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# TO GIVE BIRTH IN WATER

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TO GIVE BIRTH IN WATER  
THESIS FOR DOCTORAL DEGREE (Ph.D.)

By

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To Olle and Greta

# ABSTRACT

The aim of this thesis was to study waterbirth in a Swedish context and to bring focus on clinical outcomes and women's experiences associated with waterbirth. The literature describes advantages for women giving birth in water like relaxation and a positive birth experience. Still, waterbirth is controversial in Sweden and has not been offered at hospitals until recently.

**Study I** compared birth characteristics and outcomes of waterbirths with conventional uncomplicated births at the two clinics in Sweden providing waterbirth, from March 2014 to November 2015 (n=306+306). We found an association with fewer perineal tears of second degree among women giving birth in water and that these women were exposed to significantly less interventions such as amniotomy and oxytocin infusion intrapartum. There were no differences in Apgar scores or admissions to the neonatal intensive care unit, but three cases of umbilical cord rupture occurred among the waterbirths. Women having a waterbirth ranked their experience of childbirth higher in a numeric rating scale indicating a more positive birth experience.

**Study II** was a qualitative study based on 20 in-depth interviews describing women's experience of giving birth in water. The interviews, which took place 3-5 months postpartum were analyzed with qualitative content analysis. The overall theme emerging from the analysis was "Like an empowering microhome" describing the effect of being strengthened, enabled and authorized in the birth process. The limited space of a bathtub was described to give a relaxed and homelike feeling of privacy. Three categories were identified: "Synergy between body and mind", "Privacy and discretion" and "Natural and pleasant".

In **Study III** we explored the experience, knowledge and attitudes regarding waterbirth among midwives, obstetricians/gynecologists and neonatologists in a cross-sectional study. Using a web-based survey via The Swedish Association of Midwives and the Heads of department of all Swedish maternity wards between April and June 2016, yielded 1609 responses. The questionnaire contained a Likert Scale and open-ended questions which were analyzed with descriptive statistics and quantitative content analysis. We found that midwives had a more positive attitude to waterbirth as well as towards providing and implementing waterbirth, compared to physicians. Strong opinions were held about waterbirth, which to some extent were based on subjective attitudes secondary to knowledge, experience and evidence.

In **Study IV** we compared childbirth experience between women having a waterbirth (n=111) and women having an uncomplicated conventional birth (n=104) using the validated Childbirth Experience Questionnaire (CEQ). The 22-item questionnaire assessed four domains: Own capacity, Professional support, Perceived safety and Participation. Further, supplementary questions about the second stage of labour were added to the web-questionnaire. The total CEQ score did not differ between the groups, while women having a waterbirth scored significantly higher in the domain, "Own capacity" and lower in the domain, "Professional support". Women having a waterbirth rated significantly less pain and higher scores of being in control in the second stage of labour.

## LIST OF SCIENTIFIC PAPERS

- I. Ulfsdottir H, Saltvedt S, Georgsson S. Waterbirth in Sweden - a comparative study. *Acta obstetricia et gynecologica Scandinavica*. 2018;97(3):341-8.
  
- II. Ulfsdottir H, Saltvedt S, Ekborn M, Georgsson S. Like an empowering micro-home: A qualitative study of women's experience of giving birth in water. *Midwifery*. 2018;67:26-31.
  
- III. Ulfsdottir H, Saltvedt S, Georgsson S. Testing the waters – A cross-sectional survey of views about waterbirth among Swedish health professionals. *Women and Birth*, 2019 May 1. doi: 10.1016/j.wombi.2019.04.003. [Epub ahead of print]
  
- IV. Ulfsdottir H, Saltvedt S, Georgsson S. Women's experiences of waterbirth and conventional uncomplicated births.  
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## LIST OF ABBREVIATIONS

BMI	Body Mass Index
CEQ	Childbirth Experience Questionnaire
CTG	Cardiotocography
EDA	Epidural Anesthesia
IV	Intravenous
IVF	In Vitro Fertilization
NICU	Neonatal Intensive Care Unit
OR	Odds Ratio
PROM	Prelabor Rupture of the Membranes
RCT	Randomized controlled study
TENS	Transcutaneous Nerve Stimulation
WB	Waterbirth
CB	Conventional Birth
RCOG	Royal College of Obstetricians and Gynaecologists
RCM	Royal College of Midwives





# 1 BACKGROUND

## 1.1 HISTORY OF WATERBIRTH

Hydrotherapy defined as immersion of all or part of the body in water has been in use for thousands of years (1). Even today bathing is used for relaxation, stress reduction and pain relief. In obstetrics, the earliest documented records with waterbirths, in which the mother is covered with water and the baby is born under water, are from 1803 in France. There are anecdotal stories about waterbirth, from ancient Greece and Egypt to the Chumash Indians, Maoris and ancient China (2). However, the veracity of these stories is unconfirmed. The modern practice of waterbirth started in the late 1970s with the Russian pioneer Tjarkovsky and was spread by the French obstetrician Odent in the early 1980s (3). This new interest in waterbirth became a part of a shift from a medical and technological view of labor and birth, to a more psychological and physiological view (2).

Today, waterbirth is provided in all Nordic countries and in approximately 100 others globally. (2). In the United Kingdom (UK), where it is an option at all birth clinics (4), 9% of all births are waterbirths (5).

### **Waterbirth in Sweden**

In Sweden, water immersion and waterbirth were offered at some hospitals until 1992 when the National Board of Health and Welfare advised against both immersion in water after broken membranes and birth in water. The recommendations were formulated by the medical perinatal council connected to the National Board of Health and Welfare (6). The justification was lack of evidence regarding safety and based on a comparison between 89 births with women immersing in water after broken membranes during the first stage of labor, and the same numbers of women not having immersed in water. This comparison, which was not a research study, rested upon the findings of three infected neonates in the immersing group, compared with two in the comparison group. None of these babies were born in water (6). The non-mandatory advice, to avoid waterbirth and immersing in water after broken membranes was valid until 2002 (Personal contact I-M Andersson, National Board of Health and Welfare email 2018.10.22).

In 1993, there was an incident at a homebirth in water after which the baby died. There were different interpretations of what had caused the pathological transformations of the newborn's

lungs, which together with asphyxia were stated as the cause of death. A direct causality with waterbirth was not recognized by the National Board of Health and Welfare (7). In the 1990s, research on waterbirth was scarce and the debate following this incident was based on attitudes related to an unaccustomed phenomenon.

Until 2014, when a new clinic offering waterbirth was established, they were found only among the 70-75 homebirths/year. Today waterbirth is provided in three clinics in Sweden.

## **1.2 THE ORGANISATION OF MATERNITY CARE IN SWEDEN**

Maternity care in Sweden is provided by the State and is free of charge. Care during pregnancy and childbirth is provided to a large extent autonomously by midwives but in close cooperation with obstetricians and gynecologists. Midwives are the primary care-giver in uncomplicated pregnancies and births, as well as in care postpartum. In case the process becomes complicated, responsibility is transferred to an obstetrician or gynecologist. The organization differs from that of several other western countries, as almost every woman gives birth at an obstetrician-led birth clinic. At present, freestanding birth centers, or alongside midwifery units do not exist, and the prevalence of home births is low (0.1%) (8). Home births are free of charge only for a limited group of low-risk multiparous women living in the region of Umeå in the north of Sweden (9) Consequently, the level of maternity care is similar for low- and high-risk women who give birth in hospitals in both instances.

## **1.3 WOMAN-CENTERED CARE**

Woman-centered care is a holistic philosophy of care that focuses on each woman's health, needs, emotions, expectations and her social and cultural context, and it strives for continuity in care (10). However, woman-centered care is not linked to an institution of "midwifery-led care" and can be practiced in all settings as well as with both low-and high risk pregnancies and births (11). The word *midwife* means *with woman* and defines the responsible and reciprocal partnership between midwife and woman during pregnancy, childbirth and postpartum care, focusing on the healthy processes of, and promoting normal birth (12-14).

The woman should be given possibilities to make informed decisions for herself, her baby and family. Woman-centered care includes the family and every person that she defines as being

important to her (11). To facilitate making such a decision, the woman should be offered information based on scientific evidence, experience and knowledge, combined with an open and respectful communication based on mutual participation and collaboration (15). Woman-centered care moves the focus from the institution to the woman. This means that the woman's individual needs and aspirations are in focus rather than the needs of the institution or the professionals (11, 16). The concept of empowerment is often mentioned together with woman-centered care, offering prerequisites which are enabling the woman, giving her choices, which serve to promote her autonomy and power (11, 17).

#### **1.4 THE WOMAN'S EXPERIENCE OF CHILDBIRTH**

Childbirth is a profound life event and the woman's experience of childbirth has an impact on her well-being, the relation to the child, self-esteem, breastfeeding as well as planning of future pregnancies. (18-20). Important factors associated with women's experience of childbirth are support, confidence, pain, involvement in decision-making and sense of control (21, 22), besides objective birth events such as complications and mode of birth (23, 24). According to a systematic review, a more positive birth experience is associated with more favorable bonding and perception of the infant, while a negative birth experience is associated with feelings of maternal failure and disconnection with the baby (25). Another review found a relationship between negative birth experience and postnatal depression (26). Risk factors related to having a less positive birth experience five years after childbirth were addressed in a Danish follow-up study with 905 nulliparas. The risk factors found were having an epidural anesthesia (EDA), not having used water as pain relief or not having a spontaneous vaginal birth (27).

#### **1.5 WATERBIRTH IN PRACTICE**

Women planning for a waterbirth should be healthy, with a normal simplex pregnancy and have an expected normal birth, i.e. a low-risk birth (4). Additional criteria for low risk birth are usually: gestational age between 37+0 and 41+6, spontaneous onset of labor and a cephalic presentation (28). According to UK guidelines by Royal College of Obstetricians and Gynecologists and Royal College of Midwives (RCOG, RCM), the woman should leave the

bathtub if any complications occur during labor (29). Many women are immersed in water during only the first stage of labor in order to obtain pain relief. Women having a waterbirth are usually immersed in water during both first and second stages of labor. Bathtubs where women immerse or give birth in water can vary in size and depth, but to gain benefits of buoyancy, the bathtub should be larger than a domestic bath to allow the women to change position and deep enough to have the abdomen submerged (2, 30). However, there is no consensus regarding this (2, 31). Hydrotherapy can be combined with nitrous oxide, acupuncture and sterile water injections but not opioids, TENS or epidural anesthesia. Fetal heart rate can be monitored in water with Pinard stethoscope, water resistant doppler and Cardio Toco Graphy (CTG), which can be used both externally and internally using telemetry (2).

Blood pressure and pulse should be assessed for a woman immersing in water as blood pressure may be lowered in hydrotherapy (32). To avoid hyperthermia, the woman's temperature as well as the temperature of the water should be assessed regularly and the mother should also be encouraged to drink frequently (2). Water temperature should not exceed 37.5/38.0 °C (2, 31). A rise in maternal temperature also increases the baby's temperature and thereby the metabolic rate and oxygen demands (33).

When a woman starts to push, her pelvis must be submerged under water and should not be at the water level. At the time of birth, the baby should be born completely under water or, if the woman wants to leave the tub, completely above the water. The baby is brought to the surface immediately after birth (29). The umbilical cord should not be cut underwater (2).

## **1.6 THE EFFECT OF WATER IMMERSION**

### **Pain**

The experience of pain in labor is complex and subjective, affected by physiological, psychological and social mechanisms (34-37). The two main types of pain in labor are visceral pain and somatic pain. Visceral pain comes mainly from the stretching and dilatation of the cervix, and somatic pain from ischemia, stretching and distention of the pelvic floor, perineum and vagina (38). Cognitions and emotions affect the experience of pain; a woman who feels that she is in a safe and supportive environment and who finds labor purposeful copes well with labor, experiencing less pain (35, 39). In turn, experiences of fear and anxiety during labor can increase the pain and need for analgesia (40). During childbirth, the stress system is activated

to help the woman to cope and adapt to the physical and mental challenges (41). Excessive pain and fear lead to increased levels of catecholamines and corticosteroids which cause vasoconstriction and taut muscles which will entail ischemia and increased pain (38). Further, the circulation to the uterus and the placenta can be impaired, which may lead to prolonged labor (42).

The effects of being in a bath during childbirth are multifactorial. Some of the anesthetic effects are explained by the gate control theory. This implies that impulses of pain are inhibited by sensations of warmth and the tactile contact with water (37). A pain-relieving effect experienced by women immersing in water during the first stage of labor was found in six out of seven studies included in a systematic review of Randomized Controlled Studies (RCT) and in observational studies of waterbirth (43-46). Further, a reduced need for regional analgesia (epidural/spinal/paracervical) was found in a meta-analysis of randomized controlled trials of women immersing in water during the first stage of labor (47).

### **Relaxation**

The relaxing effect of the bath can reduce anxiety and lead to decreased sympathetic activity, giving a feeling of tranquility and well-being (31, 48, 49). Suppression of catecholamines in plasma and urine during immersion to the neck was observed in one study (49). However, a significant decrease of neuroendocrine biomarkers assessed during labor has not been shown, yet, a tendency for women with high levels of cortisol and pain at baseline to have a larger decrease after immersion than those with low baseline scores (48). Muscular relaxation, vascular dilatation and increased cardiac output follow a warm bath (50). This might reduce ischemia, one of the causes of labor pain (38), and as a consequence, the intensity and experience of pain. The hydrostatic pressure, which is proportional to the depth of the water, pushes extravascular fluid into vascular spaces increasing the central blood volume (31, 49, 51).

