Our research has shown that, for women with low risk pregnancies in the Netherlands, choosing to give birth at home is a safe choice with an outcome that is at least as good as that of planned hospital birth. We also found indications that there is some self selection among women who can decide for themselves where to have their baby, and that this preordains outcome, albeit to a limited extent. It is important, therefore, that the home birth option remains available, but especially that women at low risk are really given a free choice.

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Conflict of interest: None.

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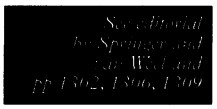
Home versus hospital deliveries: follow up study of matched pairs for procedures and outcome

Ursula Ackermann-Liebrich, Thomas Voegeli, Kathrin Günter-Witt, Isabelle Kunz, Maja Züllig, Christian Schindler, Margrit Maurer, Zurich Study Team



Abstract

***Objective*—To assess procedures and outcomes in deliveries planned at home versus those planned in hospital among women choosing the place of delivery.**

***Design*—Follow up study of matched pairs.**

***Setting*—Antenatal clinics and reference hospitals in Zurich between 1989 and 1992.**

***Subjects*—489 women opting for home delivery and 385 opting for hospital delivery; the women comprised all those attending members of the study team for antenatal care and those attending the reference hospital for antenatal care who could be matched with the women planning home confinement.**

***Main outcome measures*—Need for medication and incidence of interventions during delivery (caesarean section, forceps, vacuum extraction, episiotomy), duration of labour, occurrence of severe perineal lesions, maternal blood loss, and perinatal morbidity and death.**

***Results*—All women were followed up from their first antenatal visit till three months after delivery. Referrals during pregnancy (n = 37) and labour (70), changes of mind (15 home to hospital, eight hospital to home), and 17 miscarriages resulted in 369 births occurring at home and 486 in hospital. During delivery the home birth group needed significantly less medication and fewer interventions whereas no differences were found in durations of labour, occurrence of severe perineal lesions, and maternal blood loss. Perinatal death was recorded in one planned hospital delivery and one planned home delivery (overall perinatal mortality 2.3/1000). There was no difference between home and hospital delivered babies in birth weight, gestational age, or clinical condition. Apgar scores were slightly higher and umbilical cord pH lower in home births, but these differences may have been due to differences in clamping and the time of transportation.**

***Conclusion*—Healthy low risk women who wish to deliver at home have no increased risk either to themselves or to their babies.**

Institute for Social and Preventive Medicine of the University of Basle, CH-4051 Basle, Switzerland
Ursula Ackermann-Liebrich, *professor and head*
Kathrin Günter-Witt, *research fellow*
Isabelle Kunz, *research fellow*
Maja Züllig, *research fellow*
Christian Schindler, *statistician*

Zurich Canton, Switzerland
Thomas Voegeli, *general practitioner*
Margrit Maurer, *midwife*

Zurich Study Team
Members of the study team are listed at the end of this report. /tr;2;f

Correspondence to:
Professor Ackermann-Liebrich.

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Introduction

Since the 1940s hospital has been considered to be the safest place for a woman to give birth. Probably partially owing to optimal standards of hygiene in hospital and the availability of equipment perinatal and maternal death rates in Switzerland are among the lowest in the world (8.0/1000 and 0.02/1000, respectively (1990 data)). Questions about possibly increased risks to healthy mothers and their children in hospital were first raised in the 1980s.[1]

In 1990, 99% of all deliveries in Switzerland took place in hospital.[2] As delivery has become safer, however, so there has been growing desire among women to move away from interventions and hospitals to more "natural" childbirth. A team of general practitioners and midwives in the canton of Zurich (population 1.1 million) responded to this wish by offering the possibility of home delivery to those who requested it. The Swiss health care system is private for all outpatient care, so every woman may choose where to deliver. Fees are covered by health insurance, to which everybody subscribes.

We report a quality control study of hospital versus home delivery conducted by the team, which was organised for the purpose. As only few studies had systematically compared home and hospital deliveries[3-6] the team studied matched pairs. For ethical and practical reasons a randomised trial was not possible.[7]

Methods

This was a prospective cohort study with matched pairs. Doctors and midwives of the study team recruited all pregnant women at their first antenatal visit with one of them between March 1989 and March 1991 or when at a subsequent visit they first decided to have a home delivery. The entry criterion for each category was the intention to deliver at home or in hospital (recorded during the first antenatal visit or when the decision was taken) and an outcome criterion the place where delivery actually occurred. The team had no formal policy on criteria for accepting women for home delivery. Hence reasons for hospital referral were also recorded as an outcome in the home delivery group.

