-standardisation.

Chapter 7
In this validation study, we explored if the Birth Beliefs Scale (BBS) can be used to measure beliefs about birth among maternity care professionals in the Netherlands. The BBS questionnaire consists of eleven items that are rated on a five-point Likert scale. The BBS has been validated for pregnant women, and differentiates between views of birth as a natural process (BBS-Nat) and as a medical process (BBS-Med).

The study aimed to assess the scale's content validity, internal reliability, known-group discriminant validity. To establish content validity, the BBS was reviewed by an expert panel. Item 6 was adjusted, before the questionnaire was distributed. In total, 199 maternity care professionals, including community midwives, hospital-based midwives, and obstetricians completed the questionnaire. Data collection took place between November 2022 and March 2023.

A good internal reliability of the BBS was found, indicating consistency in measuring the constructs of medical and natural childbirth beliefs. Natural and medical birth beliefs differed between community midwives, hospital-based midwives, and obstetricians. Community midwives had the highest scores on the natural birth beliefs scale, followed by hospital-based midwives, and obstetricians showed the lowest score. For the medical birth beliefs scale an inverse scoring pattern was seen, with the highest score for obstetricians, followed by hospital-based midwives and the lowest scores for community midwives. Regression analysis indicated that work experience and the type of MCN influenced the scores on the natural birth beliefs scale.

We showed that the BBS is a valid tool for assessing childbirth beliefs among maternity care professionals. The BBS can help to create awareness within professionals of their beliefs and may help to explain practice variation in childbirth.

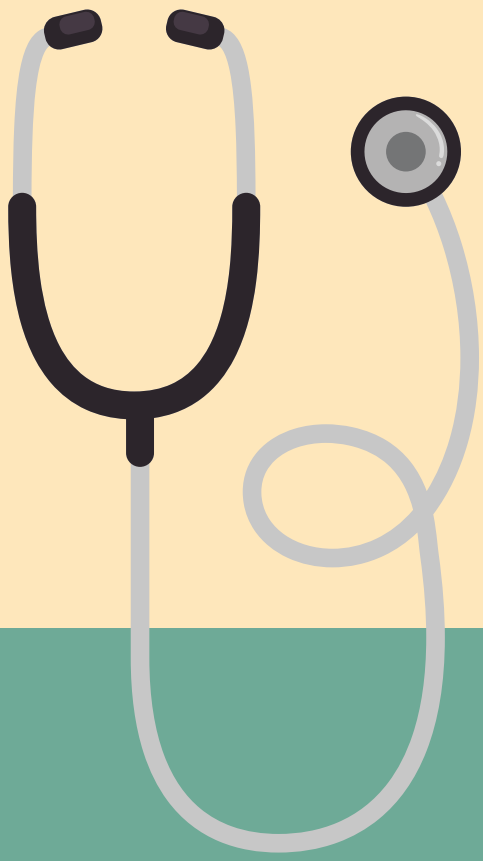
Chapter 8 | General discussion
This thesis give a broad view of a number of factors that are potential explanations for practice variation in maternity care. It describes exploratory research on the variation in childbirth interventions in the Netherlands and generates further knowledge about how personal and professional factors are related to midwives' clinical decisions about the use of childbirth interventions. We reflected on our outcomes using the sociological model of practice variation and Sutherland and Levesque's framework, which can be used to assess whether the variation is warranted or unwarranted.

National guidelines and regional protocols provide an opportunity for the detailed, evidence-based description of medical practice, however, they should not promote undesirable standardisation of care. Too much standardisation in regional protocols can decrease the existing room for

patients' preferences and other contextual factors. Providing care according to these protocols will make it more difficult to personalise care and possibly increase unwarranted practice variation. Healthcare professionals should be educated about the differences between national guidelines and regional protocols and understand the scientific rationale for the recommendations.

It is essential to recognize that midwives' attitudes, knowledge and skills differ and are influencing factors on practice variation. Midwives may also be influenced by the culture of shared working environments such as MCNs. Based on our research it seems that there should be more focus on midwives as reflective practitioners. More attention to skills as a reflective practitioner could contribute to a more personalised approach to clinical decision-making about childbirth interventions. Additionally, midwives can use these skills in the context of MCNs for effective interdisciplinary collaboration and the development of regional protocols. Together with guidance on how to translate national guidelines into regional protocols, this results in a more nuanced approach that is responsive to patient preferences, addresses uncertainty, and consequently reduces unwarranted interventions.

To develop the skills of a reflective practitioner, midwives need to reflect on their clinical decisions and whether they are influenced by their personal values and beliefs. Midwives can be helped to understand their own practice through the use of reflective models and with intervision meetings with colleagues, which helps to make sense of their experiences and identify patterns in practice.