A sense of control is an important factor in the experience of labor pain and childbirth (52-54). Qualitative studies focusing on the woman's experience of waterbirth have found that it gives women a sense of control, pain relief and relaxation. Further, the women described a calming and supporting feeling from the water as well as less interference contributing to a positive birth experience (55-58). However, the qualitative studies include few informants and are made in settings different from Swedish care. Additionally, an American study assessing birth experience, comparing women's experience of waterbirth with women's experience of



uncomplicated conventional births, found a more positive birth experience among women giving birth in water (59).

### **Interventions during labor**

Advocates have argued that waterbirth is a natural way of giving birth, which minimizes interventions like augmentation of labor (amniotomy and intravenous synthetic oxytocin) (2). Most clinics do not use augmentation with oxytocin when the woman is immersing in water, which is why these parameters are seldom presented in studies. A few observational studies include interventions, such as amniotomy and augmentation with oxytocin, showing low frequencies (60, 61). Bearing in mind that women giving birth in water form a selected low risk group, a comparison of interventions is not possible if adjustments are not made for labor dystocia or if an RCT is not performed. There are only two published randomized controlled waterbirth studies which are pilot studies (62, 63). The larger of these studies (n = 106) showed a significantly shorter duration of labor, and a decrease in use of oxytocin and analgesia as well as an increased number of spontaneous vaginal births (62). The other randomized, controlled, pilot study consisted, after several drop outs, of only 10 waterbirths (63).

In the meta-analyses of RCT:s including women immersing in water during first stage of labor, no differences were detected regarding amniotomy or intrapartum oxytocin. However, the use of regional anesthesia was reduced in the group of immersing women (47). Furthermore, a reduced need for augmentation (amniotomy and intravenous oxytocin) was seen in a RCT with nulliparous women diagnosed with labor dystocia, who were randomized to water immersion or standard management of labor dystocia (64). Moreover, a significantly reduced need for intrapartum transfer was observed among women immersing, in a cohort study of 16 577 low-risk nulliparas, birthing at a freestanding midwifery unit, alongside midwifery unit or at home (65). However, systematic reviews do not find a decrease in instrumental births or caesarean births among women immersing in water during first stage of labor (46, 47).

Episiotomy, a surgical cut of the vagina and perineum is an intervention reported being less frequent in all studies of waterbirth compared to conventional vaginal births (60, 61, 66-68).

### **Buoyancy and mobility**

The buoyancy effect of water facilitates mobility, and women immersing are often upright and less likely to suffer compression of the abdominal blood vessels as seen in supine positions (69). Such compression has a negative effect on the circulation to the uterus and the placenta

(70, 71). Mobility and upright positions also contribute to pain relief and the progress of labor as demonstrated in a Cochrane review with women not immersing in water (69).

## **1.7 PERINEAL TEARS AND WATERBIRTH**

Perineal tears are usually categorized in terms of degrees I-IV, where degree I involves a tear in perineal skin and/or vagina mucosa; II involves perineum muscles but not the anal sphincter, III the anal sphincter complex, and IV both the anal sphincter and the anorectal mucosa (72). A second-degree tear involving the perineal muscles and the rectovaginal fascia may lead to consequences, such as prolapse of pelvic organs, rectocele and may also affect sexual functioning (73-76). Additionally, III and IV degree tears are associated with anal incontinence (77, 78). More than 85% of women birthing vaginally will get some kind of perineal tear (79) with a higher incidence for nulliparas, and decreasing incidence in subsequent births (80).

Results from studies with perineal tear as outcome are inconclusive, but there is a tendency for waterbirth to have a protective effect on perineal tears. In the largest review looking at this outcome, including 31 000 waterbirths, Nutter et al., found that waterbirth was associated with intact perineum (seven studies), and if perineal tears occurred, they were to a higher extent of first degree (six studies) and second degree rather than severe lacerations (six studies). However, one study found an increased risk for a second-degree tear in waterbirth compared with conventional birth, while two studies observed comparable frequencies. Regarding sphincter ruptures, six studies found a decreased likelihood in water, three studies found equal frequencies and one (67) an increased risk with waterbirth (68). A Cochrane review noted no significant differences in second-degree tears between waterbirths and conventional births, but comprised only one study, while the rest of the studies with this outcome included women immersing only during the first stage of labor (47). A retrospective cohort study, including 6 521 waterbirths and 10 290 conventional births found an increase in lacerations in waterbirth when comparing any perineal laceration with no laceration, however, when categories of tears were assessed, the differences diminished (81). Another recent cohort study, including 1716 waterbirths found less perineal tears in the group of waterbirths compared with 21 320 conventional births (82). Geissbuhler & Eberhard described an increased number of first and second degree perineal tears, but fewer third and fourth degree lacerations among waterbirths, compared to bed births (83). In contrast, waterbirth was noted as a factor increasing risk for

anal sphincter ruptures in a risk-scoring model, counted on 298 waterbirths constituting 1.9% of the births in the material (84).

Previous studies have established that waterbirth is associated with a decrease in episiotomies compared to other vaginal births (60, 61, 66-68) . The fact that Sweden in general has a lower frequency of episiotomies (6.2%) than most other countries; 14% in the UK and 50% in the United States (79, 85) makes research on perineal tears in a Swedish context significant. The management of the second stage of labor is different in waterbirth, and the use of perineal protection by hands is less extensive in waterbirth than in conventional births (61). The midwife do not have the same overview over perineum when the woman give birth in water and there is probably more of non-directive pushing (2). But there is a gap in knowledge on this matter. The tradition and cultures regarding perineal protection with hands on/hands off varies between countries, as does the management of waterbirth (2, 61).

## **1.8 THE THIRD STAGE OF LABOR IN WATER**

There is a lack of studies on the third stage of labor in waterbirths, and there has been uncertainty regarding delivering placenta in water since the obstetrician Odent raised a theoretical risk of water embolism (3). However, there are no such cases found in the literature. Previous studies, describe different routines, with women delivering placenta in water (30, 86) and women leaving the tub before delivering the placenta (60, 87). A difficulty in estimating blood loss is another reason for leaving the tub. Studies measuring postpartum blood loss, by hemoglobin levels before and after birth, was found to entail similar, or less blood loss in waterbirth (43, 83, 86, 88). Other studies estimating blood loss found no differences between waterbirth and conventional birth (27, 60, 61, 89, 90). Further, no differences in maternal infections have been detected (68, 86, 88, 91). There are no apparent benefits with delivering the placenta in water, other than to avoid interference of the mother and baby by bringing them up from the bathtub.

## **1.9 NEONATAL OUTCOME AFTER WATERBIRTH**

Waterbirth is controversial in some countries; mostly among neonatologists who fear an increased risk of adverse outcomes for the newborn (92). There are several observational

studies of waterbirth, although, most of them are statistically underpowered to draw conclusions of neonatal outcome as complications in low-risk births are rare (43, 81, 87, 90, 93, 94). However, systematic reviews and meta-analysis with neonatal mortality as primary outcome, and neonatal morbidity as secondary outcome, report no differences between waterbirth and conventional birth. These meta-analyses comprise up to 39 000 births (5, 95). Some of the outcome variables compared were Apgar Scores, infection rate and admission to Neonatal Intensive Care Unit (NICU). In some of the studies, umbilical cord blood samples were collected, showing a similar or slightly higher pH value among babies born in water (5, 95, 96). The conclusion drawn from these studies is that there is no increased risk for neonates in waterbirth compared to conventional birth, but there is still a lack of evidence with respect to occurrence of rare adverse events and long term effects of waterbirth. The knowledge and importance of the “seeding” or transfer of microbes from mother to baby during a vaginal birth is growing (97). A change in the neonatal microbiome is conceivable as a long-term effect. One study, determining the structure of fecal microbiota, found diversity differences between infants born in water and conventionally but lacked statistical power for comparisons (98).

A case-control study of babies born with respiratory distress requiring neonatal intensive care, showed an increased morbidity among 14 neonates born in water compared with 24 neonates having a conventional birth (99). These result are not in accord with similar studies (100, 101), although, there are case reports of incidents in waterbirth, among them aspiration and infection (102-104). Increased infection rate among newborns has been discussed as a potential risk factor in waterbirth, but several studies suggest that this increase is non-existent (30, 61, 86, 94, 105). However, occasional case reports of *Legionella pneumonia* in neonates have been reported after waterbirth and there is reason not to fill up a birthing pool days in advance of labor (106, 107).

The risk for rupture of the umbilical cord is increased in waterbirths and umbilical cord avulsion is reported in 2.4/1000 waterbirths (68). There is a risk of traction in the cord when bringing the baby up to the surface, although the umbilical cord can also snap when the baby is born, because of buoyancy. As there is no routine for reporting umbilical cord avulsion in conventional births, it is not possible to calculate how much the risk is increased. Umbilical cord avulsion could have devastating consequences for the neonate but is prevented if immediate clamping of the cord is performed (30, 61, 108).

The explanation of the transition mechanisms in waterbirth is hypothetical as the mechanism controlling the switch from fetal to extrauterine breathing has not been completely explored (5). One theory is that the diving reflex prevents the neonate from aspiration when being born

in water. The diving reflex is activated by chemoreceptors in the larynx, epiglottis and the facial trigeminal nerve (109) and persists in general, during the first two to six months of the baby's life (110). Another theory is that some of the triggers, such as light, handling, and difference in temperature, which usually initiate breathing at birth, are absent when the baby is born in water of body temperature (111, 112). According to this theory, the transition is postponed for some seconds, until the baby reaches the surface. A potential risk in waterbirth is if the baby suffers from hypoxia and acidosis and gasps when being born. If this is the case, there is a risk for aspiration of the bathing water with the same mechanism as in meconium aspiration (5, 113).

There could be an indirect benefit for the baby being born in water, as the mother may have a reduced need for epidural anesthesia or other pharmacological pain relief. This may result in administration of fewer interventions like augmentation with oxytocin and possibly vacuum-extractions (114-117). The absence of medical analgesia and being born by a mother with a positive birth experience could be beneficial for the early mother-baby-interaction (25, 118).

## **1.10 ATTITUDES TO WATERBIRTH AMONG HEALTH PROFESSIONALS**

Waterbirth has been debated in Sweden as well as in other countries. However, there are varying interpretations of results in the observational studies and a lack of RCT:s (68, 92, 119). The disparate interpretations of research may mirror the attitude towards waterbirth. The diversity in attitudes towards waterbirth, between midwives and physicians, might be explained by the partly different views on pregnancy and childbirth integrated in the different professions. Midwives focus on promoting normality and health with a holistic view of birth as a normal physiological and psychological process, while physicians' views tend to focus on pathology and reducing adverse outcomes (120).

Attitude is a complex psychological construct, and definitions vary. One definition is that attitude is an emotional and mental entity that characterizes a person (121). Attitude originates from an evaluation of an object (issue or person), which affects thought and action. This could be described as a predisposition, or tendency, that influences behavior, which is based on emotions rather than rationality (121). In practice, an attitude can influence us to selectively expose ourselves to information that fits our standpoint, which can cause confirmation bias (122).

The view among sociologists, is that attitudes are influenced by the social environment and can only be inferred from the persons actions (123). An attitude may be important to a persons' social identity if it is held by a group of which he or she is a member (124). An opinion can be explained as an expression of an attitude, which can be measured by questionnaires (125). In social science, surveys of people's attitudes are frequent, and the Likert scale is a psychometric scale that is often used (126).

## 2 RATIONALE

The popularity of giving birth in water is increasing. Women share their waterbirth stories on the internet and many express that they want to choose a birth clinic offering waterbirth facilities. Even women moving between countries bring their experiences of, and requests for, waterbirth to Sweden.

For women with low-risk births, waterbirth is an alternative that is requested and provided in approximately a hundred countries. However, in Sweden, waterbirth is controversial and has not been an available option over the past decades. Health professionals have a lack of experience and their knowledge is often not based on latest research. Also, there is a lack of studies on waterbirth in a Swedish context.

The association between perineal tears and waterbirth is inconclusive and there is a need for additional research. As there are differences in the rate of episiotomies and perineal tears between countries, a study in Swedish context would add specific knowledge regarding this. The safety of the newborn is disputed and an RCT with the power to draw conclusions about the newborn is out of reach. Hence, observational studies can contribute with data that can be used in meta-analyses.

Waterbirth is often described as a way to improve or give a positive birth experience but qualitative studies are scarce and include few informants. Studies on women's experiences of waterbirth would be beneficial, both for women interested in this method and for health professionals working in maternity care. Further, there is a lack of studies assessing birth experience and comparing the experiences of waterbirth with uncomplicated conventional births.

### **3 AIM**

The overall aim was to study and evaluate waterbirth in a Swedish context and to explore the attitudes to waterbirth among health professionals.

#### **3.1 THE SPECIFIC AIMS OF THE STUDIES:**

- I. To compare birth characteristics and outcomes between waterbirths and conventional uncomplicated spontaneous vaginal births. Primary outcome was perineal tear of second degree, secondary outcomes were; interventions, outcome of the newborn and birth experience.
- II. To describe women's experiences of giving birth in water.
- III. To explore midwives', obstetricians', and neonatologists' experiences, knowledge and attitudes to waterbirth in Sweden.
- IV. To compare women's experiences of birth in water with those of women with uncomplicated conventional vaginal births.



