Posterior Perineal Injuries

Midwives' Management and Experiences of the Second Stage of Labour in Relation to Perineal Outcome

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Cover illustration: Birth Art by Damien Legget

To Stefan, Ebba, Julius, Otto, Ville

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ABSTRACT

Women commonly sustain some form of perineal and vaginal injury when giving birth. Posterior perineal injuries have short- and long-term consequences for women which may lead to reduced quality of life.

AIM: The aim of this thesis was to investigate midwives' management and experiences of the second stage of labour in relation to perineal injuries of different severity. Furthermore, the aim was to evaluate whether an intervention based on woman-centred care reduces second-degree tears in primiparous women.

METHODS: Study I, a population-based cohort study of planned home births in four Nordic countries (n=2992). The aim was to assess whether birth positions with flexibility in the sacro-iliac joints defined as flexible- or non-flexible sacrum positions were associated with perineal trauma. To explore midwives' experiences of a birth where the woman sustains severe perineal trauma (**study II**), in-depth interviews were conducted with 13 midwives. A phenomenological reflective lifeworld design was used. **Study III** is an experimental intervention study using a cohort design to reduce second-degree tears, in which 597 primiparous women participated. A multifactorial intervention consisting of 1) spontaneous pushing, 2) flexible sacrum positions, and 3) a two-step head-to-body birth was compared to standard care. **Study IV** explores the relationship between directed practices used during the second stage of labour and perineal trauma, using data from 704 primiparous women participating in the intervention study. For the quantitative studies **(I, III, IV)** bivariate analysis and multivariable logistic regression adjusting for risk factors were used to analyze the data.

RESULTS: The majority (65.2%) of women in **Study I** gave birth in flexible sacrum positions and these positions were not associated with severe perineal trauma. The experience of being a midwife when the woman sustains severe perineal trauma (**Study II**) was expressed as being caught between an accepted truth and a more complex belief. The accepted truth is that a skilled midwife can prevent severe perineal trauma while the more complex belief suggests that these injuries cannot always be avoided. Balancing between the two created a deadlock for the midwives which was difficult to resolve. The results from **Study III** showed that fewer women in the intervention group sustained a second-degree tear. The intervention remained protective even after adjusting for potential confounders and known risk factors (adj. OR 0.53; CI 95% 0.33–0.84). The most common practices used in **Study IV** were directed pushing (57.1%) and digital stretching of the vagina (29.8%). None of the practices used were associated with perineal trauma.

CONCLUSIONS: Flexible sacrum positions were not associated with severe perineal trauma in the home birth setting. A multifactorial woman-centered intervention reduced second-degree tears in primiparous women and was possible to implement without having negative side effects for women and their babies. Moreover, the directed practices midwives use during the second stage of labour were not associated with perineal trauma. Midwives experience various conflicting emotions when the woman suffers severe perineal trauma.

SAMMANFATTNING PÅ SVENSKA

Bakgrund: Skador på ändtarmsmuskeln i samband med förlossning kan orsaka problem för kvinnan lång tid efter barnets födelse. Läkningsprocessen är smärtsam och skadan kan ge upphov till samlagssmärtor, gas- och avföringsläckage. Även mindre perineala och vaginala bristningar (bristningar grad II) kan påverka kvinnors liv genom symtom som tarmtömningssvårigheter och på sikt även prolaps.

Syfte: Det övergripande syftet med den här avhandlingen är att belysa barnmorskors handläggning och upplevelse av utdrivningsskedet i relation till förlossningsbristningar av olika omfattning, samt att undersöka om en intervention under utdrivningsskedet kan påverka förekomsten av bristningar grad II.

Metod: Studie I är en populationsbaserad kohortstudie där kvinnor från Sverige, Norge, Danmark och Island som planerat att föda sitt barn i hemmet inkluderades. Förlossningsställningar som ökar flexibiliteten i bäckenet analyserades i förhållande till förlossningsbristningar samt klipp. I **Studie II** undersöktes barnmorskans upplevelse då hon bistått en födsel där kvinnan fått en skada som omfattar ändtarmsmuskulaturen. Djupintervjuer med 13 barnmorskor genomfördes och analyserades med hjälp av fenomenologisk livsvärldsansats. **Studie III** är en interventionsstudie med syfte att minska andel bristningar grad II hos förstföderskor. En multifaktoriell intervention med teoretisk förankring i kvinnocentrerad vård jämfördes med standardvård på två förlossningsavdelningar. Interventionen består av 1) spontan krystning, 2) förlossningsställningar som möjliggör flexibilitet i bäckenet samt 3) kvinnan föder fram barnets huvud i slutet på en värk och barnets kropp på nästkommande värk. I **Studie IV** beskrivs metoder som barnmorskor använder under förlossningens utdrivningsskede för att åstadkomma spontan vaginal förlossning och huruvida dessa metoder har något samband med olika typer av bristningar. Data från baslinjemätningen samt från kontrollgruppen i interventionsstudien analyserades. Till delstudierna **I, III** och **IV** har deskriptiv statistik, bivariat analys, och multivariat logistisk regressionsanalys använts.

Resultat: Av de 2992 kvinnor som planerat att föda sitt barn hemma använde en majoritet (65.2%) förlossningsställningar som ökar flexibiliteten i bäckenet (**Studie I**). Förekomsten av bristningar som omfattar ändtarmsmuskeln var 0.7% och förekomsten av klipp var 1.0%. Förlossningsställningar med ökad flexibilitet i bäckenet gav inte upphov till fler skador på ändtarmsmuskeln.

Studie II visar att när kvinnan drabbas av en bristning som omfattar ändtarmsmuskeln när hon föder barn påverkas även barnmorskan. Barnmorskan försöker förhålla sig till en inom yrkeskåren uttryckt sanning som innebär att barnmorskan genom en skicklig handläggning kan undvika att en skada uppstår. Samtidigt med denna sanning framträder en mer komplex bild som innebär att en sfinkterskada inte alltid kan undvikas oavsett agerande under utdrivningsskedet. Att samtidigt förhålla sig till dessa motstridiga sanningar kan medföra en låsning som är svår att ta sig ur. Barnmorskorna upplevde skuld och ifrågasatte även sin yrkesskicklighet. Ett sätt att hantera dessa känslor var att hitta en giltig anledning till att skadan skedde. En rädsla för att dömas av andra lika hårt som man dömde sig själv gjorde det svårare att våga öppna sig och reflektera kring det som skett med kollegor.

I interventionsstudien (**Studie III**) deltog totalt 597 förstföderskor, 296 i interventionsgruppen och 301 i kontrollgruppen. Den multifaktoriella interventionen ledde till en minskad förekomst av skador grad II utan ökad förekomst av klipp. Den skyddande effekten av interventionen kvarstod även efter justering för skillnader mellan grupperna samt riskfaktorer för bristning (adj. OR 0.53, 95% CI 0.33-0.84).

I **Studie IV** analyserades data från 704 förstföderskor. Aktiva och forcerade krystmetoder orsakade inte fler bristningar, utan var associerade med epidural användning och längd på krystskedet. De vanligaste metoderna som barnmorskor använde under utdrivningsskedet var aktiv krystning (57.1%) och levatorpress (29.8%). Metoderna användes oftast när kvinnan födde i halvsittande eller i gynläge. Förekomsten av klipp var (3.1%) och gjordes i första hand då barnmorskan bedömde mellangården som stram, hög eller oeftergivlig, inte på fetal indikation.

Slutsatser: Förlossningsställningar som ökar flexibiliteten i bäckenet leder inte till ökad förekomst av bristningar. Den multifaktoriella interventionen minskade förekomsten av grad II bristningar hos förstföderskor. De metoder som barnmorskor använder i utdrivningsskedet var inte associerade med vare sig bristningar grad II eller sfinkterskador. Att bistå vid en födsel där kvinnan fick en sfinkterskada gav upphov till motstridiga känslor hos barnmorskan. Känslor av skuld, skam och den vacklande tron på den egna yrkesskickligheten upplevdes svåra att dela med andra barnmorskor.

Implikationer: Förlossningsställningar med ökad flexibilitet i bäckenet kan rekommenderas. Barnmorskor bör hjälpa kvinnor att under utdrivningsskedet undersöka vilken förlossningsställning som passar den enskilda kvinnan bäst. Den multifaktoriella interventionen kan implementeras för att minska

bristningar grad II hos förstföderskor. Även om de metoder barnmorskor använder i utdrivningsskedet inte var associerade med bristningar så kan en del av dem betraktas som invasiva. De bör därför inte användas rutinmässigt. Det är viktigt att skapa en trygg arbetsmiljö där barnmorskor vågar ta upp och reflektera kring sina upplevelser. Barnmorskor behöver avsatt tid för reflektion för att kunna gå vidare med ökad professionell kunskap efter att ha bistått vid en födsel där kvinnan får en omfattande bristning.

LIST OF PAPERS

This thesis is based on the following papers, referred to in the text by their Roman numerals.

I. Edqvist M, Blix E, Hegaard H.K, Ólafsdottir O.A, Hildingsson I, Ingversen K, Mollberg M, Lindgren H. Perineal injuries and birth positions among 2992 women with a low risk pregnancy who opted for a home birth. BMC Pregnancy and Childbirth. 2016;16(1):196.

II. Edqvist M, Lindgren H, Lundgren I. Midwives' lived experience of a birth where the woman suffers an obstetric anal sphincter injury – a phenomenological study. BMC Pregnancy and Childbirth. 2014;14:258.

III. Edqvist M, Hildingsson I, Mollberg M, Lundgren I, Lindgren H. Midwives' Management during the Second stage of Labor in Relation to Second-Degree Tears – An Experimental Study. Birth. 2016 44(1):86-94.

IV. Edqvist M, Rådestad I, Mollberg M, Lindgren H. Directive, Supportive or both – Practices used by Midwives during the Second Stage of Labor to Facilitate Birth. *Manuscript.*

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CONTENT

1 INTRODUCTION

Most women, especially first-time mothers, sustain perineal or vaginal injuries to some extent when giving birth. Research has mainly focused on severe perineal trauma affecting the anal sphincter muscle, because of the detrimental effects on women. There is considerable knowledge regarding risk factors for severe perineal trauma, how it can affect women and women's experiences of sustaining severe perineal trauma. However less severe injuries that involve the rectovaginal fascia and the muscles in the perineal body also affect women's wellbeing. Despite efforts in evaluating preventive strategies, gaps in knowledge still exist (1).

1.1 Woman-centred care during the second stage and its relation to perineal injuries

Regardless of the type of midwife or birth setting, all midwifery philosophies reflect the concept of being with women during childbirth (2). According to the ICM (International Confederation of Midwives) standards midwifery care is based on the philosophy that childbearing is a profound experience for the woman, her partner, and her family. Midwifery care takes place in partnership with women, recognizing the woman's right to self-determination, and is respectful, personalized and non-authoritarian (3). Important values include establishing a reciprocal relationship and viewing the woman as a genuine subject (4). Although the principles of care throughout labour remain as a continuum, during the second stage of labour women often become more vulnerable and dependent on the influence of the midwife, so the need for support and encouragement is enhanced (5-7). The midwife plays an important role in either supporting or undermining the experience. When the midwife succeeds in the support it is described by women as feeling secure enough to let go (6). This part can be considered the most demanding part of the labour process for the midwife as she is responsible for both the care of the mother and the unborn baby (7). As of yet, there is no causal relationship between woman-centred care and prevention of perineal trauma, but certain care actions during the second stage can be considered woman-centred and are recommended (8). Walsh (2012) argues for the principle of "first do no harm". When applied to the second stage this principle means that childbirth professionals need to prove that practices used during the second stage are superior to women's own physiological second-stage behaviours (9).

Woman-centred care during the second stage of labour is characterized by providing the woman with information, finding out what her preferences are, encouraging her to push according to her own sensation, using an upright birth position according to her choice, and gently guiding her if necessary during the crowning of the baby (5, 6, 8, 10). However, if care actions are used routinely they might be disempowering and cannot be considered woman-centered. The key features of woman-centred care such as individualized care and continuous support during labour and birth appear more difficult to achieve in the hospital setting than in alternative settings (11-13). Directed pushing or supine positions for birth are still used, although there is little scientific evidence that these techniques are beneficial as preventive strategies for perineal trauma (14-16).

