Birthweight Percentiles for Twins Based on Sex and Chorionicity in the South of China

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Abstract

Birthweight percentile chart for different gestational age was served as an essential tool in the appropriate evaluation of neonates. Such percentile chart for twins based on different chorionicity were less reported. The aim of this study was to construct up-to-date sex specific twin neonates birth weight references by gestational ages based on different chorionicity in South of China. We retrospectively analysis 3431 twins birthweight born between 25 weeks and 40 weeks gestational age based on sex and chorionicity between 2015 to 2020 in local hospital. The smoothed birthweight percentile curves were conducted through the method, Generalized Additive Models for Location Scale and Shape (GAMLSS). The mean birth weight of monochorionic twins were significantly lower than that of dichorionic twins, and the gestational week of delivery were earlier. The calculated 50th percentile birthweight values of twin boys were higher than those for girls based on the same chorionicity, except male monochorionic twins who were born before 31 weeks gestational age. Neonates birthweight percentile chart based on sex and chorionicity provide a tool for assessing the well being of twin infants. Use twin growth charts based on chorionicity is likely to prevent the over-diagnosis of SGA in normal growth twins.

Introduction

Birthweight could further impact on physical and mental health during the later life and also can predict the health of the newborn[9]. Birthweight percentile chart was used by obstetrician and neonatologist to evaluate whether the birthweight of neonates was appropriate for gestational age or not. In 2006, World Health Organization (WHO) published percentile charts of singleton pregnancies based on multicenter studies[1]. It was reported that twin births account for 2-4% of all birth worldwide[8; 24]. The adverse outcome of twin pregnancies were extremely higher than singleton pregnancies including low birthweight. It is important to assess whether the birthweight of neonates was appropriate for gestational age or not. Previous studies have suggested that it may not be suitable for using singleton birthweight percentile chart to evaluate twins[8].

Birthweight percentile for twins based on sex have been published and updated in several countries and area, including Argentina[21], Australia[18], Canada[3], Germany[22], Japan[15], Norway[6], Taiwan[8] and Wuhan city in China[24]. However, the data analysis didn't based on chorionicity of twins which has been considered to be the decisive factor in the outcome of twin pregnancy.

The main goal of this study is to construct and present up-to-date sex and chorionicity specific twins birthweight percentile chart based on data from a population of neonates born in Guangzhou, a large city located in South China. This study could used in the assessment of the growth of twins neonates in South China.

Results

The mean gestational age and neonatal birthweight were calculated according to neonatal sex, chorionicity, mode of delivery and presence of preterm birth as shown in table 1. Overall, the mean birth weight of monochorionic twins were significantly lower than that of dichorionic twins ($t=7.57, P=0.006$), and the gestational week of delivery were earlier in monochorionic twins ($t=18.71, P<0.001$). The mean gestational age of delivery of female twin in monochorionic ones were statistically earlier than dichorionic ones ($t=6.099, P=0.014$). For female twins, the mean birth weight of monochorionic ones were lower than dichorionic ones, although the difference was non-significant ($t=2.704, P=0.100$). For male twins, the mean birth weight of monochorionic ones were lower than dichorionic ones ($t=5.528, P=0.019$), and the gestational week of delivery were earlier in monochorionic twins ($t=13.591, P<0.001$).

Mean values and standard deviations for neonatal birth weight by gestational age and values estimated for the 3rd, 10th, 50th, 75th, 90th and 97th birth weight percentiles were presented by gestational age for monochorionic and dichorionic twin girls and boys in Tables 2–5. Corresponding, the smoothed reference curves were respectively shown in Fig1–4.

The obtained results confirmed the appearance of sexual dimorphism in birth weight based on different chorionicity. The calculated 50th percentile birthweight values of twin boys were higher than those for girls based on the same chorionicity. These differences were observed in all weeks of gestational age dichorionic twins. However, the calculated values of the 50th percentile for monochorionic twin boys were lower than those for girls before 31 weeks gestational age.

