

Fetal growth standards: the NICHD fetal growth study approach in context with INTERGROWTH-21st and the World Health Organization Multicentre Growth Reference Study



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Three recently completed longitudinal cohort studies have developed intrauterine fetal growth charts, one in the United States and two international. This expert review compares and contrasts the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development Fetal Growth Studies, INTERGROWTH-21st and World Health Organization Multicentre Growth Reference Study conclusions in light of differences in aims, sampling frames, and analytical approaches. An area of controversy is whether a single growth reference is representative of growth, regardless of ethnic or country origin. The INTERGROWTH and World Health Organization Fetal studies used a similar approach as the World Health Organization Multicentre Growth Reference Study for infants and children, the aim of which was to create a single international reference for the best physiological growth for children aged 0–5 years. INTERGROWTH made the same assumption (ie, that there would be no differences internationally among countries or racial/ethnic groups in fetal growth when conditions were optimal). INTERGROWTH found differences in crown-rump length and head circumference among countries but interpreted the differences as not meaningful and presented a pooled standard. The World Health Organization Multicentre Growth Reference Study was designed to create a pooled reference, although they evaluated for and presented country differences, along with discussion of the implications. The *Eunice Kennedy Shriver* National Institute of Child Health and Human Development Study was designed to assess whether racial/ethnic-specific fetal growth standards were needed, in recognition of the fact that fetal size is commonly estimated from dimensions (head circumference, abdominal circumference, and femur length) in which there are known differences in children and adults of differing racial/ethnic groups. A pooled standard would be derived if no racial/ethnic differences were found. Highly statistically significant racial/ethnic differences in fetal growth were found resulting in the publication of racial/ethnic-specific derived standards. Despite all 3 studies including low-risk status women, the percentiles for fetal dimensions and estimated fetal weight varied among the studies. Specifically, at 39 weeks, the 50th percentile for estimated fetal weight was 3502 g for whites, 3330 g for Hispanics, 3263 g for Asians, and 3256 g for blacks in the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development Study, compared with 3186 g for INTERGROWTH and 3403 g for World Health Organization Multicentre Growth Reference Study. When applying these standards to a clinical population, it is important to be aware that different percentages of small- and large-for-gestational-age fetuses will be identified. Also, it may be necessary to use more restrictive cut points, such as the 2.5th or 97.5th, for small-for-gestational-age or large-for-gestational-age fetuses, respectively. Ideally, a comparison of diagnostic accuracy, or misclassification rates, of small-for-gestational-age and large-for-gestational-age fetuses in relation to morbidity and mortality using different criteria is necessary to make recommendations and remains an important data gap. Identification of the appropriate percentile cutoffs in relation to neonatal morbidity and mortality is needed in local populations, depending on which fetal growth chart is used. On a final point, assessment of fetal growth with a one-time measurement remains standard clinical practice, despite recognition that a single measurement can indicate only size. Ultimately, it is knowledge about fetal growth in addition to other factors and clinical judgment that should trigger intervention.

Key words: estimated fetal weight, fetal growth, small for gestational age, ultrasound reference, ultrasound standard

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Fetal growth is monitored in pregnancies to ensure fetal well-being and to intervene in the context of maternal or fetal pathology, yet there are many challenges in distinguishing normal from abnormal growth.¹⁻³ Traditionally, cross-sectional fetal biometrics and estimated fetal weight (EFW), calculated using a formula with various combinations of fetal measurements, such as the head circumference, abdominal circumference, and femur length, are compared with reference size-for-gestational-age curves to generate a percentile, with a range of 10th to 90th percentiles often considered appropriate for gestational age.^{1,4}

The choice in reference will therefore affect the percentage of fetuses that are identified as small or large for gestational age (SGA or LGA; often defined as <10th or ≥90th percentiles, respectively). Regarding EFW, intrauterine estimates of fetal weight by ultrasound are highly ($r = 0.80-0.91$) correlated with actual birthweight, although they can differ by ≥100 g and are more inaccurate at the extremes of EFW, <2000 g and >4000 g.⁵

In theory then, birthweight references, whereby weight is measured directly as opposed to estimated, might seem preferable to assess fetal growth. However, birthweight-for-gestational-age reference percentiles inaccurately describe the preterm growth of fetuses who go on to deliver at term because infants who deliver preterm are more likely to be growth restricted.^{6,7} Therefore, intrauterine references, despite the drawbacks of estimating fetal weight from ultrasound measurements, tend to be preferred to birthweight references for clinical antepartum monitoring.