1.2   Organization of childbirth in Sweden

In Sweden, care during pregnancy and childbirth is provided by the government without charge for its citizens (17). Midwives are the primary care givers during pregnancy and labour, even though they work in close collaboration with obstetricians or gynaecologists. They handle uncomplicated births independently, while obstetricians are responsible for complicated deliveries, such as assisted vaginal deliveries, and for suturing severe perineal trauma. In Sweden, women give birth in obstetrician-led maternity wards in hospitals and there are no along-side midwifery units, freestanding birth centres, or case-load midwifery practices at the moment. This means that there is no continuity of care for women during pregnancy, childbirth, and the postnatal period. Home birth is only available for multiparous women living in the Stockholm County or in one municipality in northern Sweden. In the rest of Sweden, the pregnant woman has to find a midwife willing to assist her and pay for the service herself (18). Therefore, the prevalence of planned home births is low (0.1%) compared to Denmark and Iceland where 1–2% give birth at home (18).

National statistics from 2014 show that 74.7% of Swedish women gave birth spontaneously, 17.7% had a caesarean section, and 7.6% had an assisted vaginal delivery. Of those who gave birth vaginally, 3.4% sustained severe perineal trauma and the corresponding rate for first-time (primiparous) mothers was 6.0%. Epidural analgesia was used by 52.7% of the primiparous women and 11.3% had an episiotomy (19). However, there are differences in outcomes for women not only between different regions in Sweden but also between different hospitals. There are differences in caesarean section rates,

severe perineal trauma, interventions used such as epidural analgesia, oxytocin use, and episiotomy and these differences remain even after case-mix adjustments (19, 20). Vaginal injuries or second-degree tears are not registered in the Swedish Birth register. In the future it is hoped that maternity wards will report on second-degree tears as well as severe perineal trauma (21).

1.3   Second stage of labour and midwifery metods used

The second stage of labour is defined as the duration from complete cervical dilation until the birth of the baby (22). It commences when the woman's cervix is fully dilated with or without the urge to bear down (23). The second stage is further divided into the passive second stage and active second stage. The passive second stage is defined as descent of the fetal head in the absence of involuntary expulsive contractions (23). The onset of the active second stage starts when the woman either has an urge to bear down in combination with full dilatation or when the presenting part has descended to the perineum and is visible (23, 24). For women, the division of different stages of labour may not reflect how labour is perceived (9). The urge to bear down may or may not coincide with complete dilation and women often express an urge to bear down before the cervix is fully dilated (5).

The reason for restricting the duration of the second stage originates from research showing adverse maternal and neonatal outcomes for women with a prolonged second stage (22, 25, 26). However, a specific absolute maximum duration of the second stage after which all women should undergo operative delivery has not been identified (27). Proposed time limits are four hours of complete dilation, two hours of active second stage (7), or three hours of active pushing in nulliparous women, (23, 27), and longer duration may be appropriate on individualized basis – i.e., use of epidural analgesia or with fetal malposition as long as progress is documented (27).

Management of the second stage often follows traditions described by Hunter (2004) as being with the institution (12) rather than providing evidence-based care (7). Physiologically, the maternal bearing-down efforts are most often short, with several short pushes per contraction. They are accompanied by the release of air and grunting, but in some cases by brief periods of breath holding (28). Directed pushing or the Valsalva technique is a common technique where the woman is encouraged to take a deep breath at the beginning of the contraction, to hold this breath and to push as long and hard

as she can in synchrony with her contractions (29). The technique was introduced with the aim of shortening the second stage of labour in the belief that this would benefit the mother and the baby. Directed pushing has been suggested to increase perineal injuries and pelvic floor impairment (24). As epidural analgesia weakens the desire to push and prolongs the second stage (30), midwives recognize the use of epidural analgesia as one reason for conducting directed pushing (31). Proposed disadvantages with the use of directed pushing are higher rates of fetal acidosis, maternal exhaustion, and pelvic floor impairment (32, 33); however the evidence for either method is still inconclusive (24, 29). Few studies have evaluated women's preferences, but women allocated to spontaneous pushing in one study expressed more satisfaction and less fatigue and discomfort (33).

There are several practices that midwives use in combination with directed pushing to enhance maternal bearing-down efforts and to assess progress during the second stage: digital stretching of the vagina or perineum (often referred to as levator pressure in Sweden), vaginal examinations where pressure is applied to the spinae ischiadica to stimulate the Fergusons's reflex, and stretching of the perineum (9, 34, 35). Stretching of the perineum is done either to prevent perineal injuries or to manually relax a rigid or tight perineum. In addition, there are two other known approaches: the towel-trick (also called as the Norwegian knot) and the manipulation of the symphysis pubis. The towel-trick can be described as a tug-of-war match between the midwife and the woman (who usually adopts the lithotomy or sitting position), where they are pulling a sheet in opposite directions during contractions. This method is used as an alternative to a rope or a birth sling for bearing down when the sling is not available in the birthing room or if the woman is too tired. The manipulation of the symphysis pubis is used when it is difficult for the baby's head to pass under the symphysis pubis. The midwife inserts her fingers in the vagina under the pubic arch and presses upwards during one or several contractions.

To our knowledge there are no written sources regarding these two practices, but the manipulation of the symphysis pubis might have been termed something different. The towel-trick is described by women telling their birthing stories on the internet. There is no evidence so far that these approaches are associated with perineal trauma although anecdotal evidence suggests that levator pressure and massage of the vagina may contribute to or cause perineal injuries (36). Fundal pressure is a procedure defined as manual pressure on the fundus of the uterus towards the birth canal to expedite the birth of the baby and to avoid prolonged second stage or assisted vaginal delivery (37), but this method is not recommended as it has been associated with severe perineal trauma (8, 38).

1.4 Anatomy of the pelvic floor

The anatomy of female pelvic floor is complex. During the second stage of labour damage to the pelvic floor, its muscles and nerves, and the endopelvic fascia may occur due to compression, ischemia, and stretch (39). The bladder, vagina and rectum are attached to the pelvic walls by a network of connective tissue fibre that is collectively called the endopelvic fascia. The pelvic diaphragm is formed by the levator ani muscles, the endopelvic fascia, nerves, and the connective tissue. The bulbocavernosus, transverse perineal, and external anal sphincter muscles form the second layer of the pelvic floor – i.e., the urogenital diaphragm (40).
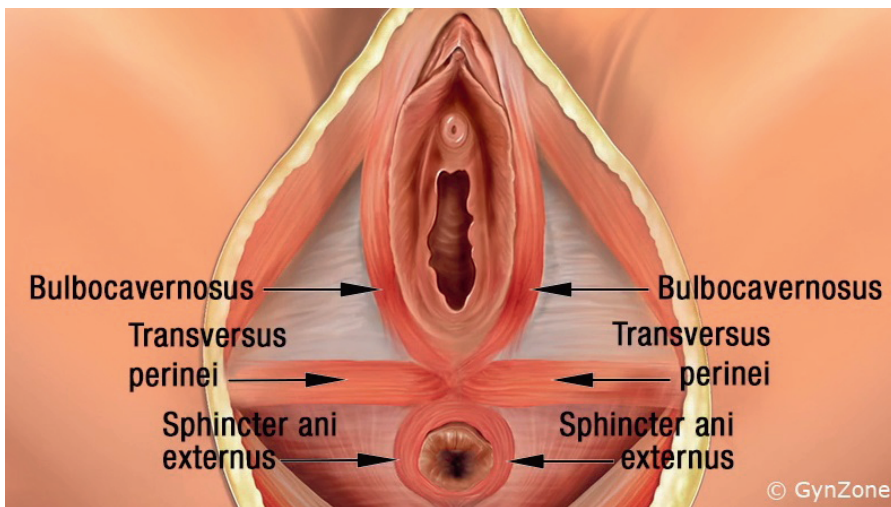

Figure 1. The superficial muscles that form the urogenital diaphragm. Reprinted with permission from S Kindberg-Fevre. www.gynzone.dk.

Anterior perineal trauma includes injury to the labia, anterior vaginal wall, urethra, or clitoris (16). Posterior perineal trauma is any injury to the posterior vaginal wall, perineal muscles, or anal sphincter (41). Posterior trauma can also be secondary to an episiotomy (42). The bulbocavernosus muscle surrounds the vaginal opening and contributes to clitoral erection and orgasm and closes the vagina (43, 44). The superficial transverse muscle is a thin transverse muscle and an important support structure for the anal canal and the external sphincter.

The puboanalis muscle (a branch of the pubocrectal muscle) is fused with the posterior vaginal wall and attached to the upper portion of the perineal body (44) and can be involved in an episiotomy or a deep vaginal tear. A second-

degree tear always involves the perineal body as the perineal muscles are inserted in this fibromuscular pyramidal tissue between the external anal sphincter and the posterior vaginal wall (44, 45). The perineal body plays an important role in supporting the pelvic floor and the anterior and posterior vaginal wall (44).
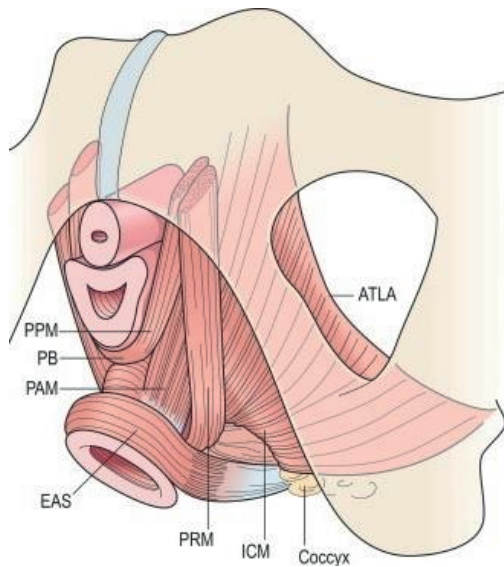
Figure 2. Schematic view of the levator ani muscles from below after the vulvar structures and perineal membrane have been removed, showing the arcus tendinous levator ani (ATLA); external anal spincter (EAS); puboanal muscle (PAM); perineal body (PB) uniting the 2 ends of the puboperineal muscle (PPM); ileococcygeus muscle (ICM); puborectal muscle (PRM). Reprinted with permission from J.O Delancey (46).

The rectovaginal fascia (septum rectovaginale) is a thin structure separating the vagina and the rectum. The rectovaginal fascia is often involved in a vaginal tear. If it is not sutured the rectum might protrude into the vagina, causing a low rectocele or proctocele (47). Symptoms are vaginal bulging, a need for digitally reducing the posterior bulge, or to apply pressure on the perineum to initiate or complete a bowel movement (47). In addition, perineal and vaginal tears that involve muscles and the rectovaginal fascia are associated with an increased risk of symptomatic pelvic organ prolapse later in life (48, 49).
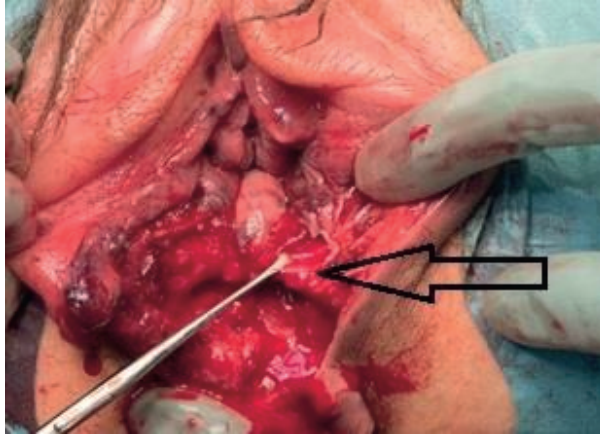
Figure 3. Torn rectovaginal fascia (arrow). Reprinted with permission from G Tegerstedt.

The anal sphincter complex consists of the external sphincter and the internal sphincter. The external sphincter is composed of striated muscles fibres which can be controlled by will, and the internal sphincter muscle is a thicker continuation of the circular fibres of the rectum. The internal sphincter muscle cannot be controlled by will since it is composed of smooth muscle fibres (50). The internal sphincter is always activated except during defecation and is responsible for maintaining continence at rest (39).

1.5 Consequences of perineal trauma

Perineal pain is common among all women after birth regardless of the presence of perineal trauma (51) and it is associated with oedema, bruising, tight sutures, infection, and wound breakdown (52). The intensity of perineal pain and discomfort women experience after a vaginal birth is generally unexpected and increases with the severity of the trauma (51, 53). Compared to an intact perineum or first degree tear, significantly more women experience perineal pain after a second-degree tear or an episiotomy (54). The pain can be intense and have a negative impact on a woman's daily activities (55) and contribute to lower self-related health one year after childbirth (56). In addition, perineal pain can impair normal sexual functioning (57). Women with second-degree tears and severe perineal trauma resumed sexual intercourse later compared to women with an intact perineum (58). Dyspareunia is common after birth but more often occurs in women with severe perineal trauma (59), while women with minor perineal

injuries or an intact perineum report greater sexual sensation and likelihood of orgasm six months postpartum (60, 61).

