

Obstetric and Neonatal Outcomes Following Hospital Transfers of Home Births and Births in Midwife-led Units in Austria

Geburtshilfliche und neonatale Outcomes nach abgebrochenen Haus- und Praxisgeburten in Österreich



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ABSTRACT

Introduction

Home births and births in midwife-led units and the associated potential risks are still being debated. An analysis of the quality of results of planned home births and births in midwife-led units which require intrapartum transfer of the mother to hospital provides important information on the quality of processes during births which occur outside hospital settings. The aim of this study was to analyze neonatal and maternal outcomes after the initial plan to deliver at home or in a midwife-led unit had to be abandoned and the mother transferred to hospital.

Material and Methods

The method used was an analysis of data obtained from the Austrian Birth Registry. The dataset consisted of singleton term pregnancies delivered in the period from 1 January 2017 to 31 December 2021 (n = 286056). For the analysis, two groups were created for comparison (planned hospital births and hospital births recorded in the Registry as births originally planned as home births or births in midwife-led units but which required a transfer to hospital) and assessed with regard to previously defined variables. Data were analyzed using frequency description, bivariate analysis and regression models.

Results

In Austria, an average of 19% of planned home births have to be discontinued and the mother transferred to hospital. Home births and births in midwife-led units which require transfer of the mother to hospital are associated with higher intervention rates intrapartum, high rates of vacuum delivery, and higher emergency c-section rates compared to planned hospital births. Multifactorial regression analysis showed significantly higher risks of poorer scores for all neonatal outcome parameters (Apgar score, pH value, transfer rate).

Conclusion

If a birth which was planned as a home delivery or as a delivery in a midwife-led unit fails to progress because of (possible) anomalies, the midwife must respond and transfer the mother to hospital. This leads to a higher percentage of clinical interventions occurring in hospital. From the perspective of clinical obstetrics, it is understandable, based on the existing data, that giving birth outside a clinical setting cannot be recommended.

ZUSAMMENFASSUNG

Einleitung

Die außerklinische Geburtshilfe und das damit verbundene Risikopotenzial werden unterschiedlich diskutiert. Die Analyse der Ergebnisqualität nach abgebrochenen Haus- und Praxisgeburten liefert wichtige Informationen zur Prozessqualität der außerklinischen Geburtshilfe. Ziel dieser Arbeit ist es, das neonatale und maternale Outcome nach abgebrochener Hausgeburt zu analysieren.

Material und Methoden

Als Methode wird eine Datenauswertung aus dem Geburtenregister Österreich gewählt. Der Datensatz umfasst Einlingsgeburten am Termin im Zeitraum von 01.01.2017 bis 31.12.2021 (n = 286056). Zur Analyse werden 2 zu vergleichende Gruppen gebildet (geplante Klinikgeburten und die

im Register als abgebrochene Haus- und Praxisgeburten markierten Klinikgeburten) und mit vorab definierten Variablen in Relation gesetzt. Die Datenauswertung erfolgte mittels deskriptiver Abbildungen der Häufigkeiten, bivariater Analysen und Regressionsmodelle.

Ergebnisse

In Österreich werden durchschnittlich 19% der geplanten Hausgeburten abgebrochen und in eine Klinik transferiert. Abgebrochene Haus- und Praxisgeburten weisen im Vergleich zu geplanten Klinikgeburten höhere Raten an Interventionen sub partu, höhere Raten an Vakuumentextraktionen und sekundären Sectiones auf. Die multifaktorielle Regressionsanalyse zeigt bei allen neonatalen Outcome-Parametern (Apgar-Wert, pH-Wert, Verlegungsrate) signifikant höhere Risiken für schlechtere Werte.

Schlussfolgerung

Wird eine Haus- oder Praxisgeburt abgebrochen, reagiert die Hebamme aufgrund (möglicherweise) auftretender Regelwidrigkeiten und transferiert die Mutter in eine Klinik. Dies bedingt im klinischen Setting eine höhere Dichte an Interventionen. Aus der Perspektive der klinischen Geburtsmedizin ist es aufgrund der vorliegenden Daten verständlich, dass eine außerklinische Geburt nicht empfohlen werden kann.