## 4 MATERIALS AND METHODS

Four studies, with four different data collections are included in the thesis. The methods used are shown in Table 1.

Table 1. Overview of the four studies included in the thesis.

	<b>Aim</b>	<b>Design</b>	<b>Participants</b>	<b>Analyses</b>
<b>Study I</b>	To compare birth characteristics and outcomes between waterbirths and conventional uncomplicated spontaneous vaginal births. Primary outcome was perineal tear of second degree, secondary outcomes were; interventions, outcome of the newborn and birth experience	Retrospective cohort study.	612 women having an uncomplicated spontaneous vaginal birth of which 306 were in water.	Descriptive and comparative statistics, logistic regression.
<b>Study II</b>	To describe women's experiences of giving birth in water.	Qualitative study.	Twenty women interviewed 3-5 months after having a waterbirth.	Qualitative content analysis
<b>Study III</b>	To explore midwives', obstetricians', and neonatologists' experiences, knowledge and attitudes to waterbirth in Sweden.	Exploratory cross-sectional study.	1609 midwives, obstetricians/gynecologists and neonatologists completing a web-questionnaire.	Descriptive and comparative statistics and quantitative content analysis.
<b>Study IV</b>	To compare women's experiences of birth in water with those of women with uncomplicated conventional vaginal births.	Prospective cohort study.	111 women giving birth in water and 105 having an uncomplicated spontaneous vaginal birth, using a validated web-questionnaire assessing birth experience 6 weeks postpartum.	Descriptive and comparative statistics.

### 4.1 DESIGN AND DATA COLLECTION

Epidemiology is a quantitative discipline and the main science used in public health, measuring distributions and determinants of health and disease (127). The origin of epidemiology is related to demography, testing hypotheses relying on statistical analyses (128). In epidemiology there are observational and experimental studies. In an experimental study, the researcher intervenes so that some people in the study group receive an exposure in a controlled way, while in observational studies, epidemiologists observe exposures and

outcomes for a specific population without intervening. **Studies I** and **IV** are cohort studies, which together with case-control studies are the two main types of observational studies. The cross-sectional design used in **Study III** is another type of observational study describing data at a specific point in time (127).

Content analysis is a method used in qualitative research and has derived from communication with roots in media and journalism (129). Originally, content analysis had a more quantitative approach, counting qualitative data (130). Today, content analysis is used both quantitatively and qualitatively, with various depths of interpretation (129). Qualitative content analysis was chosen for **Study II** with the purpose of making valid inferences from the text and to distil words into themes that describe a phenomenon (129). With a manifest approach, the obvious content is described, while in a latent approach, the interpretation is on a deeper level of abstraction (131, 132). In **Study II** a qualitative content analysis was made with both a manifest and latent approach, and in **Study III**, quantitative content analysis was used.

## **Study I**

Study I was a retrospective cohort study including all women having a waterbirth, at the two clinics providing waterbirth in Sweden from March 2014 to November 2015 (n=306).

The women were identified via birth records; when the women gave birth in water it was registered with the statement “waterbirth” in the box for birth position. The 306 women, with a conventional, uncomplicated, spontaneous vaginal birth, in the comparison group, were selected consecutively, using the birth records. These women were matched for parity at the same clinic.

Both birth clinics were situated in the city of Stockholm. Maternity ward 1, where 284 waterbirths and 284 conventional births of the 612 women were recruited, had approximately 3 300 births per year. The care was woman-centered, with mostly low-risk births and non-admission of high-risk births. This clinic had corner bathtubs, which made it possible to move and change position during labor. Maternity ward 2, where 22+22 of the women were recruited, was a modified, in-hospital birth center with approximately 1 400 births per year. This clinic had bathtubs of a domestic model, which reduced the possibility of changing positions. Both clinics provided continuous support during active labor and offered nitrous oxide in the bath.

All data were collected from the birth records, including lacerations in the vagina and perineum with degrees from I-IV (72). Dystocia in labor was registered according to Swedish national guidelines, with three hours delay from the alert line (133). Birth experience was measured

with a Numerical Rating Scale (NRS) from 0-10, with 0 signifying the worst – and 10 the best imaginable birth experience.

## **Study II**

Study II was a qualitative study, based on in-depth interviews with 20 women having a waterbirth. An inductive approach was chosen as the purpose was to extend knowledge without a given theory (132). An interview guide was developed and reviewed by five colleagues and was used as a foundation. The questions were open ended, and the interviews had the character of a conversation, where the improvised follow-up questions could be a key to deeper information.

To address the aim of describing women's experiences giving birth in water, the theme 'experience' was used:

- How did you experience giving birth?
- How did you experience being immersed and giving birth in water?
- How did you experience pain before and after immersion and during the actual birth?
- Which benefits did you experience from giving birth in water?
- Which disadvantages did you experience from giving birth in water?

At the same time as collecting informed consent for **Study I**, the women were able to state their willingness to be interviewed. Of the 162 women receiving this letter of informed consent, 145 indicated their interest in participating in an interview by giving their telephone number. Since the interview had to take place three to five months postpartum, only 74 were eligible to be contacted when there was time to perform the interviews in 2015. Of these, 20 women were randomly selected and contacted by telephone. All twenty women contacted were willing to be interviewed. This resulted in 12 nulli- and 8 multiparas aged 27-39 (median age 33). Their parity varied from 1-7 with a median of one. All women lived in Stockholm County and were in co-habitation with the baby's father. The women were given the choice of where to be interviewed; two chose the campus or the hospital and 18 chose to be interviewed at home. The interviews were recorded digitally and lasted for 30-70 minutes.

## **Study III**

This was an exploratory cross-sectional study based on a web-survey sent to midwives, obstetricians/gynecologists and neonatologists during April-June 2016.

The questionnaire containing 21 questions, including socio demographic data, was developed by the research group. A Likert scale was used, with the opportunity to elaborate on the answers in open-ended questions. The questions were about: experience and knowledge of, assisting a waterbirth, perceived benefits and risks for the woman and the baby respectively related to waterbirth and opinions about waterbirth. The questionnaire was distributed by the Swedish Association of Midwives to all midwife members at the time (n=4359), of which 1 467 completed it. The Heads of Department of all Swedish maternity wards (n=46) were contacted and requested to forward the questionnaire to the obstetricians/gynecologists. According to the Heads of Department, 440 questionnaires were forwarded, of which 105 were completed. To the neonatologists, 104 questionnaires were forwarded according to the Swedish Association of Neonatologists that helped with the distribution, 37 were completed. The questionnaire is found in Appendix I.

#### **Study IV**

Study IV was a prospective cohort study conducted at the two clinics in Sweden providing waterbirth from December 2015 until October 2018.

One clinic, with approximately 3 300 births per year located in Stockholm, included women (n=173) from December 2015 until the clinic closed in May 2016. The other clinic, with approximately 1 400 births per year, located in Ystad, a small town in Southern Sweden, included women (n=143) from June 2016 to October 2018. Both clinics provided, for the most part, continuous support by a midwife and offered the possibility of using nitrous oxide in the bath. The larger clinic in Stockholm had corner bathtubs in every room, allowing women to change position. The smaller clinic had one large bathtub, especially suited for waterbirths, where the vast majority took place. This clinic also had a bathtub of domestic model but lacked bathtubs in the other birthing rooms.

Inclusion criteria were a low risk birth; healthy woman, uncomplicated pregnancy, BMI  $\leq 30$ , singleton baby in cephalic presentation with spontaneous onset. a gestational age between 37+0 and 41+6 and a normal CTG-door test. Women who met the inclusion criteria were asked to participate in the study when admitted to the maternity ward. Women were eligible, regardless of whether or not they were interested in immersing in water. All women having a waterbirth during the study period were included in the study, but several women who were eligible and who would have ended up in the comparison group were not included due to heavy workload or forgetfulness. This resulted in a smaller comparison group than expected. As there were

different proportions in nulli- and multiparas between the groups, a stratification of parity was made.

Information about characteristics and clinical outcomes were collected from the birth records. Births with complications occurring during labor were excluded so that only women eligible for waterbirth remained in the group of conventional births. Umbilical cord samples measuring pH and base excess were collected at birth. After birth, the attending midwife completed a protocol with information about how the second- and third stages were handled as well as information about the midwives' working experience.

Childbirth Experience Questionnaire CEQ and additional questions

Approximately six weeks after birth, the women received the validated questionnaire CEQ-Childbirth Experience Questionnaire by email. The questionnaire comprises 22 items divided into four different domains or subscales measuring different aspects of maternal satisfaction with labor and birth (134). The domains are: Own capacity (eight items), Professional support (five items), Perceived Safety (six items) and Participation (three items). The items were answered with a four-point Likert-scale (20 items) and NRS scale from 0-10 (two items). Four questions, specific to the study, had been added to the questionnaire, i.e. about the second stage of labor pain, control and mobility. These questions were also answered using the using Likert scale and NRS scales. Additionally, there were questions about knowledge of, and preferences about, having a waterbirth. For women giving birth in water, further open-ended questions appeared in the web-questionnaire

Using the think aloud method, these questions were tested on ten couples staying on a postnatal ward (135). The couples read the questions and described how they interpreted them and what they would have answered. All couples had a birth within 48 hours before testing the questions, and some small corrections were made after the test. See the complete questionnaire in Appendix II.

## 4.2 DATA ANALYSIS

The level of significance was set at 0.05 for the statistical analysis in **Studies I, III and IV**.

The primary outcome for **Study I** was perineal tear of second degree (72). Secondary outcomes were interventions during labor (amniotomy, augmentation with oxytocin and internal CTG), duration of labor, neonatal outcome and birth experience. The pre-trial power calculation was

based on a prevalence of a second-degree tear of 27 %. This prevalence was based on information about all spontaneous vaginal births (n=2168) taken place at the main study clinic during the year 2014. A difference of +/- 10 % between the groups gave a study population of 576 (decrease) or 722 (increase) with a 95% confidence interval and 80% power, two tailed. As the clinic in question closed unexpectedly, we calculated using the 612 women already included.

Comparative analyses were performed with Fisher's exact tests for categorical variables and t-tests to compare continuous parametric variables between the two groups of waterbirths and conventional births. Missing data were reported on each variable when the number was less than 306. Crude and adjusted odds ratio were analyzed for the primary outcome, second degree tear and waterbirth/conventional birth. Logistic regression modeling was performed in a multivariate model, including known risk factors for perineal tears; oxytocin augmentation, time for active pushing and the size of the baby, to adjust for these confounders. Head circumference of > 36 cm was chosen instead of birthweight of >4000g as these measurements correlate and there was a difference in that parameter between the groups. Time for active pushing was divided into  $\leq 45$  min, 46-60 and >60 min of active pushing.

The qualitative data in **Study II** were analyzed using qualitative content analysis inspired by the outline of Graneheim and Lundman (131). An inductive approach was chosen, appropriate for conducting descriptive and exploratory analyses that seek findings and patterns in the collected material, rather than from existing theories (130, 132). The interviews were transcribed verbatim and read several times to obtain a sense of the whole. The complete interviews were entered in the software program NVivo 11 Starter, where meaning units were abstracted closely to the text. Meaning units were defined as words or sentences containing aspects related to each other through their content. These meaning units were condensed to shortening the text but still with preserved core. Then they were labeled with codes close to the text, mostly with nouns. After coding and re-coding several times, the final codes were sorted in clusters linking to each other. After sorting the codes, sub categories and categories were identified to answer the question "what?" as a thread throughout the codes (129). A latent approach was used to identify the essence, of the whole or the "how", which was abstracted as a theme (129, 131, 132). The results were discussed with two of the other authors in the research group. NVivo facilitated going backwards to the original transcripts to ensure the results maintained the validity of the text.

In **Study III**, descriptive and comparative statistical analysis were performed using Chi square and Fisher's exact tests for categorical variables with demographic data. The groups of

midwives and physicians were different in size as the numbers of physicians participating were small. Therefore, the neonatologists and obstetricians/gynecologists were merged into one group of physicians when making comparisons with the midwives. Mann Whitney U-test was used to compare the ranking between the answers. For the same purpose, Fishers exact test was used to compare the proportions of the Likert Scale answers between the groups of midwives and physicians. In this case, these tests generated the same significance. The comments and elaborated answers were rather short and ranged from one word to four sentences. As the comments were voluminous but did not have the depth for a qualitative content analysis, the data were suited for a quantitative analysis (129). The content needed no condensation or interpretation and was coded according to the manifest content into different codes (129, 136). In the next step, the codes were sorted into categories regarding to the subject (129). An answer from one respondent was included in several codes if different subjects were processed. The coding was carried out repeatedly for validation, and the results were discussed in the research group. NVivo 11 Starter, a software for qualitative data, was used to facilitate the coding process.

In **Study IV** the background characteristics and birth characteristics in the groups of waterbirths and conventional births were compared using Fischer's exact test for categorial variables and t-tests to compare continuous parametric variables. The answers in the Likert scale in the CEQ were transformed according to the instructions; totally agree=4, mostly agree=3, mostly disagree=2, totally disagree=1) and the NRS (0-2=1, 3-5=2, 6-8=3, 9-10=4) with some of the questions reversed. The additional questions regarding second stage were not transformed as they were not included in the CEQ.