A severe consequence of perineal trauma is anal incontinence, including flatus incontinence and soiling, mainly caused by severe trauma affecting the external or internal sphincter muscle (50). However, second-degree tears may also lead to flatus or anal incontinence (45, 62) that may be related to a lack of support from the perineal body due to poor repair. Furthermore, severe perineal injuries are known to be sometimes wrongly classified as second-degree tears (63, 64). In a national Swedish cohort 1.5 % of the women reported anal incontinence one year after childbirth (56).

Severe perineal trauma negatively affects women's lives (65), including anxiety and apprehension concerning the physical consequences of the injury such as resumption of sexual intercourse and the risk of further injury after a subsequent birth (66). When comparing women with severe perineal trauma to those with minor injuries there were no differences in quality of life (62, 67, 68), except, for those with persistent defects (69). Women with ongoing symptoms such as flatus or faecal incontinence experience their bodies as "broken, contaminated and unreliable" and these symptoms have a major impact on their self-image (70).

1.6   Classification of perineal trauma

Vaginal injuries and second-degree tears can vary from a small laceration with probably no impact, to extensive vaginal and perineal tears involving the rectovaginal fascia and the whole perineal body. A first-degree tear only includes perineal skin or vaginal mucosa, whereas a second-degree tear may include the bulbocavernosus muscle, the transverse perineal muscle, and the puboanalis muscle. The classification adopted by the RCOG (71) does not differentiate between minor or extensive perineal or vaginal injuries except if the perineal tear includes the anal sphincter complex.

First-degree tear	Injury to perineal skin and/or vaginal mucosa
Second-degree tear	Injury to perineum involving perineal muscles but not involving the anal sphincter
Third-degree tear	Injury to perineum involving the anal sphincter complex; third-degree tears may be further subdivided into three subcategories:
	Grade 3a: Less than 50% of external anal sphincter (EAS) thickness torn
	Grade 3b: More than 50% of EAS thickness torn
	Grade 3c: Both EAS and internal anal sphincter (IAS) torn
Fourth-degree tear	Injury to perineum involving the anal sphincter complex (EAS and IAS) and anorectal mucosa

Figure 4. Classification of perineal trauma, RCOG (71).

To assess perineal and vaginal tears more accurately and consistently, an extended classification for minor perineal trauma is needed. A classification for second-degree tears has been developed in Sweden (Figure 5) and was used to classify vaginal and perineal trauma in **Studies III** and **IV**. The classification is currently under evaluation by different professions and has been published in a chapter in the book *Reproductive health: the midwife's core competencies* (72).

First-degree tear	Injury to skin and/or mucosa in labiae, the perineum and/or vaginal wall <0.5 cm
Second-degree tear	Grade 2a: part of the perineal body (0.5-2 cm) and < 4 cm length in the vagina
	Grade 2b tear: total perineal body but not involving the anal sphincter *or* >4 cm length in the vagina
	Grade 2c tear: total perineal body but not involving the anal sphincter *and* >4 cm length in the vagina

Figure 5. A new Swedish classification under development (72).

1.7 Prevalence and risk factors for severe perineal trauma

Most women sustain some form of perineal trauma when giving birth vaginally. The prevalence of all types of tears is reported to be between 67% and 91% (53, 73, 74) in the hospital setting, whereas the reported prevalence for women with a planned home birth varies between 45.6 and 54.0% (75, 76). Prevalence of severe perineal trauma differs as well; the reported rates in different European countries vary from 0.1% in Romania to 4.9% in Iceland (77). These differences might be related to preventive strategies but under- and over-reporting of severe perineal trauma are known to occur (78, 79). With increased awareness and training, there appears to be an increased detection of severe perineal trauma (80, 81). Furthermore, there might be differences in classification regarding less severe trauma (42). For example, Samuelsson et al. (2002) reported an incidence of 38.5% second-degree tears in primiparous women (82). On the other hand, 18.1% of the primiparous women had an episiotomy, which involves the same muscles as a second-degree tear. In addition, all vaginal injuries were considered first-degree tears (82). McCandlish et al. (1998) reports approximately the same prevalence of second-degree tears (36.9%) but distinguishes between second-degree tears and vaginal injuries (61.5%).

Risk factors for sustaining second-degree tears are similar to the risk factors for severe perineal trauma (82, 83). Risk factors for severe perineal trauma can be related to the woman, to the fetus, or to obstetrical interventions during labour. Of the maternal risk factors, giving birth for the first time is the greatest risk factor (83, 84). However, maternal age >30-35 years (84, 85), ethnicity (84, 86), and women with previous caesarean section giving birth vaginally are also risk factors for sustaining severe perineal trauma (84, 87, 88). Fetal risk factors are birthweight >4000 g, head circumference >35 cm (85, 89), and abnormal presentation such as persistent occiput posterior presentation (85, 90). Only a few studies have explored whether fetal distress is a risk factor, but Handa et al. (2001) found an association between severe trauma and fetal distress (91). Obstetrical risk factors include assisted vaginal delivery and forceps in particular (90, 92), prolonged second stage >60 minutes (85, 91), augmentation with oxytocin (93), and fundal pressure (38).

Many risk factors are non-modifiable such as parity, age, and fetal weight (94), whereas midwifery and obstetrical interventions might be modifiable and affect the prevalence of injuries. For example, although birthweight >4000 g is strongly associated with severe perineal trauma, 70% to 90% of severe perineal trauma occurs in births where the baby's birthweight is less than 4000 g (91). Stedenfeldt et al. (2013) found that the most significant

reduction of severe perineal trauma was seen in low-risk births, while the main risk factors for severe perineal trauma remained (94).

1.8   Episiotomy

Episiotomy is a surgical incision that increases the diameter of the vaginal outlet to facilitate the baby's birth (95). The most common types of episiotomy in Scandinavia and Europe are the mediolateral and lateral episiotomy (85, 96). The midline episiotomy is not recommended because of its association with severe perineal trauma (97, 98). Proposed indications for performing an episiotomy are assisted vaginal delivery, shoulder dystocia, non-reassuring fetal heart rates, rigid or tight perineum, preterm delivery, and breech delivery (99). Episiotomy is sometimes used in an attempt to prevent severe perineal trauma caused by tearing (100) and has been found to be protective in instrumental deliveries (81, 85). The results from a Finnish retrospective population-based study showed that the lateral episiotomy was protective for primiparous women although 909 episiotomies had to be performed to prevent one case of severe perineal trauma (85).

In Sweden the prevalence of episiotomies decreased during the 1990s when the Swedish midwife Gunni Röckner showed that the intervention was overused and associated with more discomfort, pain, and delayed healing for women (101, 102). Although there is consensus that episiotomy should be selectively used, there is considerable variation in the use of this intervention by country, within countries and within the same provider group, and fewer episiotomies are seen in alternative birth settings (19, 77, 103). The question remain as to what constitutes an appropriate rate and valid indications for performing an episiotomy (99, 104).

1.9   Prevention of perineal trauma

Although written midwifery sources are scarce there is evidence from the available historical literature that prevention of perineal injuries has been a concern for midwives throughout history (105). These documents describe support of the perineum with linen pads, herbal infusions, and warm pieces of cloth soaked in oil as well as sitz baths to relieve perineal pain after childbirth (105-107). Stretching of the vagina and too much "vaginal meddling" were advised against because of the risk of injuring the woman (105).

Midwives use a variety of techniques during the second stage in the belief that these will help women to avoid perineal trauma. A slow birth of the baby's head is thought to reduce the risk of tearing (108) because it allows the tissues to gently stretch over time as the baby moves forward with each contraction and retracts afterwards (109). This slow and controlled birth of the baby can be obtained by the woman herself or in collaboration with the midwife (109, 110). Known midwifery methods to slow down the speed include telling the woman to breathe through contractions, using manual perineal protection, and using different methods to soothe the pain to make it easier for the woman to endure the so-called ring of fire (5, 110-112).

Some studies have found that home birth is associated with less severe perineal trauma (113-115), and midwives working with home births feel that it is easier to prevent severe perineal trauma in this setting (116). Strategies mentioned by the midwives include getting to know the woman in advance, letting her choose the birthing position, and gently guiding if necessary (116). However, women planning for a home birth are a selected and highly motivated population. Generally, they are multiparous, older, non-smokers, and tend to have higher socioeconomic status (103, 117). In addition, some of the risk factors for severe perineal trauma such as instrumental delivery, the lithotomy position for birth, or augmentation with oxytocin are not present in the home birth setting, since women will be transferred to hospital in the event of an emergency or slow progress of labour (118).

Evaluating manual perineal protection is difficult as a variety of techniques exist and midwives often change techniques depending on the clinical situation and risk factors (73, 119). Common techniques are the flexion technique (73), the modified Ritgen's manoeuvre (120), and a modification of the Ritgen's manoeuvre used in the Finnish intervention (120-122). Hands-on perineal protection often involves lateral flexion and a downward traction to free the anterior shoulder (73). A meta-analysis by Aasheim et al. (2011) evaluated eight randomized controlled trials for hands-on or hands-off perineal protection, perineal massage with oil, jelly, or lubricant, and hot packs held at the perineum during crowning (16). Of these interventions, only perineal massage and the hot packs had a significant preventive effect for severe perineal trauma, whereas there were no differences in severe perineal trauma between hands-off or hands-on techniques (16). They concluded that hot packs can be recommended since the procedure is well accepted by women and midwives. Perineal massage was less accepted by women as 13.4% of the women allocated to this intervention asked the midwife to stop (123). None of the studies on manual perineal techniques have evaluated whether the methods involve pain or discomfort for women. Although the hands-on techniques are not shown to be protective in randomized trials they

are associated with less severe perineal trauma when non-randomized trials are included (124) and hands-on perineal protection is recommended (23, 125).

Birth positions have been evaluated in relation to perineal trauma. Most of the studies did not primarily aim at evaluating perineal trauma, so they do not have the power to detect differences (126, 127) and meta-analyses of the subject show no differences in perineal trauma between upright or supine birth positions with or without epidurals (14, 128). However, large register-based cohort studies show that giving birth in the lateral birth position is protective (15), whereas giving birth in the lithotomy position is associated with severe perineal injuries even after adjusting for confounders (15, 129). Albers et al. (1996) suggested that the lithotomy position may increase pressure sensations in the perineal area and decrease the woman's ability to moderate the tempo of her own pushing efforts (130). Giving birth on the birth seat or squatting is associated with severe perineal trauma for multiparous- but not for primiparous women (15).

One of the definitions of upright birth positions is positions in which a line connecting the centre of a woman's third and fifth vertebrae is more vertical than horizontal (14, 131). According to this definition, sitting, squatting, the birth-seat, kneeling and standing are defined as upright positions, whereas lateral, all-fours, semi-recumbent and the lithotomy position are defined as supine positions (14), although they are different and may facilitate or hinder physiological birth. Another proposed definition is to classify birth positions in which the body weight is on or off the sacrum. Positions that take the weight off the sacrum and allow the pelvic outlet to expand might facilitate spontaneous birth (128). Birth positions that take the weight off the sacrum (i.e., flexible sacrum positions) are kneeling, standing, all-fours, lateral position, squatting and giving birth on the birth seat. On the other hand, all the positions where the woman is sitting or lying on her back, such as the supine and the semi-recumbent position, put weight on the sacrum and could be categorized as non-flexible sacrum positions.

Excellent cooperation and good surveillance of the perineum has been reported to be protective (82, 132) as well as the two-step head-to-body birth, where the fetal head is born in one contraction or between contractions and the body with the next contraction (123). The latter technique is described to occur spontaneously when women have been prepared antenatally (110) or due to good communication between the midwife and the woman (123).

In the clinical situation, midwives use a variety of methods to prevent trauma, suggesting that successful preventive strategies involve several components

known as intervention programmes or more recently described as care bundles (125). A care bundle is defined as a small set of evidence-based interventions for a defined patient segment or population and care setting that, when implemented together, will result in significantly better outcomes than when implemented individually (125). A successful reduction in severe perineal trauma seen in Norway is attributed to an intervention programme consisting of four parts: asking the woman to pant through the last contractions, a manual perineal protection technique resembling the modified Ritgen's manoeuvre (120), and a birth position where this manoeuvre is possible to perform and where the perineum can be observed. Furthermore, episiotomy is performed on indication where valid indications also include rigid perineum and an imminent tear (122, 133-135). Critics point out that the intervention has unintended consequences such as an increase in the use of episiotomy and restricting women's position for birth (122, 136). Recently, other intervention programmes or care bundles have been shown to reduce severe perineal trauma (137, 138). Methodologically, these studies only report before- and after measurements and it is not known to what extent midwives or obstetricians used the described methods or if other protective practices were used as well (134, 135, 137, 138).

