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Demographic changes and effects on the mode of delivery: a retrospective analysis of a large birth registry containing 27,729 singleton deliveries in a level I center

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Abstract

Purpose To characterize and understand the demographics (age and body mass index, BMI) of a cohort of women who delivered at a single institution over an 11-year period. The purpose of this analysis is to look for effects over time of demographic characteristics on mode of delivery.

Methods Retrospective analysis of singleton deliveries between 2004–2014, $n = 27{,}729$; level 1 perinatal center, university hospital setting. Data were extracted from the digital birth registry. All statistical analyses were done using R version 3.5.1. Variables analyzed were: age, BMI, and mode of delivery (in the current and any prior pregnancies).

Results Mean age increased from 31.1 ± 5.2 years in 2004 to 31.5 ± 5.0 years in 2014 ($p < 0.001$, $eta^2 = 0.0006$). Mean BMI before pregnancy increased from 23.7 ± 4.5 to 24.7 ± 5.2 kg/m^2. Mean BMI at delivery increased from 28.5 ± 4.7 to 29.6 ± 5.2 kg/m^2 ($p < 0.001$, $eta^2 = 0.0049$). Regarding maternal age, patients with elective Cesarean section (CS) (32.5 ± 5.3 years), emergency CS (31.6 ± 5.6 years) and CS in labor (31.4 ± 5.3 years) were older compared to those with spontaneous (31.0 ± 5.2 years) or instrument-assisted vaginal delivery such as vacuum (31.0 ± 5.0 years) and forceps (30.2 ± 5.4 years). Among the multiparous patients, the mode of delivery in prior pregnancies is the variable with the greatest effect on the mode of delivery in any subsequent pregnancies. The mode of delivery was: spontaneous (55.5%), vaginal operative including vacuum and forceps (8.8%), and Cesarean section (35.7%).

Conclusions Increase of age and BMI over years is significant, but very small and in a range which seems not clinically relevant. Previous births have the strongest effects on mode of delivery in the current pregnancy.

Keywords Cesarean · Delivery · High-risk pregnancy · Prolapse · Urogynecology

Abbreviations

BMI	Body mass index
CS	Cesarean section
PFD	Pelvic floor disorders
WHO	World Health Organization

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Introduction

The optimal rate of CS is an ongoing topic of controversy and debate. Although the rates of CS seem to have reached their peak and are now on the decline [1], there is still an active debate regarding who should be delivered by CS for reasons other than absolute medical indications [2, 3]. The World Health Organization (WHO) states that an increase in the rate of CS above 15% is not associated with a reduction of maternal and newborn mortality, and no data justifies rates above 30%. In addition, the WHO advocates the safe and appropriate use of CS whenever medically indicated [4, 5].The wide range of national CS rates (e.g. Denmark 21% [6], Germany 31%[1] and Brazil 56% [7]) highlights regional and national cultural differences and practice patterns. The healthcare systems are often not comparable to each other, and, in addition, personal preferences and economic circumstances likely influence the rate of CS in different countries [3, 8].

Quite often the so called "demographic change" (increasing age and body mass index (BMI) prior to pregnancy and at the time of delivery) of our population has been blamed as responsible for increasing rates of CS. However, whether increasing rates of CS can be justified by suspected demographic changes in our population remains controversial.

The objective of this study is to characterize and describe these demographics over time at a single institution in delivering women and to analyze variables seeking for both statistical and clinical relevance. This analysis tests the null hypothesis that demographic changes in age and BMI are clinically relevant and responsible for increasing rates of CS.

Materials and methods

The data source was a large digital birth registry at the Department of Women's Health, University Hospital of Tuebingen, Germany. All deliveries within an 11-year time period between 2004 and 2014 were analyzed retrospectively. Data were extracted from the digital birth database (i.s.h. med, SAP for Healthcare, Cerner, North Kansas City, MO, USA). This registry includes information about perinatal variables of the mothers'-to-be record of prenatal and natal care, including documentation from the Labor and Delivery ward, such as parity, age, height, specific risks in pregnancy, estimated due date, mode of delivery, fetal weight and others. Inclusion criteria were defined as: women who delivered singletons at our institution within the defined time frame. Multiple pregnancies were excluded.