Introduction

Although almost all women in Austria give birth in hospital, the percentage of births which occur outside clinical settings is around 1.5% [1]. The following table (► **Table 1**) shows the number of live births in Austria in the years 2017 to 2021 as well as distribution

of births according to place of birth. In Austria, births planned as a delivery outside a clinical setting may either be organized as a home birth in the mother's place of residence or as a delivery in a midwife-led unit (the term *Geburtshaus* i.e., birth house, was abolished when the law was amended) [2].

► **Table 1** Live births in Austria and place of birth 2017–2021 (own research).

Live births	2017	2018	2019	2020	2021
In all of Austria	86987	84804	84222	82950	85329
Place of birth (based on total number of live births)					
Hospital	85626	83473	82915	81381	83635
Midwife-led unit	303	247	273	278	314
Mother's place of residence	1012	987	940	1180	1253
During transportation	33	31	33	33	43
Other place of delivery	13	66	61	78	84
Hospital births in %	98.4	98.4	98.4	98.1	98
Live births born in a non-clinical setting in % (midwife-led unit, mother's place of residence)	1.51	1.46	1.44	1.76	1.84

In Austrian law, the Federal Law on Midwifery (*Hebammengesetz* – HebG) [2] regulates the involvement of midwives in the birth and the care of the neonate and their duty of care to every pregnant woman, parturient and new mother (HebG idGF § 3, Para 1) and defines the range of activities midwives may carry out autonomously (HebG idGF § 2, Para 1). It provides the legal basis in clinical and non-clinical settings for midwives to autonomously provide counselling, support and care during pregnancy, birth and postpartum to women with an unremarkable medical history whose pregnancy follows a regular course. The legal limitations which the Austrian Midwifery Law places on the autonomous activities of midwives oblige all midwives to call in a physician without delay if there is a suspicion of anomalies or anomalous conditions arise which could represent a danger to mother or baby and thereafter to provide support and care only in accordance with doctor's orders and in cooperation with a physician (HebG idGF § 4, Para 1). This means that if an anomalous or dangerous health condition is suspected or occurs, the home birth or birth in a midwife-led unit must not be allowed to progress outside a clinical setting and the parturient must be transferred immediately to hospital. This legal framework is the basis which significantly minimizes the potential risks to mother and child of a home birth or a birth in a midwife-led unit.

The motivations of pregnant women which lead them to chose a non-clinical setting in which to give birth have been investigated in different studies carried out in Australia by Sassine et al. [3] and Hauck et al. [4]. In addition to wanting a home birth to avoid unnecessary medical interventions and medicalized routines, pregnant women especially highlighted the continuous care provided by a midwife, the undisturbed bonding phase, better support for breastfeeding through early placing of the newborn at the breast, and the free choice of birthing position as important reasons to chose a home birth [3, 4]. The quality report on non-hospital-based obstetric care in Germany cites self-determination, familiar surroundings and a familiar midwife as the main reasons motivating women to give birth outside a hospital [5].

As every woman has the right to freely chose where to give birth, opinions on giving birth outside a clinical setting and opinions about the potential risks associated with giving birth at home or in a birthing center are divided [6, 7]. Even if the findings of the studies presented below cannot be directly transferred to the conditions in Austria without considering the respective framework conditions behind national healthcare policies, they still make the differences in positions very clear.

The criticism levelled against home births or births in midwife-led units is mainly based on the significantly higher risk of neonatal morbidity and mortality which has been demonstrated in various studies. The studies by Wax et al. [8], Cheng et al. [9] and Grünebaum et al. [10] on this topic showed that rates of maternal interventions such as epidural analgesia, episiotomies and surgical deliveries and rates of birth trauma, postpartum bleeding and infections were lower with planned home births. However, their results also showed that births in non-clinical settings were associated with higher rates of neonatal complications, lower 5-minute Apgar scores, more neonatal seizures, and higher neonatal mortality rates compared to births in hospital settings [8, 9, 10].

The studies by Homer et al. [11], Jansen et al. [12], Cox et al. [13] and Kataoka et al. [14] came to very different conclusions and reported that neonatal outcomes for non-hospital-based births were comparable to those of births delivered in clinical settings due to lower intervention and complication rates. Their studies found no differences in perinatal mortality rates, low 5-minute Apgar scores, meconium aspiration, or the need to transfer the newborn to a pediatric clinic [11, 12, 13, 14].