2 RESEARCH PROBLEM

Given that perineal trauma is common during birth and may have long-term consequences for women, it is imperative to investigate whether midwifery methods used during the second stage of labour are protective, and whether these methods can prevent perineal trauma. Giving birth at home or in birth centres has in some studies been associated with less severe perineal trauma and episiotomies compared to hospital settings. Since home birth is not registered in the medical birth registers in Nordic countries, there is still a lack of information about posterior perineal trauma and whether severe perineal trauma is associated with birth positions in this setting.

During the past decade, the prevalence of severe perineal trauma has been debated in Sweden both in the media and among midwives and obstetricians. Almost all maternity wards have programmes for educating midwives and obstetricians in preventive strategies and some clinics have been more successful than others in reducing their rates. Altogether, the focus on severe perineal trauma may affect midwives. Midwives' experiences of births where the woman suffers severe perineal trauma have not been described although, this knowledge is a piece of the puzzle in understanding different aspects of care in this field.

Perineal and vaginal injuries are the most common trauma during childbirth for primiparous women. As these injuries are associated with adverse outcomes for women, it is important to investigate whether it is possible to reduce second-degree tears, especially for primiparous women. Midwives who assist women in home births refer to a philosophy that can be described as woman-centred. Some of the factors they emphasize as important for preventing injuries such as continuity of care are impossible to achieve for women giving birth in maternity wards in Sweden today, although other techniques could be possible to translate into this setting. In Sweden, the different methods used during the second stage of labour are sparsely documented. It is not known whether midwives' practices during the active second stage to facilitate spontaneous birth and to prevent injuries are associated with perineal trauma. Furthermore, Sweden has a low prevalence of episiotomy even if rates vary between regions and hospitals. Since episiotomy affects the same muscles as a second-degree tear, it is important to explore reasons for performing an episiotomy.

3 AIM

The overall aim of this thesis was to investigate midwives' management and experiences of the second stage of labour in relation to perineal injuries of different severity. Furthermore, the aim was to evaluate whether an intervention based on woman-centred care reduces second-degree tears in primiparous women.

3.1   Specific aims of the studies:

I.   To describe the prevalence of perineal injuries of different severity in a low-risk population of women who planned to give birth at home in four Nordic countries and to compare the prevalence of perineal injuries, severe perineal trauma and episiotomy in flexible and non-flexible birth positions.

II.   To obtain a deeper understanding of midwives' lived experiences of a birth when the woman gets an obstetric anal sphincter injury.

III.   To evaluate a multifaceted intervention created to reduce second-degree tears among primiparous women.

IV.   To describe different methods used by midwives during the second stage of labour in order to facilitate birth and to investigate whether these methods were associated with perineal trauma. Furthermore, the aim was to describe midwives' reasons for performing an episiotomy in a setting with a restrictive policy.

4 EPISTEMOLOGICAL CONSIDERATIONS

The basis of the methods used in this study originates from two disciplines; epidemiology and phenomenology. The underlying epistemological concepts for the respective methodology will be presented below.

4.1 Epidemiology

Epidemiology is the study of the distribution and determinants of health-related states or diseases in specified populations and the application of this study to the control of health problems (139). Much of epidemiologic research aims at uncovering causes of disease. As it is a quantitative discipline, epidemiology relies on probability, statistics and causal reasoning based on developing and testing hypotheses. There are two categories of epidemiological studies: experimental studies and observational studies (140). In an experimental study, the investigator actively manipulates which groups receive the exposure under study, often as in a randomized controlled trial where people are randomly allocated to receive an intervention or standard care. In observational studies, epidemiologists observe exposures and outcomes for a specific population. The two main types of observational studies are cohort studies or case-control studies (140).

Modern scientific thinking as used in the natural sciences or epidemiology has its philosophical roots in the scientific revolution, which started in the 17th century (141). During this time empiricists began to rely on inductive logic. Induction begins by looking for patterns that suggest a general statement about a natural phenomenon under observation, which is reinforced or refuted with further observations. Although an empiricist, Hume (1711-1776) was sceptical of radical inductive reasoning since he did not agree with the assumption that what has been observed in the past will continue to occur in the future (140). Comte (1798-1857) synthesized positivism from empiricism and rationalism. Positivism is an epistemological theory that has been very influential in both the natural and social sciences. True knowledge about the world is received through the senses and interpreted through reason and logical thinking. Knowledge can be derived through what can be observed and tested in experiments; moreover, this approach requires researchers to be neutral and objective (141). Popper (1902-1997) also criticized the idea of gaining knowledge through induction. Popper's philosophy is known as refutationism. This school of thought encourages

scientists to subject a new hypothesis to rigorous tests that may falsify the hypothesis in preference to repetitions of the initial observations that add little beyond the weak corroboration that replication can supply. If a test refutes a hypothesis, a new hypothesis needs to be formulated that can be subjected to further tests (140). This process is an endless cycle of assumptions and refutation (140-142). Therefore, all scientific knowledge is considered tentative as any claim to knowledge may one day need to be refined or even discarded (140). Critics of refutationism argue that refutation is not logically certain because assumptions and methods used are susceptible to error (140). Kuhn (1922-1996), who coined the phrase "scientific paradigms", argued that the collective beliefs of a community of scientists determine what qualifies as scientific knowledge (140, 141). In this thesis both observational and experimental methods have been used in **Studies I, III** and **IV.**

4.2   Phenomenology as in lifeworld research

Phenomenology is not to be understood as a homogeneous philosophy, but rather as a movement with commonalities as well as variations (143). Husserl (1859-1938) is the founder of modern phenomenology and it was further developed by Merleau-Ponty (1908-1961) and others. Husserl observed that the natural sciences' enormous progress led to a totalization of natural sciences as a dictating ideal (144). He argued against applying the reductionist school of thought from the natural sciences in psychology and social sciences, as all theories on human experience, opinions, and ideas are based on experiences (143). In phenomenology this is presented as going to the things themselves, which means not relying on scientific theories or common sense, but doing justice to the studied phenomenon in all its variety (143, 144). Two central concepts of phenomenology are the natural attitude and the lifeworld. That is, in everyday life we see the objects of our experience such as physical objects, other people and even ideas as real and existing without questioning (144). However, in research the natural attitude should be abandoned in order to understand what is happening in the encounter between ourselves and the world (144). Merleau-Ponty further developed the concept of the lifeworld as the lived and subjective body. We do not have a body, we are embodied and we experience the world through our bodies (145). For example if we get ill our perception of the world changes (144). This was seen in **Study II,** where midwives described how their experience of the birth changed from fantastic to devastating when the woman sustained severe perineal trauma.

Another important concept in phenomenology is intentionality. Husserl used this concept to explain and clarify our relation to the world. Consciousness is always directed towards something. When we experience something, it is experienced as something that has a meaning to us (144). According to the theory of intentionality, humans are directed outwards and experiences are related to time. When we experience something we constantly go back and forth in time, remembering things related to the experience as well as thinking about the future in relation to the event. Therefore, the meaning of a phenomenon is infinite, always in motion, and always expanding (144).

Reflective lifeworld research design developed by Dahlberg et al (2008) was used in **Study II**. This approach is developed to explore and describe phenomena in the health care sciences based on the work of Husserl and Merleau-Ponty (144). Openness and sensitivity towards the phenomenon is central in reflective lifeworld research. This can be obtained through immediacy in the interview situation by an inductive approach that relies on open questions and encourages the informants to describe the phenomenon in their own words. Emphasis is put on the researcher's ability to bridle his or her natural attitude and preunderstanding of the phenomenon by constantly questioning his or her own assumptions and using critical reflecting during the whole research process (144).

5 METHODS

Four papers are included in this thesis. The respective method used is shown in table 1.

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

	Aim	Design	Participants	Analysis
Study I	To describe the prevalence of perineal injuries of different severity in a low-risk population of women who planned to give birth at home in four Nordic countries and to compare the prevalence of perineal injuries, severe perineal trauma and episiotomy in flexible and non-flexible birth positions	Prospective cohort study	2992 women with a planned home birth in four Nordic countries	Descriptive statistics, logistic regression
Study II	To obtain a deeper understanding of midwives' lived experiences of a birth when the woman gets an obstetric anal sphincter injury	Phenomenology – reflective lifeworld research design	Interviews with 13 midwives from three maternity wards	In accordance with reflective lifeworld research design
Study III	To evaluate a multifaceted intervention created to reduce second-degree tears among primiparous women	Non-randomized intervention study with a cohort design	597 primiparous women, 296 in the intervention group and 301 in the standard care group	Comparative statistics and stepwise logistic regression modeling
Study IV	To describe different methods used by midwives during the second stage of labour in order to facilitate birth and to investigate whether these methods were associated with perineal trauma. Furthermore, the aim was to describe midwives' reasons for performing an episiotomy in a setting with a restrictive policy	Secondary analysis of a non-randomized intervention study with a cohort design	704 women, 403 women from the baseline data and 301 women from the standard care group (interventional part of the study)	Descriptive statistics, logistic regression

5.1 Design, setting and data collection

Study I is a cohort study including women opting for a home birth in four Nordic countries (Denmark, Iceland, Norway, and Sweden) between 2008 and 2013. All midwives working with home births in the four countries were asked to recruit women to the study. After each birth, irrespective of whether it occurred at home or after transfer to hospital, the attending midwife

completed a questionnaire regarding women's background, place of birth and birth outcomes related to the woman and the baby. For the purpose of this study, severe perineal trauma, perineal injuries requiring sutures, and episiotomy were analysed. These variables were dichotomized into total perineal trauma and were compared to no injury/minor injury left unsutured. Eight birth positions were pre-defined in the questionnaire and they were further dichotomized into flexible and non-flexible birth position.

Study II is a qualitative interview study that uses a phenomenological reflective lifeworld research design developed by Dahlberg (144). As phenomenological research demands rich and nuanced data, two pilot interviews were conducted to see whether the research question could be answered by this design. While analysing the pilot interviews, it became evident that it was important to reach the midwives before their memory of the event had faded. In total, 13 midwives were interviewed – 11 at one delivery ward in Stockholm and two at two delivery wards in Gothenburg. The inclusion criterion for participating in the study was that the midwife had assisted a spontaneous birth where the woman suffered severe perineal trauma. A variation in working experience was sought and the midwives' clinical experience varied from three months to 15 years. In Stockholm, the midwives were found through the local database of the maternity ward and in Gothenburg the midwives were found by searching through the maternity wards' logbook of births. The interviews were conducted within a timespan after the birth from approximately two weeks to six months.

Studies III and **IV** originate from a non-randomized intervention study with a cohort design where an intervention was compared to standard care. Two maternity wards in Stockholm where midwives provide care to women with low- and high-risk pregnancies participated. Maternity ward 1 provides care to approximately 6,500 women/year, and maternity ward 2 provides care for approximately 4,100 women/year. The study included nulliparous Swedish-speaking women with a live singleton pregnancy, vertex presentation, and gestational age ≥37+0 weeks with spontaneous onset of labour or induction of labour. Exclusion criteria were nulliparous women with diabetes mellitus (manifest or pregnancy-induced), intrauterine growth restriction, and female genital mutilation.

