

Short stature is associated with an increased risk of Caesarean deliveries in low risk population

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Objective. Maternal somatometric characteristics are clearly associated with pregnancy outcome, first of all newborn weight and length. The impact of maternal stature on birth and especially on the mode of delivery, however, is discussed controversially. This study examined the impact of maternal stature on the mode of delivery, in particular on the Caesarean section rate.

Methods. In this prospective study, data of 4278 live births at the Viennese University Hospital were analyzed. Since preterm births, maternal age below twenty years, Caesarean delivery on request, breech or transverse presentation and coincident medical diseases such as diabetes mellitus or nephropathy, drug or alcohol abuse, twin birth or IVF were strict exclusion criteria, the study population can be described as a low risk population. Maternal anthropometrics (height, weight, weight gain) and newborn somatic characteristics (birth weight, birth length, head dimensions, APGAR scores) were documented. Binary logistic regression models were used to evaluate the risk factors for Caesarean delivery.

Results. The Caesarean section rate was 17.7%. Beside newborn somatometric characteristics, such as head dimensions and birth weight, maternal stature was significantly associated with the rate of caesarean section. With decreasing maternal stature the risk of Caesarean sections increased significantly. Especially among short and very short women (<150 cm) the rate of Caesarean deliveries was extraordinarily high (>40%). According to binary regression analyses, maternal stature had a significant impact on the mode of delivery, while, in contrast, no significant associations between the mode of delivery and maternal age, prepregnancy weight status, pregnancy weight gain as well as pelvic dimensions were found.

Conclusion. Short stature is significantly associated with the risk of Caesarean delivery.

Key words: maternal height, infant anthropometrics, Caesarean deliveries

INTRODUCTION

The relationship between maternal anthropometric characteristics, first of all maternal weight status and pregnancy weight gain, and pregnancy outcome is well known and has been documented by many authors (1–3). Especially short maternal stature was mentioned to be associated with adverse pregnancy outcome such as high rates of low birth weight newborns and low APGAR scores (4, 5). Furthermore, maternal height has been reported as an obstetric risk factor, since short maternal height may be associated with cephalo-pelvic disproportion (CPD) resulting in obstructed labor (5–7).

Therefore, short maternal stature seems to represent an important risk factor for emergency Caesarean section (8, 9). Steiner et al. (10) described short women, with a stature below 155 cm as high risk patients for Caesarean section even after controlling for labor dystocia. Witter et al. (6) showed that a maternal height less than 157 cm was significantly associated with an increased risk of Caesarean delivery. As the main causes for emergency, Caesarean section in short women, cephalo-pelvic disproportion (CPD) and labor arrest were mentioned (11–17). Although – as to be seen above – a number of studies have reported a correlation between maternal height and the risk of Caesarean section, some authors failed to find any association between maternal height and the mode of delivery (18, 19). Therefore, the present study was aimed to investigate the relationship between maternal stature, pregnancy outcome and the mode of delivery in an

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Austrian sample. Since preterm births, a maternal age below twenty years, Caesarean delivery on request, breech or transverse presentation and coincident medical diseases such as diabetes mellitus or nephropathy, drug or alcohol abuse, twin birth or IVF were strict exclusion criteria, the study population can be described as a low risk population.

MATERIALS AND METHODS

Data set

In the present study, data on 4278 births which took place at the University Clinic for Gynecology and Obstetrics in Vienna were analyzed. The data were collected prospectively and altogether the data of 7138 births were collected. In the analyses included were all births which occurred between the 39th and 41st week of gestation, because only term births of comparable gestational length should be included in analyses. Exclusively nulliparous women ageing between 20 and 41 years whose first prenatal check took place during the eighth week of gestation were enrolled in the present study. Additionally the following inclusion criteria were used: all prenatal check-ups of the mother-child passport completed, the delivery of a single infant without congenital malformations, no registered maternal diseases before and during pregnancy, no hypertension (BP < 150/90 mmHg), no proteinuria, no glucosuria, no pregnancy-related immunization. Furthermore, maternal age below twenty years, Caesarean delivery on request, breech or transverse presentation and coincident medical diseases such as diabetes mellitus or preeclampsia, drug or alcohol abuse, twin birth or IVF were strict exclusion criteria. Therefore, only 4278 births were included in the final analysis. Gestational age was calculated in terms of the number of weeks from the beginning of the last menstrual bleeding to the date of delivery (= duration of amenorrhoea) and by two consecutive ultrasound examinations performed before the 12th week of gestation. All subjects were Caucasians of Austrian or Central European origin. The study was approved by the local bioethical committee.