The Hadlock 1991 reference⁸ that is commonly used in the United States included 392 white women from a single center in Texas where each fetus contributed a single ultrasound, limiting the ability to determine fetal growth prospectively. Until recently, longitudinal ultrasound-based references were based on relatively small studies comprising mostly white women, although larger studies existed outside the United States.²

In light of critical data gaps about optimal fetal growth to aid clinical management of pregnant women, 3 longitudinal cohort studies were undertaken and provide new insights about contemporary fetal growth and how best to assess fetal growth: one in the United States, the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development (NICHD) Fetal Growth Studies^{9,10} and 2 international, INTERGROWTH-21st (INTERGROWTH)^{11,12} and World Health Organization (WHO) Multicentre Growth Reference Study (WHO Fetal).^{13,14} However, each has slightly different research aims that have an impact on the interpretation of the findings. We compare and contrast these 3 studies to aid in the application and clinical interpretation.

Approaches and assumptions

One of the main areas of dispute in the area of fetal and child growth is whether a single growth reference is representative of growth, regardless of ethnic or country origin. The INTERGROWTH¹⁵ and the WHO Fetal¹⁶ protocols started with the same premise of the WHO Multicentre Growth Reference Study (MGRS)¹⁷ for infants and children, whose overarching aim was to create a single international growth reference for children aged 0–5 years.¹⁸ Specifically, the WHO MGRS was predicated on the notion that infants and children of well-off parents and whose feeding met the WHO breast-feeding criteria represent optimal growth in size, and the WHO Fetal study was designed as a subsequent study to extend the WHO MGRS to the fetal period.

The INTERGROWTH and WHO Fetal studies on fetal growth started with the same assumption, that there would be no differences internationally in fetal growth when conditions were optimal. For the WHO MGRS, differences in length (0–2 years) and height (2–5 years) were evaluated among 6 countries: Brazil (South America), Ghana (Africa), India (Asia), Norway (Europe), Oman (Middle East), and the United States (North America). Without formal hypothesis testing, these differences were

interpreted as small enough to not be meaningful, so the final decision was to create 1 child growth standard.¹⁹

Additional measurements included head circumference, mid-upper-arm circumference, triceps, and subscapular skinfolds, but differences across countries in these dimensions were not tested. INTERGROWTH evaluated for differences in crown-rump length (CRL), head circumference (HC), and newborn length among countries, concluding that the differences were small enough, before pooling.²⁰ However, comparison of child growth measurements, especially for head circumference, have demonstrated wide variability across countries²¹ so the assumption that the small fetal differences do not reflect differences that will persist and be meaningful in infancy and childhood may need to be reconsidered.

A key determinant of INTERGROWTH's decision to pool across sites was whether the standardized site difference at different gestational ages was from a somewhat arbitrary range of -0.5 to 0.5 SD units.²⁰ Inappropriate interpretation of centiles could have resulted from pooling of sites given the allowed wide range of standardized site difference. To show this potential, our group previously calculated the probability of being below the lower limit of the standard for a particular site when the standard was constructed using data pooled across different sites for these values.²² The probability of being less than the fifth centile varied according to the range of standardized site difference. Specifically, when the standardized site difference was 0.5 , then 3.4% of fetuses (targeted centile–pooled centile = $5.0-1.6\%$) would have been misclassified as not extreme and 7.6% (targeted centile–pooled centile = $12.6-5.0\%$) of fetuses would have been misclassified as extreme.