In their study, Hirazumi and Suzuki [15] reported no negative perinatal events for births delivered in non-hospital settings under midwife-led care. Moreover, the studies by Hildingsson et al. [16] and Forster et al. [17] described the continuous quality of care and the birthing experience of non-hospital-based births as more satisfactory than births which occurred in hospital.

The findings on intrapartum transfer rates of women to hospital who planned a home birth vary considerably. The study by Anderson et al. [18] gave an intrapartum transfer rate of 8%, whereas Amelink-Verburg et al. [19] reported a transfer rate of 31.9%, although it should be noted that the frequency of intrapartum transfers of primiparae was significantly higher at 22.5%–56.3% than that recorded for multiparae, which ranged from 4.4%–16.1% [20]. The most commonly stated reasons for transferring a planned home birth to hospital in the literature are protracted labor, a request for pain medication, a suspicion or occurrence of fetal stress, and abnormal presentation or positional anomalies of the fetus [21].

A study carried out in Germany by Andrzejczak et al. [22] compared fetomaternal outcomes of births in non-clinical settings requiring intrapartum transfer to hospital with deliveries in midwife-led labor rooms in hospitals. According to their findings, in the group of planned non-hospital-based births both maternal and neonatal outcomes after transfer to hospital were significantly poorer as they were associated with higher rates of emergency caesarean section, a longer first stage of labor, higher rates of postpartum hemorrhage, higher rates of 5-min Apgar scores ≤ 7 and higher numbers of transfers of newborns to a pediatric clinic [22].

While the intervention rates and the maternal and neonatal morbidity and mortality rates associated with hospital and non-hospital births have been analyzed in different studies, the data on maternal and neonatal outcomes following transfer of a planned home birth or birth in a midwife-led birthing center to hospital in Austria has barely been studied and is very limited. An analysis of the outcomes following transfer of a planned home birth or midwife-led birth outside a hospital setting to hospital will provide important information about the process quality of non-hospital-based obstetric care.

As the intention was to close this research gap, this study aims to analyze maternal and neonatal outcomes in Austria when planned home births or planned births in midwife-led centers had to be transferred intrapartum to hospital.

Material and Method

Sample

The method used in this study was the evaluation of data from the Austrian Birth Registry (*Geburtenregister Österreich, GRÖ*) from the Institute for Clinical Epidemiology (IET) of Tirol Kliniken. The data used for analysis were obtained from hospitals which used the documentation box “transferred home births and transferred births from midwife-led centers” when recording the birth (66 of 79 obstetric departments). The chosen sample consisted of the data of singleton term births (excluding primary caesarean sections, preterm and multiple births, vaginal births in breech presentation, and births of neonates with a birthweight of less than 1500 g) delivered in the period from 1 January 2017 to 31 December 2021 (n = 286 056). The births were divided into two groups for comparison: planned hospital births and births marked in the Registry as home births or births in midwife-led units which required intrapartum transfer to hospital and were delivered in hospital (transfers of home births and of births in midwife-led centers).

Data analysis

The two groups were compared with regards to the previously defined variables “parity” and “maternal age”, “intrapartum interventions” (oxytocin, epidural analgesia, micro blood gas analysis [MBU], tocolysis), “premature rupture of membranes”, “mode of delivery” (spontaneous, vaginal surgical, emergency caesarean section, acute emergency c-section), “increased postpartum bleeding”, “disorders of placental separation”, “sex and weight of the newborn”, “neonatal Apgar scores” (5 min, 10 min), “umbilical cord pH”, “transfer to a neonatal ward, NIMCU and NICU”, and “neonatal mortality rates” (antepartum, intrapartum, postpartum).

Statistical data analysis was done using frequency description and univariate analysis and presented using odds ratio (OR). Multivariate and bivariate logistic regression analysis was done to obtain more specific predictions for neonatal outcome parameters (Apgar score, pH value, transfer rate) and maternal outcome parameters (postpartum bleeding, disorders of placental separation). The results are presented using the relative risk ratio (RRR). For this, the items “maternal age”, “parity”, “mode of delivery”, “neonatal birthweight”, “oxytocin”, “tocolysis”, “MBU”, “epidural analgesia”, “premature rupture of membranes”, and “transferred home births and births in midwife-led units” were adjusted as independent variables and a predictable risk was calculated.