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Samenvatting

Samenvatting

Hoofdstuk 1 | Introductie
Internationaal is er grote variatie in het aantal medische ingrepen dat tijdens de bevalling wordt uitgevoerd. Er zijn aanwijzingen dat ook in Nederland grote variatie bestaat in het aantal medische ingrepen in de verloskundige zorg. Medische ingrepen kunnen noodzakelijk zijn om perinatale morbiditeit en mortaliteit te voorkomen en een bepaalde mate van variatie in het gebruik van ingrepen is te verwachten, aangezien de zorg wordt afgestemd op de medische conditie en de voorkeuren van de cliënt. Praktijkvariatie kan echter ook wijzen op ongewenste verschillen in zorg, die kunnen leiden tot schade, ongelijkheid in zorgkwaliteit en hoge kosten.

Praktijkvariatie kan worden verklaard aan de hand van een sociologisch model dat factoren beschrijft die op verschillende niveaus praktijkvariatie kunnen beïnvloeden: het macro-, meso- en microniveau. In dit proefschrift richten we ons op mechanismen binnen de verloskundige zorg op meso- en microniveau die praktijkvariatie kunnen verklaren.

Het mesoniveau betreft de regionale samenwerking binnen Verloskundige Samenwerkingsverbanden (VSV's). In een VSV zijn eerstelijnsverloskundigen, klinisch verloskundigen, gynaecologen en andere disciplines zoals kinderartsen en kraamverzorgenden gezamenlijk verantwoordelijk voor de kwaliteit van de geboortezorg in een bepaalde regio. Samenwerking binnen VSV's kan uitdagend zijn, omdat zorgverleners met verschillende expertises en opvattingen tot overeenstemming moeten komen over het regionale beleid en aanbevelingen in regionale protocollen.

Het microniveau gaat over de interactie tussen de cliënt en de zorgverlener, waarbij beleidskeuzes over het gebruik van medische interventies gemaakt worden met behulp van gezamenlijke besluitvorming. Deze besluitvorming blijkt te worden beïnvloed door de houding van de zorgverlener. Op basis van eerder onderzoek zijn er aanwijzingen dat verloskundigen medische ingrepen verschillend toepassen en we willen onderzoeken wat de oorzaken van deze variatie zijn. Daarom is het algemene doel van dit proefschrift om meer inzicht te krijgen in hoe persoonlijke en professionele factoren van verloskundigen de besluitvorming over het toepassen van medische ingrepen in de verloskundige zorg beïnvloeden. Deze kennis kan bijdragen aan het verminderen van ongewenste praktijkvariatie binnen de verloskundige zorg.

Hoofdstuk 2
Dit hoofdstuk beschrijft een registratiestudie met als doel de verschillen in medische ingrepen tijdens de bevalling in ziekenhuizen te onderzoeken. Daarnaast hebben we onderzoek gedaan naar associaties tussen verschillende medische ingrepen en tussen ingrepen en nadelige uitkomsten, waarbij rekening werd gehouden met verschillen in kenmerken van vrouwen.

Voor deze studie hebben we de gegevens uit het Nederlandse perinatale register Perined van 2010 tot en met 2013, met daarin alle eenlinggeboorten vanaf 37 weken zwangerschap geanalyseerd. We hebben de volgende medische ingrepen onderzocht: inleiding van de bevalling, bijstimulatie, pijnbestrijding, vaginale kunstverlossing, keizersnede en betrokkenheid van een kinderarts na de geboorte. We vergeleken de twaalf provincies van Nederland en hebben daarbij rekening gehouden met maternale kenmerken zoals leeftijd, pariteit, etniciteit, sociaaleconomische status en mate van verstedelijking.

We vonden de grootste verschillen in medische ingrepen bij het type pijnbestrijding en bij de betrokkenheid van een kinderarts binnen 24 uur na de geboorte, gevolgd door bijstimulatie na een spontane start van de bevalling. Er was minder variatie in het inleiden van de bevalling en geplande keizersnedes, en de minste variatie zagen we in het aantal instrumentele vaginale bevallingen en keizersnedes tijdens de bevalling. In regio's waar meer medische ingrepen tijdens de bevalling werden uitgevoerd, gebeurde dit zowel bij vrouwen die aan het begin van de bevalling bij de eigen verloskundige (in de eerste lijn) of in het ziekenhuis (in de tweede lijn) onder zorg waren. Een hoger of lager percentage medische ingrepen leidde niet tot verschillen in ongunstige uitkomsten voor moeder en kind.

Op basis van deze studie kunnen we concluderen dat het belangrijk is regionale verschillen in medische ingrepen tijdens de bevalling kritisch te evalueren. Grote verschillen kunnen een aanwijzing zijn voor onnodige ingrepen, mogelijk deels veroorzaakt door onvoldoende opvolgen van nationale richtlijnen. Toekomstig onderzoek zou zich moeten richten op variaties in wetenschappelijk onderbouwde ingrepen en indicaties voor het gebruik van medische ingrepen tijdens de bevalling.