The median values of birth weight by gestational age (50th percentile) between

singletons and twins based on different chorionicity were compared using the values from the singleton nationwide cohort in China [25] as references. (Tables 6-7) The results reflected that the 50th percentile values of singleton birthweight of boys before 27 weeks gestational age were lower than monochorionic and dichorionic twins, while the birthweight of other gestational age of singleton boys and all gestational age of singleton girls were significantly higher than monochorionic and dichorionic twins at the same gestational age.

Discussion

This cross-sectional study presented neonatal birthweight references of sex-specific twin in different chorionicity between 25 and 40 weeks gestation age, based on population in Guangzhou city, China, during 2015–2019. This study is the first to provide gestational-age-specific weight references based on different dichorionicity for twins in the South of China.

Birth weight is an important indicator of fetal intrauterine development [12]. The use of neonatal birth weight curve to assess infants' growth is a usual practice. Pediatricians and neonatologists depend on these standards during the decision making if the observed variability of growth curve within the field of physiological variation or whether it indicates beyond the limits of normal field [11]. Besides, obstetricians

also share the opinion that birthweight percentile charts special for twins deserve emphasis [11]. Percentile charts for fetal weight in given gestational weeks are used as one of the parameters helpful in the evaluation of intrauterine death risk, especially for monochorionic twins.

Thus, some one may argue that the birthweight percentile curve based on different chorionicity in different may not necessary, indeed, the benefit is probably prominent. It was reported that the incidence of stillbirth and neonatal deaths in smaller dichorionic twin small for gestational(SGA) was significantly higher compared with those non-SGA ones[17]. Besides, compared to dichorionic pregnancies, monochorionic pregnancies have a higher risk of adverse outcomes, such as stillbirth, neonatal deaths and morbidities, adverse neurodevelopmental sequelae[20]. Therefore it is indeed need to distinguish the SGA twins and give them intensive care, while give the non-SGA twins routine newborn care. The birthweight percentile curve based on chorionicity and gestational age of twin are helpful as a reference for perinatal health care professionals and researchers to identify the the high risk fetus and neonates who require special care and intensive observation[8]. Thus, using twin growth charts based on chrionicity is likely to prevent the over-diagnosis of SGA in normal growth twins.

Certainly, birth weight for gestational age is an important indicator of the adequacy of fetal growth. While, restricted fetal growth is likely in a causal pathway to all forms of Attention-Deficit/Hyperactivity Disorder (ADHD)[16]. In this study, we found that the birthweight of monochorionic twins were lower than dichorionic, and most twins were lighter than singleton neonates in the same gestational age. It was reported that most infants delivered form multiple pregnancies are growth-restricted compared to singleton infants as a result of an adaptive process [4].Many authors underline the need for a separate estimation for multiples of a reliable range of normal values for fetal and newborn anthropometry [2; 5; 13; 19].

Overall, our study confirmed the basic principle that neonatal birthweight rose up with grater slopes withe the progress of gestational age during the third trimester, which was reported in singleton and twin pregnancies [7; 8; 26]. In addition, we found that the calculated 50th percentile birthweight values of twin boys were higher than those for girls based on the same chorionicity, except monochorionic twins before 31 weeks gestational age. Previous research has extensively documented that boys were born heavier than girls in singleton pregnancies [14; 23] and most twin pregnancies [10]. Besides, the mean birthweight of dichorionic twins were heavier than monochorionic twins within the same sex, which had been reported in other studies based on different races[9]. In contrast, we found that the calculated values of the 50th percentile for monochorionic twin boys were lower than those for girls before 31 weeks gestational age. The reason of this incompatibility need to be research more.

Several limitations of present study deserved to mention. Firstly, this is a single center literature, which may suit for the local region. Secondly, the sample size was relatively small in monochrionic twin infants, due to the chrionicity ratios in twin pregnancies.

Conclusion

Neonates birthweight percentile chart based on sex and chorionicity provide a tool for assessing the well being of twin infants. Use twin growth charts based on chorionicity is likely to prevent the over-diagnosis of SGA in normal growth twins.