The research proposal was presented to the Ethics Committee of the FH Gesundheitsberufe Oberösterreich (University of Applied Sciences for Healthcare Professions in Upper Austria) and was approved as unobjectionable (application for ethical approval: A-2021-055). The statistical analysis was done at the IET using STATA (StataCorp. 2013. Stata Statistical Software: Release 13. College Station, TX: StataCorp LLP).

Results

Population

Based on the total number of home births and births in midwife-led units recorded by Statistik Austria and the home births and births in midwife-led units transferred to hospital documented in the Austrian Birth Registry, the rate of home births and births in midwife-led units which had to be delivered in hospitals ranges from 16.14% to 23.08%.

► **Table 2** shows the number and percentages of planned hospital births and planned home births and births in midwife-led units which required intrapartum transfer to hospital in the sample population.

When the age cohorts in the two groups were compared (► **Table 2**), the percentage distribution was similar for the age cohorts 20–34 years, 35–39 years and 40–44 years. Only 11 women under the age of 20 and no woman over the age of 45 was recorded in the group of home births and births in midwife-led units requiring an intrapartum hospital transfer.

An analysis of the data which focussed on maternal parity (► **Table 2**) showed that births planned as a home birth or in a midwife-led unit were transferred to hospital significantly more often (60.2%) if the mother was a primipara compared to the transfer rates for multiparae (39.8%).

Intrapartum interventions

The percentage of births with intrapartum oxytocin administration (► **Table 3**) was 0.39% lower for the group of home births and births in midwife-led units requiring intrapartum transfer to hospital, but the difference did not reach significance for this category (OR 0.97; CI: 0.84–1.12).

MBU to assess the condition of the fetus (► **Table 3**) was carried out significantly more often (5.65%) in the group of home births and births in midwife-led units requiring intrapartum transfer to hospital compared to the group of non-transferred births (3.9%; OR 1.48, CI: 1.19–1.83).

During the birth, tocolysis was administered significantly more often (8.16%) in the group of home births and births in midwife-led units requiring intrapartum transfer to hospital (► **Table 3**) compared to 5.5% for the group of non-transferred births (OR 1.64, CI: 1.37–1.96).

Epidural analgesia was administered to 22.1% of women in the group of home births and births in midwife-led units requiring intrapartum transfer to hospital (► **Table 3**); the rate of epidurals administered to women in the group of planned hospitals births was 19.34% (OR 1.18, CI: 1.05–1.33).

The rate of preterm rupture of membranes was 26.49% in the group of home births and births in midwife-led units requiring intrapartum transfer to hospital (► **Table 3**) and therefore almost the same as for the group of planned hospitals births where it was 25.86% (OR 1.03, CI: 0.92–1.15).

► **Table 2** Number and percentages of planned hospital births and planned home births and births in midwife-led units which required intrapartum transfers to hospital; maternal age and parity.

	Total		Planned hospital births		Hospital transfers of planned home births and births in midwife-led units	
	N	%	N	%	N	%
Year						
2017	58214	100	57961	99.57	253	0.43
2018	56651	100	56411	99.58	240	0.42
2019	56613	100	56249	99.36	364	0.64
2020	56360	100	56016	99.39	344	0.61
2021	58218	100	57826	99.33	392	0.67
Total	286056	100	284463	99.44	1593	0.56
Maternal age						
<20 years	4338	1.52	4327	1.52	11	0.69
20–34 years	218950	76.54	217805	76.57	1145	71.88
35–39 years	52330	18.29	51978	18.27	352	22.1
40–44 years	9891	3.46	9806	3.45	85	5.34
≥45 years	502	0.18	502	0.18		
Data not available	45	0.02	45	0.02		
Total	286056	100	284463	100	1593	100
Parity						
Primiparae	143743	50.25	142784	50.19	959	60.2
Multiparae	142300	49.75	141666	49.8	634	39.8
Data not available	13	0	13	0		
Total	286056	100	284463	100	1593	100