Matching criteria for whole study population

- Age <16, 16-19, 20-29, 30-34, >34 years
- Parity 1, 2-4, >4
- Gynaecological and obstetric history (none or 24 categories which could be combined)
- Medical history (none or 12 categories)
- Partner situation (living with a partner, or living with other people, or living alone)
- Social class (five categories described by Beer[8])
- Nationality

Planned hospital deliveries were included only if they were to take place at one of the reference hospitals in the study. These were restricted in order to make comparison and access to data easier. It soon became apparent that not enough women wishing to deliver in hospital could be recruited, and private gynaecologists and outpatient departments of the larger obstetric clinics in Zurich were asked to participate. Most women who attended those agencies for antenatal care, however, were excluded because of medical history or nationality. Ultimately matching was possible mainly for healthy Swiss nationals with good educational background, as these were the group who selected themselves for home delivery. Complete data were collected on all selected women who opted for hospital delivery, though because of strict matching criteria (see box) a matching partner could be found for only about half of women potentially delivering at home.

RECRUITMENT

Sample size calculations suggested that it would be impossible to find enough home deliveries in order to show differences in perinatal mortality and other rare outcomes. The team therefore recruited all women delivering at home in the canton in the two years, an estimated sample size of 500 allowing comparison of more frequent or qualitative outcomes—for example, caesarean section, Apgar scores, and birth weight.

A total of 951 pregnant women were recruited—493 who wished to deliver at home and 458 who requested hospital delivery and satisfied criteria for serving as a matching candidate. Women who opted for home delivery were recruited between March 1989 and March 1991 and those requesting hospital delivery recruited between March 1989 and their expected date of delivery up to 31 March 1992.

In 1990 the Swiss Association of Midwives recorded 220 planned and 201 actual home deliveries in the canton of Zurich (annual report 1990, Jahresbericht des Schweizerischen Hebammenverbandes Sektion Zürich und Umgebung). The study team recorded 232 planned and 203 actual home deliveries. Even with the exclusion of women who for social reasons changed their minds during pregnancy the team still recorded more deliveries. It therefore seems likely that all home deliveries in Zurich during the study period were included in the study.

DATA COLLECTION

Members of the study team recorded data about every antenatal visit on specially designed forms. These were later coded and entered into computerised files. In addition, a delivery form was completed by the midwives. The hospitals could not be persuaded to use these forms, and data were therefore coded in the same way according to preset criteria.

Newborn infants were examined immediately after birth by the general practitioner or obstetrician and on about the third day by specially trained paediatricians. The findings of this second examination were recorded following a scheme developed by the Swiss Neonatology Group.[9] This could not be done for hospital deliveries, but a similar form was used by all the hospitals.

In addition, the mothers completed three questionnaires. A first questionnaire, during pregnancy, asked about attitudes to childbearing and delivery; a second questionnaire, completed at the same time, sought medical and social histories. Three months after delivery a third questionnaire was mailed to the mothers. This was based on a draft for an English national perinatal survey (personal communication) and asked about the experience of birth and the puerperium.

Written consent was obtained from all women. Confidential treatment of data was assured.

PROCESSING AND ANALYSING DATA

Hospital records and records of home deliveries were coded by specially trained personnel not associated with the study and data entered in an SPSS file. Data were analysed separately for the different stages of the study and also separately for matched pairs and all women. A common database was then formed for all stages and transferred to the mainframe computer at the Amt für Informatik in Basle. Further analyses were by SPSS and SAS on a mainframe computer.