Materials And Methods

Study population

We retrospectively analysis the sex specific live-birth twins birthweight based on different chorionicity in Guangdong Women and Children Hospital between 2015 to 2020. A total of 3431 twin neonates were enrolled into the study, including 366 monochorionic girls, 405 monochorionic boys, 1235 dichorionic girls and 1425 dichorionic boys. Each record included information about mode of delivery, neonatal sex, gestational age at birth, chorionicity, birth weight. All record information were collected from clinical record.

We included the live birth twins at the gestational age between 25 weeks and 40 weeks. The gestational age was estimated combined last-menstrual-period(LMP) and ultrasound scan in the first trimester. The chorionicity was assessment by ultrasound scan before to 13⁺⁶ weeks gestational age, combined the pathological examination of the placenta to determine the number of placenta or layers of amniotic and chorionic.

Ethical approval and informed consent

The study was performed in accordance with the approved guidelines and regulation. Ethical approval to conduct the research was obtained from the Research Ethics Committee of Guangdong Women and Children Hospital, Guangzhou, China (NO. 201701048). The research was performed according to the declaration of Helsinki and informed consent was obtained from all pregnant women.

Statistics analysis

Statistical analysis was conducted using R v.4.0.0 [R Development Comprehensive R Archive Network 2020]. Calculate the values 3, 10, 50, 90 and 97 percentile of the neonatal birth weight, between 25 weeks to 40 weeks gestational age in different sex and chorionicity. The obtained percentile curve were smoothed with Lambda Mu Sigma(LMS) methods, conducted by generalized additive model for location, scale and shape (GAMLSS). LMS method initially assesses the three parameters of Box-Cox power exponential distribution of the measurement.

Compared the twins neonatal parameters between different sex and chorinonicity in the same gestational age by *t* test after the normality test. All statistical test were carried out at 0.05 significance level.

Declarations

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Author Contributions

The version to be published was approved by all the authors.all authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Jing Wu was responsible for research design and management. Qian Liu was responsible for case collection, data analysis, and article writing. Yanlin Huang was responsible for data analysis. The other authors are responsible for data collection and check up work.

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Tables

Table 1. Birthweight and gestational age of twins according to variables

Variables	Numbers of cases(%)	Birthweight (kg)	Gestational age (weeks)
Numbers of twin infants	3431	2.28±0.521	34.42±2.512
Chorionicity			
Monochorionic twins	772(22.5)	2.12±0.508*	34.97±2.685*
Dichorionic twins	2659(77.5)	2.33±0.508*	35.55±2.445*
Chorionicity & sex			
Monochorionic male twins	405	2.15±0.561*	34.78±2.889*
Monochorionic female twins	366	2.11±0.504	35.19±2.427*
Dichorionic male twins	1424	2.36±0.518*	35.42±2.533*
Dichorionic female twins	1235	2.290±0.490	35.71±2.330*
Mode of delivery			
Caesarean section	2502(72.9)	2.40±0.476*	36.10±2.019*
Vaginal delivery	929(27.1)	1.95±0.49*	33.6±2.790*
Preterm birth(<37 weeks)			
Yes	2031(59.2)	2.05±0.510*	34.06±2.430*
No	1400(40.8))	2.61±0.320*	37.39±0.581*

*.the difference was significant at the level of $\alpha=0.05$.

Table 2 Monochorionic twin girls: birth weight percentile charts (GA.-gestational age [weeks], C–centile, values of weight in grams)

GA	n		SD	C3	C5	C10	C50	C90	C95	C97
28	6	1.056	0.164	0.685	0.746	0.828	1.051	1.239	1.295	1.333
29	6	1.087	0.187	0.741	0.808	0.896	1.140	1.345	1.406	1.447
30	10	1.280	0.194	0.820	0.895	0.995	1.267	1.497	1.565	1.611
31	5	1.534	0.146	0.913	0.998	1.111	1.420	1.681	1.757	1.809
32	29	1.577	0.215	1.006	1.101	1.229	1.575	1.868	1.953	2.012
33	38	1.658	0.342	1.111	1.216	1.356	1.738	2.060	2.154	2.219
34	21	2.030	0.235	1.246	1.358	1.507	1.915	2.260	2.361	2.430
35	38	1.927	0.379	1.414	1.528	1.681	2.099	2.457	2.563	2.634
36	80	2.275	0.309	1.614	1.726	1.878	2.297	2.660	2.768	2.841
37	87	2.533	0.263	1.792	1.900	2.047	2.456	2.813	2.920	2.993
38	34	2.395	0.331	1.907	2.009	2.147	2.536	2.880	2.984	3.054
39	12	2.558	0.287	1.996	2.091	2.221	2.590	2.919	3.018	3.085