Anthropometric data

The following anthropometric data were determined according to the methods described in Knussmann (20):

Maternal anthropometrics

Stature, prepregnancy weight (PPW), weight at the end of pregnancy (EPW), weight gain during pregnancy (PWG) were determined according to the methods described in Knussmann (20). Stature was determined at the first prenatal visit. Prepregnancy weight was estimated by means of the retrospective method and the first weight determination, which was carried out at the first prenatal visit (8th week of gestation). During the first 13 weeks of gestation a weight gain of only 1.7%

can be assumed. Therefore, combination of the retrospective method and weight determination at the 8th week of gestation seemed to be appropriate in the present study. To determine prepregnancy weight, the mean value of the retrospective estimated weight and the weight at the 8th week of gestation were calculated. Weight gain during pregnancy was calculated by subtraction of prepregnancy weight from body weight at the end of pregnancy. Maternal weight status before pregnancy was described as the body mass index (BMI) (kg/m²). Weight status was classified according to the WHO recommendations (21).

Newborn anthropometrics

The following parameters were taken directly from the newborn immediately after birth: birth weight, birth length, head circumference, diameter frontooccipitalis, acromial circumference.

Birth weight was classified as very low <1500 g, low 1500–2500 g, normal 2500–4000 g and high (macrosomia) >4000 g. Also, the one- and five-minute APGAR scores for the evaluation of the newborn were determined.

Obstetrical characteristics

The mode of delivery, spontaneous versus Caesarean section, was documented as an indicator of severe obstetrical complications during birth, because Caesarean sections requested by the mother were excluded from the analysis and therefore only emergency Caesarean sections were included in the present sample.

Statistical analysis

Statistical analysis was performed by means of SPSS for Windows program Version 11.0. After calculating descriptive statistics (means, SDs), group differences were tested regarding their statistical significance using Student's *t* tests. The analysis included the χ^2 for the linear trend. Additionally, odds ratios were calculated. Binary logistic regressions were computed in order to test the association among maternal stature, prepregnancy body mass as well as newborn anthropometrics and the mode of delivery. Spontaneous delivery was coded as 1 and Caesarean section as 2.

RESULTS

Mode of delivery

Within the present sample, 758 (17.7%) Caesarean sections took place. The most frequent indications for Caesarean delivery were fetal distress (42.8%) and dystocia (37.5%).

Maternal and newborn anthropometrics

The maternal height distribution is presented in Fig. 1. As to be seen, only less than 10% were shorter than 155 cm. The mean height was 164.1cm (± 6.5). The

prepregnancy weight status of the majority of women (77.0%) corresponded to the definitions of normal weight (BMI 18.5–24.99); 10.2% of the women exhibited underweight during prepregnancy phase, whereas overweight during prepregnancy phase was found among 13%, however, severe overweight (BMI > 30.00) was only described for 2.4% of the women. Since only term births were included in the present analysis, 92.6% of the newborns corresponded to the definitions of normal

weight (2500–4000 g), 1.6% were classified as low weight (<2500 g), and no birth weight below 1500 g was found; 5.8% of the newborns were classified as macrosomic (>4000 g).

Neither maternal prepregnancy weight status nor newborn weight status were significantly associated with the mode of delivery (see Table 1). In contrast, among newborns with an APGAR score below 7 the percentage of Caesarean delivery was extremely high (Table 1).

