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Reference values for the weight of freshly delivered term placentas and for placental weight–birth weight ratios

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Abstract

Background: There is evidence for a correlation between placental weight and future chronic disease, notably hypertension and diabetes. However, there are no reference scales for placentas that are readily weighed in the delivery room.
Methods: This cross-sectional study generated reference values for the weight of freshly delivered untrimmed placentas, and placental weight–birth weight (pw/bw) ratios from a database of 11,141 uncomplicated singleton term pregnancies (37–42 weeks). The data analysis followed stringent validated and state of the art methodological recommendations. A regression model was fitted to estimate the mean and standard deviation for placental weight and pw/bw ratios at each week of gestational age.
Results: Reference scales, percentile tables and regression equations are presented for placental weights according to the mode of delivery and for pw/bw ratios. Mean placental weight from vaginal deliveries was 76 g lighter than from Caesarean sections (545 ± 107 g versus 621 ± 139 g, respectively, $P < 0.05$). Mean placental weight increased by 60 g from 37 to 42 weeks irrespective of the mode of delivery. The pw/bw ratio decreased from 17.6 to 15.6 between 37 and 42 weeks.
Conclusion: For the first time, reference values for freshly delivered term placental weights depending on the mode of delivery were generated. In the light of growing evidence for a correlation of placental weight with chronic diseases in later life, these values provide the possibility to judge placentas at site for abnormalities in weight and to estimate the potential risks for chronic diseases in later life.

Keywords: Fetal programming; Fresh placental weight; Placental-ratio; Reference value; Caesarean section; Vaginal delivery

1. Introduction

There is evidence that abnormal placental weight is correlated with chronic disease in later life such as hypertension and diabetes [1–4]. A positive association between placental weight and raised blood pressure has been shown to be present already in children [5,6]. As a clinical practice, placental weights, wet, without trimming the membranes and umbilical cord are routinely recorded after delivery. Interpretation of these values and their clinical significance, however, is still unresolved. If any judgment of these measurements is performed, pathology reference scales are used, even though these scales have been generated using formaline-fixed placentas with trimmed-off membranes and umbilical cord [7,8]. The impact of fixation procedures and trimming on placental weight, however, is considerable [8–10]. Furthermore, placental weight is not acquired routinely by this method. These reference scales therefore are not applicable in common practice. Even though placental weights from wet, untrimmed placentas have been reported by others [8,11–13], to our knowledge no reference scales have yet been established for fresh term placental weights and for the corresponding placental weight–birth weight (pw–bw) ratio on a basis of a large unselected population.

Therefore, reference charts for freshly delivered, untrimmed, full-term (37–42 weeks) placentas and pw–bw ratios were established using stringent, validated and state of the art statistical techniques [14–16].

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2. Subjects and methods

From 15,926 deliveries between January 1995 to October 2002, 11,141 healthy women were selected having complete materno-fetal outcome data, uncomplicated singleton term pregnancies (37 + 0 to 42 + 0 weeks), and confirmation of gestational age by first trimester ultrasound. Pregnancies complicated by hypertension, pre-eclampsia, diabetes, and congenital malformations were excluded from calculations. All placentas were weighed on a digital baby scale (seca 349, http://www.seca.com) together with the membranes and the cord after removing obvious blood clots to verify completeness shortly after delivery. The pw–bw ratio was calculated as ratio of placental weight to neonatal weight multiplied by 100 [11,17].

Data were analyzed according to the statistical methods described by Royston and Wright [15,16] and Altman [14]. The relation between the mean of each log-transformed placental weight and gestational age as well as pw–bw ratio and gestational age was modeled by a linear regression. A standard deviation (S.D.) curve for each placental weight was estimated by regressing the scaled absolute residuals on gestational age, using linear regression. The scaled absolute residuals are the absolute differences (i.e. differences with the sign removed) between the measurement and the fitted mean curve, multiplied by a scaling factor 1.253 [14]. The goodness of the fit of each regression model was carefully assessed. The standard deviation scores or *Z*-scores for each measurement were calculated using the following formula: $Z = (\text{measurement} - \text{mean})/\text{standard deviation}$. The *Z*-score indicates the deviation of each measurement from the gestational age specific mean in units of its gestational age specific standard deviation. Normal plot of *Z*-scores resulting from fitted models and the Shapiro–Francia *W*-test [18] were applied to check the normality of the *Z*-scores. The centiles were calculated as fitted mean ± 1.645. Ninety-five percent intervals were calculated to indicate the precision of the 5th and 95th centiles. Groups were compared using a two-sample *t*-test at a 95% significance level. Accordingly, $P < 0.05$ was considered for being statistically significant. All statistical calculations were performed in Stata 8.0 for Windows (http://www.stata.com).