Table 3 Monochorionic twin boys: birth weight percentile charts (GA.-gestational age [weeks], C–centile, values of weight in grams)

GA	n	$\bar{x}$	SD	C3	C5	C10	C50	C90	C95	C97
25	2	0.790	0.000	0.467	0.520	0.597	0.836	1.078	1.156	1.212
26	3	1.103	0.310	0.519	0.573	0.651	0.892	1.137	1.217	1.273
27	4	0.880	0.192	0.563	0.617	0.694	0.933	1.175	1.254	1.310
28	8	0.973	0.212	0.619	0.674	0.751	0.992	1.236	1.316	1.372
29	12	1.132	0.160	0.709	0.766	0.847	1.101	1.357	1.440	1.499
30	11	1.215	0.172	0.837	0.900	0.988	1.264	1.542	1.633	1.696
31	12	1.402	0.298	1.004	1.072	1.170	1.475	1.783	1.883	1.953
32	29	1.802	0.244	1.170	1.244	1.350	1.676	2.010	2.118	2.193
33	28	1.754	0.281	1.307	1.384	1.493	1.832	2.175	2.286	2.365
34	51	1.994	0.300	1.454	1.534	1.647	1.997	2.350	2.465	2.546
35	38	2.183	0.271	1.631	1.713	1.831	2.196	2.563	2.682	2.767
36	72	2.431	0.309	1.817	1.902	2.024	2.403	2.784	2.908	2.995
37	87	2.549	0.270	1.972	2.059	2.182	2.564	2.949	3.074	3.162
38	30	2.756	0.374	2.062	2.146	2.266	2.639	3.014	3.135	3.221
39	12	2.418	0.436	2.061	2.139	2.252	2.600	2.949	3.063	3.143
40	4	2.458	0.138	2.021	2.092	2.196	2.514	2.834	2.938	3.011
41	2	2.455	0.219	1.974	2.040	2.134	2.424	2.717	2.812	2.879

Table 4 Dichorionic twin girls: birth weight percentile charts (GA.-gestational age [weeks], C–centile, values of weight in grams)

GA	n	$\bar{x}$	SD	C3	C5	C10	C50	C90	C95	C97
25	3	0.703	0.095	0.592	0.612	0.639	0.723	0.805	0.832	0.852
26	3	0.920	0.087	0.680	0.705	0.740	0.846	0.950	0.984	1.009
27	3	0.987	0.098	0.755	0.786	0.828	0.957	1.085	1.127	1.156
28	12	1.029	0.093	0.825	0.862	0.914	1.068	1.221	1.272	1.307
29	19	1.211	0.158	0.899	0.944	1.005	1.189	1.372	1.432	1.475
30	20	1.360	0.191	0.979	1.031	1.104	1.321	1.536	1.607	1.657
31	21	1.376	0.178	1.067	1.127	1.211	1.463	1.711	1.794	1.852
32	36	1.675	0.207	1.170	1.239	1.335	1.623	1.907	2.000	2.067
33	72	1.803	0.277	1.291	1.368	1.476	1.798	2.116	2.220	2.295
34	99	1.932	0.313	1.434	1.518	1.635	1.985	2.331	2.445	2.525
35	112	2.213	0.301	1.598	1.687	1.810	2.179	2.543	2.663	2.748
36	219	2.392	0.302	1.763	1.854	1.981	2.359	2.733	2.857	2.944
37	455	2.520	0.324	1.909	2.002	2.131	2.516	2.897	3.022	3.112
38	134	2.634	0.317	2.034	2.129	2.260	2.654	3.044	3.172	3.264
39	17	2.736	0.299	2.145	2.242	2.378	2.782	3.183	3.315	3.409
40	10	2.810	0.398	2.251	2.351	2.490	2.907	3.320	3.456	3.553