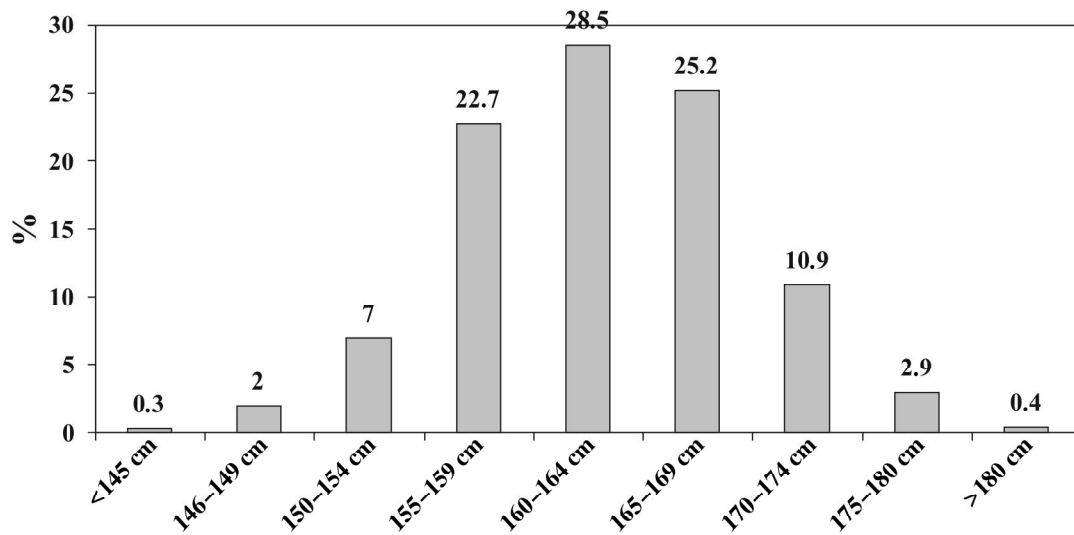


Fig. 1. Maternal height distribution

Table 1. Maternal and newborn characteristics by mode of delivery, Student's *t* tests and χ^2

	Caesarean delivery (n = 819) X (SD)	Vaginal delivery (n = 3820) X (SD)	Significance
Maternal height (cm)	162.9 (7.1)	164.3 (6.4)	<0.0001
Prepregnancy weight (kg)	59.2(10.5)	59.9 (9.7)	n. s.
Prepregnancy weight status (BMI) (kg/m ²)	22.19 (3.39)	21.75 (3.21)	<0.05
Distantia spinarum (cm)	24.8 (2.1)	24.8 (2.1)	n. s.
Distantia cristarum (cm)	27.9 (1.9)	28.0 (2.0)	n. s.
Birth weight (g)	3344.8 (435.1)	3335.3 (399.3)	n. s.
Birth length (cm)	49.9 (1.9)	49.8 (1.8)	n. s.
Acromial circumference (cm)	36.9 (2.4)	36.7 (2.2)	<0.05.
Head circumference (cm)	34.4 (1.3)	34.3 (1.4)	<0.05
Diameter frontooccipitalis (cm)	11.3 (0.7)	11.3 (0.8)	<0.05
Prepregnancy weight status			
<18.50 kg/m ²	8.7%	10.6%	n. s.
18.50–24.99 kg/m ²	75.7%	77.0%	
25.00–29.99 kg/m ²	12.7%	10.1%	
>30.00 kg/m ²	2.9%	2.3%	
Newborn weight status			
<1500 g	0.0%	0.0%	n. s.
1500–2499 g	2.0%	1.5%	
2500–3999 g	90.4%	92.7%	
>4000 g	7.6%	5.8%	
APGAR values < 7			
APGAR 1 min (n = 210)	43.3%	56.7%	<0.001
APGAR 5 min (n = 34)	38.2%	61.8%	<0.001

Maternal somatometrics and mode of delivery

Caesarean delivery was associated with a significantly lower maternal height and a significantly higher prepregnancy body mass index (Table 1). As to be seen in Fig. 2, very short women (<145 cm) showed the significantly highest rate of Caesarean sections, while the lowest percentage of Caesarean sections was found among tall women ($\chi^2 = 63.6$; $p < 0.0001$). With increasing maternal stature the relative risk of a Caesarean section decreased significantly (Table 2). An especially high risk of Caesarean section was found among very short women (<145 cm) in comparison to women of average height (>160 cm). The observed significant impact of maternal stature on the mode of delivery was corroborated by the results of a binary logistic regression analysis. Although all maternal anthropometric

parameters were included in the regression analysis, only maternal stature was significantly associated with Caesarean section (Table 3). Regarding newborn somatometrics, birth weight, birth length and acromial circumference were independently related with the mode of delivery (Table 3).

DISCUSSION

An impressive body of gynecological literature has shown that short maternal stature is frequently associated with a poor pregnancy outcome and obstetric complications often requiring emergency Caesarean sections (22, 23). Especially often the association between maternal stature height and the risk of emergency Caesarean section has been described since more than two decades by