INTERGROWTH reported the magnitude of within- and between-site variation, and some of the variances reported might be highly statistically significant. Furthermore, INTERGROWTH evaluated only CRL and HC. CRL is known to not vary as much, and HC also has less

FIGURE 1
Cohort profiles for the 3 studies

NICHD



LOCATION

12 U.S. Sites
New York [2], New Jersey, Delaware, Rhode Island, Massachusetts, South Carolina, Alabama, Illinois, and California [3]



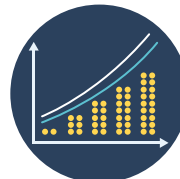
RACE & ETHNIC

Highly statistically significant differences in fetal growth by race/ethnicity
Racial/ethnic-specific derived standards



INCLUSION/ EXCLUSION

A priori exclusion of pregnancy complications, preterm delivery < 37 weeks' gestation, stillbirth and fetal factors including all structural anomalies and karyotype abnormalities



ANALYTIC APPROACHES

Data transformation: log
Model assumptions: linear mixed models, assuming a normal distribution of the fetal growth trajectories (after log transformation)
Smoothing technique over gestational age: cubic splines



ESTIMATED FETAL WEIGHT

Calculated EFW from HC, AC and FL using the Hadlock 1985 formula²⁶

INTERGROWTH



LOCATION

8 Countries
Brazil, China, India, Italy, Kenya, Oman, U.K. and U.S.



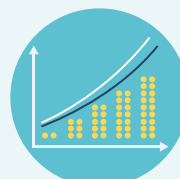
RACE & ETHNIC

One overall growth chart
No statistical testing for differences among countries



INCLUSION/ EXCLUSION

Exclusion of pregnancy complications and fetal factors such as congenital anomalies and stillbirth



ANALYTIC APPROACHES

Data transformation: none
Model assumptions: linear mixed models with location and scale assumptions, assuming a normal distribution of the fetal growth trajectories
Smoothing technique over gestational age: second-degree fractional polynomials



ESTIMATED FETAL WEIGHT

Created a new formula¹² based on only HC and AC, making the comparison of EFW less meaningful

WHO FETAL



LOCATION

10 Countries
Argentina, Brazil, Democratic Republic of the Congo, Denmark, Egypt, France, Germany, India, Norway, and Thailand



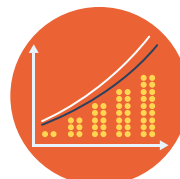
RACE & ETHNIC

One overall growth chart
Fetal growth showed natural variation, differing significantly between countries which largely followed ethnic distribution



INCLUSION/ EXCLUSION

Only optimal health inclusions
No complication excluded (no impact on percentiles)



ANALYTIC APPROACHES

Data transformation: log
Model assumptions: Quantile regression without distributional assumptions
Smoothing technique over gestational age: polynomial functions



ESTIMATED FETAL WEIGHT

Calculated EFW from HC, AC and FL using the Hadlock 1985 formula²⁶

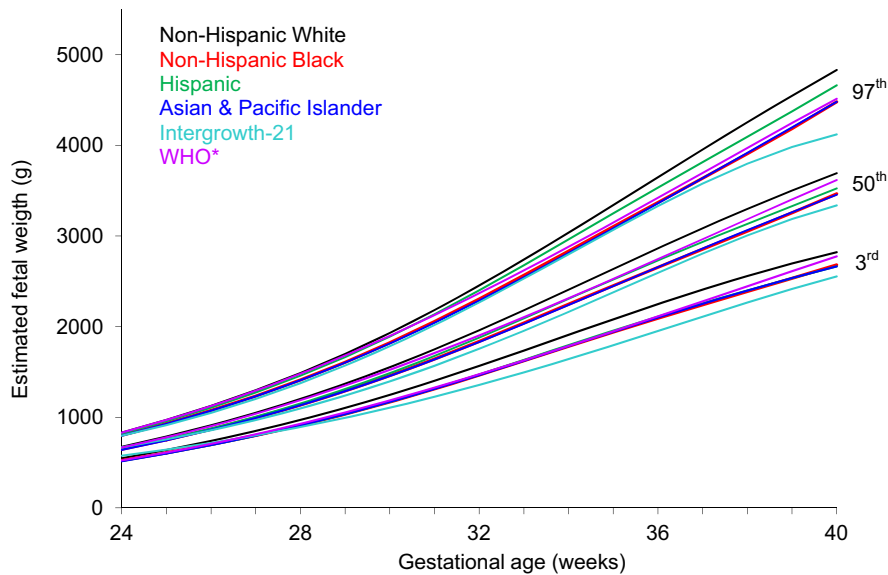
Main differences among the NICHD Fetal Growth Studies, INTERGROWTH,^{11,12} and WHO Fetal^{13,14} NICHD and WHO Fetal calculated EFW from HC, AC, and FL using the Hadlock 1985 formula,²⁶ while INTERGROWTH created a new formula¹² based on only HC and AC.