Different types of CS were defined according to Lucas et al. as follows [9]:

(a) Elective CS: "at a time suitable for both mother-to-be and obstetric team" (e.g. CS for breech presentation, CS on maternal request, CS for placenta previa totalis).
(b) CS in labor: "Rupture of membranes and/or contractions have already started." (e.g. CS for non-reassuring fetal heart beat pattern, failure of progression, arrest disorder).
(c) Emergency CS: "immediate threat to life of mother-to-be or undelivered child" (e.g. uterine rupture, severe fetal bradycardia, prolapse of umbilical cord with severe fetal bradycardia).

Data were collected on maternal demographics, including: age, BMI prior to pregnancy and at delivery, number and mode of prior deliveries, gestational age at the time of delivery, mode of delivery and fetal weight. Cross checking for plausibility and data cleaning were performed prior to analysis. All statistical analyses were done using R version 3.5.1 (The R Foundation for Statistical Computing, Vienna, Austria). Since continuous data like age, BMI, birth weight and gestational age are approximately normally distributed, these variables are described as means and standard deviations (SD). Linear regression and estimation of effect sizes were done for potential changes over the years in both BMI and age. To investigate the effect of several factors on birth mode, a multinomial regression model was formulated using the R packages 'mlogit' as well as the function 'multinom' from 'nnet'. Model fit was assessed by McFadden R^2 and relative importance of factors was estimated with function 'varImp' from R Package 'caret'. The study was approved by the local ethics committee (Ethics Committee, Department of Medicine, Eberhard Karls University and University Hospital Tuebingen, Germany; 750/2017BO2, 27.11.2017). According to the committee´s guidelines, there is no informed consent of participants required, since this is a retrospective analysis.

Results

Within the 11-year period, $n = 31{,}449$ deliveries were documented in the birth registry. 3720 deliveries (11.8%) had to be excluded due to multiple pregnancies or insufficient data recording leaving $n = 27{,}729$ singleton deliveries subject to analysis. The annual number of deliveries increased continuously from 2081 in 2004 to 2774 in 2014.

Mean age of all mothers at time of delivery was 31.3 ± 5.3 years (mean ± SD). Within the 11-year period, the mean maternal age significantly increased from 31.1 ± 5.2 years in 2004 to 31.5 ± 5.0 years in 2014 (linear regression gradient 0.04 years of age per calendar year, $p < 0.001$, $eta^2 = 0.0006$). The mean age of primigravid mothers was 29.9 ± 5.3 years. Within the 11-year period, the mean age of these primigravid women significantly increased from 29.8 ± 5.3 years in 2004 to 30.2 ± 5.0 years in 2014 (linear regression gradient 0.05 years of age per calendar year, $p < 0.001$, $eta^2 = 0.0010$).

Mean BMI before pregnancy was 24.1 ± 4.8 kg/m^2 and significantly increased from 23.7 ± 4.5 kg/m^2 in 2004 to 24.7 ± 5.2 kg/m^2 in 2014 (linear regression gradient 0.11 kg/m^2, $p < 0.001$, $eta^2 = 0.0051$). Mean BMI at delivery was 29.0 ± 4.9 kg/m^2 increasing significantly from 28.5 ± 4.7 kg/m^2 in 2004 to 29.6 ± 5.2 kg/m^2 in 2014 (linear regression gradient 0.11 kg/m^2, $p < 0.001$, $eta^2 = 0.0049$).