The flowchart (Figure 6) shows the number of women eligible for inclusion in **Study III**. Women who met the inclusion criteria were asked to participate in the study when admitted to the maternity ward. After the birth, the midwives measured the perineum and the tear together with a colleague (midwife, obstetrician, or auxiliary nurse) and they completed a study

questionnaire containing questions regarding labour variables and midwifery techniques used during birth.
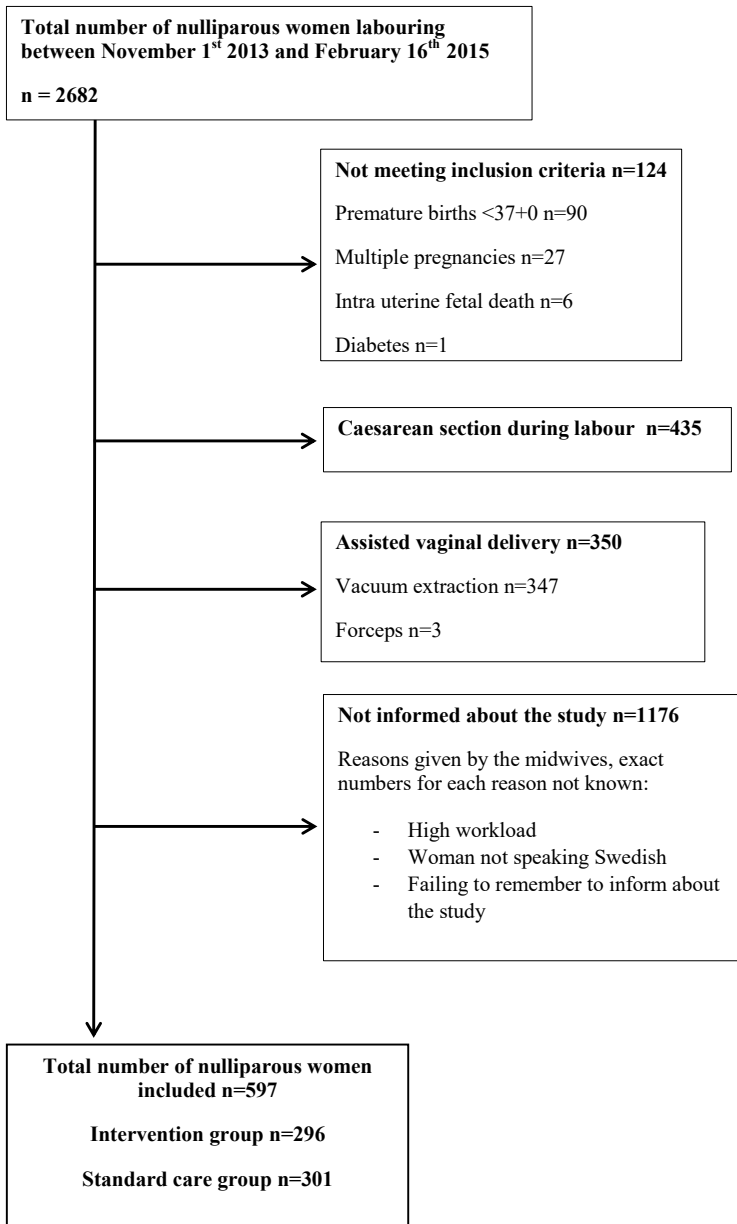

Figure 6. Flowchart over the inclusion process in study III.

5.1.1 Implementation of the study

The intervention study consisted of two parts. Since standard care is sparsely regulated, the study started with a measurement of baseline to see what standard care consisted of at the two maternity wards that participated in the project. Before the start of the study, educational sessions were held with all midwives on how to measure the tears and how to complete the study questionnaire. **Study IV** consists of women participating in the baseline measurement and controls (i.e., women participating in standard care group from the interventional part of the study).

The time planned for the baseline measurement was approximately two months at each labour ward, but in November 2013 a new maternity ward opened in Stockholm and started to employ midwives. Approximately 60% of the midwives in maternity ward 2 and 30% of the midwives in maternity ward 1 were recruited to the new clinic. This created a stressful situation at the two maternity wards for the remaining staff. At this point, the baseline period had finished and the intervention had just started in maternity ward 1. In maternity ward 2, this employment transition happened during the baseline period. To avoid the intervention starting during the most stressful period for maternity ward 2, it was decided to prolong the baseline period until it was possible to proceed with recruitment and education of midwives to the intervention group.
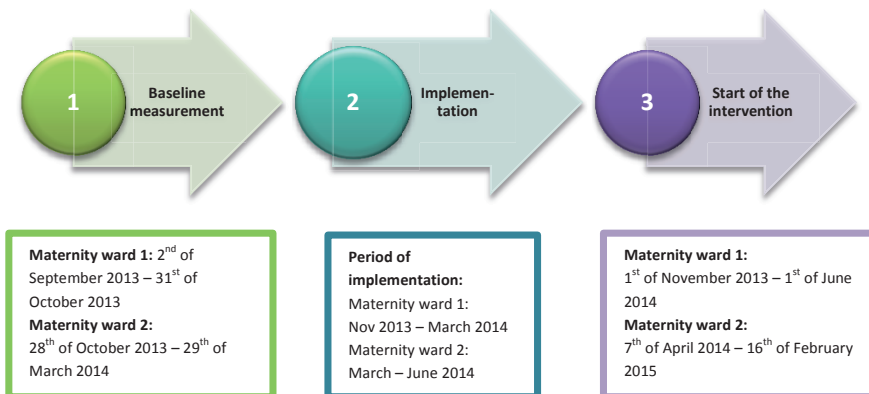
1 Baseline measurement

2 Implemen-tation

3 Start of the intervention

Maternity ward 1: 2nd of September 2013 – 31st of October 2013
Maternity ward 2: 28th of October 2013 – 29th of March 2014

Period of implementation:
Maternity ward 1: Nov 2013 – March 2014
Maternity ward 2: March – June 2014

Maternity ward 1: 1st of November 2013 – 1st of June 2014
Maternity ward 2: 7th of April 2014 – 16th of February 2015

Figure 7. The different phases of the intervention study.

After the baseline measurement at the two wards, the interventional part of the study started (**Study III**). During this period the midwives were recruited

to the intervention group and had further training on how to perform the intervention. To avoid contamination between the groups and dilution of the intervention, midwives working day shift at one maternity ward were asked to perform the intervention and midwives working night shift were asked to continue with standard care. In the other ward this was reversed (Figure 8).
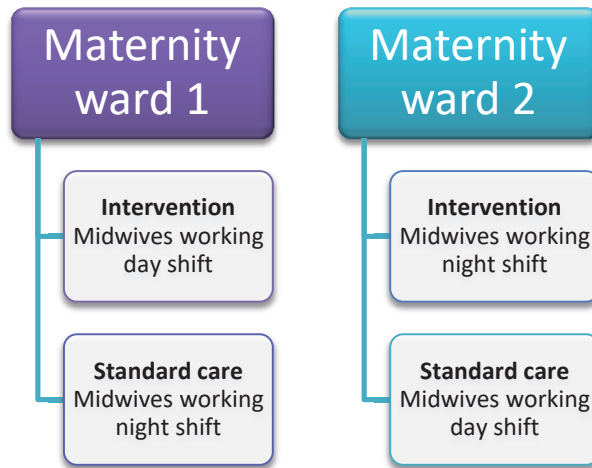
Figure 8. The division of intervention and standard care at the two participating maternity wards.

In maternity ward 1, 76% (35/46) of the midwives working day shift agreed to participate in the intervention group, whereas in maternity ward 2, 85% (17/20) of the midwives working night shift agreed to participate. Midwives in the standard care group received no additional information.

5.1.2   The intervention – The MIMA model of care

The intervention used by the midwives in the intervention group in **Study III** is based on a theoretical framework of woman-centred care (4) and consists of three parts (listed below) and is referred to as the MIMA model of care (an abbreviation for Midwives' Management during the second stage of labour). The midwives in the intervention group were asked to use all three parts of the intervention during the second stage in all births they attended.

The MIMA model of care:

- Spontaneous pushing: The woman feels a strong urge to push and follows the urge but does not put on any extra abdominal pressure. The midwife will if needed assist the woman to accomplish a controlled and slow birth of the baby by encouraging breathing and resisting the urge to push during the last contractions (133).
- Flexible sacrum positions: Birth positions with flexibility in the sacro-iliac joints, thereby enabling the pelvic outlet to expand (kneeling, standing, all-fours, lateral position, and giving birth on the birth seat) (128).
- Using the two-step principle of head-to-body birthing technique (123). With this technique the head is born at the end of a contraction or between contractions and the shoulders are born with the next contraction.
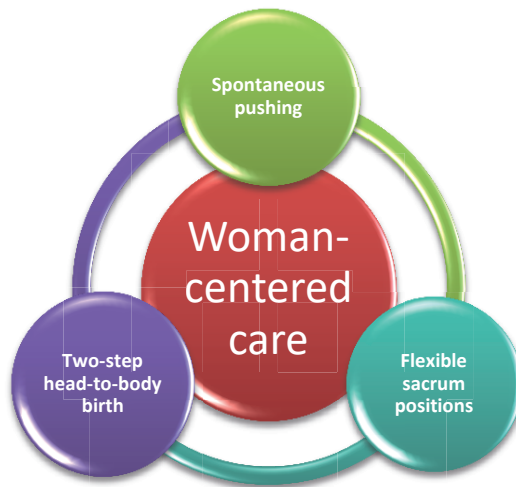
Figure 9. The MIMA model of care.

5.2 Data analysis

The outcome variables for **Study I** were severe perineal trauma, sutured injuries, and episiotomy. The primary outcome for **Studies III and IV** was second-degree tears according to international and national guidelines (71, 72). Secondary outcomes for **Study III** were the prevalence of no tear at all,

severe perineal trauma affecting the anal sphincter complex, episiotomy, and the ability of the midwives in the intervention group to use the intervention. In **Study IV,** the outcome variables were minor injury/no injury (including no tear, labial tears and first-degree tears in which vaginal injuries with a depth <0.5 cm were included), severe perineal trauma, and episiotomy.

For **Study III,** a pre-trial power calculation based on the assumption that the intervention would reduce second-degree tears by 15% compared to standard care indicated that at least 242 women were needed in each group to reach a statistical power of 80% at a 95% significance level (alpha). To ensure that enough participants were recruited to the study and taking dropouts into account, an additional 20% generated 291 women in each group.

Descriptive statistics have been used to present the data in all the quantitative studies (**Studies I, III and IV**). Furthermore Chi^2-tests and ANOVA tests were used to compare the data between the Nordic countries in **Study I**. The data in **Study III** were analysed according to intention-to-treat analysis. In **Study III and IV** odds ratios (OR) with a 95% confidence interval were calculated. In **Study III**, odds ratios were calculated for the comparisons between the outcome variables and the various explanatory variables and in **Study IV** odds ratios were calculated between the outcome variables and the techniques used by the midwives during the second stage.

In **Study I,** potential risk factors were adjusted for using logistic regression. The risk factors were birthweight >4000 g, transfer before birth, flexible sacrum positions, waterbirth and country. In **Study III,** a stepwise multivariate regression modelling was performed where all the statistically significant variables from the univariate analysis were entered one by one (age, BMI (Body Mass Index) and midwives' working experience). Thereafter, previously known risk factors for perineal trauma (birth weight >4000 g, use of oxytocin, and the length of the active second stage) were entered. In **Study IV**, logistic regression modelling was performed using a model with previously known risk factors for perineal trauma (birth weight >4000 g, use of oxytocin, and the length of the active second stage). For all logistic models, two-sided p-values <0.05 were considered significant and 95% confidence intervals (CI) were used to describe the precision of the estimates.

The data in the qualitative study **(Study II)** were analysed according to reflective lifeworld research (144). The interviews were recorded and the first step included listening to the interviews and transcribing them verbatim. The interviews were read and re-read to reach an initial understanding of the text and to get a sense of the whole. In the next step, meaning units were

abstracted according to the aim of the study and they were further organized into different clusters. The clusters and the text as a whole were used to abstract the essence of the phenomenon being studied: midwives' experiences when a woman suffers severe perineal trauma. The essence was further described by its constituents, which means that the abstracted level of the essence is broken down into parts that describe the nuances and variations of the essence. In this case, six constituents were found.

6   ETHICAL CONSIDERATIONS

The research conducted in this thesis is based on Swedish law for research concerning humans (SFS 2003:460) (146) and is in accordance with the Declaration of Helsinki regarding research involving human subjects (147). All studies have been approved by the ethical committees in the respective countries where the research was conducted. For **Study I**, ethical approval was approved separately in each of the participating countries; by the Regional Committee for Medical and Health Research Ethics (REC North) (200704605–5) in Norway; by the Regional Committee at Karolinska Institutet (2009/147-31) in Sweden; by the Capital Region committee on Health Research Ethics (H-3-2014-FSP71) in Denmark; and by the National Bioethics Committee (No. 11–031) in Iceland. **Study II** was approved by the regional committee in Gothenburg (2012/385-12) and **Studies III** and **IV** were approved by the regional committee in Stockholm (2013/859-3/2).

All women participating in **Study I** were given written information and consented to participate. They were informed of the possibility to withdraw their consent at any time without any consequences regarding care during pregnancy, birth, and the postnatal period.