Mann Whitney U-test was used to compare the ranking in all subscales as well as the total CEQ and the additional questions about the second stage of labor. To visualize the CEQ scores, means and standard deviation were counted for each domain.

## 5 ETHICAL CONSIDERATIONS

The research conducted in this thesis is in accordance with Swedish law for governing research concerning humans (SFS 2003:460) (137), and the declaration of Helsinki (138, 139). All studies have been approved by the Regional Ethical Review Board in Stockholm and have received separate approval (Table 2). For **Study I**, ethical approval was conducted in three steps as the study was re-designed.

Table 2. The ethical approvals.

Main approval "To give birth in water" Qualitative and descriptive studies (2014/2077-31)		
Complementary approval Prospective cohort study Södra BB and BB Sophia (2015/1592-32) Ystad (2016/438-32)	Complementary approval Extended inclusion retrospective cohort + questionnaire health professionals (2016/718-31)	Complementary approval Comparison group retrospective cohort (2016/1885-32)

The main ethical approval was for collecting data from waterbirths during 2014 for a descriptive study and the qualitative **Study II** (2014/2077-31). This comprised an informed consent from each woman participating. Next was a complementary approval for the prospective cohort **Study IV**, which was planned to take place at two clinics in Stockholm (BB Sophia and Södra BB) (2015/1592-32). When these two clinics were closed, we obtained approval to continue the data collection for this study in Ystad (2016/438-32). Then, we re-designed the studies with the purpose of utilizing the restricted data on waterbirths in a more optimal way. Thus, the data collected for the descriptive study, was used in a retrospective cohort study instead, which became **Study I**. For this, we needed to extend the inclusion over a longer period (2016/718-31), as well as obtain approval for the comparison group



(2016/1885-32). This did not entail obtaining individual approval from each woman regarding collecting data from the birth records.

At the same time as we extended the data collection, we obtained approval for the web-questionnaire for health professionals used in **Study III** (2016/718-31). The Ethical board in Stockholm was further contacted to confirm that the complementary approvals were enough for **Study I** and **IV**. The Ethical board responded by email, that they were, and that there was no need to supplement them with another main approval.

To collect data from birth records might lead to a derogation of privacy. Only HU had access to the data during the record scrutiny and analysis. The women who agreed to participate in **Study I** were simultaneously asked to take part in an interview for **Study II**. One hundred and forty-five women indicated their willingness to be interviewed by giving their telephone number. Of these, only 20 were asked to participate, which may be viewed as unethical since some women might feel deselected. For **Study II**, the women received information about the interview by phone, and before starting the interview, a written informed consent was collected. The participants were informed both verbally and in writing about the voluntary nature of their participation and the possibility to withdraw at any time. The women in **Study II** were discharged from hospital several months before the interview and were not in any way dependent on health professionals, which might have made their participation less problematic.

The questionnaire in **Study III** was anonymous, with questions that were not of a sensitive or private nature. There are no obvious ethical dilemmas in asking health professionals to complete a web-questionnaire about waterbirth.

In **Study IV**, women were asked to participate during or after labor. There is a risk that women may have felt obliged to take part in the study in order to please the midwife, on whom they were depending for help. However, the information about voluntary participation and being able to withdraw at any time was emphasized. The women might also have been in a situation, in active labor, where they had difficulties in absorbing information about the study and participation. The ethical board commented that it would be preferable for the women to give verbal consent during labor and written consent after birth, which was often the case. They could then consider or re-consider their participation under more optimal conditions. There might also be some women that perceived that they were supposed to immerse in water or give birth in water if they were participating in the study. The midwives were well informed that the decision of having a waterbirth should come from the women themselves without influence from the midwife.

The CEQ questionnaire was sent by mail six weeks postpartum. At this point, the women were not in the hands of any caregivers and were under no pressure to answer. The CEQ comprises questions about the childbirth experience that might be sensitive for some. However, the CEQ contains no personal questions thus minimizing the risk that the woman may feel exposed. The women gave their personal identity numbers in the questionnaire, which may have made some women feel uneasy. Women with a bad experience of childbirth are usually contacted by the clinics for follow-up counseling.

At first, we considered conducting a randomized controlled study but quickly concluded that it would be unethical. To randomize women who may have strong preferences about how they would like to give birth would restrict their autonomy.

## 6 RESULTS

### 6.1 STUDY I

In **Study I**, a retrospective cohort study, 306 waterbirths and 306 uncomplicated conventional births were included. In each group, there were 114 (37.3%) primiparous and 192 (62.7%) multiparous women, with multiparity defined as having at least one previous vaginal birth. Regarding background factors; age, BMI, tobacco use, education, civil status, psychiatric history, fear of childbirth, IVF, previous cesarean section or sick leave during pregnancy, there were no significant differences between the groups. In the waterbirth group, there were eleven women (3.6%) who had a note in their antenatal record of a wish for a waterbirth. One woman in the comparison group had such a wish but gave birth too fast to accomplish a waterbirth. The women in the comparison group had no severe diagnoses that would have excluded them from having a waterbirth. Women having a waterbirth were less exposed to interventions such as amniotomy, oxytocin infusion and internal CTG (Table 3). Nitrous oxide was used significantly more in the comparison group. In this group 107 (34%) women had an epidural anesthesia.

Table 3. Birth characteristics and interventions **Study I**.

	<b>Waterbirth</b> (n=306) n (%)	<b>Non-WB</b> (n=306) n (%)	<b>p-value</b>
Maternal age, mean (SD)	32.2 (4.9)	32.2 (4.5)	0.9
<b>Gestational age</b>			0.18
36+2-37+0	3 (1.0)	2 (0.7)	
37+1-41+0	260 (85.0)	244 (79.7)	
41+1-42+1	43 (14.1)	59 (19.3)	
Induction of labor	25 (8.2)	31 (10.1)	0.4
Amniotomy	42 (13.7)	108 (35.3)	<0.001*
Intact membranes at birth	13 (4.2)	1 (0.3)	0.002*
Oxytocin iv	16 (5.2)	96 (31.3)	<0.001*
Internal CTG	34 (11.1)	174 (56.8)	<0.001*
TENS (Transcutaneous Nerve Stimulation)	26 (8.4)	33 (10.8)	0.3
Nitrous oxide	180 (58.8)	228 (74.5)	<0.001*
Sterile water injections	19 (6.2)	21 (6.8)	0.7
Acupuncture	39 (12.7)	41 (13.4)	0.8
Occiput posterior	5 (1.6)	2 (0.7)	0.2

\* p<0.05

The duration of labor was shorter in the waterbirth group in all stages, and the diagnosis of dystocia of labor was significantly more frequent in the comparison group. Giving birth in water was associated with a lower frequency of perineal tears of second degree after adjusting for head circumference >36 cm, oxytocin augmentation and time for pushing OR 0.61 [95% CI 0.41-0.89] (Table 4).

Table 4. Factors associated with second-degree perineal tears.

n=604 (8 missing data of perineal tears)	<b>Second-degree tear or more</b> n (%)	<b>OR</b> (95% CI)	<b>Adjusted<sup>^</sup> OR</b> (95% CI)
<b>Non waterbirth</b>	300 (33.0)	Ref	
<b>Waterbirth</b>	304 (21.7)	0.6 (0.4-0.8)*	0.6 (0.4-0.9)*
<b>Head circumference</b>			
≤36cm	498 (28.5)	Ref	
>36cm	106 (35.8)	1.4 (0.9-2.1)	1.3 (0.8-2.1)
<b>Oxytocin</b>			
No	494 (27.3)	Ref	
Yes	110 (40.9)	1.9 (1.2-2.9)*	1.3 (0.8-2.1)
<b>Pushing (n=597)</b>			
≤45min	526 (26.8)	Ref	
46-60	42 (47.6)	2.5 (1.4-4.7)*	2.6 (1.4-5.0)*
>60min	29 (55.2)	3.4 (1.6-7.2)*	2.8 (1.3-6.1)*

<sup>^</sup> Adjusted for all variables above, \*p<0.05.

The birth experience, measured by NRS (0-10), showed significantly higher scores in the waterbirth group (p=0.04) than in the group of conventional births, indicating a more positive birth experience.

In Table 5, neonatal outcomes from **Studies I** and **IV** were merged for a larger sample, including 156 nulliparas and 261 multiparas in the waterbirth group, and 171 nulliparas and 239 multiparas in the group with conventional births.

Table 5. Neonatal characteristics and outcome of **Studies I and IV**, (n=827).

	<b>Waterbirth</b> n= 417	<b>Conventional birth</b> n =410	<b>p-value</b>
<b>Apgar score n (%)</b>			
<7 in 1 minute	7 (1.7)	5 (1.2)	0.8
<7 in 5 minutes	1 (0.2)	2 (0.5)	0.6
<7 in 10 minutes	0	1 (0.2)	0.5
pH arteria (n=55)	7.27 (0.09)	7.23 (0.09)	0.002*
pH venous (n= 55)	7.35 (0.08)	7.30 (0.08)	<0.001*
BE arteria (n=53)	-4.3 (3.2)	-5.6 (3.7)	0.006*
BE venous (n=55)	-4.9 (2.9)	-6.4 (2.8)	<0.001*
Umbilical cord rupture n (%)	6 (1.4)	0	0.03*
Weight (gram), mean (SD) (n=814)	3573 (423)	3621 (411)	0.09
Head circumference (cm) mean (SD) (n=820)	35.0 (1.3)	35.2 (1.3)	0.04*
Temperature C° mean (n=778)	36.9 (0.4)	36.9 (0.4)	0.4
Temperature ≤ 36.0 n (%)	15 (3.6)	12 (2.9)	0.7
Temperature ≥37.5 n (%)	27 (6.5)	27 (6.5)	1.0
Admission to NICU n (%)	9 (2.2)	24 (5.9)	0.01*
<b>Breastfed two hours postpartum n (%) (n=810)</b>			
No	80 (19.6)	68 (16.9)	
Attempt	199 (48.8)	205 (51.0)	0.7
Sucked	39 (9.6)	34 (8.5)	
Breastfed correctly	90 (22.1)	95(23.6)	

\*p<0.05

Neonatal diagnoses in the waterbirth group were; asphyxia or respiratory distress (n=3), jaundice (n=3), congenital anemia (n=1), hyponatremia (n=1) and congenital heart defect (n=1). Diagnoses in the comparison group were; asphyxia or respiratory distress (n=8), jaundice (n=8), persisting pulmonal hypertension (n=2), sepsis (n=3), hypoglycemia (n=2) one in combination with fever, congenital heart defect (n=1) and feeding problems (n=1).

## 6.2 STUDY II

This qualitative study, with the aim of describing women’s experiences of giving birth in water, received its title from the identified theme, “Like an empowering micro-home”. The latter describes the effect of being strengthened and enabled – empowered as well as feelings of privacy, discretion and homelike - the “microhome”. This theme was a common thread in the interviews - some women described it explicitly and some more latently.

Table 6. The theme, categories and subcategories.

Like an empowering micro home		
Synergy between body and mind	Privacy and discretion	Natural and pleasant
Increased focus and control over the body Mental relaxation Pain relief and physical relaxation Bouoyancy effect facilitating mobility Autonomous second stage of labor	Less exposed and bare Homelike and less clinical A free-zone - feeling of being safe and secure	Comfortable and practical Gentle transition for the baby Natural

The category, “Synergy effects between body and mind” describe the mental and physical experiences of relaxing the muscles with the warm water. This led to pain relief together with the buoyancy effect, which in enabled mental relaxation. This facilitated focus and coping with the contractions, creating an upward spiral, which made the experience more positive. These effects are described in the subcategories: Increased focus and control over the body, Mental relaxation, Pain relief and physical relaxation, Buoyancy effect facilitating mobility. Some women also described that the second stage of labor was easier thanks to the relaxation and buoyancy effect, which had saved them energy during the first stage of labor. This made them feel strong, powerful and in control. There were also several women who brought their baby to the surface themselves. These experiences are represented in the subcategory “Autonomous second stage of labor”.

The category, “Privacy and discretion” describes the demarcation and environment constituted by the bathtub and the water. This gave a feeling of protection and gave a recognition of giving birth at home rather than in a hospital. The women described being less exposed and naked thanks to the shielding effect of the water and the tub. To have an own “sphere” “womb” or “free-zone” enabled women to withdraw from the rest of the world in their “nest” where they felt safe.

“Natural and pleasant” describe the experience and thoughts of choosing a waterbirth instead of leaving the tub in the second stage of labor. Few of the women had planned for a waterbirth

in advance but said that it was natural to stay in the tub and that it felt like a gentle and pleasant transition for both themselves and their baby. There were also descriptions that it was smooth and comfortable afterwards, taking a shower directly after the birth. However, some thought that it was inconvenient to leave the tub afterwards and felt cold when getting out of the water.

### **6.3 STUDY III**

This exploratory cross-sectional survey study included 1 609 respondents, of which 1 467 were midwives, 105 were obstetricians/gynecologists and 37 were neonatologists. Of the responding midwives and obstetricians/gynecologists, 40 % currently worked at a birthing unit and 392 (26.7%) of the midwives, 10 (9.5%) of the obstetricians and 4 (10.8%) of the neonatologists had experience of attending a waterbirth. Several commented that they had gained this experience of waterbirth when working abroad.

