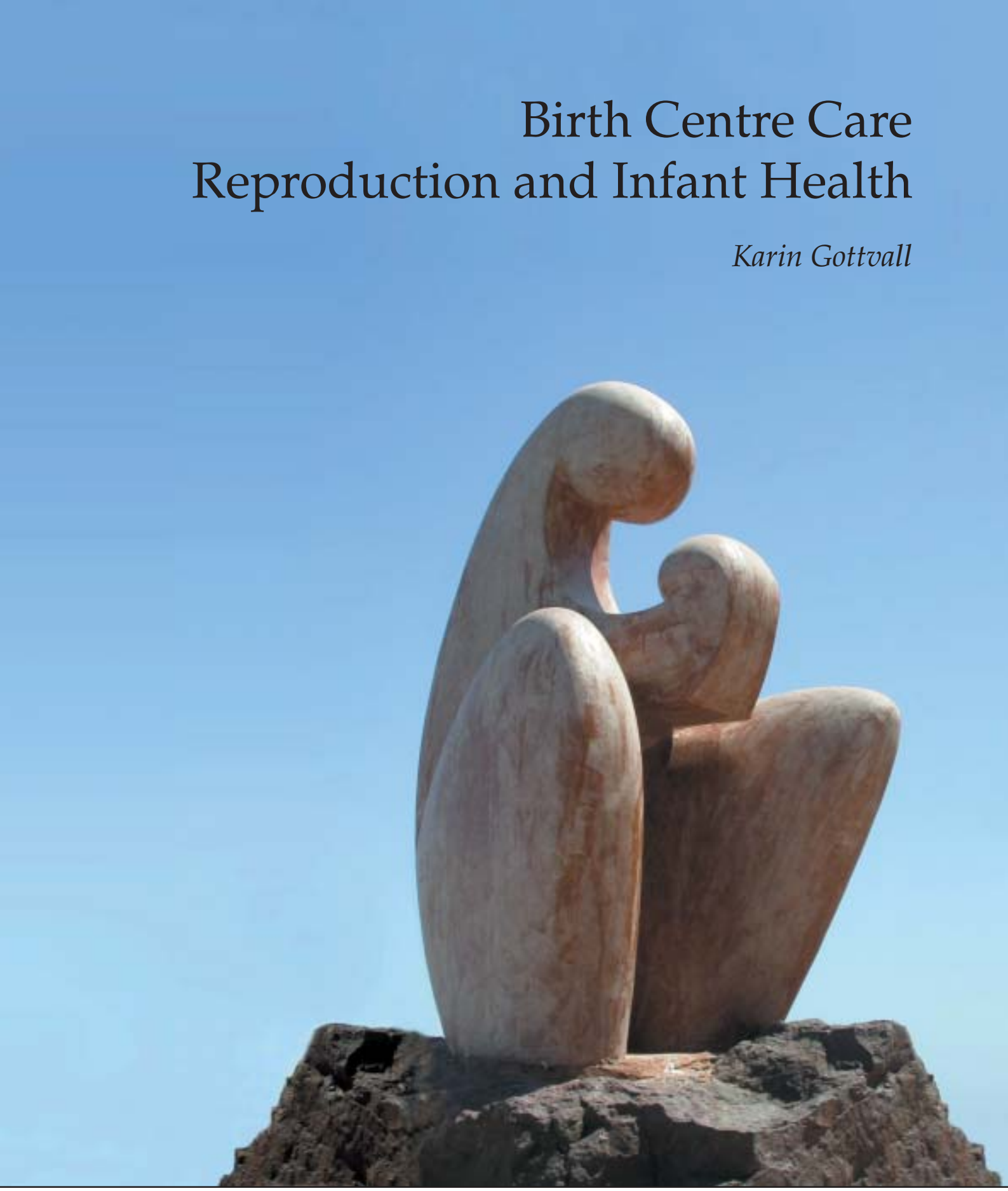
Birth Centre Care
Reproduction and Infant Health

Karin Gottvall



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Abstract

Birth Centre Care | Reproduction and Infant Health
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This thesis has two general aims, to investigate factors affecting women's decision to have a second baby and to study the effect of birth centre care on infant outcome. The specific aims were to investigate 1) whether birth centre care during a woman's first pregnancy had an effect on her future reproduction, 2) whether a negative experience of the first birth had en effect on future reproduction, and 3) whether birth centre care had an effect on perinatal mortality 4) and on morbidity during the infant's first month.

Nulliparous women randomly allocated to in-hospital birth centre care (n=505) and to standard maternity care (n=479) in early pregnancy were followed during a period of 7-10 years after the birth. Information about a second birth was collected from the Swedish Medical Birth Register and analysed by the Kaplan Meier method. No statistically significant differences were found between the groups in terms of having a second baby and the time to second birth (median: 2.85 versus 2.82 years, log-rank 1.26; p=0.26).

Experience of childbirth was assessed in 617 first-time mothers. Information relating women's global assessment of the birth experience (questionnaire two months postpartum) and various background variables (questionnaire in early pregnancy) was linked to the Swedish Medical Birth Register. Women with a negative experience had fewer subsequent children and a longer interval to the second baby. 38% of women with a negative experience did not have another baby during the following 8–10 years, compared with 17% of those with a less negative experience (p<0.001).

Two studies investigated perinatal mortality and infant morbidity in all women (n=3256) admitted to an in-hospital birth centre from 1989 to 1999. Data were compared with the outcomes for all the other women in the Greater Stockholm who gave birth in standard care during the same period and who met the same medical low-risk criteria as in the birth centre group (n=180 380). Outcome data were collected from the Swedish Medical Birth Register, the Swedish Hospital Discharge Register and medical records. Logistic regression analyses were performed to control for potential confounding background factors.

No statistically significant difference in the overall perinatal mortality rate was found between the birth centre group and the standard care group (OR 1.5; 0.9–2.4), but the infants of primiparas were at higher risk in the birth centre group (OR 2.2; 1.3–3.9). Infants in the birth centre group had a higher risk of respiratory problems (OR 1.5; 1.2–1.8) and a lower risk of clavicle and other fractures (OR 0.4; 0.3–0.6).

In conclusion, birth centre care during a woman's first pregnancy does not appear to affect future reproduction, but a negative overall childbirth experience does. Birth centre care might be associated with a higher risk of perinatal mortality in first-born babies, minor respiratory problems and a lower risk of birth trauma such as fractures. It is important to consider maternal and infant risk factors in the planning of models for childbirth care.

Keywords: Birth centre, alternative maternity care, birth experience, reproduction, perinatal mortality, infant morbidity.

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Contents

Abbrevations 6

Background 7

ALTERNATIVE MODELS OF MATERNITY CARE 7

The development of alternative birth options 7

Continuity of midwifery care 9

Research on alternative models of care 10

REPRODUCTIVE BEHAVIOUR 13

Aims 15

Methods 16

GENERAL DESIGN OF THE STUDIES 16

DATA SOURCES 17

The Stockholm Birth Centre Trial 17

The Swedish Medical Birth Register (MBR) 17

The Swedish Hospital Discharge Register (HDR) 18

STUDY POPULATIONS 18

DATA COLLECTION 21

Questionnaire 21

Medical records 22

Register data 22

STATISTICAL ANALYSES 23

Results 26

EFFECT OF BIRTH CENTRE CARE ON FUTURE REPRODUCTION 26

IMPACT OF THE FIRST CHILDBIRTH EXPERIENCE ON FUTURE REPRODUCTION 27

EFFECT OF BIRTH CENTRE CARE ON PERINATAL MORTALITY 28

EFFECT OF BIRTH CENTRE CARE AND INFANT MORBIDITY 29

Discussion 32

FACTORS AFFECTING WOMEN'S DECISION TO HAVE A SECOND BABY 32

EFFECT OF BIRTH CENTRE CARE ON INFANT OUTCOME 35

METHODOLOGICAL CONSIDERATIONS 38

General conclusions 41

Implications for the Future Research 42

Acknowledgements 43

References 45

Original Papers

The thesis is based on the following papers, which will be referred to by their Roman numerals:

I. Gottvall K, Waldenström U. Does birth center care during a woman's first pregnancy have any impact on her future reproduction? *Birth 2002; 29(3): 177-81.*

II. Gottvall K, Waldenström U. Does a traumatic birth experience have an impact on future reproduction? *BJOG 2002; 109(3): 254-6.*

III. Gottvall K, Grunewald C, Waldenström U. Safety of birth centre care: perinatal mortality over a 10 years period. *BJOG 2004; 111 (1): 71-8.*

IV. Gottvall K, Winbladh B, Cnattingius S, Waldenström U. Birth centre care over a 10-years period: infant morbidity during the first month after birth. *Submitted.*

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Abbrevations

BCG	Birth centre group
BMI	Body mass index, weight in kilograms divided by square of height in metres
CI	Confidence interval
CTG	Cardio-toco-graphi, or electronic fetal heart monitoring
HDR	Hospital Discharge Registry, In-patient Registry
HR	Hazard rate, corresponds to odds ratio in survival analysis
MBR	Medical Birth Registry
OR	Odds ratio
RR	Risk ratio
SCB	Statistics Sweden
SCG	Standard care group
SGA	Small for gestational age: Birth weight less than 2 standard deviations below the mean birth weight for gestational age.
WHO	World Health Organisation

Background

ALTERNATIVE MODELS OF MATERNITY CARE

The development of alternative birth options

The hospitalisation of childbirth has been regarded as a key factor in establishing the medical paradigm for childbirth (1, 2). The first maternity hospital (Allmänna BB) opened in Stockholm in 1772 and it initially only attracted poor women who wished to give birth anonymously (3). The majority of women continued to have their babies at home during the following 150 years. By the end of the nineteenth century, 10% of all births in Sweden took place in hospitals, but in 1940 the figure had increased to 65% and, in 1960, almost all women, 95%, gave birth in hospital. In spite of the hospitalisation of childbirth, normal deliveries remained the professional domain of midwives, whereas complications became a growing area of expertise for doctors and for obstetric science (2).