Regarding the mode of delivery, 55.5% were spontaneous vaginal deliveries, 8.4% vacuum assisted, 0.4% forceps assisted and 35.7% delivered by CS. Of the latter, 19.4% were elective (such as for breech presentation or repeat CS), 15.1% were CS in labor and 1.2% emergency CS. The rate of CS increased significantly over the years (pointbiserial correlation coefficient significantly different from 0, $p < 0.001$). The rate increased about 0.38% per year (linear regression on percentages). See Table 1 for patients' characteristics and Table 2 for changes over time. Figure 1 shows the mode of delivery over time.

Both major demographic variables, age and BMI, are associated with the mode of delivery as follows: Patients with all types of CS are older on average compared to those delivered by other modes of delivery. The mean BMI before pregnancy and at delivery is higher in patients with all types of CS.

To investigate several parameters potentially influencing the mode of delivery we chose multinomial logistic regression. BMI (at delivery), maternal age, year of delivery, birth weight, gestational age at delivery, and number and mode of previous deliveries were included as influencing factors (for details see Table 3). The multinomial regression model shows a McFadden R^2 of 0.17. Since McFadden R^2 values are generally much lower than R^2 of linear regression this value indicates quite a good fit.

Women with higher BMI at birth relative to women with lower BMI are more likely to have an elective CS and are also more likely to have a CS while in labor than spontaneous vaginal deliveries. With increasing maternal age, both elective CS and CS in labor are more likely. However, in the multivariate model, neither rates of elective CS nor of CS in labor change significantly over the years. This result compared to the increasing rates of CS in the pointbiserial correlation by year implies that the observed increase of CS rates 2004–2014 is caused by changes of the influencing factors as reported as follows and not by time itself.

After at least one spontaneous vaginal delivery (and no CS), women deliver less likely by elective CS and CS in labor compared to primigravid women. In contrast, after one previous CS, a second elective CS and to a lesser extent a CS in labor are more likely than a spontaneous delivery compared to primigravid women. After two previous CS nearly all of the patients underwent another elective CS. Therefore, prior experienced mode of delivery has the strongest influence on the mode of delivery (Table 3).

Birth weight does not have a significant influence on the rates of elective CS compared to a spontaneous vaginal delivery, but the rate of CS in labor slightly increases with increasing birth weight. With increasing gestational age, elective and CS in labor are less likely than spontaneous delivery.

Rating these variables, parity and mode of delivery of previous births are the most important factors for the mode of delivery within the current pregnancy (relative weight obtained by function varImp() for all categories> 1.40), followed by gestational age (0.40), BMI at delivery (0.13), age of mother (0.12), birth weight (0.03) and year of delivery (0.03).

Discussion

Main findings

Increasing rates of Cesarean sections have been frequently justified by the so called "demographic change" of our

Table 1 Patients' characteristics by mode of delivery

	Mode of delivery					
	Spontaneous	Vacuum	Forceps	Elective CS	CS in labor	Emergency CS
Patients, number (percentage), total of 27,729	15,389 (55.50%)	2342 (8.45%)	99 (0.36%)	5390 (19.44%)	4183 (15.09%)	326 (1.18%)
Patients in high risk group, number (percentage), total of 103, i.e. 0.37% of the complete sample	42 (40.8%)	4 (3.9%)	1 (1.0%)	17 (16.5%)	38 (36.9%)	1 (1.0%)
BMI before pregnancy (kg/m^2), mean (SD)	23.7 (4.5)	23.3 (4.1)	23.1 (4.5)	25.1 (5.5)	24.7 (5.1)	24.7 (5.7)
BMI at delivery (kg/m^2), mean (SD)	28.6 (4.6)	28.4 (4.3)	28.3 (4.9)	29.8 (5.5)	30 (5.3)	29.2 (5.6)
Maternal age (years), mean (SD)	31.0 (5.2)	31.0 (5.0)	30.2 (5.4)	32.5 (5.3)	31.4 (5.3)	31.6 (5.6)
Gestational age (week), mean (SD)	39.4 (1.9)	39.7 (1.5)	39.0 (2.5)	37.2 (3.0)	38.9 (2.9)	38.2 (3.8)
Birth weight (g), mean (SD)	3329.6 (572.8)	3348.2 (445.9)	3250.8 (589.0)	2981.1 (781.0)	3213.9 (749.4)	2763.8 (929.3)
Previous births, number of patients						
None	6298	1851	84	2267	2767	197
Previous delivery, no CS	6874	136	3	766	408	63
One previous CS	1157	279	9	1625	852	52
At least two previous CS	24	0	0	542	64	4