Self-reported knowledge about assisting a waterbirth showed significantly greater knowledge reported by midwives than physicians. Among the midwives, 48.2% (n=685), and among the physicians, 58.5% (n=83), reported that they were not at all updated regarding waterbirth, a non-significant difference between the groups. Forty comments were given to the question about the research field, with diverging statements about the evidence base for waterbirth. The midwives were more confident that the current evidence was sufficient, while more physicians requested more studies before implementing waterbirth.

There were four questions about perceived benefits and risks for the woman and the baby respectively. All questions showed significant differences in the Likert scale ratings, where the midwives stated more benefits and less risks for woman and baby than the physicians. See Figure 1 for the distributions of answers in percent and Table 7 for the different comments in numbers.

Dividing respondents into groups with, or without experience, of attending or assisting waterbirth gave significant differences ( $p < 0.001$ ) in all questions regarding opinions, risks and benefits and whether waterbirth should be implemented, with more positive answers in the experienced group.

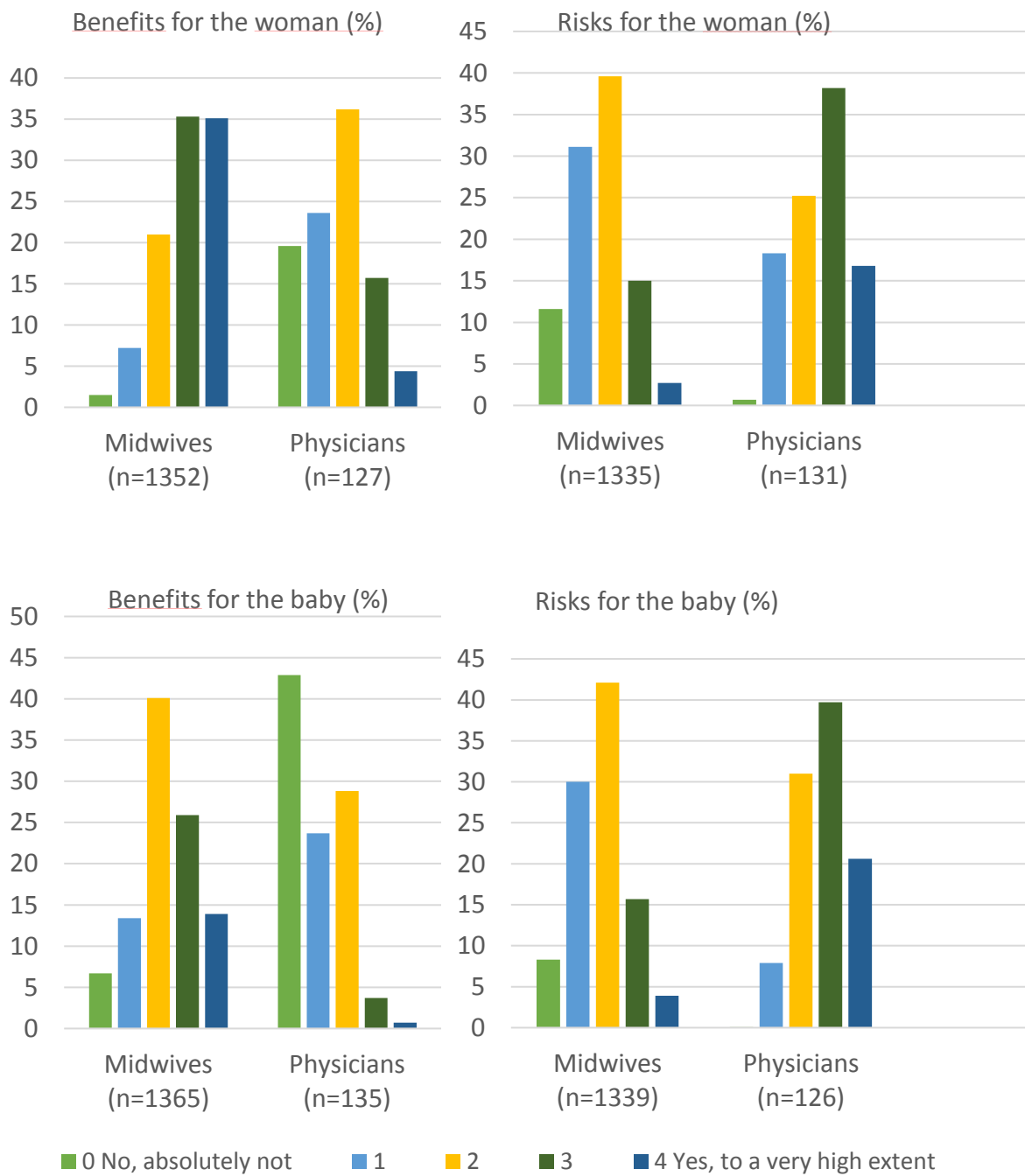


Figure 1. Perceived benefits and risks for the woman and the baby (p<0.001)



Table 7. Codes of the comments to the Likert scale questions “Do you think there are benefits/risks for the woman to give birth in water?” and “Do you think there are benefits/risks for the baby to be born in water, please specify?”

Category	Code	Midwives n	Physicians n
Perceived benefits for women	Pain relief	186	12
	Relaxing effects	154	9
	Autonomy and empowerment	43	0
	Less perineal tears	42	0
	Affects birth process in a positive direction	51	0
	Positive birth experience	31	6
	Buoyancy and mobility	31	2
	Offer alternative choices	12	3
Perceived risks for women	Hampered handling in emergency situations	88	6
	Increased perineal tears	63	13
	Importance of having strict criteria	40	2
	Difficulties in estimating blood loss	34	2
	Infection	37	6
	Water emboly	7	1
	Increased blood loss	4	0
Perceived benefits for the baby	Gentler transition	80	2
	Positive effects due to a calm mother	41	0
Perceived risks for the baby	Respiratory distress/aspiration	113	15
	Incorrect handling/ Importance of strict criteria	68	6
	Hampered fetal surveillance	33	8
	Infections	24	8
	Hampered handling in emergency situations	22	5
	Umbilical cord avulsion	11	1
	Asphyxia	6	1
	Hypo/hyperthermia	5	0

In the ratings of opinions about waterbirth, (Figure 2) there were significant differences ( $p < 0.001$ ), with a more positive attitude stated by the midwives. This question generated 342 views about the lack of experience and lack of knowledge motivating their opinion. The midwives were asked whether they were willing to assist a waterbirth, and to this question 986 (67.2%) answered “yes”, while 183 (12.5%) answered “no” with the remaining 20% refraining from answering. To this question, there were most comments about the need for education and knowledge and that the care services and midwife should comply with the woman’s choice.

For the answers to the question about whether waterbirth should be provided in Sweden, see Figure 3. The most frequent comment on this question was that it is important to offer alternatives and follow the woman’s choice, stated by 235 midwives and seven physicians. The second most common comment was that it gives benefits to the woman, stated by 102 midwives

and three physicians. Among those who were negative to implementation, the two most common arguments were, “lack of knowledge”, stated by 29 midwives and four physicians, and poor ergonomics, stated by 16 midwives and four physicians. The views between experienced and non-experienced health professionals were also disparate, yet the experienced group comprised mostly midwives.

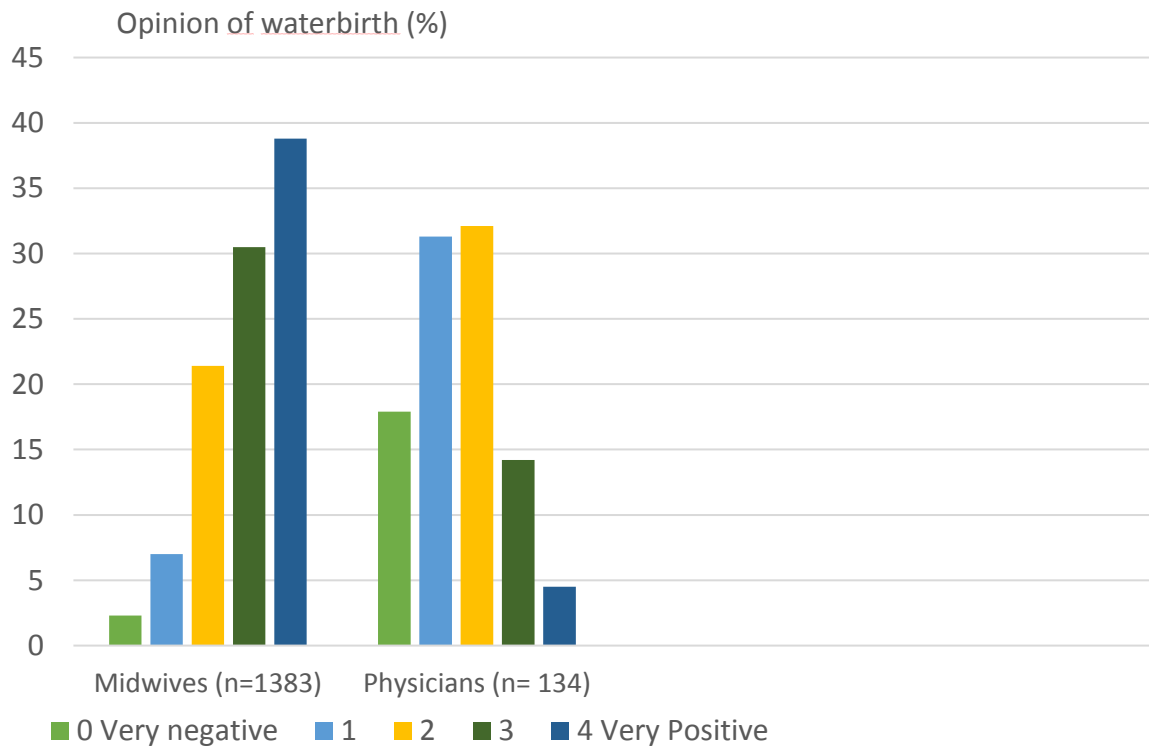


Figure 2. Opinion of waterbirth p<0.001

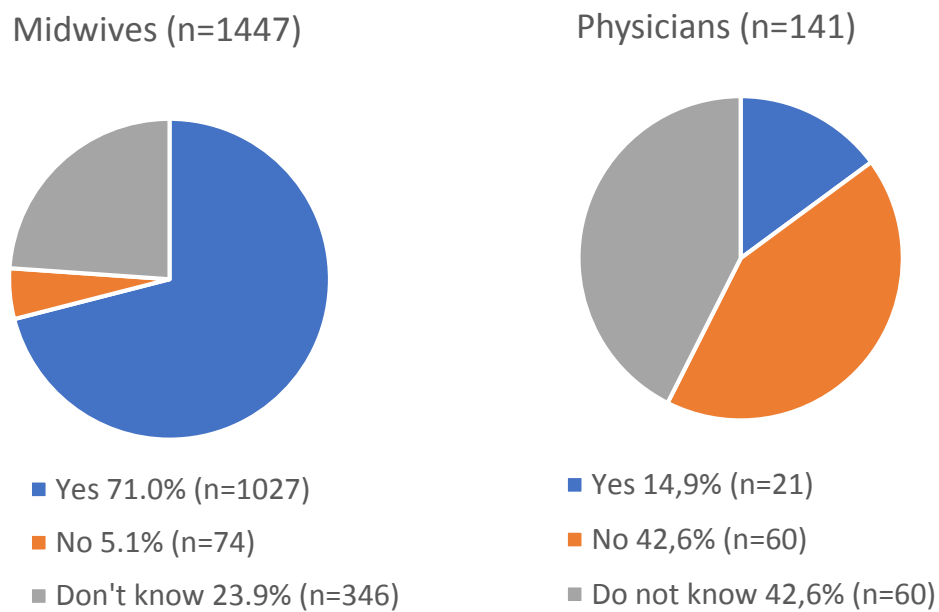


Figure 3. “Do you think waterbirth should be provided in Sweden?” p<0.001

## 6.4 STUDY IV

In total, 339 women were included, of whom 23 did not fulfill the criteria and were excluded from the analysis, and 101 did not return the web-questionnaire. Of the 215 women included in the analysis, 111 gave birth in water and 104 had a conventional uncomplicated birth. In the waterbirth group, there were 42 nulliparas versus 57 in the comparison group, and 69 versus 47 multiparas. The duration of the first stage of labor, among nulliparas giving birth in water, was significantly shorter, but there were no differences in duration of pushing between the multiparas in the two groups. The interventions, amniotomy and oxytocin were significantly less frequent for nulliparas in the group of waterbirths (WB); amniotomy 21.4% (WB) vs 52.6% conventional births (CB) and oxytocin 9.5% (WB) vs 56.1% (CB). Maternal complications, such as hemorrhage  $\geq 1000$  ml, sphincter rupture and manual placenta removal which could affect the birth experience were equally distributed between the groups (n=9 in water vs n=7 in the comparison group). Neonatal outcome for **Studies I** and **IV** were merged, see Table 3 in **Study I**.

The results of the domains and total CEQ are shown in Table 8. Significant differences were found in the domain, “Own capacity” where women birthing in water scored higher. Women who gave birth conventionally scored significantly higher in the domain “Professional support” (Figure 4). When the data was stratified by parity, the analysis was under powered, but the effect of water immersion seemed to be more pronounced among nulliparas.

