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Interinstitutional variations in mode of birth after a previous caesarean section: a cross-sectional study in six German hospitals

Abstract

Aims: Regional and interinstitutional variations have been recognized in the increasing incidence of caesarean section. Modes of birth after previous caesarean section vary widely, ranging from elective repeat caesarean section (ERCS) and unplanned repeat caesarean section (URCS) after trial of labour to vaginal birth after caesarean section (VBAC). This study describes interinstitutional variations in mode of birth after previous caesarean section in relation to regional indicators in Germany.

Material and methods: A cross-sectional study using the birth registers of six maternity units (n=12,060) in five different German states (n=370,209). Indicators were tested by χ^2 and relative deviations from regional values were expressed as relative risks and 95% confidence intervals.

Results: The percentages of women in the six units with previous caesarean section ranged from 11.9% to 15.9% (P=0.002). VBAC was planned for 36.0% to 49.8% (P=0.003) of these women, but actually completed in only 26.2% to 32.8% (P=0.66). Depending on the indicator, the units studied deviated from the regional data by up to 32% [relative risk 0.68 (0.47–0.97)] in respect of completed VBAC among all initiated VBAC.

Conclusions: There is substantial interinstitutional variation in mode of birth following previous caesarean section. This variation is in addition to regional patterns.

Keywords: Germany; mode of birth; regional variation; VBAC, vaginal birth after caesarean section.

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Background

There are more and more pregnant women who have previously had a caesarean section. This is a consequence of rising rates of caesarean section during the first childbirth [8]. Not only national variations in caesarean section rates have been noted [8, 34, 40], regional variations within countries and interinstitutional variations have been observed as well [2, 15, 25, 28, 30, 31, 36]. As a consequence, when interinstitutional variations in caesarean sections rates [2, 30] are analysed, variations in regional patterns [15, 28, 31] need to be taken

into account. For example, the caesarean section rate in the states of eastern Germany has always been much lower than in western Germany (22% vs. 30% [31]). So far, studies of interinstitutional variations have focused mostly on predictors for caesarean section in nulliparous women such as cardiotocographic anomalies, failure to progress, or breech presentation [2, 15, 30]. In addition, it is well known that in any given institution caesarean rates in multiparous women correlate significantly with a previous caesarean delivery [2, 30, 35].

Although previous vaginal birth has, without question, positive effects on the next mode of birth, having had a caesarean section increases the risks associated with a subsequent pregnancy [6, 7, 10, 11, 13, 14, 18, 21, 33]. This applies in different ways both to vaginal birth after caesarean section (VBAC) [16, 17] and to elective repeat caesarean section (ERCS) [1, 3, 14, 22].

VBAC is generally supported by the fact that the proportion of women with a low risk pregnancy who are able to have a successful vaginal birth after a previous caesarean section is around 74% [4, 12, 24, 32, 37]. More recently, there has been interest in supporting women in their decision making about mode of birth after a caesarean [19, 20], and women's views on how they experienced VBAC have received more attention [27, 39]. The fact that women who experience VBAC are often more satisfied as compared to those with a repeated caesarean section [39] is an additional reason to advocate VBAC. This and the fact that maternal morbidity increases with an increasing number of caesarean sections [29] has led to a general attitude that slightly increased risk of possible complications of VBAC is manageable.

All this shows that a decision in favour of VBAC depends on many factors. There is room to assume that variations regarding mode of birth after previous caesarean section in different maternity settings may also be influenced by liability issues and the ability of facilities to perform a rapid emergency caesarean section [5, 35, 38]. A Californian study found that VBAC percentages at 255 hospitals ranged from 0 to 44.6% [35].

Although there are various studies on regional or interinstitutional variations in caesarean sections in general, the topic is new for modes of birth after a previous caesarean section. The aim of this paper is to describe interinstitutional variations in mode of birth after a previous caesarean section among six units in different regions of Germany, accounting for the regional variation. We specifically focused on a) the percentage of initiated VBAC, b) the percentage of unplanned repeat caesarean sections (URCS), and c) the percentage of completed VBAC.

Materials and methods

This study reports data from six hospitals currently participating in the German part of a cluster randomised trial called OptiBIRTH (www.controlled-trials.com/ISRCTN10612254), which is designed for women who are pregnant after a previous caesarean section and aims to enhance maternal health by increasing the rate of VBAC in Germany, Ireland, and Italy through an antenatal intervention programme. The data used for the analysis were derived from perinatal surveys for the time period before the intervention.