AC, abdominal length; EFW, estimated fetal weight; FL, fetal length; HC, head circumference; INTERGROWTH, INTERGROWTH-21st; NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development; WHO Fetal, World Health Organization Multicentre Growth Reference Study.

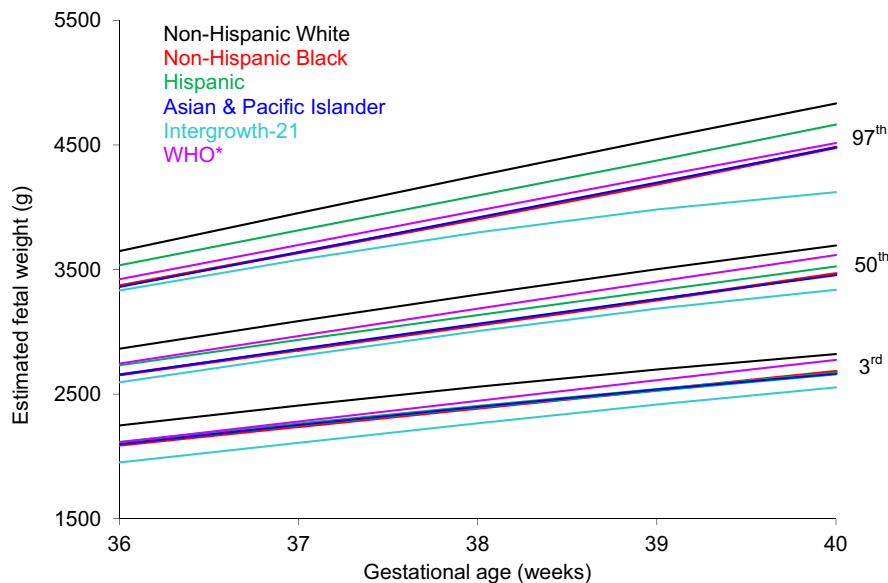
Grantz. Fetal growth charts. *Am J Obstet Gynecol* 2018.

FIGURE 2
Estimated fetal weight comparison among the 3 studies

A Estimated Fetal Weight 24-40 Weeks



B Estimated Fetal Weight 36-40 Weeks



Distribution of the EFW by race/ethnicity and gestation, NICHD Fetal Growth Study—Singletons, INTERGROWTH-21st, and WHO Fetal for 24–40 weeks of gestation (A) and 36–40 weeks of gestation (B). Estimated third, 50th, and 97th percentiles for fetal weight by study; *note that values are the 2.5th and 97.5th percentiles for the WHO Fetal study. Also, NICHD and WHO Fetal calculated the EFW from HC, AC, and FL using the Hadlock 1985 formula,²⁶ while INTERGROWTH created a new formula¹² based on only HC and AC.

AC, abdominal length; EFW, estimated fetal weight; FL, fetal length; HC, head circumference; INTERGROWTH, INTERGROWTH-21st; NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development; WHO Fetal, World Health Organization Multicentre Growth Reference Study.