BMI body mass index, *SD* standard deviation, *CS* Cesarean section; table includes distribution of high-risk group (< 160 cm maternal height, > 4 kg fetal weight, as explained in the discussion section)

Table 2 Patient's characteristics by year, see small effect sizes regarding analyzed birth variables

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Effect size eta^2	Yearly change
Births, number	2081	2491	2419	2499	2617	2567	2529	2508	2572	2672	2774	0.6219	41.6
CS, number (proportion)	695 (33.4%)	818 (32.8%)	841 (34.8%)	829 (33.2%)	984 (37.6%)	938 (036.5%)	948 (37.5%)	886 (35.3%)	995 (38.7%)	969 (36.3%)	996 (35.9%)	0.4307	0.38%
BMI before pregnancy (kg/m^2), mean (SD)	23.7 (4.5)	23.7 (4.4)	23.8 (4.5)	23.9 (4.6)	24.0 (4.8)	24.0 (4.8)	24.2 (5.0)	24.3 (4.9)	24.4 (5.2)	24.5 (5.0)	24.7 (5.2)	0.0051	0.11
BMI at delivery (kg/m^2), mean (SD)	28.5 (4.7)	28.7 (4.6)	28.6 (4.5)	28.8 (4.6)	28.9 (4.9)	28.9 (4.9)	29.1 (5.1)	29.2 (4.9)	29.3 (5.1)	29.4 (5.1)	29.6 (5.2)	0.0049	0.11
Maternal age (years), mean (SD)	31.1 (5.2)	31.1 (5.3)	31.2 (5.3)	31.2 (5.2)	31.2 (5.4)	31.3 (5.4)	31.4 (5.2)	31.4 (5.3)	31.6 (5.2)	31.4 (5.2)	31.5 (5.0)	0.0006	0.04
Primigravid maternal age (years), mean (SD)	29.8 (5.3)	29.6 (5.3)	29.7 (5.3)	29.5 (5.2)	29.8 (5.4)	29.8 (5.5)	30.1 (5.3)	29.8 (5.3)	30.2 (5.3)	29.9 (5.1)	30.2 (5.0)	0.0010	0.05
Gestational age (week), mean (SD)	39.2 (2.3)	39.3 (2.2)	39.2 (2.2)	39.2 (2.1)	39.1 (2.3)	39.1 (2.4)	39.2 (2.1)	39.2 (2.1)	39.1 (2.3)	39.1 (2.3)	39.1 (2.5)	0.0003	− 0.01
Birth weight (g), mean (SD)	3263 (636)	3297 (642)	3238 (664)	3267 (662)	3248 (660)	3234 (668)	3212 (656)	3225 (653)	3212 (666)	3217 (652)	3227 (679)	0.0009	− 6.39
Previous births percentage													
None	50.18	51.17	48.73	51.00	51.34	50.92	51.65	51.23	51.43	51.37	53.15		
Previous delivery, no CS	34.30	33.71	32.94	32.20	31.11	32.62	29.21	29.69	29.45	31.19	29.14		

Table 2 (continued)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Effect size eta^2	Yearly change
One previous CS	13.72	13.53	16.06	14.55	15.09	14.24	16.72	16.20	16.09	14.98	14.74		
At least two previous CS	1.80	1.59	2.27	2.25	2.45	2.21	2.42	2.88	3.02	2.46	2.96		

population described as increasing maternal age and BMI over time [10, 11]. It was the aim of this retrospective analysis, to gain more insights in these changes over time in order to proof their clinical relevance.