Perinatal surveys in the 16 German states are legally required as per the statutory Social Security Code (SGB V, http://www.gesetze-im-internet.de/sgb_5/_135a.html). The instructions for data collection cover the coding of operations and procedures (OPS Codes) for management and accounting purposes and in order to record the levels of performance of German hospitals, these codes being modified from the International Classification of Diseases (ICD-10; http://www.dimdi.de/static/de/index.html). Coding women with at least one previous caesarean section was introduced decades ago and has not been changed since [23].

Ethical permission for this analysis was granted by the medical chambers for the respective German states, as well as by the six participating units. Two universitary hospitals and four regional hospitals – of which three are church-affiliated institutions and one is operated by a public authority – participated. All hospitals have neonatal intensive care units and operate at a tertiary level. Access to data on the births following from all singleton pregnancies in 2011 was gained via the databases of the statewide perinatal institutes in Bavaria, Hesse, Lower Saxony, North Rhine-Westphalia, and Saxony; however, the data were excluded if the mother and the newborn child remained in the hospital beyond 31 January 2012. In addition to the data for the six units participating in the trial, statewide data covering singleton pregnancies with at least one previous caesarean section were also extracted from the databases.

We considered various subcategories relating to mode of birth after a previous caesarean section. The overall caesarean section rate and the percentage of women with at least one previous caesarean section were calculated in relation to the overall number of singleton births. In accordance with the risk catalogue of the German antenatal maternal record (Mutterpass), all women who had undergone surgery of the uterus were included in this category as well, even if it was not a caesarean section. The percentage of cases in which VBAC was initiated was obtained by dividing the number of women with at least one previous caesarean section who went into labour by the total number of women with a previous caesarean section. This category and the category ERCS are mutually exclusive; women with at least one previous caesarean section who had a planned caesarean, in other words, an elective repeat caesarean section as per the OPS Code, were assigned to the latter category. In addition, all women who underwent caesarean section and for whom no duration of labour was recorded were also considered as ERCS. Those women with a previous caesarean section who initially went into labour but ultimately delivered by caesarean section were categorised as URCS. Finally, women who completed the birth vaginally were assigned to the "completed VBAC" category.

Statistical analysis

Regional variations across the six maternity units participating in the trial and across the five states of Germany in which these units

are located were tabulated in percentages according to the indicators as defined. The differences were tested by means of the χ^2-test, with P-value <0.05 indicating a significant difference. In the next step, the units' deviations from regional data were calculated as absolute percentage differences. For further analysis the units' deviations from regional data were expressed in the form of an estimate of relative risk derived with reference to the regional data (after but excluding the data from the unit concerned from the regional data). In addition, 95% confidence intervals of the relative risks were calculated; a confidence interval that does not embrace the value "1.0" indicates a significant difference between unit and regional data. For further interpretation, rates were classified as average where the 95% confidence intervals embraced 1 and as higher or lower than average where the estimate was above or below 1, respectively, and the confidence interval did not embrace 1. In borderline cases, the categorisation followed the classification based on the estimate only.

Results

Variation across units regarding mode of birth after previous caesarean section

The annual number of births in the six units ranged from 1766 to 2507 in 2011 (Table 1). The overall caesarean section rates were between 26.7% and 34.1% (P<0.0001). The percentage of women with a caesarean section in their histories varied between 11.7% and 15.9% (P=0.002). The percentage of these women in whom vaginal labour was initiated was between 45% and 54% in six units and 36% in Unit 4 (P=0.003 and P=0.31 without Unit 4). The proportion of URCS as a percentage of initiated VBAC varied between 27.2% and 40.4%, but this variation was not significant (P=0.22). Conversely, the percentage of all cases of initiated VBAC resulting in completed VBAC varied between 59.6% and 72.8% The percentage of VBAC among all women with at least one previous caesarean section ranged from 26.2% to 32.7% (P=0.66).

Variation between states regarding the mode of birth after previous caesarean section

In 2011, the numbers of births in the five states included in the analysis varied between 33,139 in Saxony and 135,875 in North Rhine-Westphalia (Table 2). The overall caesarean section rates ranged from 22.2% in Saxony to 34% in Hesse (P<0.0001). Similarly, the number of women with a previous caesarean section also differed from 10.5% in Saxony to 15.2% in Hesse (P<0.0001). The percentage of women with initiated VBAC was between 44.5% in Bavaria

Table 1 Modes of birth among women with previous caesarean section in the study units.