This paper reports findings from matched and unmatched comparisons without adjustment for differences in social class and so on in the unmatched sample. Statistical significance of differences in means of quantitative variables between cases and controls was assessed by the one sample t test whereas McNemar's test was used to compare the frequency of binary characteristics between matched samples. In unmatched analyses the two sample z test and the χ^2 test or Fisher's exact test were used instead. In matched analyses odds ratios were estimated by the ratio of discordant pairs.[10]

STUDY POPULATION

Of the 951 women recruited, 70 who had planned their deliveries in hospital were excluded for being unmatchable owing to nationality (n = 22) or medical history (5) or because their delivery was planned in a setting not conforming with the study criteria (43). One woman who had planned a home delivery was excluded for the same reason. Six women (three planned home and three planned hospital births) moved away during pregnancy and were lost to follow up. Thus 489 planned home deliveries and 385 planned hospital deliveries remained in the study. A total of 214 matched pairs were formed (49% of women in the study).

Results

STUDY GROUPS

Tables 1 and 2 show the socioeconomic and health characteristics of the study groups[1] and, when available (table 1), comparable data for the rest of the childbearing Swiss population in 1991. In the matched pairs analysis women in the home births group weighed less than the hospital group. In the whole study population there were other differences between women planning a home birth and women planning a hospital birth. Women in the home births group were more likely to live with a partner and to be employed before pregnancy. They were taller but weighed less than the hospital group whereas no differences were shown in age, profession, or nationality.

ATTITUDE

The attitude questionnaire confirmed that women booking for home confinement had greater self determination than the controls. They wanted to influence and determine the birth themselves and preferred to rely on intuition rather than on the advice of professional carers. They also required more intimacy in the birth setting than

Table 1—*Matching criteria for whole study group. Except where stated otherwise figures are numbers (percentages) of women*

	Planned home (n = 489†)	Planned hospital (n = 385†)	P value	Total study group (n = 874†)	Average for rest of childbearing Swiss population (%)
Mean age at conception (years) (SD)	29.2 (4.3)	29.2 (4.6)	0.95	29.2 (4.4)	
Mean age at delivery (years)				30.0	28.9
Parity:					
1st Child	201 (41.1‡)	182 (47.3‡)		383 (43.8‡)	44.9§
2nd Child	175 (35.8‡)	143 (37.1‡)	0.02	318 (36.4‡)	36.7§
3rd Child or more	113 (23.1‡)	60 (15.6‡)		173 (19.8‡)	18.4§
Partner situation:					
Living with partner	452 (92.4)	346 (89.9)		798 (91.3)	
Living with group	15 (3.1)	4 (1.0)	0.004	19 (2.2)	
Living alone	22 (4.5)	35 (9.1)		57 (6.5)	
Marital status:					
Married	314 (71.4)	219 (82.0)	0.002	533 (75.4)	93.9
Not married	126 (28.6)	48 (18.0)		174 (24.6)	6.1
Nationality:					
Swiss	453 (92.6)	360 (93.5)	0.69	813 (93.0)	80.3
Other	36 (7.4)	25 (6.5)		61 (7.0)	19.7
Social class:					
Self employed	341 (69.7)	184 (47.8)		525 (60.1)	
Skilled	122 (25.0)	162 (42.1)	<0.001	284 (32.5)	
Unskilled, agriculture, missing	26 (5.3)	39 (10.1)		65 (7.4)	

†Except for marital status, where n = 440 (planned home), n = 267 (planned hospital), and n = 707 (total).
‡Rank of children of these women.
§Rank of children from same marriage, therefore not completely comparable.