3. Results

Placental and newborn weights of 11,141 deliveries were enrolled in this study. Eight thousand four hundred and sixty three newborns were delivered vaginally and 2678 were delivered by Caesarean section. Mean birth weights of newborns delivered by Caesarean section were 100 g lower ($P < 0.05$) than those delivered vaginally independent of gestational age. A summary of the study population and characteristics is given in Table 1.

Reference values were generated by superimposing raw placental weights obtained at 8463 vaginal deliveries and 2678 Caesarean sections on the estimated 5th, 50th and 95th percentiles (Figs. 1 and 2). Furthermore, reference values for raw pw–bw ratios were generated from 11,141 deliveries and superimposed on the estimated 5th, 50th and 95th percentiles (Fig. 3).

Table 1
Study population characteristics ($n = 11{,}141$)

Characteristic	Mean ± S.D.
Maternal age (years)	29.1 ± 5.45
Gestational age (weeks)	39.6 ± 1.25
Parity	1.8 ± 0.97
Birth weight (g)	
Caesarean section	3319.35 ± 522.73
Vaginal delivery	3403.42 ± 448.04

Mean placental weight was significantly increased by 75 g in deliveries by Caesarean section compared to vaginal

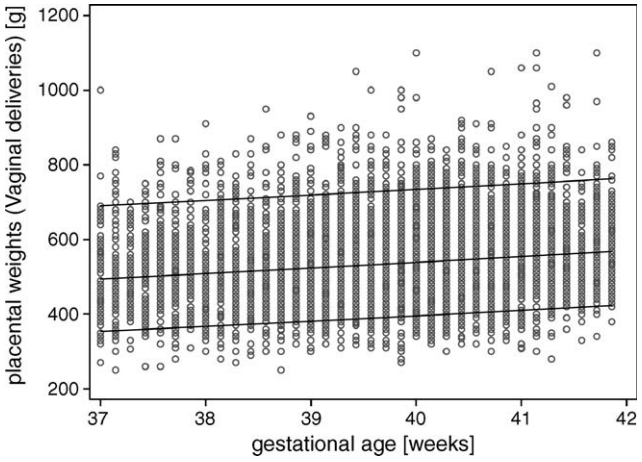

Fig. 1. Vaginal delivery ($n = 8463$): individual placental weights by gestational age with 5th, 50th and 95th centile. Mean = $10^{2.232786+0.0124653\times ga}$; S.D. = $10^{0.167713+(-0.0021502\times ga)}$, ga: gestational age.

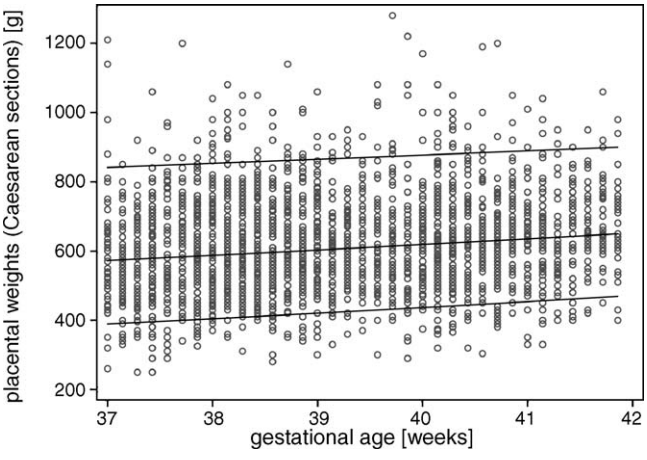

Fig. 2. Caesarean section ($n = 2678$): individual placental weights by gestational age with 5th, 50th and 95th centile. Mean = $\exp^{5.382611+0.0261279\times ga}$; S.D. = $\exp^{0.5106452+(-0.0074642\times ga)}$.