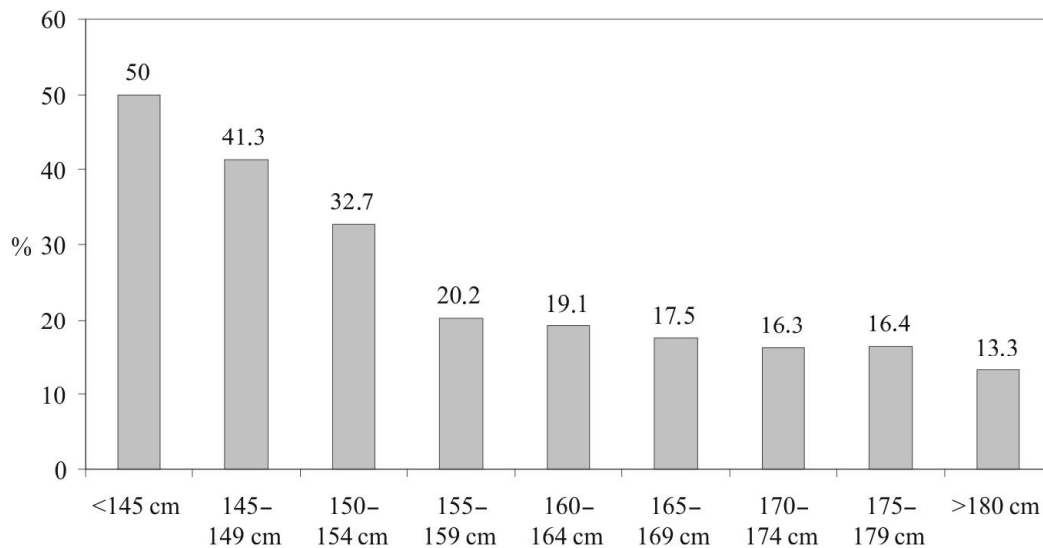


Fig. 2. Maternal height and Caesarean delivery

Table 2. Relative risk of Caesarean delivery in comparison with maternal height >160 cm (odds ratio and 95% confidence interval)

Maternal height	OR	95% confidence Interval
<145 cm	6.18	1.79–21.29
145–149 cm	4.20	2.71–6.51
150–154 cm	2.78	2.18–3.58
155–160 cm	1.38	1.18–1.61

Table 3. Binary logistic regression analysis (spontaneous = 1, section = 2)

Variable	Coefficient	Significance	95% confidence Interval
Maternal height	-0.042	<0.001	0.943–0.975
Prepregnancy BMI	0.020	n. s.	0.988–1.054
Birth weight	-0.001	<0.01	0.999–1.000
Birth length	0.135	<0.01	1.049–1.250
Acromial circumference	0.08	<0.01	1.014–1.173
Head circumference	0.078	n. s.	0.976–1.198
Diameter frontooccipitalis	0.080	n. s.	0.935–1.256

numerous authors (9–11, 14–17, 24), although some authors could not find such correlation (18,19). Nevertheless, the results of the present study supported the theory that maternal height has a significant influence on the mode of delivery. According to our results, maternal height negatively correlated with the risk of Caesarean section. On the one hand, significant group differences in maternal stature between women experiencing a vaginal delivery and those experiencing a Caesarean section could be shown. So, significantly lower mean stature values were found among women who experienced Caesarean sections. On the other hand, it turned out that 50.0% of the women shorter than 145 cm experienced a Caesarean section; this was true of 41.3% of women ranging in height between 145 and 150 cm, and true of 32.7% of women ranging in height between 150 and 155 cm. 20.2% of the women taller than 155 cm and shorter than 160 cm experienced a Caesarean section, whereas the percentage of Caesarean section fell below 20% within women taller than 160 cm. The risk of Caesarean section increased significantly with a decreasing maternal height. In contrast, this was not true of pelvic dimensions. These results corroborate the finding of the WHO collaborative study on maternal anthropometry and pregnancy outcome (25). Furthermore, the results of the present study are comparable to those of Parson et al. (13) who found a Caesarean section rate of 28.3% among women shorter than 151 cm and a Caesarean section rate of 21.6% among women taller than 160 cm. Sheiner et al. (10) reported also a significantly higher rate of Caesarean deliveries among shorter women (<155 cm) in comparison with taller ones, even after controlling for dystocia. This significant association between short stature and an increased Caesarean section rate was mainly explained by means of cephalo-pelvic disproportion (CPD) leading to dystocia (4, 11, 15, 26, 27). Sheiner et al. (10) could not prove this correlation and pointed out that short maternal stature per se might influence the obstetricians' decision for a Caesarean section. Sheiner et al. assumed that even mild deviations from the "normal" labor curves may lead to Caesarean sections if the obstetrician realizes that the mothers stature is short. The authors also pointed out the risks of caesarean sections and plead in their paper for further prospective studies to investigate this association between maternal height and the mode of delivery because it should not be forgotten that Caesarean delivery is an impending obstetric hazard that may increase maternal morbidity (28). Another approach to explain the relationship between short maternal stature and an increased risk of Caesarean delivery is the significant association between short maternal stature and young maternal age (29, 30). Especially among very short teenage mothers an extremely high rate of Caesarean sections is described. The results of the present study, however, cannot be explained in this way, because teenage mothers were

excluded from the analysis. According to the results of the present study, maternal stature is clearly associated with the mode of delivery, however, we are not able to explain this association by maternal age or cephalo-pelvic disproportion only. Therefore, further studies are suggested.

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