Table 8. CEQ scores for women who had waterbirths and conventional births.

<b>All n=215 (111 WB vs 104 CB)</b>	Waterbirth	Conventional birth	P-value
Nullipara n= 99 (42 WB vs 57 CB)	(n=111)	(n=104)	
Multipara n= 116 (69 WB vs 47 CB)	Mean (SD)	Mean (SD)	
<b>Own capacity</b> (8 items)	<b>3.17 (0.44)</b>	<b>3.04 (0.46)</b>	<b>0.022*</b>
Nullipara	3.15 (0.41)	2.92 (0.46)	0.009*
Multipara	3.18 (0.46)	3.18 (0.41)	0.93
<b>Professional support</b> (5 items)	<b>3.79 (0.39)</b>	<b>3.89 (0.23)</b>	<b>0.019*</b>
Nullipara	3.81 (0.30)	3.88 (0.27)	0.10
Multipara	3.77 (0.44)	3.90 (.18)	0.11
<b>Perceived safety</b> (6 items)	<b>3.71 (0.40)</b>	<b>3.67 (0.39)</b>	<b>0.32</b>
Nullipara	3.67 (0.47)	3.61 (0.43)	0.39
Multipara	3.74 (0.35)	3.73 (0.31)	0.80
<b>Participation</b> (3 items)	<b>3.76 (0.35)</b>	<b>3.82 (0.33)</b>	<b>0.12</b>
Nullipara	3.74 (0.36)	3.83 (0.35)	0.092
Multipara	3.78 (0.35)	3.82 (0.30)	0.63
<b>CEQ total score</b> (22 items)	<b>3.54 (0.29)</b>	<b>3.51 (0.28)</b>	<b>0.31</b>
Nullipara	3.52 (0.27)	3.45 (0.30)	0.16
Multipara	3.55 (0.30)	3.58 (0.25)	0.69

\*p<0.0

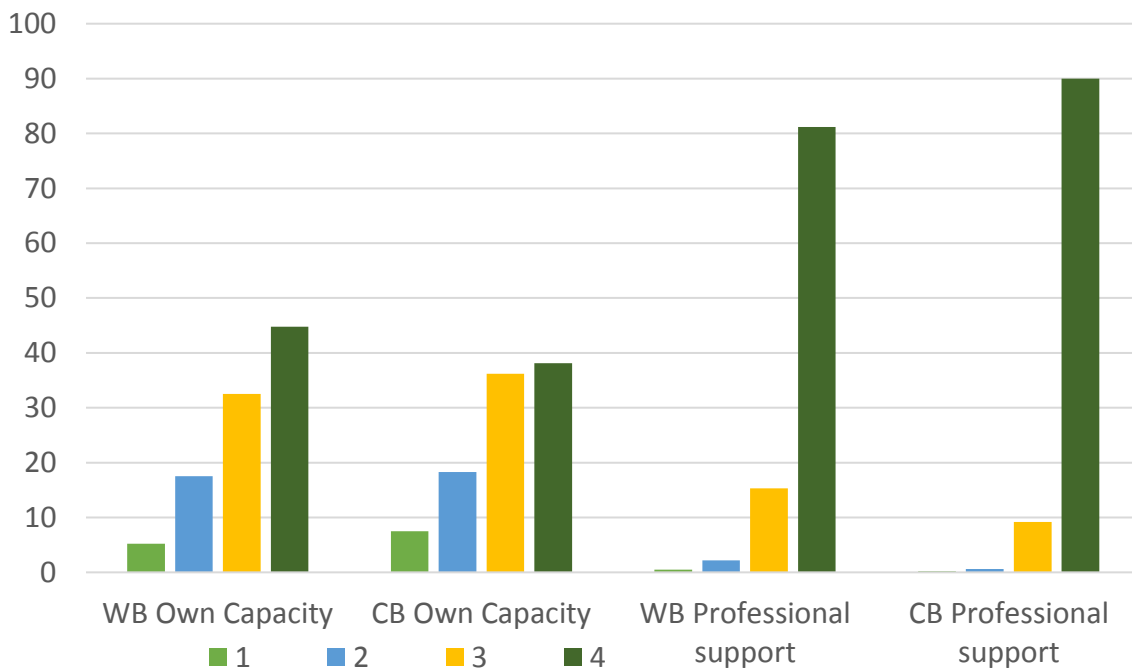


Figure 4. Responds in the domains “Own capacity” and “Professional support” Likert scale 1-4 (%)  
WB=Waterbirth n=111, CB=Conventional births n=104

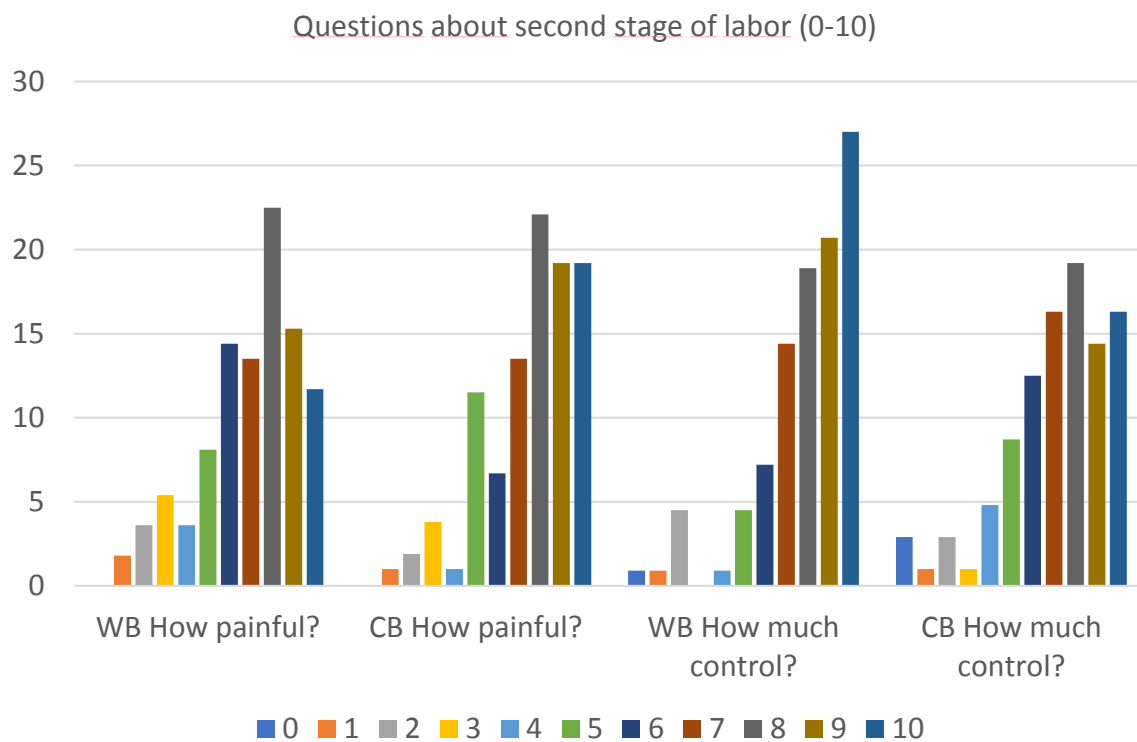


Figure 5. Pain in the second stage of labour (no pain-worst imaginable pain 0-10) and control at the moment of birth? (no control-complete control 0-10)? WB=Waterbirth n=111, CB=Conventional births n=104.

Significant differences ( $p=0.046$ ) were found in pain (0-10) during the pushing phase between waterbirth ( $6.96 \pm 2.27$ ) and the group of conventional births ( $7.55 \pm 2.13$ ), indicating less pain

during the pushing phase (Figure 5). Women giving birth in water scored higher on experienced control (0-10) at the moment of birth ( $7.88 \pm 2.22$  vs  $7.09 \pm 2.41$ ) ( $p=0.004$ ) than women having a conventional birth (Figure 5). Even here there was an effect moderation by parity with more pronounced effect among nulliparas. Further, one question about having the strength to be in their preferred position at birth showed that women having a waterbirth reported being more able to maintain that position ( $p=0.002$ ).

Of the 215 births, 37 were handled by midwives with  $\leq 3$  years working experience from a birthing unit. Of these, 23 were waterbirths and 14 were conventional births.

Cronbach's alpha coefficients were tested for internal consistency for the four subscales, (waterbirths presented first); Own capacity:  $\alpha = 0.73$  versus; 0.75; Professional support:  $\alpha = 0.85$  versus 0.72; Perceived safety:  $\alpha = 0.75$  versus 0.71; Participation:  $\alpha = 0.45$  versus 0.49.

## 7 DISCUSSION

The results presented in this thesis show that waterbirth was associated with a slightly decreased risk of second-degree perineal tear, and fewer interventions, which contribute to a de-medicalized birth. Except for the increased risk of umbilical cord ruptures, no other increased risk for the babies was detected. For the women, waterbirth was a way to achieve a positive birth experience where they felt capable, empowered and sheltered. Further, self-reported experiences of and knowledge about, waterbirth among health professionals in Sweden were limited. Also, opinions about waterbirth differed between midwives and physicians and to some extent were based on attitudes rather than knowledge and research.

### **Birth outcome**

The lower frequency of second-degree perineal tears among waterbirths may be explained by the positive effect of warmth seen in a Cochrane analysis of women receiving hot packs or a warm cloth in the perineum in conventional births (140). Other possible explanations could be relaxation, less medical anesthesia and a feeling of control at the moment of birth, which was noted in **Study IV**. There is a risk of inaccuracy in diagnoses of perineal tears when relying on birth records. However, as the births in the two groups were at the same clinics, one can presume that potential misdiagnoses were equally distributed in both groups. Further, the cohort **Study I** was performed retrospectively with the primary outcome of perineal tear unknown to the midwives assessing perineal tears, which is a methodological strength. In **Study III**, waterbirth was mentioned both as a hazard for perineal tear as well as a factor that could reduce the incidence of perineal tears. The literature does not suggest an increase in second-degree tears, but the graduation of tears and the quality of the studies varies, thus rendering the results inconclusive (47, 68). There is also a study suggesting an increase in sphincter ruptures in water, but included only a limited number of waterbirths (n=160) (67). The management of perineal protection in water seems to differ between countries (2, 61). A “hands on” approach is probably used more in Sweden than in other countries. A meta-analysis, including all degrees of tears (I-IV) respectively in waterbirths, is desirable as well as more knowledge about how perineal protection in water is performed. However, the crucial factor seems to be a slow birth, which could be obtained, with or without hands, if the woman is in control and can receive verbal guidance (140-142). A controlled birth and a decreased use of

oxytocin (a risk factor for perineal tears), could be facilitated in waterbirth, as seen in **Studies I and IV** together with an experience of being autonomous and empowered as in **Studies II and IV**.

Oxytocin for augmentation of labor is used excessively in Sweden; 50-55% of all births with spontaneous onset are augmented, 20-35% of them without a diagnosis of labor dystocia (143, 144). Both **Study I** and **Study IV** showed a decrease in the use of augmentation with oxytocin and amniotomies for women not having labor dystocia. In **Study I**, some women with labor dystocia and induced labor had a waterbirth, which made exclusion for those diagnoses in the comparison group inappropriate. This led to significantly more women with labor dystocia in the comparison group. In **Study IV**, women with labor dystocia were excluded but oxytocin stimulation was still allowed, showing significant differences in the use of both amniotomy and oxytocin infusion. The water immersion is a conceivable explanation of the difference, making midwives more cautious about intervening. Women with a longer duration of labor could also be told to leave the tub in advance of receiving a labor dystocia diagnosis. In **Study I**, the number of women with labor dystocia was significantly higher in the comparison group, which is natural since women usually are told to leave the tub if they have prolonged labor. However, when subtracting the women with induced labor and the ones with a labor dystocia diagnosis in both groups, there was still a difference in the use of oxytocin infusion and amniotomies. Some of the interventions could be explained by the more “hands on” approach when women use EDA but are still not in accordance with the guidelines (145). Water immersion may be favorable for women diagnosed with labor dystocia as seen in an RCT (64).

There are many reasons to limit the use of oxytocin intrapartum; a decreased endogenous oxytocin response during breastfeeding for women having EDA (118), an increased risk for postpartum depressions (146) as well as negative birth experience (23) have been observed. Overuse of oxytocin, meaning administration without labor dystocia, could perhaps be reduced if the woman is lying in the bathtub. The bathtub can create a barrier to unnecessary examinations and interventions, signaling normality. These circumstances were also described by the women as a feeling of being shielded and having a less clinical birth.

### **Childbirth experience**

Birth experience is a profound life event that affects the woman both in short and long term in aspects of well-being, self-esteem, the relation to the child and breastfeeding (18, 20, 25, 26). The concept of *empowerment*, which was the theme in **Study II** and closely related to the domain, “own capacity” in **Study IV**, is complex and defined in different ways in

literature (147, 148). Empowerment is about gaining power and increasing one's ability. It comes from within and is not something that is given by one person to another (11). Health professionals can create the prerequisites; encourage a person to become involved in their own care and decisions, but the birthing woman empowers herself (149). Related to self-efficacy, empowerment is a foundation which can increase self-efficacy (150). The domain, "own capacity" was rated significantly higher among women giving birth in water.