Hoofdstuk 3
In dit hoofdstuk beschrijven we de landelijke retrospectieve cohortstudie waarmee we variaties hebben onderzocht in verloskundig medische ingrepen die worden gebruikt in zowel verloskundige (eerstelijns) als obstetrische (tweedelijns) zorg. Er is gekeken naar ingrepen zoals episiotomie, toediening van oxytocine, verschil in verwijzingspercentages en de plaats van bevalling. We analyseerden de verschillen in medische ingrepen tussen de twaalf Nederlandse provincies met behulp van de gegevens uit het Nederlandse dataregister Perined. De gegevens van 614.730 eenlinggeboorten na 37 weken zwangerschap (2010–2013) werden gebruikt voor analyse. Voor maternale kenmerken is gecorrigeerd met multivariabele logistische regressie.

We vonden grote verschillen voor het percentage verwijzingen tijdens de bevalling. Bij vrouwen die voor het eerst bevielen varieerde dit tussen 55 en 68% en bij vrouwen die al eerder waren bevallen tussen 20 en 32%. In de regio's waar vaker werd overgedragen tijdens de bevalling was er ook

vaker meer dan een liter bloedverlies. We zagen ook veel variatie voor het percentage episiotomie en de toediening van oxytocine na de bevalling. Opvallend was dat in de regio's met een hoger percentage thuisbevallingen minder vaak een episiotomie werd geplaatst en minder vaak oxytocine postpartum werd toegediend.

Er bleek sprake van een noord-zuidverdeling in Nederland: noordelijke provincies hadden een hoger percentage thuisbevallingen en een lager percentage medische ingrepen (episiotomie en oxytocinegebruik postpartum) dan zuidelijke provincies. De variatie in medische ingrepen waren onafhankelijk van maternale kenmerken, wat suggereert dat verschillen in zorgverlenerspraktijk en houding van zorgverleners een rol spelen.

Deze studie laat zien dat er onderzoek gedaan moet worden naar de rol van de zorgverlener in de besluitvorming over het gebruik van medische ingrepen. Daarnaast moet er bewustwording komen bij beleidsmakers en zorgprofessionals over ongewenste praktijkvariatie in geboortezorg.

Hoofdstuk 4
In deze beschrijvende, kwalitatieve studie hebben we met behulp van diepte-interviews onderzocht welke ervaringen, overtuigingen en waarden de houding van verloskundigen ten aanzien van medische ingrepen in de verloskunde beïnvloeden. We voerden twintig interviews uit in juni 2019 en analyseerden de gegevens met behulp van inductieve analyse.

We vonden twee hoofdthema's: (1) houdingen ten opzichte van medische ingrepen en (2) invloeden op de houding van verloskundigen. In ons onderzoek beschreven verloskundigen hun houding ten opzichte van medische ingrepen als gericht op afwachten en observeren of gericht op controleren en beheersen. Verloskundigen die zorg verleende vanuit de afwachtende en observerende houding toonde meer ondersteunend gedrag, waarbij ze vrouwen zoveel mogelijk ondersteunden om autonome keuzes te maken. Verloskundigen die zorg verleenden vanuit een controlerende houding lieten meer sturend gedrag zien, waarbij ze de zwangerschap en bevalling meer controleren door aanvullende onderzoeken. Drie factoren bleken van invloed op de houding van verloskundigen: (1) samenwerking met andere zorgverleners, (2) vertrouwen en angst in het proces van zwangerschap en bevalling, en (3) opvattingen over vrouwgerichte zorg.

Alle verloskundigen in dit onderzoek waren van mening dat zwangerschap en bevalling fysiologische processen zijn en hebben de intentie om alleen medische ingrepen te doen indien nodig. Verloskundigen met een meer afwachtende houding leken meer terughoudend te zijn met het toepassen van medische ingrepen dan verloskundigen met een meer controlegerichte houding. Het is belangrijk dat verloskundigen zich bewust zijn van hoe hun ervaringen, overtuigingen en waarden hun houding ten opzichte van

medische ingrepen beïnvloeden. Dit bewustzijn kan een eerste stap zijn in het verminderen van onnodige ingrepen in de verloskunde.

Hoofdstuk 5
Deze studie evalueert hoe kennis en vaardigheden de klinische besluitvorming van verloskundigen beïnvloed met betrekking tot het gebruik van medische ingrepen in de verloskunde. De gegevens voor deze studie werden verkregen uit interviews met twintig eerstelijns verloskundigen in juni 2019. De verloskundigen verschilden in het aantal jaren werkervaring en in de mate waarin ze medische ingrepen toepasten. De interviews hadden een narratieve benadering en we analyseerden de gegevens met behulp van deductieve analyse.