During the first decades of institutionalised birth, the medical procedures did not change dramatically. The father and other relatives were excluded from the birth event; the mother was often separated from the newborn child, except when breastfeeding every four hours, and the postpartum stay lasted more than one week. In the 1970s, clinical practices changed rapidly with the introduction of epidural analgesia, electronic fetal monitoring and increasing Caesarean section rates. National recommendations gave all women the right to effective pain relief during childbirth (4) and these recommendations had a dramatic effect on the use of epidural analgesia. By the end of the 1970s and during the 1980s, a reaction towards what was seen as the medicalisation of childbirth led to changes in some hospital routines, such as the increased involvement of the woman's partner, alternative birth positions, rooming-in 24 hours a day, early discharge, more home-like birthing rooms and the opening of the first birth centre in Sweden in 1989. During the 1990s, a new shift in public and professional attitudes towards a stronger focus on safety and concerns about malpractice could be seen, reflected in an increasing Caesarean section rate (5).

The natural childbirth movement developed as a response to medical involvement in normal pregnancies. It started slowly after the Second World War, with the focus on the expectant father's right to be present during labour and birth, and then developed more rapidly during the 1970s, encouraged by the women's

liberation movement. Birthing rooms, in-hospital and freestanding birth centres, and subsequently team midwifery models, were opened in the USA and many other countries as alternative birth options to the standard maternity services. These models were offered to women who expected a normal birth and provided a family-oriented, home-like birth environment, continuity of midwifery care and limited use of medical technology. The philosophy was that childbirth was a normal and natural, rather than a medical or pathological, life event. At the same time, it was important to provide care, which was safe for mother and baby. Some women who were opposed to hospital births and what they regarded as unnecessary medical interventions chose to have a home birth. Concern about the safety of home births was also one of the reasons why alternative ways of providing maternity care developed (6). The development of alternative birth options for normal pregnancy was in line with the intentions of the World Health Organisation which stated that the health care in normal birth should be provided at the lowest possible level of intervention that is compatible with safety and that there should be a valid reason for interfering with the natural process (7).

Birthing rooms

Birthing rooms became popular in Sweden and many other countries during the 1970s and 1980s. They were home-like rooms within a traditional delivery ward. Medical equipment was usually hidden from view and the ordinary delivery staff provided care for women who were regarded as running a low risk of pregnancy and birth complications. In the event of complications that required medical interventions, the woman was often transferred to an ordinary delivery room. Birthing rooms have become less common in Sweden, to some extent as a consequence of the renovation or conversion of the standard delivery wards, which have incorporated some of the environmental aspect of birthing rooms into standard care.

Team midwifery

The team midwifery concept was introduced in Great Britain (8) in order to enhance the continuity of care for women and midwives alike. A team usually consists of a small group of midwives who provide care for a case-load of low-risk, and sometimes high-risk, women from early pregnancy, throughout birth to the final postnatal check-up. The medical involvement of a doctor is at a con-

sultative level. The continuity of midwifery care is more likely to be provided by the team as such and its common philosophy of care than by the individuals within the team. A variety of team midwifery models have been established in Great Britain (8, 9) and Australia (10–12).

Birth Centres

Birth centres can be freestanding or in-hospital. The principal difference is that freestanding units have a longer distance to the back-up hospital. In-hospital centres may be located in close proximity to the delivery ward to which women are transferred in the event of a medical complication, or in a separate building within the hospital area. The two models have much in common, such as their own staff, which provides continuity of care from the fist antenatal visit to the postnatal check-up, all located on the same premises. Women are low risk on admission in early pregnancy but can be transferred to standard care during pregnancy, labour or immediately postpartum. Medical technology, such as pharmacological pain relief, is limited and induction, stimulation of labour and instrumental deliveries are reasons for transfer. Obstetricians and paediatricians provide consultation. Birth centres generally have established protocols for screening and transfer to medical care. Women and their partners are encouraged to take part in decision-making and the environment is home like and small scale. While freestanding birth centres have flourished in the USA in particular, most centres in Australia are in-hospital. In Sweden, an in-hospital birth centre opened at the South Hospital (Södersjukhuset), Stockholm, in 1989. Two other birth centres in Gothenburg were run between 1994–1996 (the East Hospital) and from springtime 1989 to the end of 1997 at the Sahlgrenska Hospital.

Continuity of midwifery care

Continuity of care is an important characteristic of alternative maternity services. Most studies have focused on continuity defined as fewer caregivers during pregnancy and birth or as a known caregiver who provides care in labour (13). Hodnett described the concept as an ambiguous term with a number of definitions, including caregivers committed to a shared philosophy of care or care provided by a small group throughout the childbearing episode (14). An Australian definition by the Health Department of Victoria (1990) stated that continuity of care was “care which enables a women to see and develop a relationship with the same caregiver/caregivers throughout pregnancy, birth, and

the postnatal period" (15). Continuity of midwifery care usually means that the same caregiver, or a small group of caregivers, usually the midwife, plans and provides most care during pregnancy, labour, birth and the postnatal period.

Alternative models of care may provide different combinations of continuity, such as continuity by the same team of midwives from early pregnancy to the postpartum period (8–12, 16–19). In another model, midwives provided antenatal care, intrapartum care but not postpartum care (20). Only intrapartum care was also provided (21–23) and, in another trial, continuity of midwifery care was examined intrapartum and postpartum only (24).

Research on alternative models of care

Most studies of alternative birth care only include low-risk women (17, 20, 23, 24), but a few also include high-risk women (10, 19). Alternative models of care are generally compared with standard maternity care and the caregivers in standard care may vary between trials, from primarily midwives (17), a mix of midwives and physicians (8–10, 20, 23) to only physicians (16, 18, 22). Most randomised controlled trials evaluate team midwifery care models, while very few evaluate birth centre care (17, 22, 24).

Characteristics of women interested in alternative models of care

Women who choose alternative birth care, and participate in studies evaluating these models, may differ from other women. The women who choose alternative maternity care are generally older and better educated than the women who prefer conventional care (25–28). Participants in the Stockholm Birth Centre Trial were compared with a sample of pregnant women from the same catchment area but who were not interested in participating in the trial. Compared with these women, the trial participants had other professions, more positive expectations of the approaching birth and a greater interest in not being separated from the newborn child and the rest of the family immediately after birth. They were also more interested in being actively involved in their own care. Generally, women with an interest in birth centre care, who therefore chose to participate in the trial, appeared to be more concerned about the psychological aspects of childbirth. The percentage of first-time mothers in the trial was also higher than in the Swedish population (28).

Satisfaction with care

The major finding in all trials of alternative birth care is a higher degree of satisfaction with care during all phases of pregnancy, especially with the psychological aspects of care (8–10, 20, 24, 29–31). In the Stockholm Birth Centre Trial, which is the largest randomised controlled trial of birth centre care published so far, 63% of the women in the birth centre group stated that antenatal care had raised their self-esteem, compared with 18% in the control group. Measures of satisfaction may be biased by the fact that all women who participate in trials of alternative birth options may have a preference for the new option. In the Stockholm Birth Centre Trial, this issue was addressed by measuring women's disappointment with the random group allocation, but the positive effect of birth centre care on maternal satisfaction remained, even when controlling for this variable (29).

Experience of childbirth

Women's experience of childbirth is affected by many factors, such as personal expectations, amount of support from caregivers, the quality of the caregiver-patient relationship, involvement in decision-making (32), medical complications, interventions and pain during labour (33). The effect of the model of care on women's childbirth experience is not clear and one of the reasons is that many studies do not make a clear distinction between satisfaction with childbirth and satisfaction with intrapartum care. In the Stockholm Birth Centre Trial, these two outcomes were separated and, while satisfaction with intrapartum care was much higher in the birth centre group, no statistically significant difference was observed in women's overall assessment of their childbirth experience. Birth centre care increased the percentage of women with a 'very positive' birth experience by approximately 10%, but this difference was not statistically significant. When examining the specific aspects of childbirth, positive effects of birth centre care were primarily observed in first-time mothers. They were more satisfied with their own achievement and felt more involved in the birth process than primiparas in the standard care group. However, both primiparas and multiparas in the birth centre group felt greater freedom to express their feelings during labour and birth (30).

Medical interventions and outcomes

There were fewer obstetric interventions in alternatively managed groups. Lower rates of augmentation (8, 17, 18, 20, 22) and induction of labour (9, 17, 20)

have been shown. Electronic fetal monitoring was less frequently used in alternative models (9, 17, 20, 22, 23) and women in these kind of models used pharmacological pain relief less frequently. Fewer epidurals (8, 18, 20, 23) and less use of Pethidine (8, 10, 17, 20, 22) were reported. Women in alternative care had a greater proportion of spontaneous vaginal deliveries and fewer or no differences in Caesarean section rates.

Perinatal mortality

In randomised controlled trials of alternative birth care, follow-ups of perinatal mortality have produced inconclusive results. In spite of this, there is still concern regarding a possible increase in perinatal mortality as an effect of alternative models of maternity care.