Table 2—*Socioeconomic variables. Values are means (95% confidence interval)*

		Planned home	Planned hospital	P value of difference
Anthropometric characteristics:				
Height (cm)	Total	166.7 (166.1 to 167.3) (n = 448)	165.6 (165.0 to 166.2) (n = 349)	<0.05
	Matched pairs	166.7 (165.7 to 167.7) (n = 181)	166.3 (165.4 to 167.2) (n = 181)	0.56
Weight (kg)	Total	56.9 (56.2 to 57.6) (n = 449)	59.1 (58.2 to 60.0) (n = 352)	<0.001
	Matched pairs	57.3 (56.2 to 58.4) (n = 183)	60.4 (59.0 to 61.8) (n = 183)	<0.001
Woman's profession:				
Self employed (%)	Total	51.5 (47.1 to 55.9) (n = 489)	37.4 (32.6 to 42.2) (n = 385)	<0.001
	Matched pairs	43.0 (36.4 to 49.6) (n = 214)	41.6 (35.0 to 48.2) (n = 214)	0.82
Skilled (%)	Total	38.9 (34.6 to 43.2) (n = 489)	56.9 (52.0 to 61.8) (n = 385)	<0.001
	Matched pairs	49.5 (42.8 to 56.2) (n = 214)	53.7 (47.0 to 60.4) (n = 214)	0.39
Unskilled (%)	Total	2.9 (1.6 to 4.8) (n = 489)	3.4 (1.8 to 5.7) (n = 385)	0.65
	Matched pairs	2.8 (1.0 to 6.0) (n = 214)	3.3 (1.3 to 6.6) (n = 214)	1.0
Agriculture (%)	Total	1.0 (0.3 to 2.4) (n = 489)	1.0 (0.3 to 2.6) (n = 385)	1.0
	Matched pairs	0.9 (0.1 to 3.3) (n = 214)	0.9 (0.1 to 3.3) (n = 214)	1.0
Missing (%)	Total	5.7 (3.8 to 8.2) (n = 489)	1.3 (0.4 to 3.0) (n = 385)	<0.001
	Matched pairs	3.7 (1.6 to 7.2) (n = 214)	0.5 (0.0 to 2.6) (n = 214)	<0.05
Education:				
High school, university (%)	Total	42.0 (37.4 to 46.6) (n = 438)	29.9 (25.1 to 34.7) (n = 344)	<0.001
	Matched pairs	36.6 (29.5 to 43.7) (n = 175)	34.9 (27.8 to 42.0) (n = 175)	0.91
College, vocational school (%)	Total	50.0 (45.3 to 54.7) (n = 438)	54.9 (49.6 to 60.2) (n = 344)	0.17
	Matched pairs	57.7 (50.4 to 65.0) (n = 175)	51.4 (44.0 to 58.8) (n = 175)	0.33
Primary school (%)	Total	8.0 (5.5 to 10.5) (n = 438)	15.1 (11.3 to 18.9) (n = 344)	<0.01
	Matched pairs	5.7 (2.8 to 10.3) (n = 175)	13.7 (9.0 to 19.7) (n = 175)	<0.05
Employment:				
Employed before pregnancy (%)	Total	70.9 (66.7 to 75.1) (n = 450)	77.4 (73.0 to 81.8) (n = 354)	<0.05
	Matched pairs	74.5 (68.2 to 80.8) (n = 184)	76.6 (70.5 to 82.7) (n = 184)	0.67
Employed during pregnancy (%)	Total	69.1 (64.8 to 73.4) (n = 447)	73.1 (68.5 to 77.7) (n = 353)	0.22
	Matched pairs	71.4 (64.9 to 77.9) (n = 185)	74.1 (67.8 to 80.4) (n = 185)	0.59

women planning a hospital delivery. Women in the home births group were noticeably less anxious about delivery and had more confidence in their bodies than women in the hospital group.

OUTCOMES OF PREGNANCY AND ACTUAL PLACE OF DELIVERY

Of the 874 women in the study, 17 miscarried (fig 1). Seven miscarriages were recorded in the matched pairs analysis, two in the planned home deliveries group and five in the planned hospital deliveries group. For the analysis of birth outcome these miscarriages reduced the number of matched pairs available to 207 (414 women). Among the remaining 483 women in the planned home delivery group, 37 (7.7%) were referred to hospital during pregnancy and 15 (3.1%) changed their minds and wished to give birth in hospital. Conversely, eight (2.1%) of the 374 women in the planned hospital delivery group changed to wishing to deliver at home. Among these women, four were referred to hospital during delivery. After the onset of labour 70 (15.9%) of the remaining 439 women had to be transferred to hospital. This proportion was considerably higher in primiparous women (25%). Thus 369 deliveries actually occurred at home and 486 in hospital. Two women who wished to deliver in hospital gave birth unattended, one at home and one in the taxi. Both women went to hospital for postnatal care.[11]

Table 3—*Birth complications. Results expressed as numbers (percentages) of women*