Mode of delivery, disorders of placental separation and postpartum bleeding

The rate of spontaneous births in the group of home births and births in midwife-led units requiring intrapartum transfer to hospital was 65.6%, which was significantly lower than in the comparative group where it was 75.35%. At the same time, the rates of vaginal surgical delivery (vacuum-assisted delivery 11.99% vs 9.2%; OR 1.5, CI: 1.28–1.75; forceps-assisted delivery 0.13% vs 0.05%; OR 2.63, CI: 0.65–10.62) and emergency caesarean sections (20.9% vs 14.37%; OR 1.67, CI: 1.48–1.89) were higher. The acute emergency caesarean section rate for the group of planned hospital births was 0.96% and was almost the same as that of the group of planned home births and births in midwife-led units requiring intrapartum transfer to hospital with 0.94% (OR 1.13, CI: 0.68–1.89) (► **Table 3**).

Postpartum hemorrhage was recorded for ten of the women in the group of planned home births and births in midwife-led units requiring intrapartum transfer to hospital (► **Table 3**). This amounts to about 0.63% of births and is therefore not significantly higher compared to the percentage of 0.45% recorded for the group of planned hospital births (OR 1.39, CI: 0.75–2.60).

The rate of disorders of placental separation (► **Table 3**) was recorded as 3.04% for planned hospital births and therefore not significantly higher than the rate of 2.64% for planned home births and births in midwife-led units requiring intrapartum transfer to hospital (OR 0.86, CI: 0.64–1.18).

Multifactorial regression analysis showed no significantly increased risk with regards to the maternal outcome parameters “postpartum bleeding” (RRR 1.33; CI: 0.71–2.49) and “disorders of placental separation” (RRR 0.84; CI: 0.62–1.14) for the group of home births and births in midwife-led units requiring intrapartum transfer to hospital.

Neonatal outcome parameters

► **Table 4** shows no significant differences between newborns in both groups with regards to sex and birthweight.

The 5-minute Apgar scores (► **Table 4**) of the newborns of the group of home births and births in midwife-led units requiring intrapartum transfer to hospital were significantly poorer compared to those for the group of planned hospital births. An Apgar score between 0 and 4 was recorded for 2.32% of births (OR 10.51, CI: 7.52–14.67), a score between 5 and 8 for 5.59% (OR 1.62, CI: 1.31–2.01) and a score of 9 or 10 for 89.45% of births. By compar-

► Table 3 Intrapartum interventions, mode of delivery, postpartum bleeding and disorders of placental separation for planned hospital births and planned home births and births in midwife-led units requiring intrapartum transfer to hospital.

	Total (n = 286 056)		Planned hospital births		Home births and births in a midwife-led unit transferred to hospital intrapartum		OR	95% CI
	N	%	N	%	n	%		
Interventions (1)								
Oxytocin intrapartum	41 887	14.64	41 660	14.65	227	14.25	0.97	0.84–1.12
MBU	11 180	3.91	11 090	3.9	90	5.65	1.48***	1.19–1.83
Tocolysis intrapartum	14 787	5.17	14 657	5.15	130	8.16	1.64***	1.37–1.96
Epidural analgesia	55 356	19.35	55 004	19.34	352	22.1	1.18**	1.05–1.33
Preterm rupture of membranes	73 995	25.87	73 573	25.86	422	26.49	1.03	0.92–1.15
Mode of delivery								
Spontaneous	215 394	75.3	214 349	75.35	1045	65.6		
Vacuum-assisted (2)	26 352	9.21	26 161	9.2	191	11.99	1.5***	1.28–1.75
Forceps-assisted (2)	158	0.06	156	0.05	2	0.13	2.63	0.65–10.62
Emergency c-section (2)	41 211	14.410	40 878	14.37	333	20.9	1.67***	1.48–1.89
Acute emergency c-section (2)	2 733	0.96	2 718	0.96	15	0.94	1.13	0.68–1.89
Not specified	208	0.07	201	0.07	7	0.44		
Total	286 056	100	284 463	100	1 593	100		
Postpartum bleeding (3)	1 293	0.45	1 283	0.45	10	0.63	1.39	0.75–2.60
Disorders of placental separation (4)	8 684	3.04	8 642	3.04	42	2.64	0.86	0.64–1.18

(1) Reference category: no intervention
 (2) Reference category: mode of delivery = spontaneous
 (3) Reference category: no postpartum bleeding
 (4) Reference category no disorders of placental separation
 ** p < 0.01, *** p < 0.001

ison, the scores for the newborns of the group of planned hospital births were 0.24% for Apgar scores between 0 and 4, 3.69% for scores between 5 and 8, and 95.87% with scores of 9 or 10.

