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Standard curves of placental weight and fetal/placental weight ratio in Japanese population: difference according to the delivery mode, fetal sex, or maternal parity

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ABSTRACT

Objectives: Placental weight (PW) and fetal/placental weight ratio (F/P) have been considered to be useful parameters for understanding the pathophysiology of fetal growth. However, there have been no standard data on PW and F/P in Asian populations. This study was conducted to establish nomograms of PW and F/P in the Japanese population and to clarify characteristics of PW and F/P in this population.
Study design: Included in the study were 79,590 Japanese cases: 58,871 vaginal and 20,719 cesarean deliveries at obstetrical facilities (2001–2002) and registered to the Japan Society of Obstetrics and Gynecology Database. Multiple pregnancies, stillbirths, and fetal anomalies were excluded. Nomograms of PW and F/P were created by spline methods in groups categorized by fetal sex (male or female) and maternal parity (primipara or multipara).
Results: Standard curves of PW and F/P were established, which indicated that PW and F/P were lower in cesarean deliveries than vaginal deliveries, especially during preterm period. PW differed depending on fetal sex and maternal parity. F/P differed according to fetal sex.
Conclusion: We for the first time established standard curves of PW and F/P in the Japanese population with statistically sufficient data, which showed that PW and F/P were lower in cesarean deliveries. PW and F/P were also affected by fetal sex. These data might be useful to understand the pathophysiology between the fetus and placenta *in utero*.

Introduction

The placenta nourishes the fetus and is closely related to fetal growth. Placental weight (PW) has been reported to change according to various pregnancy-related conditions. Lower or higher PW has been associated with chronic hypertension/preeclampsia and maternal anemia/gestational diabetes/fetal growth restriction, respectively [1–3]. PW can be considered to be an indicator refractory to the maternal and fetal environment. Fetal/placental weight ratio (F/P) has also attracted placentologist' attention; it may illustrate some underlying conditions of some placental disorders, especially those of growth-restricted fetuses. Our previous study showed that F/P was significantly lower in female fetuses, primiparity, small for gestational age infants, and preeclampsia as compared with male fetuses, multiparity, appropriate for gestational age infants, and non-preeclampsia, respectively [4]. PW and F/P are thought to be important for assessing pathophysiology, especially in these settings.

Recently, PW and F/P have been discussed in association with developmental origins of health and disease (DOHaD). A Norwegian birth cohort study has revealed that infants with a decreased F/P at birth were more likely to develop some cardiovascular events in adulthood [5]. Therefore, endemic nomograms of PW and F/P have been established for some ethnic groups and then used in birth-cohort analysis [6,7]. However, there have not been any reports of PW and F/P in Asian populations to date. This study has been conducted to generate nomograms for PW and F/P in the Japanese population.

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Table 1
Numbers of study participants (n = 79,590) by fetal sex, delivery route, and parity.

GW	Male				Female			
	Cesarean		Vaginal		Cesarean		Vaginal	
	Primi	Multi	Primi	Multi	Primi	Multi	Primi	Multi
22	3	8	25	21	3	2	12	19
23	10	14	29	40	9	6	26	35
24	28	30	39	43	25	39	21	30
25	46	43	34	37	32	46	23	26
26	54	49	27	37	45	49	32	21
27	61	65	40	28	63	68	24	30
28	79	70	27	44	82	66	31	21
29	87	77	36	53	91	80	41	42
30	99	101	52	55	94	94	32	47
31	115	94	66	72	110	106	48	50
32	152	128	96	103	139	135	68	64
33	146	147	145	177	148	122	91	118
34	175	182	199	200	194	149	129	147
35	203	213	277	263	218	236	203	184
36	352	384	463	462	289	318	350	357
37	888	1458	1063	1227	852	1398	887	1121
38	952	1465	2565	2876	967	1421	2110	2561
39	638	357	4265	4505	542	339	4106	4315
40	777	247	4028	3510	677	209	4571	3854
41	549	107	1552	1013	503	100	2005	1225
Total	5414	5239	15,028	14,766	5083	4983	14,810	14,267

Abbreviations: GW: gestational weeks, Primi: primiparity, Multi: multiparity.