In the Stockholm Birth Centre Trial, perinatal mortality was defined as intrauterine death after 22 weeks of gestation or infant death within seven days of birth. Eight infants died in the birth centre group (0.9%) and two (0.2%) in the standard care group (OR 4.0; 95% CI 0.8 – 39.2). The higher odds ratio for perinatal mortality in the birth centre group raised concern that lack of statistical power may have accounted for the non-statistically significant difference between the two groups (17).

A systematic review was conducted in order further to explore the outcomes of alternative forms of maternity care (34). Comparing these models was, however, far from straightforward, as they differed extensively in terms of care content. This review therefore focused on forms of care characterised by continuity of midwifery care and included seven trials (8–10, 17, 18, 20, 35) and 9,148 women. As in the Stockholm Birth Centre Trial, maternal satisfaction was greater and intervention rates were lower, but perinatal mortality was higher in the alternative groups, even if the increase was not statistically significant (OR 1.6, 95% CI 0.99 – 2.95).

A more recent review by Hodnett (36), focusing on home-like yet institutional birth environments versus conventional hospital care, included six trials (17, 20, 21, 23, 24, 37), two of which were the same as in the above-mentioned review. Again, a home-like setting was associated with greater maternal satisfaction and less intervention but a non-statistically significant increase in perinatal mortality (OR 1.5, 95% CI 0.8–2.8). The author concluded, "Just as an over-enthusiastic focus on risk and intervention can lead to unnecessary interventions and

avoidable complications for healthy childbearing women and their fetuses, an over-emphasis on normality may lead to delayed recognition of or action regarding complications. Caregivers and their clients should be alert to the need for detection and prompt action in the event of unforeseen complications".

Infant morbidity

Most studies of alternative birth care found no differences in transfers to neonatal care or Apgar scores between alternative care and standard care. Of three trials which did report significant differences, two found a reduction in newborns with low Apgar scores at one minute (10, 18) and one found an increase in the number of babies with low Apgar score at five minutes (8). A reduction in the numbers of babies admitted to specialist care was reported (18, 38).

In the Stockholm Birth Centre Trial, more first-born babies were admitted to neonatal care in the birth centre group than in the standard care group, while the converse was true for newborns of multiparous women. Eight infants had some form of serious morbidity, which was not caused by malformations or preterm birth. Six of them were in the alternative group and in three of these cases possible avoidable factors were identified (17).

It is important to better monitor and follow up mortality and morbidity in infants born in alternative birth care. The use of already established cohorts and randomised controlled trials should be encouraged.

REPRODUCTIVE BEHAVIOUR

Reproduction and fertility are an important part of female life and also the development of society. In Sweden today, there are many factors that may facilitate fertility. There are extremely few maternal and perinatal deaths, generally good access to effective contraception, no illegal abortions and little poverty and malnutrition. All women have more or less equal access to high-quality antenatal, intrapartum and postpartum care, which is free of charge.

As in many industrialised countries, the fertility rate has decreased in Sweden in recent decades, similar to the development in many other western societies. The total fertility rate declined from 2.4 children per woman in 1965 to 2.1 in 1990 and 1.5 in 1999, which is the lowest rate since the collection of national statistics began in the mid-18th century. The corresponding figures for Italy, which has the lowest fertility rate in the European Union, were 2.7, 1.3 and 1.2 (39).

The reduction in fertility is a matter of great concern for society, as a declining number of younger people will have to cover the costs associated with an increasingly old population. The reasons why some women avoid motherhood, or choose to have only one child, need to be better understood.

Factors affecting women's reproduction

In addition to medical reasons for infertility, many other factors may impact on a woman's reproduction, such as the parent's social and economic situation, attitudes to childbirth and motherhood, and other career plans. Factors in the labour market, as well as social factors, such as housing conditions and availability of day care for the children are also important. Several studies have shown that a primary Caesarean section is associated with an increased risk of not having any more children (40–44). Maternal age may be another problem (45), as women tend to postpone their first pregnancy. Single status has also been associated with a reduced likelihood of having a second baby (44, 46) and women who had a premature birth were less likely to become pregnant during a four-year follow-up period compared with women with a normal gestation (47). A woman's experience of her first birth could possibly also affect her willingness to have another baby.

Anecdotally, midwives at the Stockholm Birth Centre sometimes heard women saying that their birth centre experience was so positive that they were considering coming back very soon and having another baby. Whether such comments were based on satisfaction with the care received or with the birth experience itself is difficult to say. We also know from clinical practice that some women who experience their first birth as a traumatic event decide not to have another baby. The causal link between the two variables has not been established and many factors, such as women's socio-demographic background, expectations of the birth and personality traits, may increase the risk of some women having a negative birth experience, as well as influencing the decision to become pregnant again. However, to our knowledge, the association between the characteristics of maternity care and the birth experience in relation to subsequent reproduction has not been studied systematically.

Aims

This thesis has two general aims, to investigate factors affecting women's decision to have a second baby and to study the effect of birth centre care on infant outcomes.

The specific aims were:

(i) To investigate whether or not birth centre care, compared with standard care, during a woman's first pregnancy had an effect on having a second baby and the spacing to the next birth

(ii) To investigate whether or not a negative experience of the first birth had an effect on having a second baby and on the spacing to the next birth

(iii) To investigate the effect of birth centre care on perinatal mortality

(iv) To investigate the effect of birth centre care on infant morbidity during the first month after birth

Methods

GENERAL DESIGN OF THE STUDIES

Paper I is a follow-up of a randomised controlled trial, which was initially designed to evaluate the effects of an in-hospital birth centre on a wide range of outcomes (see the Stockholm Birth Centre Trial below). Nulliparous women with an expected date of delivery from October 1989 to June 1993 were randomly allocated in early pregnancy to in-hospital birth centre care or standard maternity care. These women's personal identification number was linked to the Swedish Medical Birth Register (MBR) in order to obtain data on subsequent births during a period of seven to 10 years after the first birth.

Paper II is a cohort study of first-time mothers who participated in the Stockholm Birth Centre Trial, with the birth centre group and the standard care group merged into one cohort. The women's overall birth experience, as assessed two months postpartum, was related to subsequent births during the following eight to 10 years, by linkage to the MBR.

Papers III and IV are cohort studies comparing perinatal mortality and infant morbidity during the first month after birth, in all women admitted to the Stockholm birth centre during a period of 10 years, from its opening in October 1989 to 1999. These women were compared with a control group comprising all other women who gave birth in the Greater Stockholm area during the same time period and who met the same low-risk criteria as women in birth centre care.

Table 1. Overview of the papers

Paper	Type of study	Number of subjects	Data collection	Outcome measures	Data coll. period
Paper I	Randomised controlled trial	Primiparous women allocated to BCG (n=505) and SCG (n=479)	Questionaire (during pregnancy and 2-months post partum), MBR	Future reproduction Time to second birth	1989-1993 Follow-up 7-10 years
Paper II	Cohort study	617 women who assessed overall birth experience two month after first birth	Questionaire (during pregnancy and 2-months post partum), MBR	Future reproduction Time to second birth	1989-1992 Follow-up 8-10 years
Paper III	Cohort study	3 256 pregnancies in BCG and 180 380 in SCG	Medical records, MBR	Perinatal mortality	1989-2000
Paper IV	Cohort study	3 238 infants in BCG and 179 502 in SCG	MBR, HDR	Infant morbidity	1989-2000

BCG=Birth Centre Group. SCG= Standard Care Group. MBR=Swedish Medical Birth Register. HDR = Swedish Hospital Discharge Register

DATA SOURCES

The Stockholm Birth Centre Trial

From its start in 1989 until 1993, the in-hospital birth centre at Södersjukhuset, Stockholm, was part of a randomised controlled trial. The aim was to study the effect of birth centre care on satisfaction with care, experience of childbirth, fathers' involvement in infant care and utilisation of parental leave, breast-feeding, medical procedures (pain relief, induction, stimulation of labour, mode of delivery), transfer rates and infant and maternal outcomes. Data were collected from three questionnaires, one before randomisation in early pregnancy, a second at the end of pregnancy and a third two months after the birth. Medical data were retrieved from the hospital records covering antenatal, intrapartum and postpartum care. From October 1989 to February 1992, 1 230 women were allocated to either birth centre care or standard care. Data from these women formed the basis for the study of most of the outcomes (29, 30). However, this sample did not provide sufficient power for the study of rare outcomes, such as perinatal mortality and severe morbidity. Additional funding was obtained for a prolongation of the recruitment period by a further 1.5 years and a total of 1 860 women were thus included in the Stockholm Birth Centre Trial. The expected date of birth in these women ranged from October 1989 to the end of June 1993 (17).

The Swedish Medical Birth Register (MBR)

The Swedish Medical Birth register is kept by the Swedish National Board of Health and Welfare. Medical information relating to all hospital births and the few home births in Sweden has been kept in the MBR since 1973. The purpose of the register is to compile information relating to antenatal and perinatal factors and their importance for the health of the infant. The register covers 98–99% of all births in Sweden (48–50). It was established after the introduction of a standardised set of medical records used by all antenatal care clinics and delivery units and at the examination of the newborn infants. Copies of the form, marked with the mothers' person identification number (PIN), are sent to the Swedish National Board of Health and Welfare. One of the most important components in the use of the Swedish health registries is the PIN; a unique ten-digit number assigned to each resident in Sweden. This PIN is used in a wide variety of contexts, including population-based registers, relating to births, deaths, medical diagnoses and socio-economic and family data, for example. The PIN makes it possible to link information between different registers and to link data between defined cohorts and the registers.