Study II focused on midwives and their experiences. It could be argued that midwives as health professionals are not in a vulnerable position and that they are obliged to participate in research activities that may give new insights to problems that might further develop midwifery care. However, there may be ethical dilemmas if the midwives who are being interviewed feel that they are forced to participate. The midwives in this study were contacted by phone and were informed about the study and asked if they would be willing to participate. They were given the option to decline participation and if they seemed hesitant, an agreement was made as to whether the researcher could call later and if so, after how long. Only one midwife declined participation. The participants were further offered the opportunity to withdraw their consent at any time or to read the transcripts of their interview, though none of them chose to.

For **Study III** and **IV**, women were given written information regarding the study and consented to participate on arrival at the maternity ward or during labour when the midwives felt that it was appropriate to ask. They were informed that they could withdraw their consent at any time without any consequences in terms of care during labour and birth. It could be considered unethical to ask women in labour about participation in research as they may be in a vulnerable position and feel coerced to participate. Furthermore,

women did not receive exact information as to what the MIMA model of care consisted of. It was considered possible to address women during labour and to blind them since the practices used in the intervention were already in use to some extent, and could be encountered by women during the second stage in ordinary care. In addition, the midwives in the intervention group were told that as the intervention was woman-centred, women's wishes during birth were more important than performing all parts of the intervention. For example, if the woman had a strong preference for adopting a non-flexible sacrum position this would be accepted.

7   RESULTS

7.1   Study I

From the original cohort of 3068 women with a planned home birth, 2992 were selected for the analysis. Women who had a caesarean section or an instrumental delivery after transfer to hospital were excluded. Of the 2992 women, 196 (6.6%) gave birth spontaneously after transfer to hospital. The women who planned to give birth in the four countries differed significantly in all sociodemographic variables (Table 2). More women in Denmark were smokers (9.3%) and the highest proportion of planned home births for women expecting their first baby occurred in Iceland (21.3%) and in Denmark (17.4%).

Table 2. Socio-demographic background for 2992 women participating in Study I.

	Total N=2992 n(%)	Norway N= 468 n (%)	Sweden N= 438 n (%)	Denmark N= 1799 n (%)	Iceland N= 287 n (%)
Age groups*					
<25 years	202 (6.8)	26 (5.6)	24 (5.5)	119 (6.6)	33 (11.5)
25-35 years	1923 (64.3)	295 (63.0)	234 (53.4)	1188 (66.0)	206 (72.0)
>35 years	850 (28.4)	145 (31.0)	177 (40.4)	481 (26.7)	47 (16.4)
Marital status*	2918 (97.5)	449 (95.7)	407 (92.9)	1779 (98.9)	284 (99.0)
Tobacco use*	198 (6.6)	16 (3.4)	5 (1.1)	167 (9.3)	10 (3.5)
Number of children					
First baby	524 (17.5)	80 (17.1)	70 (16.0)	313 (17.4)	61 (21.3)
One previous child	1257 (42.0)	175 (37.4)	208 (47.5)	753 (41.9)	121 (42.2)
Two previous children	828 (27.7)	137 (29.3)	113 (25.8)	494 (27.5)	84 (29.3)
Three or more previous children	322 (10.8)	74 (15.8)	46 (10.5)	182 (10.1)	20 (7.0)
Body Mass Index (BMI) groups*					
<18.5	101 (3.4)	16 (3.4)	16 (4.7)	60 (3.3)	9 (3.1)
18,5-24.9	1943 (64.9)	289 (61.8)	260 (59.4)	1220 (67.8)	174 (60.6)
25.0-30.0	516 (17.2)	87 (18.6)	51 (11.6)	323 (18.0)	55 (19.9)
>30	196 (6.6)	25 (5.3)	17 (3.9)	116 (6.4)	38 (13.2)

*p<0.05 ** p<0.01 ***p<0.001

Severe perineal trauma occurred in 0.7% of all the women, 2.3% for primiparas and 0.3% for multiparas, and the overall prevalence of sutured injuries was 41.5%. The prevalence of episiotomy was 1.0% and women who were transferred to hospital were more likely to have an episiotomy (OR 3.98; CI 95% 1.72–9.22). Women gave birth in a variety of positions (Table 3) and most women used flexible sacrum positions. There was no association between flexible sacrum positions and severe perineal trauma (adj. OR 0.68; CI 95% 0.26–1.79) or sutured injuries (adj. OR 1.02; CI 95% 0.86–1.21). Flexible sacrum positions were associated with fewer episiotomies (adj. OR 0.20; CI 95% 0.10–0.54). Table 3 shows the numbers of severe perineal trauma for different birth positions.

Table 3. The prevalence of severe perineal trauma in different birth positions among 2992 women participating in study I.

	Total N=2992 n(%)	Severe perineal trauma* N= 22 n (%)
Birth position		
Semi-recumbent	687 (23.0)	6 (30.0)
Supine	238 (8.0)	2 (10.0)
Lateral	420 (14.0)	2 (10.0)
Birth seat/squatting	251 (8.4)	3 (15.0)
All-fours	326 (10.9)	2 (10.0)
Kneeling	737 (24.6)	4 (20.0)
Standing	216 (7.2)	1 (5.0)
Flexible sacrum positions	1950 (67.8)	12 (60.0)

* Severe perineal trauma affecting the anal sphincter muscle
(classification grade 3 and 4 according to RCOG) (71).

7.2   Study II

In study II, the experience of being a midwife when the woman suffers severe perineal trauma during childbirth was described as confronting a truth which is perceived as well known among midwives. This truth is that a skilled midwife can prevent severe perineal trauma. At the same time the midwife has to relate to a more complex belief, which implies that sphincter injuries cannot always be avoided no matter what the midwife does during

the active phase of the second stage and the birth of the baby. When the midwives try to relate to both this accepted truth and the more complex belief at the same time they can find themselves in a deadlock, which is difficult to resolve.

This deadlock involves time and space, from the active phase of the second stage where the presenting part is visualized, when the sphincter injury is diagnosed until afterwards when the midwife reflects upon the whole situation and context. The midwife considers whether it would have been possible to act differently in the particular situation but at the same time senses that that there were factors at the time that made it impossible to manage the birth differently. The accepted truth among midwives that a skilled midwife can avoid severe perineal trauma creates feelings of guilt.

When relating only to this accepted truth, the midwives experience guilt for letting the woman down, questioning their skills as midwives and the professional foothold is lost for a while. When the midwives relate to the more complex belief, they can feel relieved since they did their utmost to avoid the trauma and sphincter injuries are not always avoidable. To be in such a locked position means to doubt which perspective to choose, the accepted truth or the more complex belief. The midwife tries to handle the feelings of guilt by finding a valid explanation for the sphincter injury. If a valid explanation is found there is a way out of the deadlock and the feeling of guilt is diminished.

The experiences of guilt and blaming oneself for what happened may be related to a fear of appearing vulnerable. When judging themselves the midwives are also afraid of being judged by others. This is also part of the deadlock as it stops the midwife from opening up and addressing the feelings connected to the experience and the course events took. To be able to move on the midwife reflects back to find explanations for what happened and to develop professionally, but may feel that there are no answers to the questions. Ultimately the midwife accepts what happened and moves on without any definite answers to the questions why this happened and how it can be prevented from happening again. The essence can be further described by its six constituents: "to see and evaluate the signs and feel the tear occurring", "to do everything possible to prevent the injury", "not seeing any signs and being surprised", "to seek explanations for why the injury happened", "coping with guilt and self-blame" and "to accept, move on and forgive oneself".

7.3   Study III

In this intervention study, a total of 597 nulliparous women participated; 296 in the intervention group and 301 in the standard care group. The two groups of women were fairly well balanced, except that women in the intervention group were slightly younger and had a higher BMI. When compared to the baseline measurement, the only differences found between the groups were smoking at beginning of pregnancy (Table 4) and the working experience of the midwives. The group that performed standard care consisted of more newly qualified midwives, 41% versus to 23.1%, and there were more experienced midwives (>10 years) in the intervention group, 38.7% versus 27.8% (p<0.001).

Table 4. Socio-demographic background for 1000 primiparous women participating in the intervention study.

	Baseline N=403 n(%)	Intervention group N=296 n(%)	Standard care group N=301 n(%)
Age groups (years)			
<25	75 (18.8)	65 (22.0)	40 (13.3)
25-35	282 (70.9)	208 (70.5)	232 (77.3)
>35	41 (10.3)	22 (7.5)	28 (9.3)
Married/cohabit	399 (99.0)	291 (98.6)	297 (99.0)
Tobacco use at beginning of pregnancy	9 (2.4)	13 (4.7)	3 (1.1)*
Body Mass Index (BMI) groups			
<18.5	17 (4.6)	9 (3.3)	14 (5.0)
18.5-24.9	271 (73.4)	199 (72.1)	218 (77.9)
25.0-30.0	62 (16.8)	56 (20.3)	35 (12.5)
>30.0	19 (5.1)	12 (4.3)	13 (4.6)
Health related problems before/during pregnancy#	53 (13.8)	31 (11.0)	35 (12.2)
Assisted pregnancy (IVF/ICSI)	17 (4.2)	17 (5.8)	14 (4.7)
Psychiatric problems (anxiety, depression etc)##	42 (10.9)	25 (8.4)	35 (11.6)

*p<0.05 **p<0.01 ***p<0.001

\# Composite variable including asthma, thrombosis, chronic kidney disease,
 endocrine diseases, diabetes, epilepsy, chronic hypertension
\#\# The variable was retrieved from the birth register

Furthermore, there were no differences with regard to obstetric variables such as labour onset, augmentation with oxytocin, and epidural analgesia (Table 5). The Apgar scores did not differ between the groups and there were no babies with an Apgar score of <5 at five minutes.

Table 5. Obstetric and birth characteristics of 597 women who participated in study III.

	Intervention group N=296 n(%)	Standard care group N=301 n(%)
Induction of labour	41 (13.9)	48 (15.9)
Epidural analgesia	181 (61.1)	184 (61.1)
Augmentation with oxytocin during labour	162 (55.1)	178 (59.1)
Active second stage		
< 30 min	149 (51.9)	154 (52.0)
30-60 min	103 (35.9)	107 (36.1)
> 60 min	35 (11.9)	35 (11.8)
Occiput posterior	6 (2.0)	13 (4.3)
Birth weight, g (mean)	3482	3521
Head circumference, cm (mean)	34.7	34.8
Perineal trauma		
Minor injury (no tear, labia, first degree)	75 (25.5)	51 (17.1)
Second-degree tear (primary outcome)*	208 (70.7)	234 (78.3)
Severe perineal trauma[#]	11 (3.7)	14 (4.7)

*p<0.05 **p<0.01 ***p<0.001
#Trauma affecting the anal sphincter complex (grade 3 and 4)

The midwives in the intervention group used the techniques included in the MIMA model of care to a significantly greater extent than those in the control group even if spontaneous pushing, flexible sacrum positions and the two-step head-to-body birthing technique were also used in the standard care group (Table 6). When all three parts of the MIMA model of care were assessed as a composite variable, this combined approach was only used by 5.7% in the standard care group compared to 18.0% (p<0.001) in the

intervention group (Table 6). When the composite variable was recalculated to include spontaneous pushing all of the time and most of the time, the corresponding rates were 28.4% compared to 12.6% respectively (p<0.001).

The percentage of women in the intervention group who suffered a second-degree tear (70.7%) was lower than in the standard care group (78.3%). There were no differences in severe perineal trauma between the groups 3.7% compared to 4.7% (p=0.57) and the prevalence of episiotomies was low in both groups (1.7% and 3.0%). The factors included in the stepwise logistic regression model did not alter the protectiveness of the intervention (adj. OR 0.53, 95% CI 0.33-0.84).

Table 6. Components of the MIMA model of care in 597 women participating in study III.