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variation, as demonstrated in the results below. WHO Fetal was designed to create a pooled reference, although they

evaluated for and showed country differences along with discussion of the implications.¹³

The primary objective of the NICHD study was also to create optimal fetal growth standards.²³ Unlike the 2

TABLE 1
The 50th percentiles for fetal anthropometric measurements by gestational age for the 3 studies^a

Gestational age, wks ^b	Estimated fetal weight (g) 50th percentiles ^c					
	NICHD white	NICHD Hispanic	NICHD Asian	NICHD black	INTERGROWTH	WHO Fetal
24	674	651	640	647	668	665
25	787	758	745	751	756	778
26	912	876	862	866	856	902
27	1050	1007	990	994	969	1039
28	1202	1151	1132	1134	1097	1189
29	1369	1311	1287	1289	1239	1350
30	1552	1486	1456	1459	1396	1523
31	1749	1676	1637	1642	1568	1707
32	1960	1879	1830	1837	1755	1901
33	2180	2090	2031	2040	1954	2103
34	2408	2307	2238	2247	2162	2312
35	2637	2521	2448	2452	2378	2527
36	2864	2731	2656	2654	2594	2745
37	3086	2935	2862	2854	2806	2966
38	3299	3134	3065	3054	3006	3186
39	3502	3330	3263	3256	3186	3403
40	3693	3525	3455	3466	3338	3617

INTERGROWTH, INTERGROWTH-21st; NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development; WHO Fetal, World Health Organization Multicentre Growth Reference Study.

^a The NICHD Fetal Growth Studies,^{9,10} INTERGROWTH,^{11,12} and WHO Fetal^{13,14}; ^b Results were reported for the exact day (eg, 16.0 weeks) for the NICHD and WHO studies, while INTERGROWTH results were reported for completed weeks (eg, 16 weeks = 16 weeks 0 days to 16 weeks 6 days); ^c Note that NICHD and WHO Fetal calculated EFW from HC, AC, and FL using the Hadlock 1985 formula,²⁶ while INTERGROWTH created a new formula¹² based on only HC and AC.

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international studies, the NICHD study was designed to assess whether racial/ethnic fetal growth standards were needed, in recognition of the fact that because fetal size is commonly estimated from dimensions, particularly post-cranial dimensions (ie, abdominal circumference [AC] and femur length [FL]), in which there are known differences in children and adults of differing racial/ethnic groups, separate standards might be necessary to capture optimal growth and more precisely estimate fetal weight.^{24,25}

Highly statistically significant racial/ethnic differences in fetal growth were found, and by order of detection were as follows: humerus and femur lengths (beginning as early as 10 weeks), abdominal circumference (16 weeks), head circumference (21 weeks), and biparietal diameter (27 weeks) with

racial/ethnic differences continuing throughout gestation, so racial/ethnic-specific curves were derived.⁹

One of the continuing debates in designing and conducting an ultrasound or any physical growth study is how to select study subjects, and the terminology of reference vs standards. An ultrasound reference is a sample of pregnancies from a population and by definition contains high-risk pregnancies at risk for fetal growth restriction or overgrowth, including preexisting conditions and pregnancy complications.