The collection of data for the MBR starts on the woman's first antenatal visit. The midwife takes the woman's history according to a standard protocol, including reproductive and obstetric history, smoking habits, height and weight, state of health and family situation. Infant data in the MBR includes live births, single or multiple births, birth weight, gestational age, sex, Apgar score and infant diagnoses. All live births from 22+0 gestational weeks and all stillbirths from 28 weeks of gestation are included in the register (51). Any misclassification of perinatal mortality is likely to be extremely low as data relating to perinatal death are compared with data from the Cause of Deaths Register. Information about maternal age and complications during pregnancy and delivery is collected before hospital discharge after the birth. The mother's country of birth is obtained from the Civil Registry kept by Statistics Sweden by linking the PIN.

The Swedish Hospital Discharge Register (HDR)

The Swedish Hospital Discharge Register (HDR), which is kept by the Swedish National Board of Health and Welfare, includes data on hospital admissions and discharges from virtually all Swedish hospitals. The dates of admission and discharge and the discharge codes for diagnoses are available. A complete PIN is recorded in 99.1% of all reported in-patient occasions. About 40% of this incompleteness is due to newborns or individuals who are citizens of another country. Each record corresponds to one episode of hospitalisation and contains one main diagnosis and up to five contributory diagnoses coded according to the International Classification of Diseases (52).

International Classification of Diseases (ICD)

Complications and interventions during pregnancy and delivery are classified according to the Swedish version of the International Classification of Diseases (ICD). Diagnoses are classified according to the ICD–9 from 1987 through 1996 and the ICD–10 from 1997. A physician notes the diagnoses at the time of discharge from the hospital, using a standard form on which definitions of the diagnoses are written in the text next to the ICD codes and a check box (49, 50).

STUDY POPULATIONS

Paper I

Of all the 1 860 women who were recruited to the Stockholm Birth Centre Trial in early pregnancy, only the 1 063 nulliparas were included in this study. Sixteen

women were excluded because of a miscarriage and two could not be found in the MBR. Of the remaining 1 045 women, complete data were available for 984 (94%). Of the final sample, 505 women had been allocated to the birth centre group and 479 to the standard care group. The size of this sample enabled the detection of a difference between the two groups in time to the second birth of 4.3 months (80% power, confidence 95%).

Paper II

Of the 1 230 women who were included in the study of women's childbirth experience in the Stockholm Birth Centre Trial (30), only the 681 primiparas were included in Paper II. Nine women had a miscarriage or fetal loss and, of the remaining 672 women, 629 (93.6%) returned the follow-up questionnaire mailed two months after the birth and 617 (91.8%) responded to the specific question about women's overall birth experience. All 617 women could be matched with data from the MBR.

Papers III and IV

These studies included all women admitted to the birth centre between October 1989 and December 1999 and a control group of other women in standard care. Many women came back to the birth centre for a second or third pregnancy and the total number of bookings was 3 423. In these studies, one pregnancy is treated as 'one woman'. When miscarriages (n=83), multiple pregnancies (n=40), and 44 pregnancies, which could not be matched with information from the MBR were excluded, 3 256 pregnancies in 2 534 women remained. They made up the study group in Paper III (Figure 1). No case of perinatal death was found in the medical records of the 44 pregnancies that could not be matched with the MBR.

Women were usually admitted to the birth centre in early pregnancy, but in some cases they were admitted at a later stage (mean: 20 weeks; median: 18 weeks). The follow-up also included women who were transferred to specialist care during pregnancy, or who moved to some other place in Sweden. The births took place during the period November 1989 to July 2000. Women who participated in the Stockholm Birth Centre Trial (October 1989 to June 1993) and were randomised to the 'intervention group' were part of the birth centre group in these studies.

Control group data were extracted from the Swedish Medical Birth Register and included all the women with a singleton pregnancy who met the same low-risk medical criteria as the women in the birth centre group (no disease associated with risk during pregnancy, non-smokers and previous birth not a Caesarean section) and who gave birth in the Stockholm county during the same period. As with the birth centre group, women in the control group could have given birth several times during the observation period and each pregnancy was treated as 'one woman'. In addition to the exclusion of multiple pregnancies, the following were excluded: smokers (15.4%) and women with a history of Caesarean section (5.8%), diabetes (0.3%), epilepsy (0.2%), or hypertension (0.3%). The standard care group comprised 180 380 pregnancies in 126 818 women (Paper III).

In Paper IV, the same sample as in Paper III was studied, but cases of perinatal death were excluded. The birth centre group included 2 520 women with a total of 3 238 pregnancies and the control group 126 243 women with 179 502 pregnancies.

The size of the two samples in Papers III and IV was defined by practical circumstances by including in the birth centre group all the women admitted to the centre since its opening and in the standard care group all the women who

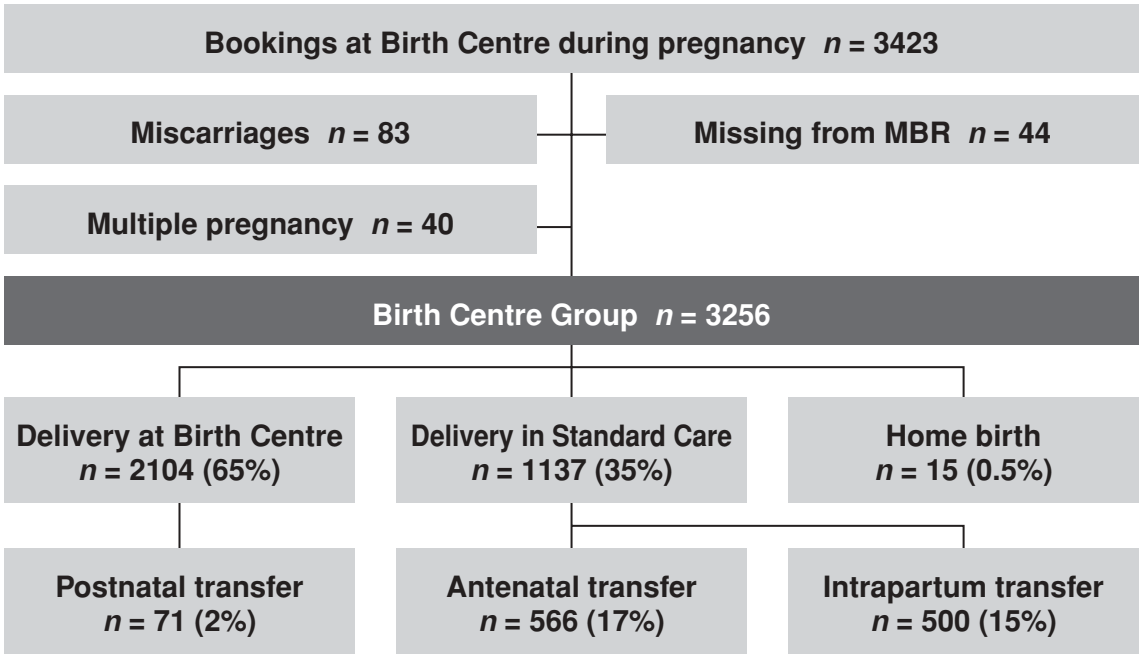

Figure 1. Women booked at the Stockholm Birth Centre, 1989–1999.

gave birth in the same catchment area and who met similar medical inclusion criteria. The study had 80% power (95% CI) to detect a difference in perinatal mortality from an expected 5/1000 in the standard care group to 9/1000 in the birth centre group, or a rate ratio of 1.8.

DATA COLLECTION

In Papers I and II, data were collected using questionnaires completed by the women before randomisation in early pregnancy and two months after birth. Follow-up data on a subsequent birth were collected from the MBR. In Papers III and IV, data were collected from the MBR (Papers III and IV), the HDR (Paper IV) and medical records (Paper III).

Questionnaire

In early pregnancy

The first questionnaire included questions about the women's socio-demographic background, such as age, marital status, ethnic background, education and smoking habits, and questions about physical health, expectations and anxieties related to the approaching birth, anticipated pain during labour and worries about the responsibility of taking care of the newborn (Papers I and II). In Paper II, questions about attitudes to decision-making, anxiety (about the approaching birth, labour pain) and expectations (expected birth experience, expectations relating to competence as a mother) were also used.

The background questionnaire (Paper II) also included two scales from the Karolinska Scales of Personality (KSP) measuring trait anxiety, with ten items focusing on somatic anxiety and ten on psychic anxiety. Somatic anxiety referred to physiological symptoms and somatic complaints such as palpitations and sweating as a predominant feature, accompanied by feelings of vague discomfort amounting occasionally to panic. Psychic anxiety referred to anxiety expressed as a cognitive structure linked to awareness of problems, worrying, anticipatory anxiety and prolonged post-stress reactions, low self-confidence and discomfort in social situations (53, 54). A locus-of-control instrument (55, 56) measured the degree to which the individual felt able to control her own life (internal locus of control) versus the degree to which she felt controlled by extrinsic factors such as fate, chance and other people (external locus of control). In this study, the responses on the KSP and the locus of control scales were divided into three categories, "low" (25% and below), "medium" (more than 25%

and less than 75%) and "high" (75% and above). The response rate to the background questionnaire was 100 per cent (30).