Unit	Number of births n (%)	Overall caesarean section rate n (%)	Women with previous caesarean section among all women n (%)	Initiated VBAC among women with previous caesarean section n (%)	Unplanned repeated caesarean section among women with planned VBAC n (%)	Completed VBAC among women with planned VBAC n (%)	Completed VBAC among women with previous caesarean section n (%)
Unit 1	2046	697	325	162	63	99	99
(Bavaria)		34.1%	15.9%	49.8%	38.9%	61.1%	30.5%
Unit 2	2507	710	327	161	65	96	96
(Hesse)		28.3%	13%	49.2%	40.4%	59.6%	29.4%
Unit 3	1927	516	229	108	33	75	75
(Lower Saxony)		26.8%	11.9%	47.2%	30.6%	69.4%	32.8%
Unit 4	1722	557	225	81	22	59	59
(Lower Saxony)		32.3%	13.1%	36.0%	27.2%	72.8%	26.2%
Unit 5	1766	530	248	134	53	81	81
(North Rhine-Westphalia)		30%	14%	54%	39.6%	60.4%	32.7%
Unit 6	2092	558	244	109	37	72	72
(Saxony)		26.7%	11.7%	44.7%	33.9%	66.1%	29.5%
P-value[a]	–	<0.0001	0.002	0.003	0.22	[b]	0.66

[a]χ^2-test.

[b]This column is complementary to the preceding one.

VBAC=vaginal birth after caesarean section.

Table 2 Modes of birth among women with previous caesarean section in selected states of Germany.

State	Number of births n (%)	Overall caesarean section rate n (%)	Women with previous caesarean section among all women n (%)	Initiated VBAC among women with previous caesarean section n (%)	Unplanned repeated caesarean section among women with planned VBAC n (%)	Completed VBAC among women with planned VBAC n (%)	Completed VBAC among women with previous caesarean section n (%)
Bavaria	98,467	32,286	13,894	6187	2544	3643	3643
		32.8%	14.1%	44.5%	41.1%	58.9%	26.2%
Hesse	47,177	16,029/47.177	7185	3220	1377	1843	1843
		34.0%	15.2%	44.8%	42.8%	57.2%	25.7%
Lower Saxony	55,551	18,090/55.551	8340	3797	1517	2280	2280
		32.6%	15.0%	45.5%	40.0%	60.0%	27.3%
North Rhine-Westphalia	135,875	44,477/135,875	20,484	9593	3762	5831	5831
		32.7%	15.1%	46.8%	39.2%	60.8%	28.5%
Saxony	33,139	7342/33,139	3469	2017	617	1400	1400
		22.2%	10.5%	58.1%	30.6%	69.4%	40.4%
P-value[a]	–	<0.0001	<0.0001	<0.0001	<0.0001	[b]	<0.0001[a]

[a]χ^2-test.

[b]This column is complementary to the preceding one.

VBAC=vaginal birth after caesarean section.

and 58.1% in Saxony (P<0.0001). The percentage of URCS in relation to planned VBAC also differed between the states (30.6% in Saxony and 42.8% in Hesse, P<0.0001). The percentages of completed VBAC in relation to all initiated VBAC ranged between 57.2% in Hesse and 69.4% in Saxony (P<0.0001). Finally, there was substantial variation with regard to the percentage of all women with previous caesarean sections who completed VBAC (P<0.0001).

Deviations between units and regional modes of birth after a previous caesarean section

Comparing the various units to the corresponding federal state data with respect to the absolute differences, the greatest differences were observed regarding the overall caesarean section rate which ranged from 5.8% below the state's average in unit 3 and 4.5% above the state's average in Unit 6 (Table 3). The proportion of women who had a caesarean section in their history ranged from 3.1% below the average in Unit 3 to 1.8% above the average in Unit 1. Initiated vaginal birth after previous caesarean section varied between 13.4% below the average in Unit 6 to 7.2% above the average in Unit 5. Consequently, elective repeat caesarean section ranged between 13.4% above the mean to 7.2% below the mean numbers of the respective states. Unplanned repeated caesarean sections ranged between 12.8% below the mean average numbers of the state in Unit 4 to 3.3%, which were above the average numbers of the state in Unit 6. The rate of women with a vaginal birth after caesarean compared to all the women who previously had had a caesarean ranged between 10.9% in Unit 6 being below the average numbers of the respective state to 5.5% in Unit 3 being above the average of the numbers in this particular state.

In terms of relative differences, of the six study units only two displayed percentages of overall caesarean sections very similar to those of the remainder of their regions; of the others, one had a 26% higher and the remaining three between 8% and 18% lower caesarean rates (Table 4). The percentages of women in the units with previous caesarean sections also differed from the regional data. Initiated VBAC deviated from regional data by up to 24% (relative scale). For URCS, the units' proportions were lower by up to 32% and higher by up to 12% than the corresponding regional data. Finally, completed VBAC deviated from the regional data by up to 28%.