		Planned home	Planned hospital	Odds ratio (95% confidence interval)	P value
Breech presentation	Total	15 (3.1)	16 (4.4)	0.62 (0.29 to 1.30)	0.21
	Matched pairs	3 (1.5)	9 (4.5)	0.33 (0.06 to 1.34)	0.15
Twins	Total	2 (0.4)	7 (1.9)	0.22 (0.05 to 1.06)†	0.06
	Matched pairs	0	3 (1.4)	0 (0 to 1.71)	0.25
Hypertension	Total	6 (1.2)	10 (2.7)	0.46 (0.16 to 1.27)†	0.13
	Matched pairs	3 (1.4)	5 (2.4)	0.60 (0.09 to 3.08)	0.73
Premature rupture of membranes (>1 hour before labour)	Total	69 (14.8)	48 (14.2)	1.05 (0.71 to 1.56)	0.90
	Matched pairs	37 (18.6)	34 (17.1)	1.11 (0.64 to 1.94)	0.79
Preterm birth (<259 days)	Total	7 (1.5)	13 (3.5)	0.40 (0.16 to 1.02)†	0.07
	Matched pairs	2 (1.0)	5 (2.5)	0.40 (0.04 to 2.44)	0.45
Vaginal bleeding	Total	3 (0.6)	5 (1.3)	0.46 (0.11 to 1.94)†	0.31
	Matched pairs	0	2 (1.0)	0 (0 to 3.47)	0.50
Post-term delivery (>293 days)	Total	24 (5.0)	15 (4.1)	1.24 (0.64 to 2.39)	0.53
	Matched pairs	14 (6.9)	13 (6.4)	1.08 (0.47 to 2.49)	1.0

†Limited accuracy confidence interval.

OBSTETRIC COMPLICATIONS

There was no difference between the home birth and hospital birth groups in the incidence of breech presentation, twins, pre-eclampsia, premature rupture of the membranes, premature birth, vaginal bleeding, or post-term delivery (table 3). There were, however, more premature births in the planned hospital deliveries group (table 3). There were no consistent differences in the durations of labour between the groups (table 4). Not one maternal death occurred during the study.

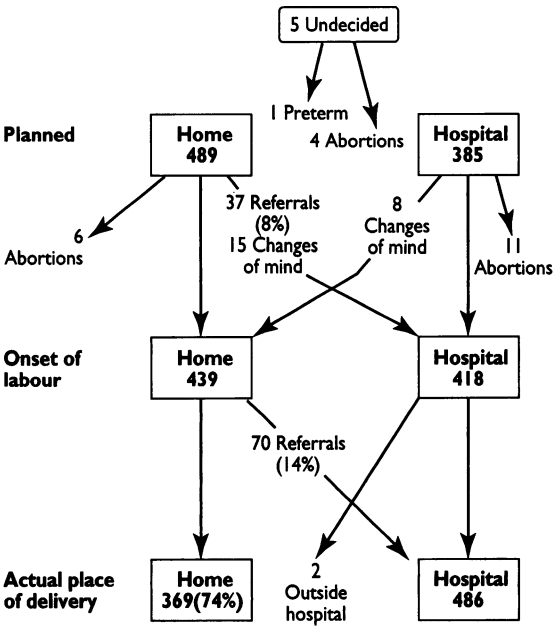

Fig 1—*Flow chart of study population*

Table 4—*Median durations of labour (minutes)*

		Planned home	Planned hospital	P value
1st Stage	Total	300 (n = 426)	300 (n = 231)	0.78†
	Matched pairs	300 (n = 114)	302 (n = 114)	0.41‡
2nd Stage	Total	15 (n = 425)	20 (n = 232)	<0.01†
	Matched pairs	19 (n = 113)	20 (n = 113)	0.87‡
Period of pushing	Total	12 (n = 393)	10 (n = 267)	<0.01†
	Matched pairs	14 (n = 121)	10 (n = 121)	<0.001‡
Start of labour until delivery	Total	349 (n = 464)	387 (n = 257)	0.17†
	Matched pairs	357 (n = 151)	325 (n = 151)	0.58‡

†z Test applied after logarithmic transformation.
‡One sample *t* test applied after logarithmic transformation.

Of the 70 women booked for home delivery who were transferred to hospital after the onset of labour, 20 showed signs of fetal distress (abnormal fetal heart rate or green amniotic fluid, or both), 16 underwent caesarean section, and 14 had a vaginal operative delivery.