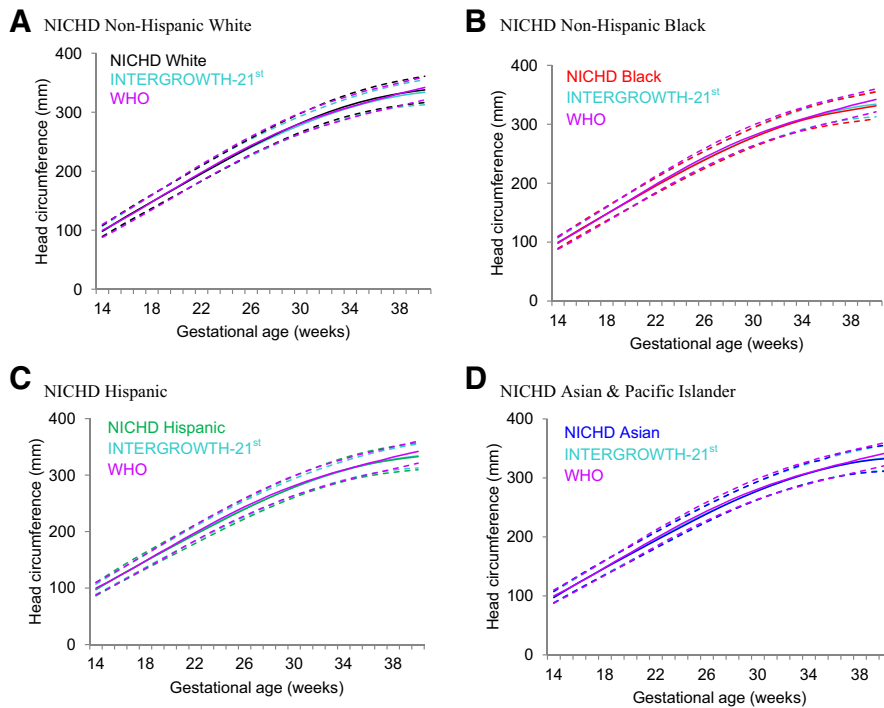
An ultrasound standard includes fetuses at low risk for growth disturbances, with the goal of describing how all fetuses should grow, as opposed to traditional reference charts that describe how some have grown at a given place and time. However, distinguishing the normal from abnormal fetal growth remains a

challenge, and the term standard in regard to fetal growth is controversial.

It is also important to note that because standards are variance restricted, their percentiles and interpretation are not the same as previous references. For example, the fifth percentile of a reference is not equivalent to the fifth percentile of a standard, in which fetuses are at lower risk for growth aberrations. It may be necessary to use more restrictive cut points, such as the 2.5th or 97.5th percentiles, for SGA or LGA, respectively.

All 3 studies selected healthy women who were positioned for optimal fetal growth and had a known last menstrual period, although the specific inclusion and exclusion criteria varied. The cohort profiles of main differences for the 3 studies are presented in [Figure 1](#). One of the main differences was the racial/

FIGURE 3
Head circumference comparison among the 3 studies



Distribution of head circumference, NICHD Fetal Growth Study—Singletons, INTERGROWTH-21st, and WHO Fetal. Estimated fifth, 50th, and 95th percentiles for head circumference are by race/ethnicity and gestation and study.

INTERGROWTH, INTERGROWTH-21st; NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development; WHO Fetal, World Health Organization Multicentre Growth Reference Study.

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ethnic and country variation in women recruited by the 3 studies. The NICHD Study was conducted at 12 US sites (New York [2], New Jersey, Delaware, Rhode Island, Massachusetts, South Carolina, Alabama, Illinois, and California [3]), INTERGROWTH was completed in 8 countries (Brazil, China, India, Italy, Kenya, Oman, the United Kingdom, and the United States), and the WHO Fetal study in 10 countries (Argentina, Brazil, Democratic Republic of the Congo, Denmark, Egypt, France, Germany, India, Norway, and Thailand).

Another main difference was the exclusion of pregnancy complications and fetal factors such as congenital anomalies and stillbirth from the NICHD Study and INTERGROWTH, given the intention of creating standards; the NICHD defined additional a priori exclusion criteria or preterm delivery <37 weeks' gestation and karyotype

abnormalities, neither of which was excluded from INTERGROWTH. WHO Fetal did not exclude pregnancies with complications, with the rationale that they wanted their study to be more of a reference.¹³

The 3 studies used different statistical analytic approaches to model the fetal growth trajectories and calculate the corresponding percentiles. Both INTERGROWTH and NICHD assumed a parametric distribution of the fetal growth trajectories, under a linear mixed model, in which the methods used to create a smoothed mean trajectory differed slightly. After log transformation, the fetal growth data can be reasonably modeled by the linear mixed-effects models, assuming normally distributed random effects and error terms.