Reviewing the different modes of birth in women with previous caesarean section, interesting characteristics of the individual units emerge (Table 5). For example, Units 1, 2, and 5 all had higher percentages of initiated VBAC and also higher percentages of completed VBAC than the respective averages for the corresponding regions. Unit 3 had an average percentage of initiated VBAC but fewer URCS and, therefore, more

Table 3 Absolute differences in percentage between units and corresponding regional data.

Unit	Overall caesarean section rate (%)	Women with previous caesarean section among all women (%)	Initiated VBAC among all women with previous caesarean section (%)	Unplanned repeated caesarean section among women with planned VBAC (%)	VBAC among all women with previous caesarean section (%)
Unit 1 (Bavaria)	+1.3	+1.8	+5.3	−2.2	+4.3
Unit 2 (Hesse)	−5.7	−2.2	+4.4	−2.4	+3.7
Unit 3 (Lower Saxony)	−5.8	−3.1	+1.7	−9.4	+5.5
Unit 4 (Lower Saxony)	−0.3	−1.9	−9.5	−12.8	−1.1
Unit 5 (North Rhine-Westphalia)	−2.7	−1.1	+7.2	+0.4	+4.2
Unit 6 (Saxony)	+4.5	+1.2	−13.4	+3.3	−10.9

Table 4 Modes of births after previous caesarean section in the study units compared to their respective regional data.

Unit	Overall caesarean section rate RR (95% CI)	Women with previous caesarean section in their histories among all women RR (95% CI)	Initiated VBAC among all women with previous caesarean section RR (95% CI)	Unplanned repeated caesarean section among women with planned VBAC RR (95% CI)	VBAC among all women with previous caesarean section RR (95% CI)
Unit 1 (Bavaria)	1.04 (0.98–1.11)	1.13 (1.02–1.25)[a]	1.12 (1.00–1.25)	0.94 (0.78–1.15)	1.17 (0.99–1.38)
Unit 2 (Hesse)	0.83 (0.77–0.88)[a]	0.85 (0.77–0.94)[a]	1.10 (0.99–1.24)	0.94 (0.78–1.14)	1.15 (0.97–1.37)
Unit 3 (Lower Saxony)	0.82 (0.76–0.88)[a]	0.79 (0.69–0.89)[a]	1.04 (0.90–1.19)	0.76 (0.57–1.01)	1.20 (1.00–1.46)
Unit 4 (Lower Saxony)	0.99 (0.93–1.06)	0.87 (0.77–0.98)[a]	0.79 (0.66–0.94)[a]	0.68 (0.47–0.97)[a]	0.96 (0.77–1.20)
Unit 5 (North Rhine-Westphalia)	0.92 (0.85–0.98)[a]	0.93 (0.83–1.05)	1.16 (1.03–1.30)[a]	1.01 (0.82–1.25)	1.15 (0.96–1.38)
Unit 6 (Saxony)	1.26 (1.17–1.36)[a]	1.16 (1.03–1.31)[a]	0.76 (0.65–0.87)[a]	1.12 (0.85–1.46)	0.72 (0.59–0.87)[a]

Notes: The data of the unit concerned were excluded from the regional data in each case.
RR=relative risk, CI=confidence interval; for better readability RR significantly different from 1 are indicated by[a].

completed VBAC than its state overall. Unit 6 had an average caesarean rate overall, a higher proportion of women with previous caesarean section, and, although fewer cases of initiated VBAC, still a higher proportion of URCS and fewer completed VBAC. Also interesting was Unit 4 which had an average caesarean rate; here, fewer VBAC were initiated, but there were also fewer URCS, resulting in an average level of completed VBAC. Overall, the study units tended to be more optimistic regarding planned VBAC but also to achieve a higher overall percentage of completed VBAC than the corresponding regional averages.

Discussion

This analysis demonstrated that mode of birth after previous caesarean section differed considerably across the

Table 5 Unit characteristics in comparison to regional data (based on Table 4).