Materials and methods

The study protocol was reviewed and approved by the institutional review board of Nippon Medical University, Tama-Nagayama Hospital. Individual data were collected from the Japan Perinatal Registry Network database from 2001 to 2002, which is managed by the Japan Society of Obstetrics and Gynecology. The characteristics of this database were previously reported [4,8,9]. The exclusion criteria included the following: gestational week at delivery less than 22 weeks and over 42 weeks, multiple pregnancy, stillbirth, fetal hydrops, congenital anomaly, cases with unknown gestational week or fetal sex, the following pregnancy complication, *i.e.*, diabetes, preeclampsia, anemia, maternal cardiac or renal or autoimmune disease, younger pregnancy less than 20 years old, elder pregnancy over than 35 years old, women with smoking habit or alcohol abuse, excessively body weight with BMI less than 18.5, or over than 25.0. The study population consisted of 79,590 placentas from pregnant women. The number of cesarean deliveries was 20,719 (26.0%), and the other 58,871 cases (74.0%) were delivered vaginally. After manually removing blood clots, the untrimmed placenta together with the membranes and umbilical cord was weighed by the midwife in according to the previous method [4], in briefly; the untrimmed placentas were weighted by a midwife shortly after delivery, with the membranes and umbilical cord attached. The methodology was including that not drain prior to weighing, within two hours after delivery, in delivery room or its accompanying room, unfixed and fresh and wet placenta, with standardized scales by medical devise grade, and total weighing in correcting each placental block as in fragmented placenta. The birth weight of the infant was measured in grams. F/P was calculated by dividing birth weight by PW in grams. PW and birth weight were expressed in grams, and F/P was calculated and rounded off to three decimal places.

The neonatal growth chart in general use in Japan, published by Itabashi et al. in 2010 [10], was generated based on data from vaginal deliveries because birth weight in cesarean deliveries is significantly decreased during the preterm period. In this study, PW and F/P in vaginal deliveries were analyzed separately from cesarean deliveries.

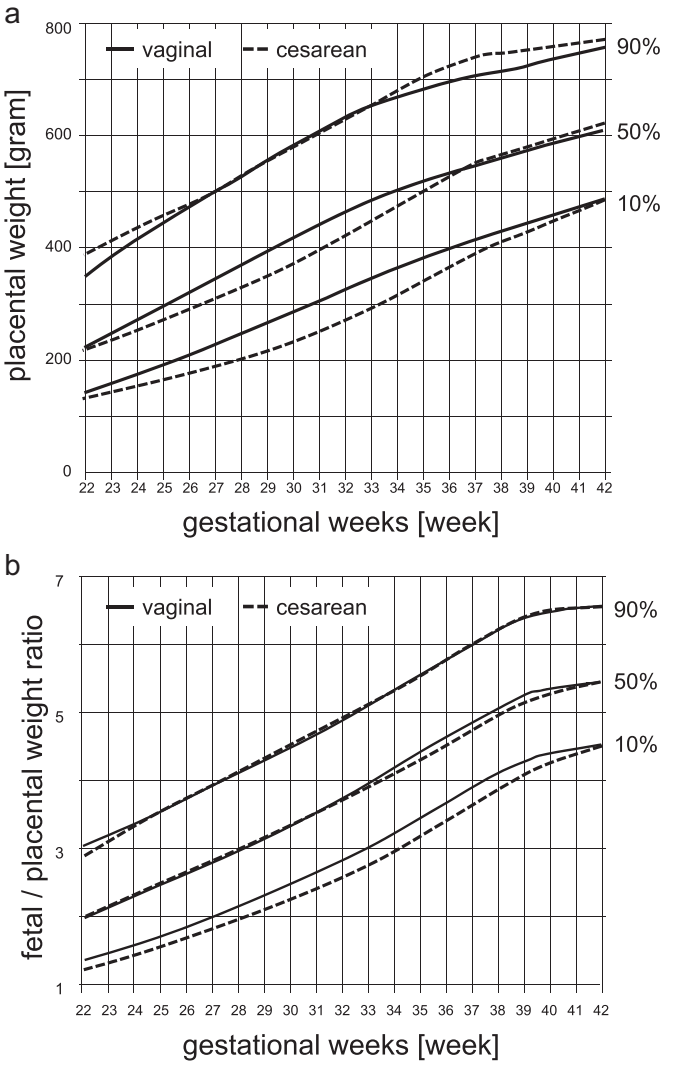

Fig. 1. The 10, 50, and 90 percentile standard curves for placental weight (a) and fetal/placental weight ratio (F/P) (b) by gestational weeks for vaginal deliveries (solid lines) and cesarean deliveries (dashed lines).

Standard curves of PW and F/P were constructed by the LMS method according to fetal sex (male or female) and maternal parity (nulliparous or multiparous), and were represented as 10th, 50th, and 90th percentiles for every gestational week and day. The LMS method was used to calculate three sets of values for each gestational day, *i.e.*, skewness (L), median (M), and coefficient of variation (S), using Box–Cox transformation [11]. The curve obtained by L, M, and S was smoothed by the spline method of nonlinear regression. The Z score was a measure of the distance in standard deviations of a sample from the mean and was calculated by L, M, and S using the following numerical formula: $Z = [(\text{sample data}/M)^{L} - 1]/(L \times S)$. Analysis with the LMS method was performed with a computer program: LMS Chartmaker Pro Ver. 2.54 (Harlow Printing Limited, UK).

Results

Table 1 shows the number of study subjects (n = 79,590) according to fetal sex (male or female), delivery route (cesarean or vaginal), and maternal parity (primiparous or multiparous). PW in the cesarean group is markedly lower, especially in the preterm