Two months after birth

In the two-month follow-up questionnaire women answered questions about experience of labour and birth. Different aspects of the birth experience were explored, such as experience of pain (intensity and attitude to labour pain), satisfaction with own achievement, involvement in the birth process, anxiety and support from partner and midwife. These questions were followed by a question about the overall assessment of labour and birth, expressed on a seven-point scale with the anchors verbally defined (1 = very negative, 7 = very positive). This overall measure was the independent variable in Paper II.

Medical records

Paper II included the following data extracted from medical records: method of pain relief in labour (epidural, Pethidine, nitrous oxide), augmentation of labour, mode of delivery (normal vaginal, vacuum extraction, Caesarean section), infant birth weight, Apgar score < 7 at five minutes and admission to neonatal care.

In Paper III, all the case records of perinatal deaths in the birth centre group were examined by an external and independent obstetrician - a consultant in obstetrics and gynaecology at the National Board of Health and Welfare handling cases of malpractice in Sweden. These cases were analysed in order to establish whether the particular model of care could possibly explain the outcome and each case was classified using the criteria 'unavoidable', 'possibly avoidable' and 'avoidable'.

Register data

The PIN from the study samples in Papers I-IV was retrieved manually from files at the birth centre unit. The PIN of each woman was then linked to the requested data from the MBR and returned to the researcher after the personal identification had been deleted. The observation period for women's subsequent birth in Papers I and II was dependent on when the women had been enrolled in the Stockholm Birth Centre Trial. The maximum possible observation period for the first woman entered was 10.2 years and for the last 7.9 years in Paper I and 6.5 years in Paper II.

In Papers III and IV, the PIN of all the women admitted to the birth centre from its opening in 1989 to the end of 1999 (the last birth in July 2000) was linked to the MBR and, in Paper IV, also to the HDR.

The following information was collected from the MBR: maternal age at the time of birth, marital status including cohabitation with the infant's father or other family situation, body mass index (BMI) measured in early pregnancy and categorised according to the recommendations of the WHO (underweight < 18.5; normal 18.5–24.9; overweight 25–29.9 and obese ≥ 30), reproductive history and complications during pregnancy, delivery and the neonatal period. The history of perinatal mortality included both previous stillbirths and infant deaths 0–6 days postpartum. Newborn babies were classified as being small for gestational age (SGA) if their birth weight was 2 standard deviations (SD) below the mean weight for the gestational age according to the Swedish standard (57). Late neonatal death was defined as infant death 7–28 days after birth.

Information relating to infant re-admissions to hospital during the first month after birth was collected from the HDR and included infant diagnoses, number of days in hospital and day of discharge. Infant outcomes diagnosed soon after the birth, such as Apgar score, major malformation and small for gestational age, were collected from the MBR, whereas all other diagnoses were collected from both the MBR and HDR. In the analysis, the information relating to infant diagnoses from the two registers was merged. This was necessary in order to control for possible errors that might occur because of differences in the duration of the postpartum stay in the two groups and in order to obtain data on hospital admissions up to one month after the birth.

STATISTICAL ANALYSES

In Paper I, the analysis was based on intention to treat (58); in other words, all the women were included in their allotted group regardless of transfer to standard care because of a medical complication or need for pharmacological pain relief, or because of withdrawal from the study. In Papers III and IV, all the women admitted to the birth centre from its opening until 1999 were included, regardless of whether these women had been transferred, moved to some other place in Sweden, or were admitted with more than one pregnancy.

In Paper II, the variable 'overall birth experience' was dichotomised in advance in a way that would make it possible to study the subgroup of women with the most negative experiences. Previous studies (30, 31, 59) have shown that ap-

proximately 10% of women assessed labour and birth in negative terms. In the present study of primiparous women, 12 % scored 1 or 2 on the seven-point scale and we chose to compare this group with women who scored 3–7.

Survival analysis was used in Papers I and II. This method is used when interest focuses on the time period from a fixed starting point, in this case the birth of a woman's first baby, to another event, in this case the second birth. One of the most common sources of data analysed using this method is the time from the diagnosis of a disease or surgery to an undesirable event such as death. This explains the terms 'survival times', 'survival data' and 'survival analysis'. In these studies, the measurement of "time to second birth" captured the effect both of women who had a second baby within the observation period and those who did not. Women who did not have a second baby during the follow-up period were treated as censored observations; this indicates that the period of observation was cut off before the event of interest occurred. Women's reproduction in this case is followed for varying lengths of time, depending on when the women entered the birth centre.

The Kaplan Meier (KM) method (60) allows comparisons between the groups, even though the length of follow-up varied between the individual women. The KM survival curve presents the probability of having a second baby in a given period of time. To test the null hypothesis, the log-rank test was used. To explore the effects of several variables at the same time on time to next birth, the Cox regression method was used. In Cox regression (61), the hazard ratio corresponds to the risk ratio and the method is equivalent to regression analysis, apart from the fact that the dependent variable is the hazard (risk) at a given time. Differences in time to the second birth were calculated using the log-rank test (60, 61).

In Paper II, all the possible confounders and the independent variable 'overall birth experience' were included in a Cox regression analysis and were excluded stepwise, one by one, if they did not contribute to the model. We included in the final model only those variables, which differed statistically between the two groups in the univariate analysis. The method of including all variables combined with backward selection produced the same result as when only the statistically significant variables were included.

In Paper III, comparisons between the birth centre and the standard care groups relating to socio-demographic and obstetric background were made using de-

scriptive statistics and the chi^2 test. Mortality rates were estimated by rate ratios (RR) and 95% confidence intervals, crude and stratified by parity. Logistic regression analyses (62) were conducted in order to control for differences in maternal age and length of gestation. These findings are presented separately for primiparas and multiparas.

In Paper IV, comparisons between the birth centre group and the standard care group relating to socio-demographic background, obstetric history and outcomes of labour were performed using the chi^2 test. Infant diagnoses are presented as percentages in each group and as the crude odds ratio (OR) with 95% confidence intervals for the occurrence of the respective diagnosis in the birth centre group. Adjusted odds ratios were estimated by controlling for differences between the two groups in terms of the women's background, such as parity, maternal age, country of birth, history of infertility, history of perinatal deaths and gestational age (62).

Results

EFFECT OF BIRTH CENTRE CARE ON FUTURE REPRODUCTION

Paper I

Having a second child or not and the interval to the second birth were investigated in women who had been randomly allocated to in-hospital birth centre care (n=505) and standard maternity care (n=479) during their first pregnancy.

There was no major difference between women in the birth centre group and the standard care group regarding the time to second birth (Figure 2). Two years after the first birth, 26 per cent in the birth centre group and 24 per cent in the standard care group gave birth to their second baby (OR 1.1, 95% CI 0.8–1.5); after three years, this figure was 52 per cent in both groups and, after six years, 72 and 75 per cent respectively (OR 0.8, 95% CI 0.6–1.1). The interval to the second birth, expressed as the median, was 2.85 years in the birth centre group (95% CI 2.55–3.15) and 2.82 years in the standard care group (95% CI 2.58–3.06, log rank 1.26, p = 0.26).

Even when the intention-to-treat method was abandoned by comparing only the subgroup of women in the birth centre group who actually gave birth at the centre with the standard care group, there was still no statistically significant difference in terms of the time to the second birth.

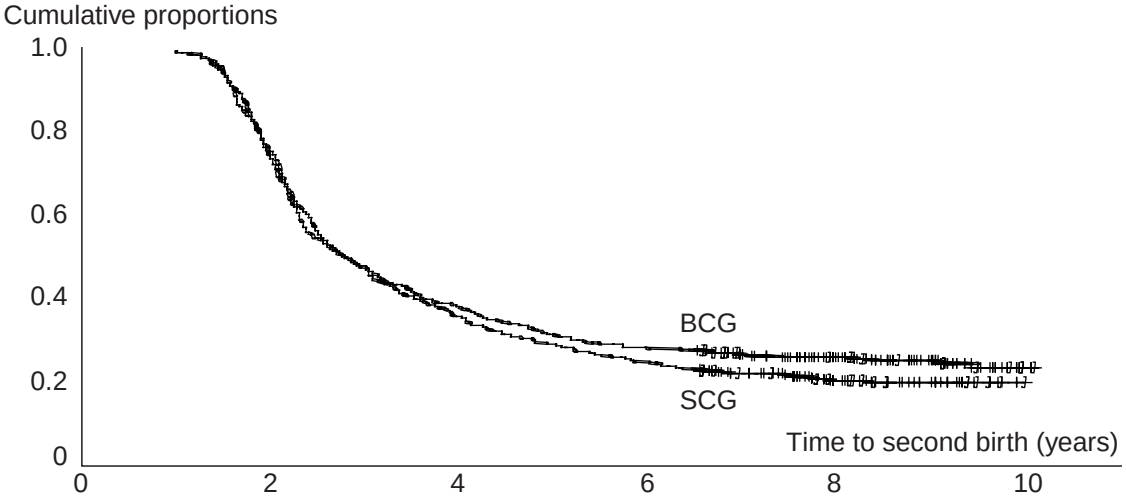

Figure 2. Time to second birth for women in the birth centre group (BCG) versus the standard care group (SCG) illustrated by Kaplan Meier curves.

IMPACT OF THE FIRST CHILDBIRTH EXPERIENCE ON FUTURE REPRODUCTION

Paper II

The impact of women's overall experience of their first labour and birth on the decision about whether or not to have a second child and the interval to the second birth was investigated in 617 first-time mothers.