Wij vonden dat kennis, communicatieve vaardigheden en kritisch denkvermogen invloed hebben op de klinische besluitvorming van verloskundigen ten aanzien van gebruik van medische ingrepen. Verloskundigen verwierven hun kennis via de opleiding tot verloskundige en breidden deze verder uit door reflectie op ervaringen en wetenschappelijk onderzoek. Kritisch denkvermogen speelt een belangrijke rol bij het vinden van een balans in het gebruik van medische ingrepen. Verloskundigen die minder vaak ingrepen toepasten, leken een hoger niveau van reflectieve vaardigheden te hebben, waarbij ze continu evalueren of een ingreep noodzakelijk is. Deze verloskundigen hanteerden een meer gebalanceerde communicatiestijl, waarbij zowel instrumentele als affectieve communicatievaardigheden werden gebruikt in de interactie met vrouwen. Ze boden vrouwen verschillende opties aan, stimuleerden gezamenlijke besluitvorming en verkenden actief de voorkeuren van de vrouw. Daarnaast hadden ze meer vaardigheden om discussies met andere zorgprofessionals aan te gaan. Verloskundigen die vaker ingrepen toepasten, communiceerden meer sturend, waarbij ingrepen als standaardprocedure werden gepresenteerd in plaats van als optie. Verloskundigen met reflectieve vaardigheden, kritisch denkvermogen en de vaardigheid om beleidskeuzes bespreekbaar te maken, leken meer gepersonaliseerde beslissingen over ingrepen te nemen, in plaats van standaardprocedures te volgen.

Op basis van deze bevindingen concluderen we dat verloskundigen met de kennis en vaardigheden van een reflectieve professional meer gepersonaliseerde zorg in plaats van gestandaardiseerde zorg geven. Door reflectie te stimuleren en training te geven in communicatieve vaardigheden en kritisch denkvermogen, kan het gebruik van medische ingrepen beter worden afgestemd op de behoeften van de zwangere.

Hoofdstuk 6
In dit hoofdstuk beschreven we de systematische documentanalyse waarin we de variatie tussen regionale protocollen hebben geanalyseerd met betrekking tot aanbevelingen voor het inleiden van de bevalling. Daarnaast onderzochten

we in hoeverre de aanbevelingen uit nationale richtlijnen werden gebruikt in regionale protocollen en of er een verband is met de kwaliteit van de nationale richtlijnen. Het doel was om te onderzoeken hoe verloskundige samenwerkingsverbanden (VSV's) nationale richtlijnen omzetten naar regionale protocollen en of variatie in deze protocollen kunnen bijdragen aan praktijkvariatie.

We hebben vier nationale richtlijnen vergeleken met achttien regionale protocollen uit zes verschillende VSV's. De READ-methode (*Ready materials, Extract data, Analyze, Distil*) werd gebruikt om de inhoud van de regionale protocollen te analyseren en het AGREE II-instrument werd gebruikt om de kwaliteit van de nationale richtlijnen te beoordelen. Aanvullend ontwikkelden we een analytisch kader om regionale protocollen te evalueren.

Onze analyse toonde grote variatie in de aanbevelingen van regionale protocollen, wat kan bijdragen aan de huidige praktijkvariatie in IOL in Nederland. Sommige VSV's volgden de aanbevelingen uit de nationale richtlijnen nauwgezet, terwijl andere VSV's hun eigen aanbevelingen formuleerden. In bepaalde regio's varieerde het per onderwerp of de aanbevelingen uit nationale richtlijnen werden gevolgd of eigen aanbevelingen werden geformuleerd. In VSV's met een hoog percentage IOL werden extra risicofactoren en strengere afkapwaardes toegevoegd als indicatie voor een inleiding. VSV's met een laag percentage IOL beschreven meer mogelijkheden om de bevalling binnen de eerstelijns zorg voort te zetten. Opvallend was dat in de protocollen van deze VSV's vaker expliciet aandacht werd besteed aan gedeelde besluitvorming en de voorkeuren van de zwangere vrouw.

Dit onderzoek laat zien dat de aanbevelingen uit nationale richtlijnen niet systematisch en willekeurig over worden genomen in regionale protocollen. Er lijkt behoefte aan sturing en ondersteuning voor zorgverleners om nationale richtlijnen op een systematische manier te vertalen naar regionale protocollen. Het is belangrijk dat in regionale protocollen contextuele factoren worden meegenomen en er ruimte blijft voor de voorkeuren van de vrouw om te voorkomen dat protocollen leiden tot overmatige standaardisatie en ingrepen.

Hoofdstuk 7
In deze validatiestudie hebben we onderzocht of de Birth Beliefs Scale (BBS) gebruikt kan worden om bevalovertuigingen te meten onder zorgprofessionals in de Nederlandse geboortezorg. De BBS blijkt een goed instrument om onderscheid te maken tussen bevallingsovertuigingen als een medisch proces (BBS-Med) en als een natuurlijk proces (BBS-Nat) bij zwangere vrouwen. De BBS bestaat uit twee meetschalen: vijf stellingen over de bevalling als een natuurlijk proces en zes stellingen over de bevalling als een medisch proces. Een hogere score duidt op sterkere overtuigingen over de bevalling als een natuurlijk of als een medisch proces.