Moreover, the 10-minute Apgar scores for the newborns of the group of home births and births in midwife-led units requiring intrapartum transfer to hospital were also significantly lower (► Table 4). 1.19% were in the category 0–4 points compared with 0.21% (OR 5.84, CI: 3.69–9.25); 2.01% were in the category 5–8 points compared with 1.12% (OR 1.88, CI: 1.32–2.67), and 94.16% were in the category 9 or 10 points compared with 98.47%.

An umbilical cord pH < 7.0 was recorded for 12 neonates (0.75%, OR 2.74, CI: 1.54–4.87) in the group of home births and births in midwife-led units requiring intrapartum transfer, which was significantly higher than the 0.31% recorded for the newborns of the group of planned hospitals births. When we reviewed all newborns with umbilical cord pH values of 7.01–7.10, the rates were approximately the same for both groups (► Table 4).

With a rate of 5.59% (OR 1.57, CI: 1.27–1.95), newborns from the group of home births and births in midwife-led units requiring intrapartum transfer were transferred to a pediatric clinic for monitoring significantly more often than the newborns from the group of planned hospital births (3.62%) (► Table 4).

Overall, one neonatal death antepartum, one intrapartum death and four postpartum neonatal deaths were recorded for the group of home births and births in midwife-led units requiring intrapartum transfer (► Table 4).

When the Apgar scores at 5 and 10 minutes for the newborns of the group of home births and births in midwife-led units requiring intrapartum transfer were evaluated, multifactorial regression analysis showed significantly poorer scores both for the group with a score of 0–4 and for the group with a score of 5–8 points (► Table 5). Similarly, the risk of a poor umbilical cord pH value was also significantly higher (RRR 2.13; CI: 1.16–3.91) for the group of newborns with a pH of < 7.0 from the home births and births in midwife-led units group. With a RRR of 1.41 (CI: 1.14–

► **Table 4** Sex and birthweight of newborns, Apgar scores after 5 and 10 minutes, umbilical cord pH, neonatal transfers, and perinatal mortality.

	Total		Planned hospital births		Home births and births in a midwife-led unit transferred to hospital intrapartum		OR	95% CI
	N	%	N	%	N	%		
Sex								
Male	146306	51.15	145495	51.15	811	50.91		
Female	139746	48.85	138964	48.85	782	49.09		
Not specified	4	0	4	0				
Total	286056	100	284463	100	1593	100		
Birthweight (g)								
1500–2499	4159	1.45	4138	1.45	21	1.32		
2500–3999	253336	88.56	251950	88.57	1386	87.01		
4000–6500	28561	9.98	28375	9.97	186	11.68		
Total	286056	100	284463	100	1593	100		
Apgar scores at 5 minutes/groups (1)								
0–4	711	0.25	674	0.24	37	2.32	10.51***	7.52–14.67
5–8	10592	3.7	10503	3.69	89	5.59	1.62***	1.31–2.01
9–10	274137	95.83	272712	95.87	1425	89.45		
Not specified	616	0.22	574	0.2	42	2.64		
Total	286056	100	284463	100	1593	100		
Apgar scores at 10 minutes/groups (2)								
0–4	626	0.22	607	0.21	19	1.19	5.84***	3.69–9.25
5–8	3209	1.12	3177	1.12	32	2.01	1.88***	1.32–2.67
9–10	281597	98.44	280097	98.47	1500	94.16		
Not specified	624	0.22	582	0.2	42	2.64		
Total	286056	100	284463	100	1593	100		
Umbilical cord pH/groups (3)								
<7.0	896	0.31	884	0.31	12	0.75	2.74**	1.54–4.87
7–7.1	60132	21.02	59804	21.02	328	20.59	1.11	0.97–1.26
7.2–7.25	69218	24.2	68897	24.22	321	20.15	0.94	0.83–1.07
>7.25	146642	51.26	145920	51.3	722	45.32		
Not specified	9168	3.2	8958	3.15	210	13.18		
Total	286056	100	284463	100	1593	100		
Infant transferred (4)								
No	275660	96.37	274156	96.38	1504	94.41		
Yes	10396	3.63	10307	3.62	89	5.59	1.57***	1.27–1.95
Total	286056	100	284463	100	1593	100		