A negative birth experience (scores 1 and 2 on the seven-point scale) was associated with a longer interval to the next birth, but no major differences were found between women scoring 3 to 7, as illustrated by the Kaplan Meier curves in Figure 3. Of women with a negative birth experience, 38% did not have another baby during the follow-up period, whereas 17% of women scoring 3–7 did not have a second baby (RR 2.2; 95% CI 1.6–3.1, $p < 0.001$). The estimated median time to the second birth was 4.2 years for women scoring 1 and 2 on the childbirth experience scale and 2.4 years for women scoring 3–7 (log rank 16.0, $p < 0.001$).

In the multivariate analysis, a negative experience of the first birth, being 35 years or older and being single contributed to the explanation of future reproduction. Women with an average to positive birth experience (scores 3–7) had a 1.7 times higher probability of having a second birth during the eight to 10 years following their first birth, compared with women with a negative childbirth experience.

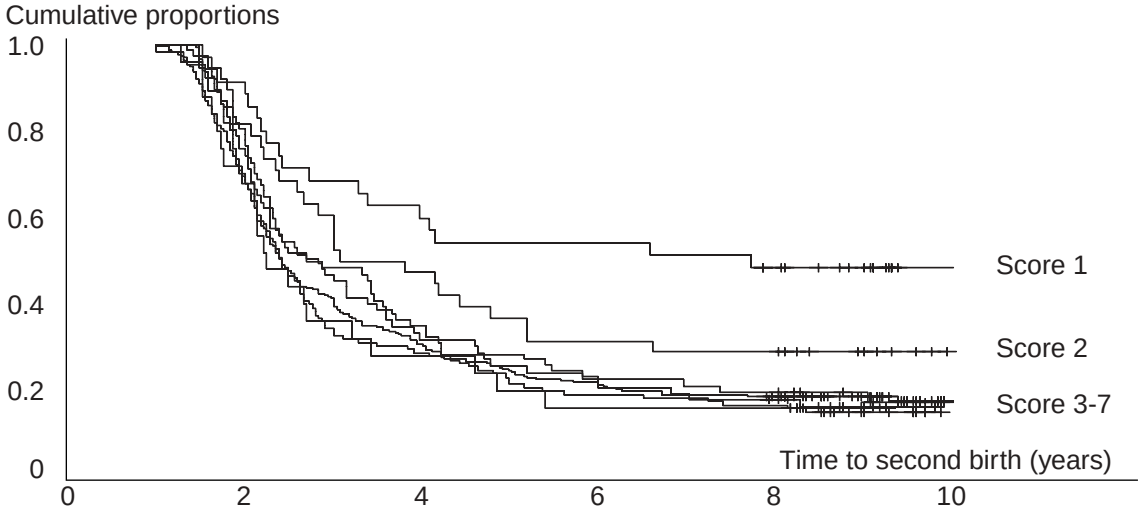

Figure 3. Time to second birth in relation to overall experience of the first birth. The scores on the childbirth experience scale were 1–7 (1=very negative, 7= very positive).

When analysing only those women who had a higher probability of another pregnancy; that is, those who were married/cohabiting or who were 35 years or younger, a negative birth experience was still associated with an increased risk of not having a second baby (RR 1.76, 95% CI. 1.27–2.45 $p < 0.001$).

EFFECT OF BIRTH CENTRE CARE ON PERINATAL MORTALITY

Paper III

Perinatal mortality was investigated in women admitted to birth centre care during pregnancy (n=3 256 pregnancies) over a 10-year period and was compared with the outcomes for women in standard care who met similar medical low-risk criteria (n=180 380 pregnancies).

Perinatal mortality was 5.5 per thousand births in the birth centre group and 4.8 in the control group, a non-statistically significant difference. However, analysis by parity revealed a statistically significant increase in primiparas in the birth centre group, 9.4/1000 compared with 5.2/1000 in the control group (RR 1.8; 95% CI 1.06–3.00), and a non-significant decrease in multiparas, 2.2/1000 compared with 4.5/1000 in the control group. Fetal deaths before the onset of labour and infant deaths after the birth did not differ statistically, but the intrapartum death rate was higher in the birth centre group; this increase appeared in the group of primiparas. The infant death rate seven to 27 days after the birth did not differ statistically between the two groups.

Maternal age over 35 years, as well as pre-term (<37 weeks) and post-term (>=42 weeks) delivery, were associated with an increased risk of perinatal death and controlling for these variables in the multivariate analysis increased the risk of perinatal death in the birth centre group in primiparas (adjusted OR 2.2; 95% CI 1.3-3.9) (Table 2).

The medical records of the 18 cases of perinatal death in the birth centre group were analysed in detail and also assessed by an external independent reviewer. One case was found in which intrapartum death might have been avoided. This was a primiparous woman who gave birth at 41+6 weeks' gestation and who was transferred from the birth centre to the standard delivery ward eight hours before the birth. The slow management of this birth could be discussed. In three other cases, the outcome might possibly have been influenced by the way care was provided. In one case of intra-uterine death before labour, the outcome might have been different if the woman had been admitted for electronic fetal

Table 2. Perinatal mortality in the birth centre group compared with the standard care group, adjusted for gestational age and maternal age.

	n (incidence of perinatal deaths)	All		Primiparas		Multiparas	
		OR	95% CI	OR	95% CI	OR	95% CI
Model of care							
Standard care	180380 (874)	1.0	Ref	1.0	Ref	1.0	Ref
Birth Centre care	3256 (18)	1.5	0.9-2.4	2.2	1.3-3.9	0.7	0.3-1.9
Maternal age, years							
<25	30075 (150)	1,1	0.9-1.3	1,1	0.9-1.4	1,0	0.7-1.4
25-34	123756 (547)	1.0	Ref	1.0	Ref	1.0	Ref
≥35	29805 (195)	1.4	1.2-1.7	1.6	1.2-2.1	1,3	1.0-1.6
Gestation, weeks							
<37	8310 (444)	23.9	20.8-27.5	18,0	14.9-21.9	32.6	26.7-39.9
37-41	159782 (375)	1.0	Ref	1.0	Ref	1.0	Ref
≥42	15041 (50)	1,4	1.1-1.9	1.6	1.1-2.2	1.1	0.6-1.8

hearth rate monitoring when she phoned the centre about fewer fetal movements. In two cases of intrapartum death, the outcome might have been prevented by CTG monitoring, although in one of these cases the mother was opposed to its use.

EFFECT OF BIRTH CENTRE CARE AND INFANT MORBIDITY

Paper IV

Morbidity during the first month after birth was investigated in 3 238 infants of women admitted to birth centre care during pregnancy, compared with 179 502 infants of women in standard care, who met the same low-risk criteria.

Infant re-admissions to hospital during the first month after birth were 6.8% in the birth centre group and 5.1% in the standard care group (OR 1.3; 95% CI 1.2–1.5). The higher proportion of re-admissions in the birth centre group was due to hyperbilirubinemia or immunisation (23% in birth centre group and 13% in the standard care group) and was probably related to the shorter duration of the post-partum stay in the birth centre group. Further analysis revealed that no exchange blood transfusions were made in the re-admitted birth centre group infants and no life threatening diagnoses were found. The most frequent diagnoses in the group of re-admitted infants in the birth centre group were icterus requiring phototherapy (30 cases), AB0 immunisation (11 cases), unspecified viral infection (9 cases), other infection (7 cases), and feeding problems (7 cases).

After controlling for parity, maternal age, country of birth, obstetric history and gestational age, the results revealed that respiratory problems were more com-

mon in the birth centre group than in the standard care group (adjusted OR 1.5; 95% CI 1.2–1.8). Hypoglycaemia and fractures were less common in the birth centre group compared with the standard care group (Table 3).

Table 3. Infant morbidity in the birth centre group (BCG) compared with the standard care group (SCG). Crude and adjusted** odds ratios for the occurrence of different diagnoses.*

	BCG n=3238		SCG n=179502		CRUDE			ADJUSTED		
Diagnoses	**n**	**%**	**n**	**%**	**OR**	**95% CI**	**P**	**OR**	**95% CI**	**P**
Major malformations [1]	52	1.6	3319	1.8	0.87	0.66-1.14	0.31	0.92	0.70-1.21	0.56
Apgar score <7 at 5 min [1]	26	0.8	1606	0.9	0.92	0.62-1.36	0.67	1,03	0.69-1.52	0.90
Small for gestational age [1]	56	1.7	4037	2.2	0.77	0.59-1.0	0.05	0.93	0.71-1.21	0.58
Hypoxia or asphyxia [2]	44	1.4	3047	1.7	0.80	0.59-1.08	0.14	0.85	0.63-1.16	0.30
Respiratory problems [3] (pneumonia excluded)	112	3.5	5274	2.9	1.18	0.98-1.43	0.08	1.47	1.20-1.79	<0.001
Intracranial haemorrhage [4] and CNS lesion	2	0.1	185	0.1	0.60	0.15-2.41	0.47	0.75	0.18-3.05	0.68
Cerebral symptoms [5] (seizures included)	11	0.3	532	0.3	1.15	0.63-2.09	0.65	1.18	0.65-2.15	0.59
Peripheral nerve lesion [6] (brachial plexus included)	1	0.03	282	0.2	0.20	0.03-1.40	0.07	0.19	0.03-1.36	0.10
Infections [7] (pneumonia included)	49	1.5	3169	1.8	0.86	0.64-1.14	0.28	0.97	0.73-1.30	0.86
Immunisation/ Hyperbilirubinemia [8]	80	2.5	5180	2.9	0.85	0.68-1.07	0.16	0.95	0.76-1.19	0.67
Hypoglycaemia [9]	15	0.5	2059	1.1	0.40	0.24-0.67	<0.001	0.44	0.27-0.74	0.002
Fractures [10] (clavicle included)	18	0.6	2505	1.4	0.40	0.25-0.63	<0.001	0.39	0.25-0.62	<0.001