Om de BBS te valideren voor verloskundig zorgverleners hebben we de (1) inhoudsvaliditeit, (2) interne validiteit en (3) discriminant validiteit getest. Om de inhoudsvaliditeit te testen, werd de BBS beoordeeld door een expertpanel. Stelling 6 werd aangepast voordat de vragenlijst werd verspreid. In totaal vulden 199 geboortezorgprofessionals de vragenlijst in, waaronder eerstelijns verloskundigen, klinisch verloskundigen en gynaecologen. De gegevensverzameling vond plaats tussen november 2022 en maart 2023.

De BBS bleek een goede interne betrouwbaarheid te hebben, wat betekent dat de BBS betrouwbaar een verschil in bevallingsovertuigingen tussen verloskundig zorgverleners meet. In ons onderzoek was de gemiddelde score met betrekking tot de overtuiging dat bevallen een medisch proces is 2,72 punten (op een 5-puntsschaal). Gynaecologen scoorden hoger (3,22) op de opvatting dat bevallen een medisch proces is dan klinisch verloskundigen (2,92) en eerstelijns verloskundigen (2,72). De gemiddelde score op de overtuiging dat bevallen een natuurlijk proces is, was 3,89, met een omgekeerd scoringspatroon. Eerstelijns verloskundigen hadden de hoogste scores (4,24), gevolgd door klinisch verloskundigen (3,94) en gynaecologen (3,21). De scores verschilden significant tussen alle disciplines op beiden meetschalen. Met regressieanalyse zagen we een effect van het type VSV en werkervaring op de overtuigingen dat bevallen een natuurlijk proces is.

Met deze studie laten we zien dat de bevallingsovertuigingen van verloskundig zorgverleners verschillen en kunnen worden onderzocht met behulp van de BBS. Het gebruik van de BBS kan verloskundig zorgverleners inzicht geven in hun bevalovertuigingen. Dit inzicht kan helpen tijdens gezamenlijke besluitvorming, waarbij een balans tussen professionele overtuigingen en cliëntvoorkeuren belangrijk is, en het risico op onterechte praktijkvariatie kan verminderen.

Hoofdstuk 8 | Discussie
Dit proefschrift biedt een overzicht van een aantal factoren die praktijkvariatie in de geboortezorg mede kunnen verklaren. Ons onderzoek naar de regionale variatie in medische ingrepen tijdens de bevalling geeft belangrijk inzicht over praktijkvariatie in Nederland en de andere studies genereren verdere kennis over hoe persoonlijke en professionele factoren besluitvorming van verloskundigen beïnvloedt over het gebruik van interventies. Met behulp van het sociologische model van praktijkvariatie en het kader van Sutherland en Levesque, welke gebruikt kan worden om te beoordelen of er sprake is van ongewenste variatie, hebben we op onze bevindingen gereflecteerd.

Nationale richtlijnen en regionale protocollen bieden een kans om medisch beleid gedetailleerd en wetenschappelijk onderbouwd te beschrijven, maar kunnen ook leiden tot ongewenste standaardisering van zorg. Te veel standaardisatie in regionale protocollen kan de ruimte voor cliëntvoorkeuren en andere contextuele factoren verkleinen. Wanneer deze protocollen strikt

gevolgd worden, is het moeilijker om zorg te personaliseren en wordt de kans op ongewenste praktijkvariatie groter. Zorgprofessionals moeten worden geschoold in de verschillen tussen nationale richtlijnen en regionale protocollen en inzicht krijgen in de wetenschappelijke onderbouwing van de aanbevelingen.

Het is belangrijk te erkennen dat verloskundigen verschillen in houding, kennis en vaardigheden en dat deze persoonlijke factoren ook invloed hebben op het doen van medische ingrepen. Daarbij worden zij beïnvloed door de cultuur binnen samenwerkingen, zoals het VSV. Uit ons onderzoek blijkt dat er meer aandacht zou moeten zijn voor de rol van verloskundigen als reflectieve professionals. Meer focus op vaardigheden als reflectief zorgverlener kan bijdragen aan een meer gepersonaliseerde benadering van de besluitvorming over verloskundige ingrepen. Verloskundigen kunnen deze vaardigheden ook inzetten binnen VSV's voor de bevordering van effectieve interdisciplinaire samenwerking en de ontwikkeling van regionale protocollen. Gecombineerd met ondersteuning in het opstellen van regionale protocollen gebaseerd op nationale richtlijnen, zorgt dit tot een genuanceerdere aanpak die rekening houdt met cliëntvoorkeuren, onzekerheden adresseert en uiteindelijk ongewenste ingrepen vermindert.

Om de vaardigheden van een reflectieve professional te ontwikkelen, moeten verloskundigen nadenken over hun klinische besluitvorming en in hoeverre deze wordt beïnvloed door persoonlijke waarden en overtuigingen. Reflectiemodellen en intervisiebijeenkomsten met collega's kunnen hen helpen om hun eigen beleidsvoering beter te begrijpen, hun ervaringen te verwerken en patronen in hun handelen te herkennen.