During delivery women in the home births group needed significantly fewer inductions of labour, less analgesia, and less medication to induce or support labour. They also had fewer caesarean operations and less application of forceps or vacuum extraction. Episiotomy was also less frequent in the planned home births group; on the other hand, severe perineal lesions were not more frequent in this group (table 5). Women at home usually delivered sitting, on knees and elbows, or standing; women in hospital usually delivered horizontally. Blood loss in all vaginal deliveries was the same in both groups (median 300 ml).[12]

NEONATAL OUTCOME

Perinatal death was recorded in one planned home delivery (a stillbirth discovered at term before the onset of labour with no apparent abnormality in the fetus or placenta) and one planned hospital delivery (the infant died on the second day with multiple malformations, including hypoplasia of the left ventricle). These cases correspond to a perinatal death rate of 2.3/1000 (perinatal death rate in Zurich (1990 data) 7.9/1000).

Morbidity—Comparing birth weights and gestational ages of infants in the planned home and hospital delivery groups (table 6) showed no differences either in mean values or in numbers of cases with weights or ages outside the normal range. The mean Apgar score at one minute was the same in both groups, but at five and 10 minutes babies in the planned home delivery group had higher scores. On the other hand, the mean pH in umbilical arterial and venous blood was lower in the home births group, which also had more infants with arterial pH under 7.15. Detailed examination by a neutral paediatrician between the 2nd and 6th days of life showed no differences between home and hospital born infants.[13]

MOTHERS' EXPERIENCE

We record only some of the most important findings of the questionnaire sent to women three months after delivery. Seventy per cent of women in the home births group and 48% of women in the hospital births group ticked "the birth was my own achievement" ($P<0.05$). Home births showed more constancy in relation to care professionals, who mostly were known to the women before delivery and seldom changed, staying even during prolonged labour. A clear difference emerged in

Table 5—*Interventions during delivery. Results expressed as numbers (percentages) of women*

		Planned home	Planned hospital	Odds ratio (95% confidence interval)	P value
Induction of labour	Total	22 (4.6)	60 (16.0)	0.25 (0.15 to 0.42)	<0.001
	Matched pairs	7 (3.4)	35 (16.9)	0.18 (0.06 to 0.43)	<0.001
Caesarean section	Total	25 (5.2)	51 (13.6)	0.35 (0.21 to 0.57)	<0.001
	Matched pairs	12 (5.8)	24 (11.6)	0.45 (0.19 to 1.00)	0.05
Analgesics†	Total	78 (17.1)	154 (48.7)	0.22 (0.16 to 0.30)	<0.001
	Matched pairs	27 (15.7)	73 (42.4)	0.16 (0.07 to 0.33)	<0.001
Medication during expulsion period†‡	Total	93 (20.4)	112 (35.6)	0.46 (0.33 to 0.64)	<0.001
	Matched pairs	30 (17.4)	61 (35.5)	0.34 (0.18 to 0.61)	<0.001
Forceps or vacuum extraction†	Total	20 (4.4)	42 (13.0)	0.31 (0.18 to 0.53)	<0.001
	Matched pairs	8 (4.6)	18 (10.4)	0.41 (0.14 to 1.04)	0.06
Episiotomy without perineal lesion†	Total	119 (26.0)	247 (76.5)	0.11 (0.07 to 0.15)	<0.001
	Matched pairs	45 (26.0)	128 (74.0)	0.09 (0.04 to 0.18)	<0.001
Perineal lesion†	Total	163 (35.6)	48 (14.9)	3.17 (2.21 to 4.54)	<0.001
	Matched pairs	65 (37.6)	29 (16.8)	3.25 (1.83 to 6.10)	<0.001
Perineal and vaginal lesion†	Total	5 (1.1)	7 (2.2)	0.50 (0.16 to 1.60)§	0.24
	Matched pairs	1 (0.6)	4 (2.4)	0.25 (0.005 to 2.53)	0.38
Intact perineum†	Total	176 (38.4)	28 (8.7)	6.58 (4.27 to 10.11)	<0.001
	Matched pairs	63 (36.4)	16 (9.2)	6.22 (3.05 to 14.31)	<0.001

†Excludes women delivered by caesarean section.
‡Demoxytocin in home deliveries; synthetic oxytocin in hospital.
§Limited accuracy confidence interval.

the subgroup of women whose labour lasted more than 12 hours. Women delivering at home were cared for more patiently and encouraged more to deliver spontaneously; even when referred to hospital these women's experience was not worse than that of women in hospital who had a vaginal operative delivery.