	Intervention group n=296 (%)	Standard care group n=301 (%)	OR (95% CI)
Components and composite variable for the MIMA model of care			
Spontaneous pushing	122 (41.6)	94 (31.2)	1.57 (1.12-2.20)*
Flexible sacrum position	202 (68.2)	175 (58.3)	1.55 (1.11-2.16)*
Two-step principle of head-to-body birth	142 (48.5)	97 (32.9)	1.92 (1.38-2.68)***
The MIMA model of care#	53 (18.0)	17 (5.7)	3.65 (2.06-6.46)***

*p<0.05 **p<0.01 ***p<0.001

The MIMA model of care is a composite variable of the use of all the three parts of the intervention during the entire second stage

7.4   Study IV

A total of 704 primiparous women participated in this study – 403 from the baseline measurement and 301 from the control group in the interventional part of the study. Epidural analgesia was the second most common pain relief (59.5%), and the pudendal block was used in 6.0% of the women. Furthermore, augmentation with oxytocin was used in 58.3% of the women. Of the practices used by midwives during the second stage, directed pushing was the most common (57.1%) and associated with the use of epidural analgesia (OR 2.10; CI 1.54-2.85) and duration of the second stage (OR 1.02; CI 1.01-1.02), where the use of directed pushing increased the longer the

second stage lasted. However, directed pushing was used in 50.9% of the cases where the women pushed for less than 30 minutes. Other techniques used were levator pressure (29.8%) and the towel-trick (18.4%). Although interventions were common during the second stage, 36.4% of the women received none of the interventions described in this study. Fewer of these women used epidural analgesia (OR 0.40; CI 0.29-0.55) and had a duration of second stage shorter than 60 minutes (OR 0.25; CI 0.14-0.46).

Table 7. Socio-demographic background for 704 primiparous women participating in Study IV.

	Total
	N=704 n(%)
Age, mean (SD)	29.7 (4.45)
Age groups (years)	
<25	115 (16.5)
25-35	514 (73.6)
>35	69 (9.9)
Married/cohabitting	696 (99.0)
Tobacco use	12 (1.8)
Body Mass Index (BMI) groups	
<18.5	31 (4.8)
18.5-24.9	489 (75.3)
25.0-30.0	97 (14.9)
>30.0	32 (4.9)
Health related problems before/during pregnancy#	88 (13.1)
Assisted pregnancy (IVF/ICSI)	32 (4.5)
Psychiatric problems (anxiety, depression etc)	77 (11.5)

Composite variable including asthma, thrombosis, chronic kidney disease,

endocrine diseases, diabetes, epilepsy, chronic hypertension

The most common birth position was the birth seat and the least common position was to give birth on all fours (3.8%). The lithotomy position for birth was used sometime during the second stage in 17.0% of the women but only 12.1% gave birth in that position. Levator pressure was used at some time during the second stage in 41.4% of women giving birth in the sitting position and 70.6% in the lithotomy compared to only 9.0% of the women giving birth kneeling (Table 8). In 21.0% of the women, the midwives perceived that there was a significant risk for tearing. In case of an imminent tear, the most common practice used was to ask the woman to pant through the contractions.

In **Study IV**, 77.3% of the women sustained a second-degree tear and the midwives performed a rectal examination to assess the tear in 86.9%. No babies had an Apgar score less than 5 at five minutes, and only four babies (0.6%) had an Apgar score of 5-7 at five minutes. None of the techniques performed by the midwives during the active second stage were statistically significantly associated with perineal trauma regardless of whether they were used to assist the women to give birth or to prevent perineal injuries. The rate of episiotomy was 3.1% and episiotomy was associated with the use of the towel-trick (adj. OR 2.77, 95% CI 1.11-6.89), levator pressure (adj. OR 4.22, 95% CI 1.58-11.29), and fundal pressure (adj. OR 4.26, 95% CI 1.01-17.89). Furthermore, episiotomy was not performed on fetal indication but was associated with the length of the second stage (OR 1.04 CI 1.02-1.05).

Table 8. Practices used during the second stage to facilitate birth, birth positions, and percentages of practices used in the different birth positions among 704 primiparous women participationg in Study IV.

Table 8. Practices used during the second stage to facilitate birth, birth positions, and percentage of practices used in the different birth positions among 704 primiparous women participating in Study IV

	TOTAL N=704 n(%)	Sitting 199 (28.3)	Lithotomy* 85 (12.1)	Lateral 111 (15.8)	Kneeling 68 (9.7)	All-fours 27 (3.8)	Birth seat 213 (30.3)
Interventions during the active stage of second stage							
Directed pushing[a]	400 (57.1)	138 (69.7)	74 (87.1)	47 (42.7)	17 (25.4)	11 (40.7)	113 (53.1)
Lithotomy position used sometime during the second stage[b]	119 (17.0)	30 (15.2)	81 (95.3)	3 (2.7)	2 (3.0)	0	2 (0.9)
The towel-trick[c]	129 (18.4)	52 (26.3)	35 (41.2)	10 (9.1)	4 (6.0)	1 (3.7)	27 (12.7)
Levator pressure[d]	209 (29.8)	82 (41.4)	60 (70.6)	14 (12.7)	6 (9.0)	3 (11.1)	44 (20.7)
Pressure applied at the spinae ischiadica[e]	36 (5.1)	12 (6.1)	18 (21.2)	1 (0.9)	0	0	4 (1.9)
Fundal pressure	16 (2.3)	9 (4.5)	7 (8.2)	0	0	0	0
Manipulation of the symphysis pubis[f]	61 (8.7)	19 (9.6)	30 (35.3)	4 (3.6)	0	1 (3.7)	7 (3.3)
Manual stretching of the perineum	150 (21.9)	50 (25.5)	51 (61.4)	18 (17.1)	7 (10.4)	1 (3.7)	23 (11.2)

*Lithotomy or supine

a Verbal and non-verbal instructions

b Lithotomy position used sometime during the second stage before the birth

c The midwife and the woman pull a sheet between them during contractions to increase bearing down efforts

d Teaching the woman how to push with fingers in the vagina

Increasing the urge to push (to activate Ferguson's reflex)

f The manipulation of the symphysis pubis is used when it is difficult for the baby to pass under the symphysis pubis

8 DISCUSSION

The results from this thesis show that it is possible to use woman-centred care actions during the second stage in different birth settings. For women opting for a home-birth the use of flexible sacrum positions was not associated with severe perineal trauma, and the prevalence of severe perineal trauma in this setting was low. When some of the care actions associated with home birth and alternative birth settings were combined into a multifactorial intervention (the MIMA model of care), second-degree tears in primiparous women were reduced without having negative side effects. The results show that it was possible to implement this intervention in larger maternity wards with high workloads for the midwives. In addition, midwives used a variety of techniques to facilitate spontaneous birth, most of them being directed. These strategies were not associated with perineal trauma but with the use of epidural analgesia and the length of the second stage. If a woman sustained severe perineal trauma the midwife experienced various conflicting emotions. Feelings of guilt and shame were dominant, and these feelings were related not only to the woman but also towards the perceived professional self-image. A fear of being exposed and judged by others hindered the midwives from sharing their experiences.

The prevalence of severe perineal trauma found in **Study I** is in line with previous research (75, 113, 115, 148). However, the levels of severe perineal trauma do not always differ significantly between birth settings (103) and low rates of severe trauma are also found in hospital settings (77, 149). Home births are associated with practices that can be considered women-centred and that are recommended (4, 8). In **Study I**, this is seen in the variation of birth positions used by women, the option of giving birth in water, and the low prevalence of episiotomy. To what extent different birth positions influences perineal trauma is still unclear (14) but the use of upright birth positions has been viewed as one probable cause for the increased incidence of severe perineal trauma in the Nordic countries (150). As flexible sacrum positions were not associated with any types of perineal trauma in **Study I**, this suggests that midwives were skilled in attending women in both upright and supine positions.

One limitation of **Study I** is the lack of information regarding preventive strategies used by the midwives and only having information about birth positions. For example it would be of interest to know whether manual perineal protection and directed methods are used in this setting. However, a cohort study reporting on prevalence of severe perineal trauma and second-degree tears found no associations between different perineal protection

techniques and directed approaches such as digital stretching of the vagina (36).

Kirkham describes the culture of midwifery at larger maternity wards such as the ones seen in **Studies II, III,** and **IV** as one of hierarchical institutions that pressure midwives to conform (151); ultimately this culture results in guilt and self-blame and a lack of awareness of the commonality of experiences (152). Midwifery has been described as highly emotional work as it involves many conflicts and dilemmas (12). Hunter's concept of being with the institution rather than being with women became evident in **Study II** where midwives expressed their experiences as a deadlock between an accepted truth and a more complex coexisting belief. When the midwives experienced that their colleagues provided superficial comfort, they found it difficult to share their true feelings about being caught in this deadlock. Midwives' knowledge develops through an integration of theoretical and praxis knowledge through reflection with colleagues (153), by putting tacit knowledge into words (154). The shown hesitancy to share experiences of vulnerability and uncertainty is worrying as learning from the experience is crucial for professional development.

The results from **Study III** show that the MIMA model of care reduced second-degree tears among primiparous women. This result is important as second-degree tears are associated with adverse consequences for women such as lower pelvic floor strength (155), lower levels of vaginal arousal and orgasm (58, 61), and pelvic organ prolapse later in life (48, 49). Both the results from **Study III** and from a recently published study (138) add to the growing evidence that different interventions incorporating more than one method to prevent perineal trauma are effective in reducing perineal trauma (133, 137, 138). However, in contrast to the Finnish intervention (133) neither the MIMA model of care nor the intervention used in the study by Basu et al. (2016) focused on the specific perineal protection technique used in Finnish intervention or promoted a more liberal use of episiotomy (138).

Compared to the other interventions studies the strength of the MIMA study is the study questionnaire as it included questions regarding the intervention and other practices used during the second stage, including different perineal protection techniques. The results from the analysed questionnaires completed after birth showed that the midwives in the intervention group used the different parts of the intervention to a higher extent than midwives in the standard care group. It can be debated whether the total use of the intervention by 18.0% during the entire second stage is low in this type of setting. When introducing the intervention, some of the midwives voiced concerns. Most of their worries were related to whether it would be possible

for primiparous women with epidural analgesia to push spontaneously (156) and whether the two-step head-to-body birthing technique was safe for the baby (157). Reflective meetings were held to discuss difficulties and give feed-back to the midwives, but in retrospect further hands-on training during real births might have improved the overall use of the intervention (133). In addition, since the MIMA model of care is a woman-centred intervention, midwives were told to respect women's wishes. If a woman had a strong preference for a non-flexible birth position this was more important than being able to carry out all parts of the intervention. In addition, the midwives had to follow the rules and regulations at the respective maternity ward regulations, which meant that they sometimes were unable to perform the intervention.

The main finding in **Study IV** was that the directed practices used by the midwives to facilitate birth were not associated with any kind of perineal trauma, a finding that is in line with previous research (16, 24, 36). A mixture of practices was used, where the low use of episiotomy, avoidance of fundal pressure and supine positions for birth imply that the midwives were aware of current evidence-based recommendations (8, 14, 100). However, other practices that are discouraged were common, such as perineal massage and directed pushing (8). Furthermore, the directed practices (except for fundal pressure) were used in almost all birth positions, and even in the birth seat which is a position with a reputation of causing severe perineal trauma, even if the evidence for this is inconclusive (15, 126, 150). As the midwives seemed aware of some of the current recommendations for the second stage, this gives a more diverse picture of a technico-medical setting with high rates of interventions during the second stage.

In **Study IV**, the midwives were not asked why they used the different practices. However, the directive approaches were associated with the use of epidural analgesia and the length of the second stage. In an observational study by Roberts et al. (2007), midwives used directed pushing when women expressed distress, pain, or fear, and on fetal indication, but it was also used for no obvious reason, suggesting this was due to the caregiver's preferences (35). As the midwives used directed pushing to a high extent even when the second stage progressed normally, it could be concluded that directed pushing is used routinely in some cases. The question is whether it is necessary to use directed pushing, levator pressure, and other directed practices in birth settings with high prevalence of epidural analgesia and if so, to what extent. The practices midwives use to improve maternal pushing efforts might be disempowering (34) and not in line with woman-centred care. These practices may communicate to the woman that the midwife is the

expert, which is an authoritarian approach where women's bodies are objectified (4, 10, 34, 158). However, women undergoing prolonged labour express feelings of being trapped and being possessed by pain and fear (159). In cases with prolonged labour and second stage women might perceive directed practices as a relief and as good care (35).

9   METHODOLOGICAL CONSIDERATIONS

The different aims of the papers included in this thesis led to the use of both qualitative and quantitative methods. Discussions of objectivity, validity, and generalizability do not belong to a particular paradigm of research but should be used in qualitative as well as quantitative research, as these discussions supersede the divisions of scientific traditions (144). In quantitative research, internal validity refers to the reliability or accuracy of the study results. A study's internal validity reflects the author's and reviewer's confidence that the study design, implementation, and data analysis have minimized or eliminated bias and that the findings are representative of the true association between exposure and outcome (160).