The women in **Study II** described a feeling of autonomy, confidence and "birthing by themselves" in the second stage of labor. In **Study IV**, there were higher ratings in the domain "own capacity" among women giving birth, in combination with a lower ranking in the domain "professional support" in the same group. This was somewhat surprising as the midwives assisting waterbirths exhibited enthusiasm in this "newly" available alternative. A strong correlation between caregiver support and women's satisfaction with childbirth has been shown in a systematic review (22), while the findings in **Study IV** show an inverse relationship. One interpretation is that women felt less dependent on the midwife, or that role of the midwife was less central when experiencing authority and empowerment. In **Study II**, women described synergy effects between body and mind obtained by contact with the warm water. In this way, both mental and physical relaxation contributed to pain relief, a feeling of control and coping with the contractions, without needing guidance from the midwife. There were also descriptions of a free-zone and a barrier where they could withdraw from the rest of the world. The domestic milieu of a bathtub gave a feeling less clinical and exposed as well as more private. The bathtub contributed to a birthing atmosphere that radiated calm, safety and control. A feeling of control has previously been found in qualitative studies of waterbirth (55-57).

The additional questions in **Study IV**, about second stage of labor, showed that waterbirth was associated with higher ratings of control, as well as lower ratings of pain, in the pushing phase and at the moment of birth. The experience of less pain is interesting as the comparison group included women having an EDA. In **Study IV**, the proportions of nulli- and multiparas differed between the groups and a stratification of parity was made. The CEQ was originally validated for nulliparas (134) and the results showed a tendency for nulliparous women to rate more benefits from waterbirth than multiparas. This was also the case regarding the additional questions about the second stage of labor. However, the stratification rendered the analysis underpowered to detect differences of medium size (151). Additionally, the inclusion rate for the conventional births in **Study IV** was low, and we do not know if the women included, differs from the total group of eligible women.



The point in time for assessing birth experience may influence the outcome (152, 153) and there is no gold standard for this. If measuring before the woman is discharged from hospital, she might refrain from criticizing the care and health professionals. This may be the case with the NRS in **Study I**, which is also a blunt tool which can imply different interpretations. It could also be challenging for the woman to separate the joy from having a healthy baby from the actual birth process (25). In **Study IV**, we chose to measure the birth experience six weeks postpartum, when women may find it easier to distinguish their own subjective experience from their perception of the care they received (154). There is a lack of studies comparing experience of waterbirth with conventional birth, using an objective instrument. The findings concerning the association of higher “Own capacity” among women giving birth in water in **Study IV**, were in line with a similar American study, yet less pronounced (59). A limitation in measuring birth experience among women having a waterbirth is the selected group, women who stay in the water are the ones who experience its benefits. An American study including 327 women, calculated how many of the women who initiated hydrotherapy discontinued before birth, finding that 9% left because they needed medical pain relief and 20.9% left because of complications, while the rest birthed in water (155). Another study observed that 48% of the 576 women who entered the waterbirth tub, exited the tub prior to birth, the most common reasons were maternal choice (50%) and medical indications (32%) (156). The study also found that women were more likely to continue labor in water if they had a care provider with more experience with waterbirths.

Satisfaction can to some extent relate to a patient's expectations and this group could have a more positive approach to childbirth (22). However, among the women in **Study I** and **IV**, a minority had expressed a wish for waterbirth in advance. To address a possible difference between women immersing during the first stage of labor and having a waterbirth, we could have interviewed women who left the tub for various reasons. Moreover, our plan was to subgroup women immersing during first stage of labor but not in the second stage in **Study IV**. However, the study sample was not large enough to achieve this.

### **Neonatal outcome**

The study population was too small to draw any firm conclusions about neonatal outcome. Nevertheless, neonatal outcome was described and compared as this is a crucial outcome, without which these studies would miss some importance. These results hopefully can be added to a meta-analysis in the future. According to the parameters; Apgar Score, admission to NICU, blood samples from the umbilical cord (n=55), temperature and breastfeeding within two hours postpartum, the outcomes in **Studies I** and **IV** did not indicate an increased morbidity among

babies born in water compared to conventional low-risk births (n=417 WB+410 CB). It is important to highlight the incidence of six umbilical cord ruptures. An increased risk is also seen in previous studies of waterbirth (68, 101), but not as high as the 1.4% seen in the present studies. The adverse consequences of a ruptured cord could be eliminated if the midwife is observant and clamps the cord immediately, but if not observed, the baby can develop anemia and require a blood transfusion (108). Further, an umbilical cord rupture entails an early cut of the umbilical cord for the babies who will miss the placental transfusion following a delayed cord cut (157).

Most studies on waterbirth are observational studies (81, 82), such as the cohorts in **Studies I and IV**, and the difficulties in selecting an equitable comparison group cannot be ignored. Even if the background characteristics did not differ between the groups, the frequency of meconium stained amniotic fluid was significantly higher in the group of conventional births in **Study I**. Hence, these women may often have been advised against, or to discontinue bathing. The difficulties in finding a correct denominator was demonstrated in an American retrospective cohort study including 6 534 waterbirths and 10 290 non-waterbirths. All women were at low risk and the births were divided into waterbirths, intended waterbirths and non-waterbirths. A significant lower 5-minute Apgar Score was found in the intended waterbirth group, but no differences were found in Apgar Scores between the groups of waterbirth and non-waterbirth (81). A higher frequency of admissions to NICU in the non-waterbirth group was observed in **Studies I and IV**, which may be explained by selection bias or possibly a type I error. However, systematic reviews and meta-analyses of waterbirth, conclude that risks are not increased for babies born in water in a low-risk population (5, 95, 96) and it is not always possible to perform an RCT (158).

There might be possible indirect benefits for babies born in water, due to a reduced need of EDA and oxytocin augmentation during labor (47, 64). Fentanyl and synthetic oxytocin intrapartum might have an effect on the babies' behavior, the mothers' lactation as well as onset and duration of breast feeding (159-162). A positive birth experience can connote a good start for the interaction between mother and baby, while a negative birth experience can interfere with the woman's ability to bond with her child (25). There is an association between EDA and birth by vacuum extraction (116, 117). This could mean that the use of vacuum extractions can be reduced with less use of EDA. Oxytocin stimulation can also entail a risk for hyperstimulation leading to adverse neonatal outcome (163).

In **Study III**, several potential risk factors for the baby were mentioned by both physicians and midwives, of which water aspiration and respiratory distress were the most common. A baby

born with intact membranes will physiologically have a “waterbirth” and thereby might run the risk of water aspiration, whereas no studies were found advising against this. However, amniotic fluid is isotonic, and an aspiration would not cause hyponatremia, which could be the case with fresh water. Hyponatremia was seen in one baby in **Study I** and has been the outcome in a few case reports of waterbirth (164). The risk of not following or having strict criteria for waterbirth was mentioned in **Study III**, since evidence is based on low-risk births. Infection was another risk frequently mentioned by health professionals in **Study III** but is not implied within systematic reviews (5, 95, 96), even if case reports do exist.

### **Attitudes to waterbirth and maternity care**

In the middle of the 20<sup>th</sup> century, childbirth was institutionalized and located in hospitals in most Western countries, and the biomedical view became authoritative knowledge. This entailed that knowledge about, and the management of, giving birth were transferred from women to the expertise, making it a medical issue (165). Maternity care changed from a social, to a medical model where risk assessment became a prominent function (120). Ideally, risk assessment can be supportive for women with low-risk pregnancies and births and at the same time preventive for women with higher risks. However, it is important to avoid over-monitoring, which instead could make women lose confidence in their abilities to birth naturally (120). Waterbirth can be regarded as a symbolic issue, demonstrating the tension between the medical view of childbirth and the view of childbirth as a natural and significant life event. As the medical perspective on childbirth is accepted as superior and authoritative, it may devalue other views (165), which may explain the skepticism towards waterbirth in Sweden.

*Clinical decision making* is a multidimensional process of prioritizing and individualizing care in collaboration with the patient and caregivers (166). It relies on the “verbal, visual and intuitive information available to the practitioner and the way this is interpreted by that individual”(120). The assessment of risk is to some extent based on human judgment and is therefore both subjective and objective. In maternity care, clinical decision making could connote difficulties in separating objective and subjective risks (120). Health professionals in maternity care ought to create opportunities for a woman to make informed decisions for herself, her baby and her family, based on scientific evidence, experience and knowledge (16).

A recurring argument from midwives and some physicians in **Study III** were referred to women’s right to have a choice. In Sweden there are few choices with regard to childbirth. No freestanding birth centers or alongside midwifery units exist and the possibilities of having a

home birth are considerably limited. To provide woman-centered care is to share decision making, individualizing and giving care that is optimal for one woman in a specific situation (12, 16). Waterbirth might, for some women opting for a natural birth, be an alternative within hospital care where normal births can be exposed to an overuse of augmentation as seen in **Studies I and IV** as well as in previous studies (143, 167).

Waterbirth is an option limited to women with low-risk births, although, by providing waterbirths at some clinics, midwives may be reminded of the normality of low-risk births, which ideally can decrease unnecessary interventions by following existing guidelines. In **Study III**, midwives advocating waterbirth took the view that it is a natural way of giving birth, while physicians disapprovingly described waterbirth as unnatural. Midwives have formerly described assisting in waterbirth as something that contributes to a calm, peaceful and more “instinctive birthing”, which is empowering and helps to create a “woman-centred atmosphere” (168).

In **Study III**, we found that opinions about waterbirth in Sweden, to a large extent, seem to be based on subjective attitudes that are secondary to knowledge and evidence. An attitude is based on emotions more than rationality and is a predisposition that influences behavior (121). If we selectively expose ourselves to information that fits our standpoint, this can lead to confirmation bias (122). An ethnographic study from Australia comparing information for parents and policies about EDA and waterbirth showed that evidence concerning waterbirth was interpreted in a more risk-orientated way while the risks of EDA were presented more diffusely (169). One example is the recurrent argument of the risk of water emboli if the placenta is delivered in water, which also was mentioned in **Study III**. However, this risk is theoretical and no cases of this are to be found in the literature (47, 170).

A need for knowledge and education in managing waterbirth was expressed by many midwives and physicians in **Study III**. It is important that midwives feel confident and competent when carrying out their duties. Introduction by an experienced colleague as well as training was mentioned as a condition for assisting in waterbirths. This highlights the necessity of satisfying health professionals’ demands for education to be able to meet women’s requests for giving birth in water.

The goal for all midwives and obstetricians ought to be to provide the best possible care for birthing women, where both safety and birth experience are in focus. Ideally, there is no contraposition between safety and a positive birth experience, where one of them diminishes

the other. Research, knowledge, experience and individualized care are ways to achieve optimized care.

## 8 METHODOLOGICAL CONSIDERATIONS

To address the various aims of the studies, both quantitative and qualitative methods were used together with different types of instruments. To reach the aim of comparing clinical outcomes between waterbirths and conventional births, the first idea was to conduct a Randomized Controlled Study (RCT), which is highly requested in the field of waterbirth (171). An RCT is considered to provide the highest degree of evidence as it has good internal validity and avoids unknown confounders (172). However, we concluded that an RCT would be unethical, time consuming and with potentially large drop outs. This could lead to attrition bias - a systematic difference between people who leave the study and those who continue (173). To randomize to waterbirth, which is something that relies on the woman's active participation, and which in turn is influenced by her preferences, might also affect the outcome (158). The cohort studies included are observational, consequently associations are studied and not causations (127).

### 8.1 BIAS

**Bias** is a systematic error that to some degree is almost always present in a study. Bias can occur at any phase of research, from the study design to the data analysis and publication. (172).

#### **Selection bias**

There were challenges in finding an equitable comparison group for the cohorts in **Studies I** and **IV**. Even if there are no evident differences in the background characteristics between the waterbirth and the comparison groups, there may be differences not detected in the birth records and ones appearing during labor that are not taken into account (127). Women choosing a waterbirth may differ from those who do not, even if the majority of the women in these studies did not aim for a waterbirth in prior to labor. This is a strength compared to other studies with a more selected group of women striving for a natural birth. In **Study IV**, midwives were told to include low risk-women regardless if they were interested in immersing in water, but they only included a small sample since they forgot or did not prioritize the study when they had a high workload. We have no information about the group of women eligible but not prompted to participate. A baseline measurement of low-risk women would have made it possible to find eventual differences between the baseline, the waterbirth group and the comparison group.

Women with induced labor or labor dystocia were not excluded in **Study I**, since women with these conditions existed in the waterbirth group. This resulted in higher numbers of these diagnoses in the comparison group which made the groups differ. A matching with these conditions could have been a way to diminish the differences but would have been time-consuming and difficult to do perform equivalently. Instead, adjustments for the duration of pushing and oxytocin was made when calculating the odds ratio for the primary outcome - perineal tears of second degree.

## 8.2 CONFOUNDER

A simple definition of a confounder is: a factor that disturbs or confuses the effects of both the exposure and the outcome (127). When calculating OR for second-degree perineal tears in **Study I**, we adjusted for oxytocin stimulation and duration of active pushing in the multivariate regression model. Instead of adjusting for babies' birth weight >4000g, we adjusted for head circumference >36 cm of the baby. The reason for this was a slight difference regarding head circumference between the waterbirth group and the comparison group, whereas birth weight >4 000 gram gave the same results. A large baby could mean less likelihood of a waterbirth as labor dystocia and need for EDA are more common in these births (174, 175).