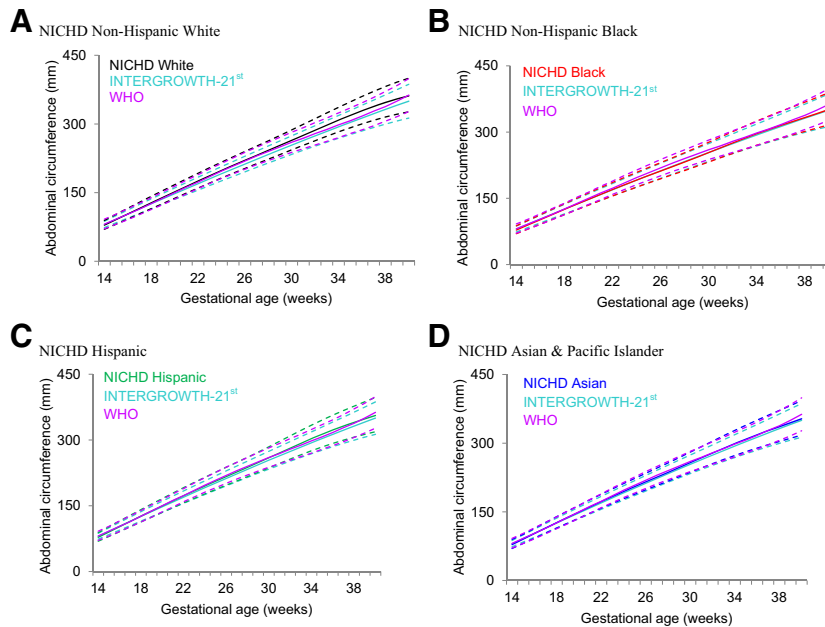
WHO Fetal used quantile regression to estimate percentiles directly and made somewhat fewer restrictive assumptions.

Despite different model assumptions and smoothing techniques, the approaches are flexible to capture the smooth fetal growth trajectories so that they should yield similar results when applied to the same fetal growth data set. In other words, any differences in results are unlikely due to the different methods used, although they have not been rigorously compared.

The analyses also adjusted for different covariates, which are not able to be summarized here because of the many analyses. For example, the WHO Fetal primary analyses did not adjust for country but secondary analyses adjusted for county and full interaction between country and gestational age.¹³ Their EFW analyses adjusted for fetal sex, while the femur length analyses did not.

It is important to note that NICHD and WHO Fetal calculated EFW from HC, AC, and FL using the Hadlock 1985 formula,²⁶ while INTERGROWTH

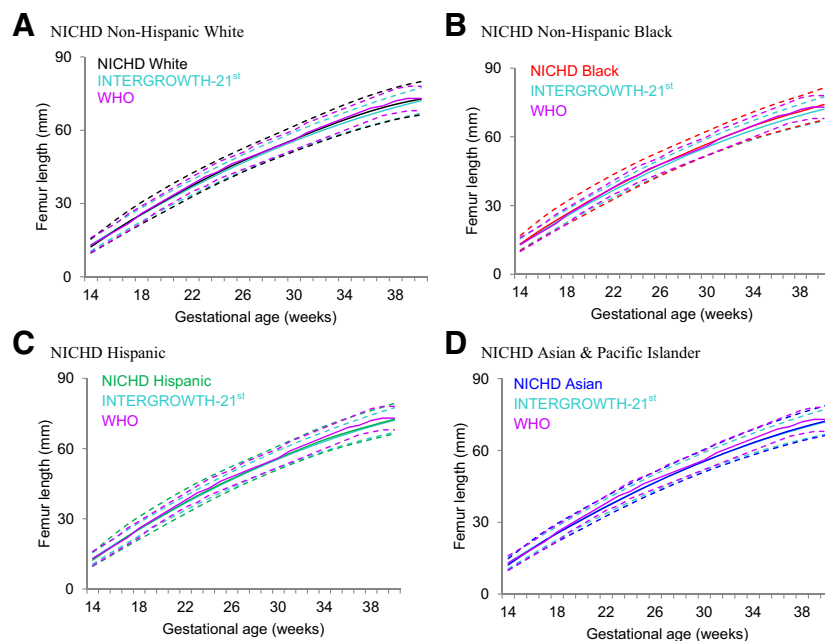
FIGURE 4
Abdominal circumference comparison among the 3 studies



Distribution of head circumference, NICHD Fetal Growth Study—Singletons, INTERGROWTH-21st, and WHO Fetal. Estimated fifth, 50th, and 95th percentiles for abdominal circumference are by race/ethnicity and gestation and study.