Although a significant increase of maternal age could be detected in our sample within the 11-year time frame from 2004 until 2014, the increase found was 4.8 months only. The missing clinical relevance can be recognized by very low effect sizes. In addition, an increase of BMI before pregnancy of 1.0 kg/m^2 and 1.1 kg/m^2 at delivery within 11 years cannot be described as a subject of clinical importance either.

Even though women at higher age were significantly more likely to deliver their children by CS, as were women with a higher BMI, parity and mode of delivery in previous pregnancies could be identified as the most influencing factor for the mode of delivery in the current pregnancy.

Strengths and limitations

This is a retrospective analysis of a birth registry of one of the largest level I perinatal centers in a university hospital setting in Germany. As described by Sandall, an increasing majority of women deliver their children in units from 3000–4999 deliveries per year in Europe [12]. Over 27,000 deliveries were analyzed providing a sufficient sample size for the relevant statistical analysis. To minimize heterogeneity, multiple pregnancies were excluded. In addition, statistical analyses include estimation of effect sizes to quantify the clinical relevance independent of sample size. A multinomial regression model was used as the appropriate statistical tool to identify relevant factors.

Obviously, the retrospective design of this analysis has to be considered. In addition, despite the large sample size, our results may not be comparable or generalizable to other care providing systems or countries. In addition, our sample surely is at increased risk in general, therefore our initial rate of CS of 33.4% was higher than the nationwide average (31%) [1]. Our aim was to describe the current situation in our specific sample to better understand the ongoing debate regarding high rates of CS.

Interpretations

Although there is a demographic change in our sample, its clinical relevance might be lower than expected. Therefore, high rates of CS should not be justified by increasing age and BMI over time, at least in our specific population. Even though changes in age and BMI are associated with the mode of delivery, these influencing effects are small.

The prior experienced mode of delivery in multiparous women has a greater effect in the multivariate model than age and BMI. In addition, the lower the gestational age, the

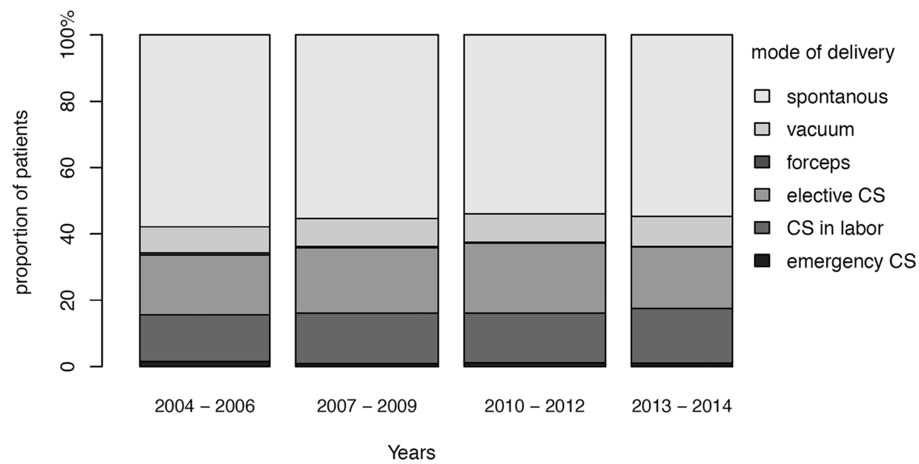

Fig. 1 Mode of delivery in four time periods (*CS* Cesarean section)

Table 3 Multinominal logistic regression with main outcome being the mode of delivery