Table 5 Dichorionic twin boys: birth weight percentile charts (GA.-gestational age [weeks], C–centile, values of weight in grams)

GA	n	$\bar{x}$	SD	C3	C5	C10	C50	C90	C95	C97
25	5	0.870	0.171	0.603	0.637	0.686	0.849	1.009	1.057	1.089
26	7	1.001	0.114	0.672	0.709	0.764	0.945	1.124	1.177	1.213
27	6	1.032	0.081	0.739	0.781	0.841	1.041	1.238	1.296	1.336
28	16	1.064	0.161	0.816	0.862	0.929	1.149	1.366	1.431	1.474
29	34	1.336	0.172	0.909	0.959	1.034	1.278	1.519	1.591	1.639
30	25	1.430	0.217	1.013	1.068	1.150	1.420	1.686	1.765	1.819
31	39	1.569	0.260	1.127	1.188	1.278	1.573	1.864	1.951	2.009
32	45	1.738	0.300	1.256	1.322	1.419	1.739	2.054	2.148	2.212
33	97	1.913	0.243	1.398	1.468	1.572	1.915	2.254	2.355	2.422
34	113	2.103	0.284	1.555	1.630	1.741	2.105	2.466	2.573	2.645
35	133	2.263	0.352	1.727	1.806	1.922	2.305	2.683	2.796	2.871
36	237	2.546	0.297	1.896	1.976	2.095	2.488	2.875	2.991	3.069
37	509	2.637	0.307	2.043	2.123	2.242	2.634	3.023	3.138	3.216
38	141	2.728	0.310	2.176	2.255	2.373	2.762	3.147	3.261	3.339
39	17	2.857	0.303	2.310	2.389	2.505	2.889	3.269	3.383	3.460

Table 6 Comparison of the median birthweight of twins based on different chorionicity versus singletons-girls

Gestational age (weeks)	C50 monochorionic twins	C50 dichorionic twins	C50 singletons
28	1.051	1.068	1.109
29	1.140	1.189	1.261
30	1.267	1.321	1.419
31	1.420	1.463	1.591
32	1.575	1.623	1.782
33	1.738	1.798	1.993
34	1.915	1.985	2.225
35	2.099	2.179	2.472
36	2.297	2.359	2.727
37	2.456	2.516	2.964
38	2.536	2.654	3.153
39	2.590	2.782	3.275

Table 7 Comparison of the median birthweight of twins based on different chorionicity versus singletons-boys

Gestational age (weeks)	C50 monochorionic twins	C50 dichorionic twins	C50 singletons
25	0.723	0.849	0.766
26	0.846	0.945	0.909
27	0.957	1.041	1.053
28	1.068	1.149	1.196
29	1.189	1.278	1.343
30	1.321	1.420	1.497
31	1.463	1.573	1.666
32	1.623	1.739	1.857
33	1.798	1.915	2.071
34	1.985	2.105	2.306
35	2.179	2.305	2.558
36	2.359	2.488	2.820
37	2.516	2.634	3.073
38	2.654	2.762	3.273
39	2.782	2.889	3.399

Figures

The percentile chart of birth weight by gestational age for dichorionic male twin neonates

Figure 1

The smoothed reference curves were respectively shown in Fig1

The percentile chart of birth weight by gestational age for dichorionic female twin neonates

Figure 2

The smoothed reference curves were respectively shown in Fig2

The percentile chart of birth weight by gestational age for monochorionic female twin neonates

Figure 3

The smoothed reference curves were respectively shown in Fig3

The percentile chart of birth weight by gestational age for monochorionic male twin neonates

Figure 4

The smoothed reference curves were respectively shown in Fig4