►Table 4 continued

	Total		Planned hospital births		Home births and births in a midwife-led unit transferred to hospital intrapartum		OR	95% CI
	N	%	N	%	N	%		
Time of death								
Died antepartum/IUFD	257	0.09	256	0.09	1	0.06		
Intrapartum	7	0	6	0	1	0.06		
Postpartum	82	0.03	78	0.03	4	0.25		
Alive	285710	99.88	284123	99.88	1587	99.62		
Total	286056	100	284463	100	1593	100		

(1) Reference category: Apgar score at 5 minutes = 9.10
 (2) Reference category: Apgar score at 10 minutes = 9.10
 (3) Reference category: umbilical cord pH < 7.25
 (4) Reference category: infant transferred = no
 ** p < 0.01, *** p < 0.001

►Table 5 Multivariate regression analysis of neonatal outcome parameters.

Home births and births in a midwife-led unit transferred to hospital intrapartum					
	RRR	95% CI		RRR	95% CI
Apgar score at 5 min groups (1)			Apgar score at 10 min groups (1)		
0–4	10.24***	7.26–14.44	0 bis 4	5.95***	3.70–9.55
5–8	1.37**	1.10–1.70	5 bis 8	1.56*	1.10–2.23
Umbilical cord arterial pH (2)					
< 7.0	2.13*	1.16–3.91			
7–7.1	1.10	0.94–1.24			
7.2–7.25	0.97	0.85–1.11			
Infant transferred (3)					
Yes	1.41*	1.14–1.76			

(1) Reference category: Apgar score at 1 minute = 9.10
 (2) Reference category: pH > 7.25
 (3) Reference category: transfer = no
 * p < 0.05, ** p < 0.01, *** p < 0.001

1.76), the transfer rates for newborns from the home births and births in midwife-led units group requiring transfer to hospital were also significantly higher.

Discussion

The Austrian Midwifery Law § 4(1) states that the autonomous exercise of the profession of midwifery ends “when there is a suspicion of or occurrence of a condition which is anomalous and dangerous for mother or child.” Such an event necessitates discon-

tinuation of the birth at home or in the midwife-led unit and a transfer of the mother and child to the nearest maternity hospital. According to the data presented above, the birth was abandoned in 16.4% to 23.08% of cases where delivery was planned at home or in a midwife-led unit and the parturient was transferred to hospital. With an average transfer rate of 18.92%, our findings lie between the results of Anderson et al. [18], who reported an 8% transfer rate, and those of Amelink-Verburg et al. [19], who recorded a transfer rate of just under 32%.

► **Table 6** Summary of interventions carried out intrapartum.

	Total		Planned hospital births		Home births and births in a midwife-led unit transferred to hospital intrapartum		OR	95% CI
	N	%	N	%	N	%		
Oxytocin intrapartum	41 887	14.64	41 660	14.65	227	14.25	0.97 (1)	0.84–1.12
MBU	11 180	3.91	11 090	3.9	90	5.65	1.48*** (2)	1.19–1.83
Tocolysis	14 787	5.17	14 657	5.15	130	8.16	1.64*** (3)	1.37–1.96
Epidural analgesia	55 356	19.35	55 004	19.34	352	22.1	1.18** (4)	1.05–1.33

p<0.01, *p<0.001

Reference category: (1) oxytocin = no; (2) MBU = no; (3) tocolysis = no; (4) epidural analgesia = no

Similar to the data by Blix et al. [20], our results show that just under ⅔ (60.2%) of parturients transferred to hospital were primiparae.

If a homebirth or birth in a midwife-led unit is abandoned, the midwife is reacting to a suspicion or the occurrence of anomalies and arranges the transfer of the mother to hospital. In a clinical setting, such (suspected) diagnoses lead to higher concentrations of diagnostic procedures or interventions. While the percentage of women given oxytocin was lower in the group of home births or births in midwife-led units transferred to hospital, the rates for micro blood gas analysis, tocolysis and epidural analgesia were higher (► **Table 6**). Even though the precise indications and diagnoses are missing in the registry data, these interventions indicate that, as was also reported by Blix et al. [21], the most common reasons for abandoning a planned home birth or birth in a midwife-led unit are protracted labor, the request for or necessity of pain relief, and a suspicion of or the occurrence of imminent intrauterine asphyxia.