	Elective CS versus spontaneous				CS in labor versus spontaneous			
	est.	Odds ratio	95% CI	*p*	est.	Odds ratio	95% CI	*p*
BMI at delivery (kg/m^2)	0.07	1.07	1.05; 1.08	< 0.001	0.06	1.06	1.05; 1.07	< 0.001
Maternal age (years)	0.07	1.07	1.06; 1.09	< 0.001	0.05	1.05	1.04; 1.06	< 0.001
Previous delivery, no CS	1.40	0.25	0.23; 0.27	< 0.001	– 2.36	0.09	0.08; 0.11	< 0.001
One previous CS	1.12	3.08	2.77; 3.43	< 0.001	0.31	1.36	1.22; 1.52	< 0.001
At least two previous CS	3.76	43.00	42.63; 43.35	< 0.001	1.47	4.36	4.32; 4.39	< 0.001
Year of delivery	0.03	0.97	0.97; 0.97	< 0.001	– 0.00	1.00	1.00; 1.00	0.732
Birth weight (100 g)	0.00	1.00	0.98; 1.01	0.590	0.02	1.02	1.01; 1.03	< 0.001
Gestational age (weeks)	0.26	0.77	0.74; 0.80	< 0.001	– 0.13	0.87	0.85; 0.90	< 0.001

Forceps, vacuum and emergency CS were excluded. In respect of previous deliveries patients are categorized as: patients without previous delivery, patients with only previous spontaneous deliveries, patients with one and patients with at least two previous CS

more likely CS will be the mode of delivery in this current pregnancy.

The increasing number of women having had a CS in their previous pregnancy explains the raising rates of CS in our sample. Therefore, it is important to realize that increasing rates of CS have amplifying effects in the future since the previously experienced mode of delivery is the variable of strongest influence.

Even though maternal age changes over time are of limited relevance, the high maternal age at the time of delivery in itself needs to be addressed. In our sample, the maternal age at the time of delivery was 31.1 years overall and 29.9 years in the primigravid group. Norman et al. described young women being more likely to have a vaginal delivery compared to their older controls [13]. Castiglioni et al. could show that higher age is associated with an increased risk of CS [14]. In addition, Wehberg et al. published their analysis of women at the age of 20–34 years with a rate of elective CS at 7.5%, whereas women aged 35–44 years delivered by CS in 13.6% (odds ratio CS at the age of 35–44 1.58 95% CI 1.51–1.66, total sample of deliveries $n = 226{,}612$) [6]. Begum et al. described a significant association between CS and higher maternal age in their population ($n = 2549$) [15].

Regarding BMI, the awareness of a worldwide increase of obesity remains important, although in our sample neither an increasing BMI of clinical relevance, nor a high BMI in itself could be identified. Poobalan et al. described a 50% increase of the risk to deliver by CS in overweight women and even higher in obese women [10].

This last paragraph of the discussion emphasizes the cooperation between obstetrics and urogynecology, regarding the ongoing discussion how to reduce rates of CS. The significance of this cooperation has been described before, seeking to provide a pelvic floor protection for mothers-to-be [2]. Whereas the demographic change in our sample could not be proven to be of clinical relevance, these variables are still of great importance. Age, BMI and parity are known to be major risk factors for the prevalence of pelvic floor disorders (PFD) such as urinary or fecal incontinence and pelvic organ prolapse in a woman's later life [16–18]. Obstetricians and urogynecologists are about to cooperate more intensively to identify women for medical indicated CS to prevent pelvic floor disorders, and vice versa, to identify women who can be encouraged to deliver spontaneously. Systems of risk stratification such as UR–CHOICE ask specific questions to determine the risk for prolapse and incontinence in a woman's life depending on certain variables such as U, prevalence of urinary incontinence before pregnancy, R, race/ethnicity, C, child bearing started at what age?, H, mothers' height, O, overweight, I inheritance, C, number of children desired, E, estimated fetal weight [19, 20]. There is evidence that women smaller than 160 cm are at a specifically higher risk for prolapse in their ongoing later life, especially if the newborn has a weight of more than 4 kg. Gyhagen et al. describe in their study that the prevalence of prolapse in women smaller than 160 cm within 20 years increases significantly from 13.4% to 24.2% if the fetal weight is 4 kg and more (OR 2.06; 95% CI 1.19–3.55) [21]. Since the actual size of this specific cohort of women being at high risk for PFD has not been described, we used our descriptive analysis to provide these numbers in our sample as follows: number of mothers < 160 cm height, > 4 kg fetal weight $n = 104$, 0.37% of the overall sample of 27,729. The mean age of these mothers was 30.9 ± 5.4 years (mean ± SD). In this cohort, the mode of delivery was distributed as: spontaneous (41.3%; $n = 43$), vaginal operative (4.8%; $n = 5$), elective CS (16.3%; $n = 17$), CS in labor (36.5%; $n = 38$), emergency CS (1.0%; $n = 1$), overall rate of CS (53.8%; $n = 58$). From all women who started vaginal delivery and ended up in a CS, in $n = 29$ (76%) the indication for CS was failure to progress in the second stage of labor. In our sample, the high-risk population is very small, suggesting that pelvic protective effects of CS might not be relevant for the majority of mothers-to-be.