A

Appendices

Impact Paragraph

This paragraph reflects on the achieved and expected scientific and societal impact of the results of this thesis.

Impact on use of childbirth interventions
Our research contributes to the body of knowledge about practice variation in the Netherlands. In our nationwide studies, we found large regional variation in the use of most childbirth interventions after correction for population characteristics, without significant differences in regional perinatal morbidity and mortality rates (chapter 2 and 3). As indicated in international research, the overuse of interventions during maternity care can result in medicalisation of physiological pregnancy and childbirth (1,2). This unnecessary use of interventions can harm women and their newborns, and can increase healthcare costs (3). Based on our findings, it seems that there is an overuse of childbirth interventions in the Netherlands and that the risks of medicalisation also apply to maternity care in this country.

Our work has provided new insights into how personal and professional factors influence midwives' clinical-decisions about the use of interventions in childbirth. These findings can help midwives to reflect on their care. Critical reflection can help to determine whether midwives are providing medicalised care influenced by their attitudes. Midwives can contribute to reducing the medicalisation of maternity care, if they are capable of critical reflection on their provided care and take ownership of their influence on clinical decisions about the use of interventions in childbirth. With these skills, midwives can contribute to prevent ineffective or unnecessary care. This is in line with the 'Passende zorg' programme the Dutch government has launched to improve the quality of care, increase health benefits and avoid unnecessary costs. This programme investigates care in different specialities, including maternity care (4). Care is evaluated in this programme by the ministry of Health together with healthcare professionals and patients. The aim is to come up with specific arrangements for transformation of care, that can actually be implemented and make care more appropriate for patients.

In the Netherlands, maternity care is organised regionally in collaborating networks with community midwives, obstetricians, and other disciplines, such as paediatricians and maternity care assistants (5,6). These so-called maternity care networks (MCNs) are usually situated around one hospital and the midwifery practices in the same region. The outcomes of this thesis show that support for MCNs is necessary to improve the quality of maternity care (chapter 7). We observed that the translation of national guidelines to regional protocols is arbitrary and not very systematic. A high-quality national programme on guideline development can support MCNs. Basically, national guidelines provide a systematic literature review and evidence-based recommendations on 'what' and 'when' certain care is needed. Guidelines

give direction to regional protocols, leaving only context-specific factors such as 'who' and 'how ' to be specified in a regional protocol (7). To be effective, guidelines should create room for women's preferences and should also describe where evidence is lacking. In addition, national associations such as the Federatie van Medisch Specialisten (FMS), Koninklije Nederlandse Organisatie van Verloskundigen (KNOV) and Nederlandse Vereniging voor Obstetrie en Gynaecologie (NVOG), need to ensure that guidelines are still up to date or need to be revised. It appears that most maternity care professionals do not know the difference between a guideline and a protocol adequately. National associations and bachelor programmes can be of help to educate (future) maternity care professionals about the differences between national guidelines and regional protocols and the risk of too much standardisation of care. Reflective practitioners have the skills to interpret the evidence and can have a role in the development of regional protocols creating awareness for not evidence-based care.

Supporting MCNs in the development of regional protocols can avoid random use of study results in regional protocols and give room to women's preferences, which supports personalised care and decrease unwarranted practice variation. These protocols should clarify which treatments are evidence-based and which are less or not evidence-based.

Our results show that not all midwives have sufficient knowledge and skills of a reflective practitioner to provide care adapted to the personal context of women (chapter 5). These knowledge and skills can be trained to midwives. A large systematic review investigated what matters to childbearing women based on their beliefs, expectations, and values (8). The outcomes of this review were used for the recommendations in the intrapartum guideline of the World Health Organisation (9). The review showed that most healthy women want a positive birth experience and prefer a physiological labour and birth. When women's preferences are taken into account through personalised care, it is expected that this on average will result in less medicalisation (8). In other words, personalised care can reduce the unnecessary use of interventions that can potentially harm women and their newborns and increase healthcare costs.

Scientific relevance

Overall in medicine, practice variation in interventions can be explained by a sociological model that describes factors that interact with practice variation at macro-, meso-, and micro-level (10). As far as we know, this is the first time that the sociological model is used for maternity care. Based on the results of this thesis, we found that the model is useful to extend knowledge about factors interacting with practice variation in maternity care at the meso- and micro-level. The investigation of factors on micro-level has added in-depth knowledge about the clinical decisions midwives make in the use of interventions. This knowledge shows that the maternity care professional has

an important role in the clinical decisions that are made. Often, research is focused on risk groups, risk factors for adverse outcomes or factors on meso-level, rather than on the role of the healthcare professional in clinical decisions. The studies performed at meso-level have contributed to the body of knowledge about how factors like guidelines and collaboration influence maternity care professionals in their clinical decisions about the use of interventions. Our studies help to understand how recommendations in regional protocols and differences in birth beliefs of healthcare professionals are factors in practice variation in maternity care. We have focused on these factors, but there are more factors that interact in the mechanism of practice variation. More research is needed to investigate these factors and how they contribute to the clinical decision-making process.