As opposed to random error, bias is a systematic error and a study can be biased because of the way the participants were selected, the way the study variables were measured or as the result of confounding factors (140). Bias can cause estimates of association to be either larger or smaller than the true association (161). External validity refers to whether causal relationships can be generalized to different measures, persons, settings, and times (162).

In qualitative research, reliability and validity refers to selecting an appropriate method for a given question and applying that method in a coherent, justifiable, and rigorous manner, and adopting research methods that are accepted by the research community as legitimate (163). Generalizability of qualitative research can be judged on several grounds. For example if the authors clearly define how the findings apply to other contexts, the results can be generalized with a greater degree of confidence (164).

9.1   Studies I, III, IV

In **Study I**, the data used originate from a cohort study where different outcomes for women with a planned home birth in four Nordic countries have been studied. **Studies III** and **IV** are non-randomized experimental studies with a cohort design. The strength of the scientific inference supported by a study depends on its internal validity (165). Randomized controlled trials (RCT) are widely perceived as the best standard research design for evaluating the effectiveness of treatment and interventions as they have good internal validity and minimize confounding (166). However, there are circumstances where RCTs can be considered inappropriate, impossible, or inadequate (167). Furthermore, the validity of observational studies,

compared to RCTs for estimating the effectiveness of interventions has been debated (168) and several reviews have concluded that there is little difference in the estimates of the effectiveness between the different designs, especially when compared to prospective observational studies of good quality (165, 166, 168).

In **Study I**, a randomized trial to evaluate the possible benefits or risks for women who plan to give birth at home was considered impossible since women have strong opinions with respect to place of birth and will not agree to be randomized (169). A cohort study with the intention of including all women with a planned home birth in four Nordic countries was therefore considered the best option.

There were several challenges when designing the intervention study (**Studies III** and **IV**), and a randomized controlled trial or a cluster randomized trial was considered. The main reason for not choosing to evaluate the research questions in **Study III** with a randomized controlled trial was the possibility of contamination and dilution of the intervention and standard care. Contamination would most likely occur if a midwife was allocated to perform the intervention at one birth and standard care at the next. A cluster randomized trial, using the stepped wedge design (170) could have been the best option. However, this was considered impossible for logistical reasons and due to lack of economic resources. Cluster randomized trials would need larger sample sizes (171) and the inclusion of multiple maternity wards in the project. One more maternity ward was asked to participate in the study but declined due to many other ongoing research projects and heavy workloads for the midwives. As a cluster randomized trial was considered impossible, midwives working day shift were asked to participate in the intervention group and midwives working night shift were asked to continue with standard care, a strategy that intended to minimize any possible dilution of the intervention.To avoid bias because of cultural differences between midwives working day and night shift, midwives working night shift at the other ward were asked to perform the intervention.

A strength with the MIMA model of care (**Study III**) compared to other multifactorial interventions (133, 137, 138) to reduce perineal trauma is the detailed study questionnaire used in the baseline measurement and during the interventional part of the study. These questionnaires made it possible to assess the practices used by midwives during the second stage and to what extent the intervention was used, without only relying on the incidence of perineal trauma before and after the intervention.

9.1.1 Selection bias

In **Study I**, the intention was to include all women with a planned home birth in four Nordic countries. It is estimated that the study included 90% of the home births in Sweden and Norway, 80% in Iceland and 80-90% in Denmark (118). As planned home births are not systematically registered, it is impossible to know the exact number of women not included and whether they differed in sociodemographic background or in birth outcomes. The data collection in Denmark was most challenging as home birth is more common there than in the other countries and all midwives may attend home births even though they mainly attend births in maternity wards in the hospital (118).

Selection bias occurs when important prognostic factors are not distributed equally among the groups being compared, a condition that results in confounding. In prospective studies, selection bias is usually introduced by the biased allocation of patients to groups. When choosing a non-randomized design, the problem of selection bias cannot be ruled out (166). As seen in Figure 6, many women supposedly eligible were not included in **Study III**. The midwives were asked to record reasons for not including women in the study but most often they forgot even when they were reminded. In order to deal with the potential problem of selection bias, a baseline measurement was performed before the interventional part of the study. It was used to compare whether there were differences in sociodemographic background between the baseline measurement compared to the intervention and standard care group. Moreover the data from the baseline period were used to assess what standard care consisted of at the two maternity wards.

9.1.2 Information bias

In **Study I**, the midwives completed the questionnaires. The questionnaires were to be completed one week after the birth but sometimes midwives forgot and were reminded and completed the questionnaire retrospectively, which may have introduced recall bias. Furthermore, the data provided by the midwives could not be verified in registers or patient files. When the original cohort study was designed it aimed not only to study the association between birth positions and perineal injuries of different severity. Not all variables of interest were recorded such as perineal protection or whether warm compresses were applied. However, parity and birthweight were recorded, which in other studies are shown to be more influential on perineal outcome (36, 94). Another source of potential bias is that it is not known whether the midwives performed rectal examinations. When professionals are trained in assessing and classifying tears, the detection rate of severe perineal trauma often increases (80).

In **Studies III** and **IV**, a study questionnaire was developed. To minimize information bias, the questions were tested in two steps. First, five experienced midwives were invited to evaluate the questions and consider whether any important issues were missing. Second, the questionnaire was tested by six midwives during one month and their evaluations of using the questionnaire and using the MIMA model of care were evaluated in a focus group. To evaluate the primary outcome (second-degree tears) as accurately as possible, it was decided that the midwives would measure the tears after the birth with a measuring stick marked in centimetres. The most reliable method for measuring a tear and which kind of stick was best to use were also tested. To increase the accuracy of the measurements, educational sessions were held with the midwives before the study started. To further address information bias, midwives were asked to measure the tear with a colleague. It was not possible to blind the midwives, but the women who participated in the study were blinded as to whether they received the intervention or standard care. The measurements of the tears were further classified by the first author according to international standards (71) and using a new Swedish classification (72). The measurements together with descriptions of the tear and follow-up questions in the questionnaire regarding assessment and suturing of the tear made the classification possible. As the first author was not blinded to the group allocation, this might have introduced bias. To ensure the validity of the classifications, notes were taken to explain how the classifications were made and meetings were held with two uro-gynaecologists to discuss a selected number of study questionnaires.

9.1.3   Confounding

The third threat to internal validity is confounding. Confounding is a mixing or blurring of effects. These effects, can be controlled in several ways: restriction, matching, stratification, and by multivariate techniques (172). In **Study I**, restriction was used since women with assisted vaginal births were excluded and logistic regression was performed to control for possible confounders. In **Studies III** and **IV**, restriction was used since only primiparous women who gave birth spontaneously to full-term babies were included. Furthermore, in **Studies III** and **IV**, stepwise logistic regression modelling was performed.

9.1.4   External validity

Women who choose home birth are generally older, non-smokers, have higher education, and are often multiparous (103). Giving birth at home also means giving birth without pain relief and medical interventions such as augmentation with oxytocin. Therefore, it is not possible to generalize the findings from **Study I** regarding flexible sacrum positions and perineal outcome for women giving birth in general or for primiparous women in particular. The question whether the techniques used to prevent perineal injuries in the home birth setting were possible to transfer to another setting refers to external validity, and was one of the research questions evaluated in **study III**.

One of the strengths of **Study III** was that the intervention was possible to perform for midwives working in larger maternity wards with high rates of epidurals and augmentation of oxytocin. Furthermore, the study was conducted with positive outcomes despite the extremely strained working situation for the midwives when many of their colleagues quit. However, there are some considerations regarding the generalizability of the findings in **Study III**. Only Swedish speaking women were included, making it difficult to assess whether the intervention would work in areas with high rates of immigrant women. In addition, midwives working at the participating wards are familiar with upright birth positions and this could affect the generalizability of the findings.

9.1.5   Reliability

Reliability concerns the level of agreement between different assessments of the same outcome, made by the same rater at different times, or by different raters. In **Studies III** and **IV**, the data from the study questionnaires were entered into SPSS by midwifery students participating in research courses and the principal investigator. All data were checked by the principal investigator to see that the values entered were correct.

One of the reasons for conducting the baseline measurement was to assess whether the intervention was diluted into the standard care group. As mentioned earlier, during the study period a new maternity ward recruited almost 60% of the midwives in one of the maternity wards and approximately 30% of the midwives in the other. In consultation with the statistician involved in the project it was decided to prolong the baseline measurement at the maternity ward where the interventional part of the study had not started. However, fewer women were included during this period of the baseline measurement because of the strained working situation at the maternity ward. Even if both wards managed to employ new midwives, this could have

affected inclusion rates. The statistician concluded that this situation could be considered as a stress test of the intervention (Max Petzold, personal communication).

9.2 Study II

9.2.1 Validity

Study II is a qualitative study where a reflective lifeworld phenomenological design (144) was used. This design was chosen since phenomenology is well suited to explore and deepen the understanding of a complex phenomenon (143, 144). The issues of objectivity and validity have been addressed through different strategies. Being open and sensitive towards the phenomenon is one of the key concepts of reflective lifeworld research. It means meeting the informants and their experiences in an open way and without prejudice. The latter is difficult as being a midwife and a researcher with a special interest in preventing perineal injuries meant having a preunderstanding of the phenomenon. The concept of bridling (144) was used to handle the researchers' preunderstanding of the subject and to ensure validity during the interviews and through the entire research process. Bridling during the interviews meant learning to identify when the preunderstanding occurred. During the interviews the researcher sometimes understood too quickly and forgot to explore the informants' experience further with probing questions. By being aware of the preunderstanding it was possible to see when it happened, making it possible to create immediacy in the interviews. Immediacy implies establishing trust and letting the informant steer the encounter to let the phenomenon show itself in all its complexity and variations (144). During the analysis, openness meant being critical and self-reflective to see the "otherness" of the phenomenon being studied (173). Variety in age and working experiences was sought among the midwives to increase the richness and variation in the data. Dahlberg et al. (2008) recommends doing more interviews if the interviewer is inexperienced and if the phenomenon appears to be complex (144).

9.2.2 Generalizability

The generalizability of phenomenological research is context- and time-dependent and the findings from this study are applicable in similar contexts (144). It might not be relevant for midwives working in other birth settings or in smaller maternity wards or for midwives outside Sweden. On the other hand, this does not entirely mean that the application of qualitative studies cannot be transferred to other contexts; if this is done, the findings must be related to the new context (173).

10 CONCLUSIONS AND IMPLICATIONS

The result of this thesis shows that the majority of women who opt for a home birth in four of the Scandinavian countries gave birth in flexible sacrum positions. Flexible sacrum positions were neither associated with severe trauma, nor sutured trauma but were associated with fewer episiotomies. The results can be used to increase both midwives' and women's knowledge about outcomes in this type of setting and for women interested in this type of care. As flexible sacrum positions were not associated with severe perineal trauma, women should be recommended to use whichever birth position they find comfortable when they give birth. Midwives can actively help women by asking them if they have any preferences and, if they do not, participate in exploring what suits the individual woman.

When some of the care actions associated with home birth and alternative birth settings were combined into a concept of care (the MIMA model of care), it reduced second-degree tears in primiparous women without having negative side effects for women and their babies. It is possible to use this concept of care in larger maternity wards where midwives often have to care for two women in labour at the same time.

When a woman sustained severe perineal trauma, the midwife who assisted her experienced contradicting emotions leading to a feeling of being in a deadlock that was difficult to resolve. The experience not only generated feelings of guilt and shame directed towards the woman, but also caused the midwife to question her professional judgment and expertise. Furthermore, the results from this thesis show that in a setting where women use epidural analgesia to a high extent midwives use many directed practices that should not be used routinely and need to be evaluated further. Midwives need to ask themselves why an intervention is used and whether it is necessary. Reflection can be used to handle the various and conflicting emotions that occur when women sustain severe perineal trauma as well as to discuss when practices may be overused and when they may be necessary. Time for reflection should be scheduled for midwives working in maternity wards and it should be regarded as a prerequisite for professional development.

11 FUTURE RESEARCH

- More knowledge is needed about how women experience the second stage of labour and the methods midwives use to prevent injuries and to facilitate birth.

- What are the facilitators and inhibitors associated with using woman-centred care during the second stage of labour?

- Can peer support, reflection and feedback during the second stage of labour have an impact on the prevalence of perineal injuries and reduce routine interventions during the second stage?

- Is peer support during the second stage of labour acceptable for women and does it have any negative consequences for midwives?

- Studies are needed to evaluate the impact of physiological birth on the pelvic floor for women opting for a home birth since this group of women receive low levels of obstetric interventions.

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