The interaction between obstetrics and urogynecology will be of increasing importance to provide a patient-oriented, individualized treatment of mothers-to-be including aspects of pelvic floor protection based on informed consent. In our aging society, benefits of early motherhood should be of growing awareness.

Conclusion

The demographic change should not be used to justify high rates of CS. Small increases in both maternal age and BMI do not seem to be of clinical relevance due to their small effect sizes. The most important variable associated with the mode of delivery in our sample was previous birth mode and only to a lower extend age and BMI.

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Compliance with ethical standards

Conflict of interest There are no conflicts of interest.

Ethical approval The study was approved by the local ethics committee (Ethics Committee, Department of Medicine, Eberhard Karls University and University Hospital Tuebingen, Germany; 750/2017BO2, 27.11.2017). According to the committee´s guidelines, there is no informed consent of participants required, since this is a retrospective analysis.

References

1. Statistisches Bundesamt. Krankenhausentbindungen in Deutschland—Jahre 1991–2015. https://www.destatis.de/DE/ZahlenFakten/GesellschaftStaat/Gesundheit/Krankenhaeuser/Tabellen/KrankenhausentbindeungenKaiserschnitt.htm. Accessed June 2018
2. Huebner M, Brucker SY, Tunn R, Naumann G, Reisenauer C, Abele H (2017) Intrapartal pelvic floor protection: a pragmatic and interdisciplinary approach between obstetrics and urogynecology. Arch Gynecol Obstet 295(4):795–798. https://doi.org/10.1007/s00404-017-4316-x
3. Bihler J, Tunn R, Reisenauer C, Pauluschke-Frohlich J, Wagner P, Abele H, Rall KK, Naumann G, Wallwiener M, Brucker SY, Hubner M (2017) Personal preference of mode of delivery. What do urogynaecologists choose? Preliminary results of the DECISION Study. Geburtshilfe Frauenheilkd 77(11):1182–1188. https://doi.org/10.1055/s-0043-120919
4. Betran AP, Torloni MR, Zhang JJ, Gulmezoglu AM, Section WHOWGoC (2016) WHO Statement on Caesarean Section Rates. BJOG 123(5):667–670. https://doi.org/10.1111/1471-0528.13526
5. World Health Organization Human Reproduction Programme A (2015) WHO statement on caesarean section rates. Reprod Health Matters 23(45):149–150. https://doi.org/10.1016/j.rhm.2015.07.007
6. Wehberg S, Guldberg R, Gradel KO, Kesmodel US, Munk L, Andersson CB, Jolving LR, Nielsen J, Norgard BM (2018) Risk factors and between-hospital variation of caesarean section in Denmark: a cohort study. BMJ Open 8(2):e019120. https://doi.org/10.1136/bmjopen-2017-019120
7. Fahmy WM, Crispim CA, Cliffe S (2018) Association between maternal death and cesarean section in Latin America: a systematic literature review. Midwifery 59:88–93. https://doi.org/10.1016/j.midw.2018.01.009
8. Bermudez-Tamayo C, Johri M, Chaillet N (2018) Budget impact of a program for safely reducing caesarean sections in Canada. Midwifery 60:20–26. https://doi.org/10.1016/j.midw.2018.01.022