Movement and massage were the most frequent devices used to combat pain in both groups. Ninety per cent of women delivering at home reported that they could always move freely and 59% that they could choose their birth position; 57% of women in hospital reported that they could move freely and 35% that they could choose their birth position.

Table 6—*Neonatal morbidity (excluding twin births)*

		Planned home	Planned hospital	P value
Mean birth weight (g) (SD)	Total	3390 (462)	3374 (456)	0.62†
	Matched pairs	3353 (422)	3428 (438)	0.08‡
No (%) with birth weight <2500 g	Total	12 (2.5)	13 (3.6)	0.42§
	Matched pairs	4(2.0)	5 (2.5)	1.00¶
No (%) with birth weight 2500-4000 g	Total	437 (91.4)	326 (89.8)	0.42††
	Matched pairs	189 (94.0)	180 (89.6)	0.16¶
No (%) with birth weight >4000 g	Total	29 (6.1)	24 (6.6)	0.75††
	Matched pairs	8 (4.0)	16 (8.0)	0.15¶
Mean gestational age (days) (SD)	Total	280.4 (9.4)	279.4 (10.2)	0.15†
	Matched pairs	281.2 (8.1)	281.0 (9.5)	0.82‡
No (%) with gestational age <259 days	Total	7 (1.5)	13 (3.5)	0.07§
	Matched pairs	2 (1.0)	5 (2.5)	0.45¶
No (%) with gestational age 259-293 days	Total	448 (93.5)	339 (92.4)	0.60††
	Matched pairs	187 (92.1)	185 (91.1)	0.86¶
No (%) with gestational age >293 days	Total	24 (5.0)	15 (4.1)	0.53††
	Matched pairs	14 (6.9)	13 (6.4)	1.00¶
Mean Apgar score at one minute (SD)	Total	7.90 (1.38)	7.98 (1.12)	0.82‡‡
	Matched pairs	7.78 (1.54)	8.03 (1.09)	0.07‡
Mean Apgar score at five minutes (SD)	Total	9.28 (0.90)	9.01 (0.68)	<0.001‡‡
	Matched pairs	9.26 (0.90)	9.08 (0.64)	<0.05‡
Mean Apgar score at 10 minutes (SD)	Total	9.75 (0.54)	9.40 (0.68)	<0.001‡‡
	Matched pairs	9.70 (0.65)	9.48 (0.70)	<0.001‡
Mean umbilical cord artery pH (SD)	Total	7.21 (0.10)	7.26 (0.08)	<0.001†
	Matched pairs	7.20 (0.10)	7.25 (0.08)	<0.001‡
Mean umbilical cord vein pH (SD)	Total	7.31 (0.08)	7.35 (0.08)	<0.001†
	Matched pairs	7.30 (0.08)	7.35 (0.08)	<0.001‡
No (%) of infants with arterial pH <7.15	Total	95 (24.4)	21 (6.0)	<0.001††
	Matched pairs	44 (27.2)	11 (6.8)	<0.001¶

†z Test.
‡One sample *t* test.
§Fisher's exact test.
¶McNemar's test.
††χ^2 Test.
‡‡Wilcoxon test applied because of skewed distribution.

In 64% of home births and 62% of hospital births the father helped to care for the baby. Ninety four per cent of mothers delivered at home and 84% of mothers delivered in hospital held the baby immediately after birth; 86% and 73% of mothers, respectively, nursed the baby within the first hour of life.

Discussion

In Switzerland women wishing to deliver at home are a small minority. As this study confirms, they do not represent the childbearing Swiss population but are a self selected, low risk group with good health. Studying the outcome of home deliveries is important for quality control, but findings should be interpreted with caution. The number of participants was too small to detect differences either in maternal or perinatal mortality between the groups or in rare birth complications—for example, not one case of umbilical cord prolapse or abruptio placentae occurred. However, the low perinatal death rate was commensurate with the low risk status of the study population.