* *Reference group*

** *Adjusted for parity, maternal age, country of birth, gestational age, history of infertility and history of perinatal mortality*

[1] *Data only from the Swedish Medical Birth Register. Swedish Medical Birth Register and Hospital Discharge register are merged in all other variables*

[2–10] *Based on international classification of diagnoses, ICD-9 before 1997 and ICD-10 after 1997.*

[2] *ICD-9; 768, ICD-10; P20-21.*

[3] *ICD-9; 769, 770B-Z (770A excluded), ICD-10; P22, P24-28 (P23 excluded).*

[4] *ICD-9; 767A, 772B,C, ICD-10; P100-109, P523-529.*

[5] *ICD-9; 779A-C, ICD-10; P90-91.*

[6] *ICD-9; 767E-H, ICD-10; P110-119, P140-149.*

[7] *ICD-9; 762H, 770A, 771, ICD-10; P23, P027, P35-39.*

[8] *ICD-9; 773, 774G, ICD-10; P550, P599.*

[9] *ICD-9; 775H, ICD-10; P703-709.*

[10] *ICD-9; 767B-D, ICD-10; P130-139.*

A more detailed analysis of the specific diagnoses summarised as 'respiratory problems' revealed no statistically significant differences regarding infant respiratory distress syndrome, aspiration and transient tachypnea, but the proportion of 'other respiratory problems' (ICD9: 770W, X and ICD10: P 228, 229, 288, 289) was higher in the birth centre group than the standard care group (OR 3.1; 95% CI 2.2–4.4).

As the diagnostic procedures may vary between hospitals and the standard care group data were collected from different hospitals, whereas the birth centre group data were almost exclusively collected from one hospital (Södersjukhuset), we also analysed the cases from this hospital separately. The statistically significant differences in respiratory problems decreased, and the difference in fractures remained at the same level, whereas the significant differences in rates of hypoglycaemia disappeared.

Discussion

The two principal aims of this thesis, to investigate factors affecting women's decision to have a second baby and the effects of birth centre care on infant outcomes, represent two different research questions and will therefore be discussed separately.

One of the main findings in this thesis was that birth centre care during a woman's first pregnancy did not affect the decision to have a second baby and the spacing to the next birth, but a negative childbirth experience did. The other main finding was that birth centre care had no effect on overall perinatal mortality, but that an increased risk was found in first-time mothers, and this was related to the intrapartum period. Most infant diagnoses did not differ between the birth centre and the standard care groups, but fewer infants in the birth centre group had fractures, and more respiratory problems were observed in the birth centre group.

FACTORS AFFECTING WOMEN'S DECISION TO HAVE A SECOND BABY

Paper I

To our knowledge, Paper I is the first study to investigate whether the type and characteristics of maternity care received during a woman's first pregnancy and birth have an impact on her future reproduction. The hypothesis that a model of maternity care could have such an effect was based on the findings of the Stockholm Birth Centre Trial, which revealed that women in birth centre care were more satisfied with the care they received and that they also tended to have a more positive overall birth experience. In addition, some women were overwhelmingly enthusiastic about their experiences and told their midwife that they would soon return with a new pregnancy.

The finding that birth centre care did not impact on future reproduction is supported by Hemminki, who showed that lower fertility appeared to result more from physical difficulties of infertility than from a lessened desire for having children (42). Others have shown that the decision to become pregnant and complete the pregnancy is affected by several medical, social, economic, and personal factors (40–46).

Women are generally pleased with at least antenatal and intrapartum care (59), and women's expectations in early pregnancy are very much in line with current antenatal practices in Sweden (63, 64). If standard maternity care is of a high standard and well accepted by pregnant women (65), as it is in Sweden, the services as such may be less important. Even if women in birth centre care were more satisfied with the care they received, women in standard care were still relatively pleased with their care (29). This may be another explanation of why the experience of care, as such, had no long-term effect on women's reproductive behaviour.

In Paper I, women were randomly allocated to the individual models of care, which minimised the bias caused by selecting women for the two groups. Sociodemographic background and other variables that might influence women's willingness to have a second child were similar at baseline. However, more birth centre women than standard care women attended childbirth education classes during pregnancy (83% and 64% respectively in the complete groups including both primiparas and multiparas) (29). These classes do not usually include information or discussions about family planning or the spacing of children and the difference in the attendance rate probably had no effect on the outcome variable. There was no reason to believe that the women in the two groups differed systematically with regards to other factors during the observation period that might have affected future reproduction.

The size of the sample in Paper I was large enough to detect relevant differences, such as a difference in time to the second birth of 4.3 months (80% power, $p<0.05$), and the observation period was reasonably long, as each woman was followed for a period of at least 6.5 years. However, one limitation of the study was the selection of women for the trial. For obvious reasons, only women with an interest in birth centre care and who were willing to be randomised to this new model or standard care were included. These women differed from the general population by being older, better educated and more interested in the psychological aspects of childbirth (28). These women may be more vocal and capable of seeing that their needs are met, irrespective of the model of care, compared with other women, and this may be another explanation of why birth centre care in this study did not have any effect on future reproduction.

Paper II

The most significant finding in Paper II was that women with a negative experience of their first birth had fewer subsequent children and a longer interval to the second birth. For understandable reasons, being older or single was also associated with future reproduction.

This study was conducted as a cohort study and it made use of data that had already been collected and related to women's assessment of their childbirth experience at two months postpartum. Although this study controlled for a wide range of variables that could have an impact on whether or not women have a second child, such as socio-demographic background, outcome of first labour and birth, expectations relating to birth and parenthood, attitudes to decision-making, and anxiety, the possibility that other important confounders may have been overlooked cannot be exclude.

Personality factors are a possible confounder, since they might affect the willingness to have another child, as well as the experience of birth. It is well established that personality variables may affect health and progression of disorder (66). Of five major personality dimensions related to health outcomes, described by John and Srivastava (67) as agreeableness, conscientiousness, extraversion, openness and neuroticism, it is probably the last one which is most commonly associated with health complaints and negative outcomes (68). Theoretically, the personality trait of neuroticism could affect women's experience of their first birth, as well as their willingness to have a second baby. In Paper II, neuroticism-related personality scales, such as the somatic and psychic anxiety scales in the Karolinska Scales of Personality, were used to control for the confounding impact of personality. It has previously been demonstrated that these scales are good markers of the neuroticism construct (69).

The appropriate time for measuring satisfaction with care has been discussed, as responses may be affected by a person's degree of dependence on the caregiver (70). Similarly, the distance from the event may affect the measurement of satisfaction with the childbirth experience. Even if there are data suggesting that women actually remember childbirth very well over time (71, 72), other studies have shown that many women become more critical over time (73, 74). A recent Swedish study revealed that almost one in four women became more critical at one year compared with two months after the birth (75). It is only possible to speculate about whether the differences observed in Paper II

would have become even more obvious, or vice versa, if women's childbirth experience had been assessed at a later point in time.

One limitation of Paper II was that the women were drawn from a birth centre trial. As stated earlier, these women focus more heavily on the psychological aspects of childbirth, including more positive expectations of the approaching birth, than other women (28). The possibility cannot be excluded that the childbirth experience was more important to these women compared with the general population.

In spite of this limitation, the study provides data that strongly suggest that woman's experiences of the first birth have an impact on future reproductive behaviour. The finding elucidates the importance of taking women's experiences into account when providing intrapartum care and of paying attention to their birth experiences during postpartum follow-up.

EFFECT OF BIRTH CENTRE CARE ON INFANT OUTCOME

Paper III

No statistically significant difference was found in overall perinatal mortality between women booked for birth centre care during pregnancy, compared with women in standard maternity care. However, the perinatal mortality rate was higher in the primiparas and tended to be lower, yet not statistically significant, in multiparas in the birth centre group.

An important question is whether the two samples are really comparable. After excluding smokers, women with multiple pregnancies and high-risk medical criteria, the standard care group was more low-risk than the general population of women who gave birth in Stockholm during the same period. This was reflected in a lower perinatal mortality rate, 4.8/1 000, compared with 5.6/1 000 in the population from which the sample was drawn. Even if we by exclusion of risk groups made the standard care group comparable to the birth centre group, and thus more low-risk at baseline than the general population, the birth centre group was still probably even more low-risk. Some risk factors for perinatal mortality were under-represented in the birth centre group; they included maternal overweight (76, 77), a history of infertility (78), preterm birth and low infant birth weight (79). Thus, a possible increased perinatal mortality in the birth centre group could not be due to selection bias.

As described earlier, women who choose birth centre care differ from other women, not only by running a lower risk of medical complications but also by being older, better educated and by being more concerned with the psychological aspects of childbirth and having a more critical attitude to medical interventions (28). In some cases, these attitudes may increase the risk of an adverse outcome by delaying necessary intervention or transfer to standard care. When all the differences in women's background and riskstatus are taken into account it is possible to conclude that women characterised by an interest in birth centre care did not run a higher risk of perinatal mortality- in fact, quite the contrary.