9. Lucas DN, Yentis SM, Kinsella SM, Holdcroft A, May AE, Wee M, Robinson PN (2000) Urgency of caesarean section: a new classification. J R Soc Med 93(7):346–350. https://doi.org/10.1177/014107680009300703
10. Poobalan AS, Aucott LS, Gurung T, Smith WC, Bhattacharya S (2009) Obesity as an independent risk factor for elective and emergency caesarean delivery in nulliparous women—systematic review and meta-analysis of cohort studies. Obes Rev 10(1):28–35. https://doi.org/10.1111/j.1467-789X.2008.00537.x
11. Breart G (1997) Delayed childbearing. Eur J Obstet Gynecol Reprod Biol 75(1):71–73
12. Sandall J (2015) Place of birth in Europe. Entre Nous The Eur Mag Sexual Reprod Health 81:16–17
13. Norman JE, Stock SJ (2018) Birth options after a caesarean section. BMJ 360:j5737. https://doi.org/10.1136/bmj.j5737
14. Castiglioni L, Schmiedeberg C (2018) Joint effect of education and age at childbirth on the risk of caesarean delivery: findings from Germany 2008–2015. Public Health 155:1–7. https://doi.org/10.1016/j.puhe.2017.10.020
15. Begum T, Rahman A, Nababan H, Hoque DME, Khan AF, Ali T, Anwar I (2017) Indications and determinants of caesarean section delivery: evidence from a population-based study in Matlab, Bangladesh. PLoS ONE 12(11):e0188074. https://doi.org/10.1371/journal.pone.0188074
16. Caudwell-Hall J, Kamisan Atan I, Brown C, Guzman Rojas R, Langer S, Shek KL, Dietz HP (2018) Can pelvic floor trauma be predicted antenatally? Acta Obstet Gynecol Scand. https://doi.org/10.1111/aogs.13315
17. Glazener C, Elders A, Macarthur C, Lancashire RJ, Herbison P, Hagen S, Dean N, Bain C, Toozs-Hobson P, Richardson K, McDonald A, McPherson G, Wilson D, ProLong Study G (2013) Childbirth and prolapse: long-term associations with the symptoms and objective measurement of pelvic organ prolapse. BJOG 120(2):161–168. https://doi.org/10.1111/1471-0528.12075
18. Nygaard I, Barber MD, Burgio KL, Kenton K, Meikle S, Schaffer J, Spino C, Whitehead WE, Wu J, Brody DJ, Pelvic Floor Disorders N (2008) Prevalence of symptomatic pelvic floor disorders in US women. JAMA 300(11):1311–1316. https://doi.org/10.1001/jama.300.11.1311
19. Jelovsek JE, Chagin K, Gyhagen M, Hagen S, Wilson D, Kattan MW, Elders A, Barber MD, Areskoug B, MacArthur C, Milsom I (2018) Predicting risk of pelvic floor disorders 12 and 20 years after delivery. Am J Obstet Gynecol 218(2):222. https://doi.org/10.1016/j.ajog.2017.10.014 **(e221–222 e219)**
20. Wilson D, Dornan J, Milsom I, Freeman R (2014) UR-CHOICE: can we provide mothers-to-be with information about the risk of future pelvic floor dysfunction? Int Urogynecol J 25(11):1449–1452. https://doi.org/10.1007/s00192-014-2376-z
21. Gyhagen M, Bullarbo M, Nielsen TF, Milsom I (2013) Prevalence and risk factors for pelvic organ prolapse 20 years after childbirth: a national cohort study in singleton primiparae after vaginal or caesarean delivery. BJOG 120(2):152–160. https://doi.org/10.1111/1471-0528.12020