Unit	Overall caesarean section rate RR (95% CI)	Women with previous caesarean section among all women RR (95% CI)	Initiated VBAC among all women with previous caesarean section RR (95% CI)	Unplanned repeated caesarean section among women with planned VBAC RR (95% CI)	VBAC among all women with previous caesarean section RR (95% CI)
Unit 1 (Bavaria)	Average	Higher than average	Higher than average	Average	Higher than average
Unit 2 (Hesse)	Lower than average	Lower than average	Higher than average	Average	Higher than average
Unit 3 (Lower Saxony)	Lower than average	Lower than average	Average	Lower than average	Higher than average
Unit 4 (Lower Saxony)	Average	Lower than average	Lower than average	Lower than average	Average
Unit 5 (North Rhine-Westphalia)	Lower than average	Lower than average	Higher than average	Average	Average
Unit 6 (Saxony)	Higher than average	Higher than average	Lower than average	Average	Lower than average

study units. Furthermore, the units' data differed in a complex fashion from regional average data, indicating additional heterogeneity contributing to the mosaic associated with varying modes of birth after previous caesarean section.

The overall caesarean section rates and the percentages of women with a previous caesarean section in their histories were similar among the western German states but differed from those of Saxony in eastern Germany which confirmed the already known lower rates of caesarean section in the former East Germany [31]. In the regional comparison, Saxony showed the highest proportion of planned VBAC and conversely the lowest proportion of ERCS. The chance to give birth vaginally seems to be best in Saxony. In one unit the proportion of women with initiated VBAC was lower than in the others, whereas the difference was less pronounced for completed VBAC. This might indicate that above a certain level of initiated VBAC, the probability of completing a VBAC decreases. But given the fact that the observation is based on a single unit, further studies are necessary. That a higher percentage of women with initiated VBAC result also in a higher percentage of women with completed VBAC is clearly demonstrated in regional data from Saxony.

The strengths of the analysis are the detailed approach to the different modes of birth in a pregnancy following a previous caesarean section and the contrasting of units' data with the regional data. However, the study also has several limitations. For example, there were some inconsistent data regarding the mode of birth. A reason for such inconsistency can be explained by some reluctance to indicate the mode of birth, given the perinatal audits and traditionally low caesarean section rates. Therefore, the mode of birth is not directly coded in the coding system used for surgery and procedures (OPS), or at least not for all modes of birth. Consequently, information on mode of birth was partly constructed using proxy variables. Caesarean section was classified as ERCS or URCS depending on whether labour duration was coded or not. Coding labour duration is usually not obligatory for quality assurance in perinatal units according to the requirements of the German statutory Social Security Code (SGB V). Missing data are, therefore, an issue in perinatal records. Data from the OPS coding system may differ from those in the maternity cards carried by the women themselves which represent an independent source of data alongside the OPS coding system. For the purpose of the study, differing data from these two sources were checked in individual records and corrected based on plausibility (e.g., n=36 cases in North Rhine-Westphalia). Furthermore, units may have different practices when entering data in the perinatal survey database, resulting in further uncertainty regarding data validity. In the database internal plausibility indicators are used to improve data quality, but problems are still possible.

This study is also limited in that it focuses solely on the mode of birth and does not consider individual risk factors. Two of the participating units were university hospitals offering services on a tertiary level which usually corresponds to more high-risk pregnancies in their populations. The fact that all hospitals have neonatal intensive care units is a selection because this is not routinely the case. Information about the indications of

the cesarean sections was not available for the analysis. Previous research indicated possible differences in the interpretation of relative indications between former East and West Germany [31]. The chance to give birth vaginally seems to be best in Saxony. Variations in caesarean section rates are obviously due to the fact that indications for elective caesarean sections are applied more rigorously in the eastern part of Germany compared to the western part [31]. In a previous study this has been particularly relevant for relative indications that might be considered in cumulative manner and, thus, become a stronger indication [26]. Increased maternal age, increased hypertension, gestational diabetes not treated with insulin, growth restricted fetus, placenta praevia marginalis, and a pregnancy after artificial reproductive techniques in a slightly worried nullipara with an estimated baby of around 4000 g might end up more likely in an elective caesarean section compared to a woman with only one or two of these indicators. Furthermore, maternal request for a caesarean section does not mean an indication itself but may contribute to the increase in elective caesarean sections if further relative indicators are present as well. The application of an absolute indication for a caesarean section remains essential for a good maternal and fetal outcome and won't vary in regions or institutions. These include placental abruption, placenta praevia, or transverse lie of the unborn. Further studies on interinstitutional variations may seek to adjust for risk related to labour and birth [9].

Our study suggests that an analysis of mode of birth after previous caesarean section should consider institutional characteristics and regional patterns. The same is true of interventions to increase the VBAC rates. A recent Cochrane review stated that there is currently no evidence of differences in VBAC rates between intervention groups with decision support and control groups [20]. The authors concluded that research is needed on shared decision support interventions for women regarding their mode of birth after a previous caesarean section. Knowledge of regional as well as interinstitutional patterns can contribute further understanding to existing patterns of VBAC.

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