CHARACTERISTICS OF WOMEN WHO WISH FOR HOME DELIVERY

Overall the women recruited for this study had a higher educational level and included more Swiss nationals than the average childbearing population in Switzerland.[14,15] The women were also older and included a higher proportion living with a partner. No difference in parity could be shown between the study population and other pregnant Swiss women (birth certificates record only the number of children from the same marriage, not parity).

Women who planned their deliveries at home and in hospital differed in their attitudes to health, pregnancy, responsibility, and independence. Usually it takes a certain tenacity for a woman to realise a home birth in a health care system in which this is considered irresponsible. The eight women who changed their minds during pregnancy and wanted a home birth rather than hospital delivery (who might therefore have been less convinced than other women) had a high rate (50%) of referral during labour.

MAIN RESULTS

A lower rate of caesarean section and vaginal operative delivery as well as restricted use of agents to induce or stimulate labour were associated with a more

expectative management of premature rupture of the membranes and post-term pregnancy in the home births group. Stricter indications for episiotomy were used in home deliveries. There was no evidence that the more liberal use of episiotomy in hospitals prevented severe perineal lesions.

The lower rate of interventions in home births meant a lower risk of subsequent complications for the mother. This advantage was not outweighed by a worse neonatal outcome. However, infants in the planned home delivery group seemed mildly more stressed immediately after birth (lower umbilical cord pH), though they recovered better than babies in the planned hospital delivery group (higher Apgar scores at five and 10 minutes). Differences in umbilical cord pH may have been due to differences in clamping and the time of transportation. In home deliveries the umbilical cord was mostly clamped late (1-20 minutes (mean 5) after delivery) and transportation to a measuring instrument took on average 83 minutes. Each factor can lower the pH.[16-20]

PROBLEM OF MATCHING

Under the circumstances of antenatal care in Switzerland randomisation of women wishing for home delivery was not considered feasible, so women were matched at the first consultation. In a country where over 99% of deliveries take place in hospital this should have been easy, and strict matching criteria were therefore defined. This led to problems: any women with a gynaecological, obstetric, or medical history was difficult to match; the matched pairs therefore included the healthiest women and more primiparous women than in the total group. Socioeconomic status also differed between home and hospital delivered women in the total group: results are presented for each separately. The matched pairs showed more precise odds ratios but wider confidence intervals.

The biggest difference in personal characteristics between the home delivery and hospital delivery groups was in their attitudes to delivery and confinement. These differences were statistically significant but not of a magnitude which would explain the large differences in management of delivery between the groups.

Conclusion

In a setting in which pregnant women can choose the place of delivery and attention at home is guaranteed, a referral system is available and adequate, and hospitals respect the patient's original decision when she arrives there, home delivery has advantages over hospital delivery: home delivery results in fewer interventions and more comfort for the mother.

This study does not have sufficient power to exclude differences in rare events. The probability of these events concerns both sides—for example, the rare complications of interventions in hospital as well as unmanageable bleeding at home. However, most indicators suggest that home delivery does not pose a higher risk than hospital delivery and that it reduces some of the additional risks of interventions. This study has improved collaboration between hospitals and the home delivery teams, thus possibly leading to lower risk for all women concerned. Many questions remain open and need to be studied in places with a higher proportion of home deliveries.

Key messages

- Many pregnant women in Zurich who opt for home delivery may be referred to hospital before labour (8% in this series) or during labour (14%), especially primiparous women (25% during labour)
- Interventions (induction, caesarean section, medication, forceps, or vacuum extraction) may be considerably less frequent in women who originally opt for home delivery
- There are no obvious disadvantages of home delivery for mother or child when the mother opts for home delivery
- More studies are needed to look into the small risks of death, serious bleeding, and complications of interventions, which could not be evaluated in this study owing to limited power

Members of the study team were: general practitioners Th Voegeli, E Ashkenazi, J Ashkenazi, U Bachmann, D Baumann, N Egli, P Frey, U Gehrig, U Glenck, P Hofmann, M Huber, C Jordi, C Landerer, P Lattmann, B Maggi, R Niehus, B Oertli, D Rähle, J Reichel, T Walser, and D Winizki and midwives M Maurer, C America, I Bärlocher, H Bürki, L Daemen, E Geier, S Gloor, O Hägler, R Herzog, B Landheer, M J Meister, E Schibli, and E Zingg.

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