## 8.3 INFORMATION BIAS

If the information collected about the subjects is incorrect, a systemic information bias can appear (127). In **Study I**, there is a potential risk that midwives do not classify perineal tears correctly. But in this case, the misclassification probably is non differential as it is related to the outcome and not the exposure. The same midwives were classifying perineal tears in both the waterbirth group and the comparison group. Thus, it is reasonable to assume that it was done in the same way. Additionally, the midwives were not aware of the study and the primary outcome of perineal tears as this was a retrospective study. There is a risk that the information in the birth records is interpreted wrongly, therefore data were left out when the information regarding the severity of tear was unclear.

## 8.4 SELF-SELECTION BIAS

Self-administrated surveys have a high risk of selection bias due to self-selection, which means that the study group differs from the population intended to study. **Study III** is an exploratory study, aiming to explore an unknown subject (176). Respondents completing the survey might have more interest in, or strong opinions about waterbirth than those who did not respond. However, there is still a large group of responses in the middle of the Likert scale and from professionals without experience or knowledge. It is possible that this group is under-represented, and that the findings may be more polarized than in reality. **Study III** has many respondents but a low response rate, the actual rate is unknown as there were reports of many questionnaires ending up in the e-mail junk box. There is also uncertainty about the accuracy in the reports of numbers of forwarded questionnaires made by the Heads of Departments.

In **Study IV**, we do not know the reasons for the women (32%) not returning the CEQ. According to the clinical outcomes, there is nothing that distinguishes them from the respondents. However, we know nothing about their birth experience as we did not retrieve the NRS-score in the birth records. More women in the group of conventional births did not return the questionnaire. As the study was called, “The waterbirth study” they might have gained the impression that their participation was less important and therefore may have been less inclined to respond.

## 8.5 VALIDITY

**Internal validity** refers to how well a study measures what it was set out to measure and is influenced by bias and confounding. Through validation, instruments are tested to ensure that they assess parameters they are intended to measure, thus increasing the internal validity (134, 177). In **Study III**, a non-validated questionnaire was used while CEQ in **Study IV** has been validated. In **Study III**, we are not claiming to have used a psychometric measurement but have only described responses to specific questions with an exploratory approach. The questions were pilot tested on 11 midwives and physicians to be able to adjust eventual ambiguities in the wording.

Regarding **external validity**, the outcome of **Studies I** and **IV** can only be generalized to other settings providing waterbirth to a low-risk population providing a similar type of care. The



management of the second stage of labor may differ between clinics and countries, which could influence the outcome and make it difficult to generalize (61, 178). The support given during labor may also be a factor influencing the birth experience, and the results are at first and foremost applicable to similar settings. The findings in **Study III** are specific to Sweden and cannot be generalized. However, the results may still be of interest outside Sweden as the views and perceptions of waterbirth also are debated in other countries (92, 179, 180).

## 8.6 RELIABILITY

In both **Studies III** and **IV**, a Likert scale was used; in **Study III** a five-point scale, and in **Study IV** a four point scale. In social science, surveys of people's attitudes are frequent, and the Likert scale is a psychometric scale often used (126, 181). A Likert scale is a bipolar scaling method with positive and negative statements. The numbers of options on the scale can differ; an even-point scale forces the respondent to choose between positive and negative (used in **Study IV**), while a middle option in a 5-point Likert scale enables a neutral opinion (used in **Study III**) (182, 183). The numbers of scale categories can affect reliability, which can drop if few scale categories are used while too many can instead cause difficulties in discriminating for the respondents (184).

Cronbach's alpha was tested in **Study IV** to test the reliability by calculating internal consistency. The results showed good internal consistency ( $\alpha = 0.71-0.85$ ) between the items in all domains except for "participation" which was poor ( $\alpha < 0.5$ ). This domain consisted of only three items and have also showed lower consistency in previous studies (134).

## 8.7 TRUSTWORTHINESS IN QUALITATIVE STUDIES

There is an ongoing discussion as to whether or not the concepts of reliability and validity should be used in qualitative research. (185). The term **credibility**, which describes how well data and analyses address the intended aim and give a comprehensive picture of the phenomena, is often used instead of internal validity. The number of 20 interviews was chosen to be able to obtain a multifaceted picture (186). The sample was consecutive and not purposive, but the women still had varied background in terms of education, age, housing,

parity and two of them were foreign born. All gave birth at the same clinic in Stockholm which could indicate a selected group. However, some were referred from other clinics due to a heavy workload.

To achieve credibility, the findings should represent information in accordance with the participants' original views (187, 188). Selecting suitable meaning units and coding are crucial for the outcome, and the original transcripts were referred to several times in order to maintain the validity of the text. Examples of the process of identifying meaning units, condensing and coding them are included in the article for the readers to gain an understanding of the analytic process. The analyses were made by one person (HU) and the findings were discussed afterwards within the research group. The benefits of one or more persons analyzing data are discussed in the literature. It could be regarded as a strength to include more than one person's perspective. However, reaching a consensus is not a confirmation of reliability as the results can be affected by the group dynamics (129, 189, 190).

**Transferability** is the concept often used for generalizability or external validity in qualitative studies. The findings in **Study II** might be transferred to other women in similar settings where waterbirth is offered to low risk women. The care provided, as well as the milieu and design of the birthing pool, can influence the experience of waterbirth but there is no reason to believe that Swedish women differ from other women in Western countries in their experience of birthing in water. However, the lack of information and knowledge about the opportunity of giving birth in water prior to labor, may in some way have affected these women's experience. Some reported that they thought it was forbidden and most of them were not striving for a birth without medical anesthesia.

**Dependability** refers to whether the data collection and analysis change over time during the process. The interviews were conducted by two persons, which might affect the consistency. The interview guide was used as a support to help the interviewers stay close to the aim, although the interviews were more like conversations. Follow-up questions were probably used more frequently during the latter of the 14 +6 interviews, but the analysis was made after all data had been collected.

**Reflexivity** needs to be maintained during the research process. When analyzing, it is important to be aware of previous experience, preconceptions and understanding of the phenomena. Already, by choosing subjects and methods to investigate, the researchers' background has an influence (190). This awareness might apply to all research, not only qualitative. However, according to Krippendorff, familiarity is necessary for capturing

important nuances of the underlying meaning that otherwise would be lost (129). Experience of many years working at a birthing unit using water immersion in the first stage of labor, but without personal experience of assisting a waterbirth brought a neutral curiosity to the project. Waterbirth was not mentioned during midwife education in the year 2000 and was a topic seldom discussed at clinics without mentioning the incident that had taken place in 1993.

## 9 CONCLUSIONS AND IMPLICATIONS

Waterbirth could be an alternative for women requesting a more natural birth in hospitals and a way to normalize low-risk births by reducing un-necessary interventions. There was a slightly lower frequency of second-degree perineal tears among waterbirths compared to conventional births. This information may be of importance to women considering having a waterbirth, and the results can be added to future meta-analyses for more robust conclusions. Women who gave birth in water felt empowered and experienced a feeling of control, confidence and coping as well as a feeling of homeliness and privacy. Waterbirth may be a way to increase one's own capacity and self-efficacy in childbirth. The benefits of pain relief and increased control seemed to continue through the second stage of labor.

Except for umbilical cord rupture, no other increased risk for the babies was detected, but the studies are underpowered to draw any firm conclusions regarding neonatal outcome.

Health professionals are requesting education and an introduction to waterbirth to be able to meet the women's requests for waterbirth. Lack of knowledge and subjective opinions among health professionals may affect the advice given to prospective parents seeking information about waterbirth. By highlighting the topic of waterbirth and contributing a small piece of evidence to the puzzle, the first in Swedish context, this thesis may contribute to making the discussions in Sweden more evidence based as well as improving the information and choices given to families.

## 10 FUTURE RESEARCH

A study describing the management of perineal protection in waterbirth would add valuable knowledge.

We found that waterbirth was associated with fewer interventions. An RCT with women diagnosed with labor dystocia, randomized to water immersion during the first stage of labor or standard care (augmentation with oxytocin), would give more information regarding this outcome.

Assessing neuroendocrine biomarkers on the baby in the umbilical cord at birth would add more knowledge about the state of health of babies born in water.

The knowledge of the importance of the human microbiome is growing. It would be interesting to explore if a waterbirth influences the transfer of microbes that occurs from mother to baby during a vaginal birth.

## 11 POPULÄRVETENSKAPLIG SAMMANFATTNING

Vattenfödsel, vilket innebär att kvinnan befinner sig i vatten och föder fram barnet under vattenytan, erbjuds till kvinnor med lågriskförlossningar i våra nordiska grannländer och i ett hundratal länder runtom i världen. En lågriskförlossning brukar definieras som en förlossning där kvinnan är frisk och har haft en okomplicerad graviditet med en förlossningsstart i fullgången tid, det vill säga i graviditetsvecka 37+0 till 41+6. Barnet ska också ligga i huvudbjudning. Om komplikationer skulle tillstöta under förlossningen avråds kvinnan från att föda i vatten.

I Sverige har vattenfödsel inte erbjudits på sjukhus under de senaste decennierna vilket gör att erfarenhet hos vårdpersonalen kring denna vårdform är begränsad. Det pågår diskussioner i Sverige, men även på andra håll i världen, huruvida vattenfödsel skulle innebära ökade risker för barnet. Idag finns en efterfrågan från kvinnor i Sverige att få föda i vatten. Kännedom om vårdalternativet sprids genom kvinnor som delar berättelser om vattenfödslar på internet och från kvinnor som flyttar till Sverige med denna erfarenhet.

Syftet med denna avhandling var att utvärdera vattenfödsel i svensk kontext. I de olika delstudierna jämfördes vattenfödslar med konventionella födslar bland annat vad gäller bristningar, förlossningsingrepp såsom värkstimulering och hinnsprängning (att ta håll på fosterhinnorna så att vattnet går), barnets välbefinnande vid födseln samt kvinnornas förlossningsupplevelse. För att få djupare kunskap om hur kvinnor upplevde det att föda i vatten gjordes även intervjuer där de fick beskriva sina upplevelser och erfarenheter. Vidare undersöktes vårdpersonalens erfarenhet, kunskap och attityder kring vattenfödsel.

Vid jämförelsen mellan vattenfödslar och vanliga okomplicerade födslar framkom att antalet mellanstora bristningar (grad II bristningar) som innefattar muskler i mellangården men inte ändtarmsmuskeln, var något var något lägre bland kvinnorna som födde i vatten. Detta stämmer överens med flera utländska studier på området. Barnmorskan har inte alltid samma uppsikt över mellangården när framfödandet sker i vatten men värmen kan vara gynnsamt för elasticiteten i vävnaden. Den avslappning som vattnet kan medföra för kvinnan kan också vara fördelaktig.

Resultatet vid jämförelsen mellan vattenfödslar och vanliga okomplicerade födslar var att användandet av värkstimulerande dropp och hinnsprängning utfördes i mindre utsträckning bland de som födde i vatten. I de genomförda studierna med sammanlagt 827 barn sågs ingen skillnad vad gäller barnets välmående avseende Apgarpoäng, vilket är en bedömning av barnets vitalitet under de första levnadsminuterna, behov av andningsstöd, överflyttning till nyföddhetsavdelning eller barnets temperatur. Dock visade det sig att navelsträngen oftare gick av i samband med barnets födelse när barnet föddes i vatten. Detta kan innebära en risk för barnet om inte barnmorskan omedelbart klämmer åt navelsträngen. De genomförda

studierna är för små för att slutsatser vad gäller barnet ska kunna dras, men de överensstämmer med utländska meta-analyser vilka inte heller påvisat skillnader mellan vattenfödda barn och de som inte fötts i vatten.

I en enkät som mäter förlossningsupplevelsen angav kvinnorna som födde i vatten en högre grad av upplevd ”egen kapacitet” jämfört med de som inte födde i vatten. Samtidigt skattade kvinnorna som födde i vatten sin barnmorskas stöd något lägre, vilket kan tolkas som att de upplevde barnmorskans roll mindre central när de kände sig stärkta i sin egen förmåga att föda. Kvinnorna som födde i vatten skattade även en högre känsla av kontroll och lägre nivå av smärta vid barnets framfödande.

Kvinnorna som intervjuades beskrev förutom en känsla av smärtlindring och avslappning, en upplevelse av vara stärkta och självständiga under födandet och att vattnet bidrog till trygghet och möjlighet till att skärma av omvärlden. Att ligga i ett badkar gjorde också upplevelsen mer hemlik och mindre klinisk och förlossningen beskrevs som naturlig.

För att undersöka vårdpersonalens erfarenhet, kunskap och inställning till vattenfödelse utformades en enkät som skickades ut via mejl till barnmorskor, förlossningsläkare/gynekologer och barnläkare. Svaren visade att barnmorskor hade större erfarenhet av, och kunskap om, vattenfödelse än läkare och att de ofta fått den erfarenheten vid tjänstgöring utomlands. Barnmorskorna skattade mer fördelar och mindre risker för både kvinna och barn vid vattenfödelse än läkarna. Bland läkarna ville majoriteten inte att vattenfödelse ska erbjudas i Sverige medan majoriteten av barnmorskorna vill att det ska erbjudas. Många barnmorskor angav att de först ville ha introduktion och kunskap, innan de själva ville handlägga en vattenfödelse.

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