Similarly, the rates for vaginal surgical deliveries and emergency caesarean sections were higher in the group of home births or births in midwife-led units transferred to hospital. This is the logical consequence of abandoning delivery in a non-clinical setting and carrying out interventions such as tocolysis, MBU or epidural analgesia. The rate of 0.94% for acute emergency caesarean sections in the group of home births and births in midwife-led units transferred to hospital is comparable with the rate of 0.96% for the group of planned hospital births. The registry data do not show how long parturient women were already receiving care in hospital before the decision for an acute emergency caesarean section was taken.

The postpartum hemorrhage rate was higher by 0.18 percentage points in the group of home births and births in midwife-led units transferred to hospital while the rate of disorders of placental separation was lower by 0.40 percentage points. Multifactorial regression analysis did not find any significantly increased risk for these categories (RRR 1.33; p = 0.712).

The Apgar scores at 5 and 10 minutes of newborns from the group of planned home births and births in midwife-led units transferred to hospital were significantly poorer for the categories 0–4 points, 5–8 points, and 9 and 10 points. Similarly, the group of home births and births in midwife-led units transferred to hospital also had poorer cord pH values in the category <7.0, although the results for the group with cord pH values of 7.01–7.10 were approximately the same. The rates of neonatal transfers to a pediatric clinic was another outcome parameter. Here again, the transfer rate for newborns from the group of home births and births in midwife-led units transferred to hospital was higher by 1.97%. Multifactorial regression analysis of neonatal outcome parameters showed significantly higher risks for the groups with Apgar scores of 0–4 points and 5–8 points, pH values of <7 and higher rates of transfer to a pediatric clinic.

The registry data do not provide information about the diagnoses or background of the recorded fetal and neonatal deaths (1 × antepartum, 1 × intrapartum, 4 × postpartum). It is unfortunately not possible to answer the question whether these deaths could have been avoided if the birth had been a planned hospital birth.

Limitations

When analyzing the data obtained from registries, one of the limitations is always the quality of the data, as characteristics may have been recorded incorrectly. Moreover, it was not possible to find out the reasons why the home birth or birth in a midwife-led unit needed to be transferred to hospital nor the time of the transfer nor the causalities. Data from 13 (out of 79) obstetric departments in Austria could not be used for the analysis, as no valid data could be obtained with regards to the characteristic “home birth or birth in a midwife-led unit requiring transfer to hospital”.

Another limitation of the analysis is a potential performance bias based on the chosen cohorts. During the birth, a life-threatening condition for mother and child is suspected or occurs in the cohort of abandoned home births and births in midwife-led units,

which is why the mother and child have to be transferred to hospital. It was not possible to determine from the registry data what the percentage of women with the same characteristics was in the group of planned hospital births.

Conclusions

In Austria, an average of 18.92% of births planned as home births or births in midwife-led units are transferred to hospital intrapartum; 60.2% of the affected women are primigravidae. If a birth at home or in a midwife-led unit has to be abandoned, the midwife is responding to a suspicion or the occurrence of anomalies and arranges for the mother to be transferred to hospital. In a hospital setting, such (suspected) diagnoses result in a greater concentration of diagnostic procedures or interventions. This means that home births or births in midwife-led units which had to be abandoned have higher rates of intrapartum interventions (MBU, tocolysis, epidural analgesia) and higher rates of vacuum-assisted deliveries and emergency c-sections compared to planned hospital births. In addition, the neonatal outcome parameters (Apgar score, cord pH, transfer rates) of neonates born to the group of planned home births or births in midwife-led units which had to be transferred to hospital were poorer.

From the perspective of hospital-based obstetrics, it is therefore understandable that a birth in a non-clinical setting cannot be recommended even to pregnant low-risk women when they are being advised about birth modes. This is based on the consideration that an acute high-risk situation, which could require immediate life-saving interventions for the infant and/or mother, can develop at any time during delivery and/or during the placental expulsion phase.

Conflict of Interest

The authors declare that they have no conflict of interest.

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