Target groups
This thesis explores the variation in childbirth interventions in the Netherlands and generates further knowledge about how personal and professional factors are related to midwives' clinical decisions about the use of childbirth interventions. Accordingly, our findings are of interest to maternity care professionals, researchers, and policymakers in the Netherlands. Because we focused on midwives' clinical decision-making, this thesis is of particular interest to the Dutch Association of Midwives (KNOV) and the midwifery educational programmes. Insights into regional protocol development and birth beliefs of different maternity care professionals provide knowledge for collaboration within Maternity Care Networks, and are therefore of interest to organisations that support Maternity Care Networks, such as the College Perinatale Zorg (CPZ), Federatie van VSV's, and regional consortia. The knowledge of national guideline development and the regional implementation of national guidelines is of use for the national associations of midwives, obstetricians, and paediatricians as well as the CPZ, where all professional associations coordinate together. Together they can improve the national guideline development procedures and make them more compatible. This will improve regional maternity care as well as care for the client.

Although our research was conducted in the Netherlands, knowledge about midwives' clinical decisions about the use of childbirth interventions go beyond the Dutch context, they are also relevant for an international audience of maternity care professionals, researchers and policymakers.

Activities
As a practising midwife, I am a board member of the regional maternity care network. The board is responsible to assure the quality of care in this region, part of my role is to generate insight into intervention rates and set up quality improvement programmes. At a national level, I disseminate my knowledge of practice variation as a professional expert in meetings on practice variation among 18 different Maternity Care Networks.

During the course of this thesis, I continued to do my work as a guideline developer for the Dutch Association of Midwives. This ensured the application of knowledge from guidelines to research and vice versa. During this period I have also facilitated peer review meetings for practising midwives on midwifery topics. In these sessions, midwives discuss differences in care and whether they want to make adjustments in their care.

The results of this thesis will also be shared with others in several ways. We have published the results of our studies in peer-reviewed, open access scientific journals, reaching a broad range of maternity care professionals and researchers. Additionally, we have and will present our results at various national and international conferences.

Presentations

October 2021 – Pitch your PhD, CAPHRI

September 2023 - Normal Labour and Birth Conference, Aarhus – Denmark
Oral presentation: Influence of midwives' attitude, knowledge, and skills on the appropriate use of childbirth interventions: a qualitative study among 20 midwives in the Netherlands

February 2024 – CARE4 – International Scientific Nursing and Midwifery Congress, Antwerp – Belgium
Oral presentation: The contribution of regional protocols on practice variation in induction of labor: a critical document analysis

May 2025 – LEV-congres Nederland - Ede
Oral presentation: De verloskundige als beïnvloedende factor? Invloed van persoonlijke en professionele factoren van verloskundigen op het toepassen van interventies

May 2025 – Nordic Midwifery Congress, Copenhagen – Denmark
Oral presentation: The contribution of regional protocols on practice variation in induction of labor: a critical document analysis

Poster presentation: Validation of the Birth Beliefs Scale for maternity care professionals in the Netherlands

June 2025 – Rotary Nederland
Oral presentation: De verloskundige als beïnvloedende factor? Invloed van persoonlijke en professionele factoren van verloskundigen op het toepassen van interventies

Publications

- Lianne Zondag-McDermott, Tamar van Haaren-ten Haken, Pien Offerhaus, Eveline Mestdagh, Liesbeth Scheepers en Marianne Nieuwenhuijze. Validatiestudie van de Birth Beliefs Scale voor verloskundig zorgverleners. De verloskundige. 2025, 2: 45-49.
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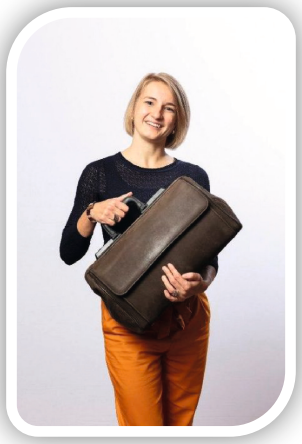
Curriculum Vitae

Lianne Zondag werd op 26 augustus 1989 geboren te Tiel. Ze groeide op in Geldermalsen als jongste van drie kinderen. Na het behalen van haar VWO-diploma op het Koningin Wilhelmina College te Culemborg in 2007, startte zij aan de Verloskundige Academie Rotterdam. In 2011 werd Lianne beëdigd als verloskundige en startte als eerstelijns verloskundige in Culemborg. In 2015 behaalde zij haar mastertitel aan Hannover Medical School en ging ze werken als beleidsmedewerker bij de Koninklijke Nederlandse Organisatie van Verloskundigen. Na een functie als docent-onderzoeker aan de Verloskunde Academie Rotterdam is ze sinds 2019 als zelfstandige werkzaam in verschillende rollen zoals richtlijnontwikkelaar, projectleider, wetenschappelijk adviseur, ITV-begeleider en onafhankelijk beoordelaar van masterscripties.