In birth centre care, as well as in standard care, a detailed analysis of the individual cases of perinatal mortality would probably reveal events that could have been avoided or managed differently. In Paper III, we decided to analyse cases of perinatal mortality only in the birth centre group. Apart from the difficulty associated with tracing and analysing all the 874 hospital records with perinatal deaths in the standard care group, the observed differences in mortality rates favoured the standard care group. Consequently, we tried to elicit additional information about these cases in the birth centre group in order to explain the possible causes of the observed differences.

Analyses of the 18 perinatal deaths did not permit any valid conclusions to be drawn about possible unsafe practices. The external reviewer identified one case with avoidable factors and three cases in which perinatal death could possibly have been avoided. The possible risk factors that might affect perinatal mortality in the birth centre group will be discussed.

Possible risk factors

One practice that could possibly interfere with safety is transfer during labour. It may be associated with some delay, especially if the birth centre is not located close to a delivery ward. Another risk factor may be that the staff on the standard delivery ward may be influenced by the probability that a woman who has been transferred from a birth centre often favours 'natural childbirth' and they may therefore continue to manage labour as if the woman were still low risk when she has actually become high risk. This was probably the case in one of the perinatal deaths.

Still another risk factor may be the lack of access to electronic fetal monitoring (CTG) at the birth centre, or after it had been introduced for admission tests, its

overly restrictive use during labour. Two of the intrapartum deaths could possibly have been avoided by using CTG.

Another potential risk factor when it comes to birth centre care is the philosophy that emphasises a strong belief in the natural process. As stated by Hodnett (36), this may delay the recognition of or action regarding imminent complications. It may not only apply to the birth centre staff but also to its consumers. In one case of perinatal death, the mother declined electronic fetal monitoring, which may have made the midwife less inclined to transfer when she recorded tachycardia by the stethoscope.

The management of prolonged pregnancy may have been yet another risk factor in three cases in which gestation ranged from 41+3 to 42+0 weeks. Even pregnancies before 42 weeks may require special attention. This conclusion is supported by studies by Ingemarsson and colleagues (80), who demonstrated a higher rate of intra-uterine death in primiparas at 41 weeks and beyond, and by Divon and colleagues (81), who found a small yet significant increase in fetal mortality in accurately dated pregnancies that extended beyond 41 weeks of gestation.

Most of these risk factors were discussed by the staff at the birth centre when the data from the Stockholm Birth Centre Trial were published in 1993 (29) and changes were made to the medical guidelines regarding the management of post-term pregnancies in 1997, while CTG was introduced in 1998, but mainly for admission tests. Greater attention was also paid to women with prolonged labour, with effects on the intrapartum transfer rate. In spite of these changes, no obvious pattern was found in the perinatal mortality rate over time. However, this may be related to the small number of cases each year.

Paper IV

Perinatal mortality in Sweden is very low and difficult to study, there is therefore important to investigate infant morbidity. The existence of MBR and HDR makes it possible to study infant diagnosis.

The main findings were a higher rate of respiratory problems and a lower rate of fractures in the birth centre group compared with the control group in standard care. The overall hospital stay was also shorter in the birth centre group.

The finding that appeared most worrying was a higher rate of respiratory problems in the birth centre group. However, the more detailed analysis revealed

that this difference was not related to the more severe diagnoses, such as infant respiratory distress, but rather to the group of miscellaneous respiratory problems. No obvious explanation of this finding was found. However, the possibility cannot exclude that minor diagnoses were recorded more carefully in the birth centre group, especially during the first years when the birth centre was part of a research project and everything was monitored in detail. This practice may then have continued during the following years. When only infants born at South Hospital were included in the analysis the observed difference in respiratory problems was only bordering on statistical significance, suggesting that differences in clinical practices regarding the recording of diagnoses may have contributed to the findings.

The most positive finding from the birth centre perspective was the smaller number of fractures in the birth centre group than in the standard care group. This finding could possibly be related to the less frequent use of medical interventions (82, 83), such as a lower rate of instrumental vaginal deliveries, in the birth centre group. Less use of oxytocin stimulation (17) and more alternative birth positions (84), in the birth centre group may also have been important.

There was also a low rate of hypoglycaemia in the birth centre group, this may be due to the earlier establishment of breastfeeding, but it is probably more a result of different routines for diagnosing non-symptomatic hypoglycaemia in the different hospitals. This latter explanation is supported by the fact that statistical differences disappeared when only the birth centre group and standard care group infants born at Södersjukhuset were included in the analysis.

Severe infant morbidity was not increased in the birth centre group. The most valid finding regarding infant morbidity was that birth trauma, such as fractures, was less common in birth centre care than standard care.

METHODOLOGICAL CONSIDERATIONS

Three of the papers in this thesis (Papers II-IV) were observational studies, which aimed to draw conclusions about cause and effect. The optimal design for research questions of this kind is a randomised controlled trial, which minimises bias caused by the selection of participants for the study groups and permits more valid conclusions about causality. In Paper II, randomisation was, not appropriate for obvious reasons, as women cannot be randomly allocated to a positive and negative birth experience. In Papers III and IV, randomisation

would have been possible, but only in theory. When a birth option, like the birth centre at Södersjukhuset, has become established, randomisation is usually no longer possible, or acceptable. Under the circumstances, the most optimal design was used in these two studies by taking advantage of the national medical birth registers in Sweden and including all the women who gave birth in the County of Stockholm during the 10-year observation period and who met similar low-risk criteria and by adjusting statistically for differences in the known maternal characteristics that might influence infant outcome. In spite of the adjustment for possible confounders in Papers III and IV, as well as in Paper II, the possibility cannot be excluded that important factors may have been overlooked, either because they were not measured (in the questionnaires or MBR) or because they were unknown. The results of the studies must therefore be interpreted with this in mind.

Register data

The Swedish Medical Birth Registry was the principal source of data in this thesis. The quality of the information reported in MBR has been assessed and, although it is impossible to avoid missing data in a large register, the size of the register still makes it accurate for evaluation of aggregated data (48). It provides data on 97–99% of all infants born in Sweden (51) and is one of the most complete birth registers in the world . All the information is collected prospectively and is therefore free from recall bias. The most serious problems with missing data in the MBR is probably that related to infant diagnoses, particularly for infants who have been transferred to neonatal wards (50). This problem was addressed by merging the MBR data with information from the Hospital Discharge Register, which includes 99.1 per cent of all hospital admissions (85).

The Swedish national registration number (PIN) was a prerequisite for conducting this thesis. It made it possible to link background data and data relating to women's experience of childbirth collected by questionnaires in a previous study to MBR data on subsequent births (Papers I and II) and to follow infant outcomes in two models of care during a 10-year period (Papers III and IV). Personal integrity has been discussed in relation to the PIN, but the security measures for protecting the participants are rigorous and by deleting the PIN after merging of data sets, no individual can be traced.

Sample size

The size of study samples is an important methodological issue. A study requires an adequate sample size to provide sufficient power to detect the differences in outcomes suggested by the hypothesis of the study. Studies of rare events, such as perinatal mortality and morbidity, in Papers III and IV require large samples. All previous studies of alternative models of maternity care, including the meta-analyses, have included insufficient numbers of women to enable valid conclusions to be drawn about infant safety. Even the sample in Papers III and IV, which was defined by practical circumstances, may have been too small to draw conclusions about overall perinatal mortality.

General conclusions

No effect by birth centre care during a woman's first pregnancy was observed on her decision to have a second baby, suggesting that the model of care may be a less important factor in this important decision in life. This finding is valid within the Swedish model of maternity care, where satisfaction with standard care is relatively high. However, a negative experience of the first birth was associated with having fewer subsequent children and, in those who had a second child during the observation period, a longer interval to the next birth. These findings confirm what many women and professionals believe but which has not previously been demonstrated in a research context. A positive experience of childbirth is one of the goals of Swedish intrapartum care (86) and the finding of this thesis reveal that this goal is important, not only in its own right but also for its long-term consequences.

Birth centre care in this thesis was associated with a significant increase in perinatal mortality in first-born babies, and this risk was associated with the intrapartum event (87). Subsequent severe infant morbidity did not increase in the birth centre group. The most valid finding regarding infant morbidity was that birth trauma, such as fractures, was less common in birth centre care than standard care.

Possible risk factors have been discussed in the planning and revision of birth centre care and many of them have been dealt with and eliminated in current clinical practice. It is important to consider maternal and infant risk factors in the planning of alternative models of childbirth care.

Implications for the Future Research

The impact of a woman's first childbirth experience on future reproduction could be further explored in four different ways:

- by studying a more representative sample of first-time mothers than those in the current study, which only comprised women who had been admitted to birth centre care
- by measuring women's assessment of their childbirth experience longer after the birth but before some women may have become pregnant again, for instance at six months postpartum
- by prolonging the period of follow-up after the first birth
- by studying the reasons why some women avoid a second pregnancy because of traumatic birth experiences.

The issue of infant safety in relation to birth centres and other models of alternative birth care require further investigation, ideally by means of randomised controlled trials. However, conducting these trials may be difficult in places where alternative birth options are already established and it is therefore important to consider the possibility of conducting a trial whenever a new birth option is being planned.

Alternative models of maternity care have been associated with major advantages, in terms of the reduction in pain relief and increased maternal satisfaction, for example, but it is still not clear which specific aspects of these birth options are effective. Evaluations have often included an entire package of care and not one specific intervention. Future research should focus on evaluating one aspect at a time, such as the impact of different forms of continuity of care, different access to pain relief or other medical interventions.

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