Ondertussen bleef ze fulltime werkzaam als eerstelijns verloskundige, waarbij ze in 2017 de overstap maakte naar Verloskundige praktijk de Toekomst in Geldermalsen en associeerde als praktijkhouder. Als eerstelijns verloskundige heeft Lianne bestuursfuncties vervuld bij het Geboorte Consortium Midden-Nederland, Verloskundige Vereniging Catena en is momenteel bestuurslid van het Netwerk Geboortezorg Rivierenland. Daarnaast heeft ze als lid zitting gehad in verschillende KNOV-werkgroepen en was ze één van de initiatiefnemers van de groep wetenschappelijk adviseurs van de KNOV.

In 2020 startte Lianne haar promotietraject bij Prof. Dr. Marianne Nieuwenhuijze en was ze als buiten promovendus betrokken bij de VALID-studie. In 2023 verkreeg Lianne een promotiebeurs van de KNOV om het laatste deel van haar promotietraject te kunnen afronden.

Lianne woont samen met haar man Sam en hun dochter Suze (2024) in Geldermalsen. In haar vrije tijd speelt ze trompet en bugel bij Big Band Betuwe en Koninklijke Harmonie Pieter Aafjes en is ze graag in de tuin bezig.



Dankwoord

Vaak heb ik dit promotietraject mijn hobby genoemd. Ik heb veel plezier gehad om aan de onderzoeken te werken en werd blij om op deze manier met verloskunde bezig te zijn. Neemt niet weg dat promoveren als praktijk houdend verloskundige en extern promovendus een eenzame weg kan zijn, die ik niet had kunnen gaan zonder een aantal heel belangrijke mensen.

Prof. dr. M.J. Nieuwenhuijze, beste Marianne, waarschijnlijk kan je het niet meer herinneren, maar op een Kennispoort Congres ergens in 2016 heb je al een zaadje geplant dat promoveren een optie zou kunnen zijn. Na verschillende andere zaadjes en een valse start, heb ik bij jou aangeklopt om te sparren of het ook echt iets zou kunnen zijn wat ik zou kunnen gaan doen. Bedankt dat je altijd vertrouwen hebt gehad dat het zou lukken en dat je het niet groter hebt gemaakt dan het is. Op belangrijke momenten was je snel bereikbaar en wist je met een enkele opmerking aan te geven dat ik een keuze moest maken of vooral de praktijk of privé even voorrang moest geven. Met jouw ondersteuning heb ik me nooit verloren gevoeld tijdens de afgelopen 5 jaar en geen onnodige stress ervaren.

Dr. T.M. van Haaren-ten Haken, beste Tamar, gevraagd als copromotor van iemand die je helemaal niet kende, puur op introductie van Marianne. Best gedurfd. Ik ben blij dat je toentertijd 'ja' hebt gezegd en één van mijn copromotoren bent. Ondanks je drukke agenda gevuld met allerlei onderwijs en onderzoeksactiviteiten vond je toch altijd de tijd om feedback te geven, te sparren, of even (online) mee te luisteren bij een presentatie. Bedankt voor je rustige en weloverwogen feedback en het voorbeeld dat het soms juist belangrijk is even stil te staan en een paar stappen terug of opzij te doen.

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Lieve Woudy, wat vind ik het bijzonder en leuk dat jij mijn paranimf wil zijn. Vanaf het VWO zijn we ieder onze eigen weg gegaan, en we gaan goed. Dat ik gewoon één van die topvrouwen uit het bedrijfsleven ken, maakt me

trots en helpt me dingen van een andere kant te bekijken. Ik hoop dat onze vriendschap nog lang zal bestaan en we elkaar laten leren van onze heel verschillende levens. Zodra ik weer wat uit de luiers ben, hoop ik dat we de tijd kunnen vinden nog wat extra stukjes van de wereld te ontdekken!

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Als extern promovendus had ik geen onderzoek maatjes waar ik regelmatig mee op een afdeling zat. Ik ben trots zoveel 'vroede vrouwen' te mogen kennen, die ook affiniteit hebben met onderzoek. Lieve Hannah, een deel van deze 5 jaar was jij mijn 'afdeling', samen werken in Utrecht of thuis bij één van ons beiden. Sparren over de combinatie praktijk – onderzoek, even mopperen, successen delen en als mooiste herinnering onze werkvakantie in Zuid-Frankrijk zodat we een week ongestoord konden werken aan ons onderzoek. Je stimuleert me buiten mijn vertrouwde kader te denken, niet altijd makkelijk, wel goed. Nog even en dan mag jij je ook doctor noemen!

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