INTERGROWTH, INTERGROWTH-21st; NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development; WHO Fetal, World Health Organization Multicentre Growth Reference Study. Grantz. Fetal growth charts. *Am J Obstet Gynecol* 2018.

FIGURE 5
Femur length comparison among the 3 studies



Distribution of head circumference, NICHD Fetal Growth Study—Singletons, INTERGROWTH-21st, and WHO Fetal. Estimated fifth, 50th, and 95th percentiles are for femur length by race/ethnicity and gestation and study.

INTERGROWTH, INTERGROWTH-21st; NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development; WHO Fetal, World Health Organization Multicentre Growth Reference Study. Grantz. Fetal growth charts. *Am J Obstet Gynecol* 2018.

TABLE 2
The 50th percentiles for fetal anthropometric measurements by gestational age for the 3 studies^a

Gestational age, wks ^b	Head circumference (mm) 50th percentiles					
	NICHD white	NICHD Hispanic	NICHD Asian	NICHD black	INTERGROWTH	WHO Fetal
24	219	218	217	218	219	222
25	231	229	228	229	230	233
26	242	240	239	239	241	244
27	253	250	250	250	251	254
28	263	260	260	259	260	264
29	273	270	269	269	270	273
30	282	279	278	278	278	281
31	290	287	287	286	287	289
32	299	295	295	294	294	296
33	306	303	302	301	302	303
34	313	309	308	307	308	309
35	318	315	314	312	314	315
36	324	320	320	317	319	321
37	328	324	324	321	324	326
38	332	327	328	324	328	332
39	335	330	331	328	331	337
40	338	333	333	331	334	342

INTERGROWTH, INTERGROWTH-21st; NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development; WHO Fetal, World Health Organization Multicentre Growth Reference Study.

^a The NICHD Fetal Growth Studies,^{9,10} INTERGROWTH,^{11,12} and WHO Fetal^{13,14}; ^b Results were reported for the exact day (eg, 16.0 weeks) for the NICHD and WHO studies, while INTERGROWTH results were reported for completed weeks (eg, 16 weeks = 16 weeks 0 days to 16 weeks 6 days).

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created a new formula¹² based on only HC and AC:

INTERGROWTH: created a new formula (based on HC and AC)¹²

$$\text{Log}(\text{EFW}) = 5.084820 - 54.06633 \times (\text{AC}/100)^3 - 95.80076 \times (\text{AC}/100)^3 \times \log(\text{AC}/100) + 3.136370 \times (\text{HC}/100)$$

NICHD and WHO Fetal: Hadlock 1985 (based on HC, AC, and FL)²⁶

$$\text{Log}_{10} \text{ weight} = 1.326 - 0.00326 \text{ AC} \times \text{FL} + 0.0107 \text{ HC} + 0.0438 \text{ AC} + 0.158 \text{ FL}$$

Another slight difference among studies was the gestational ages that were included in the models to calculate EFW percentiles. Given the clinical

uncertainty associated with EFW before 15 weeks, NICHD originally did not intend to report EFW based on the actual measurements taken by sonographers between 10 and 14 weeks but to extrapolate data from the measurements taken at ≥ 15 weeks, but subsequently they reran the analysis using the actual measurements for EFW at 10–14 weeks and not the extrapolated data because other fetal parameters were presented for that gestational period.⁹

INTERGROWTH and WHO Fetal included EFW starting at 14 weeks of gestation but note that INTERGROWTH presented percentiles only starting at 22 weeks.^{12,13} Results were reported for the exact day (eg, 16.0 weeks) for the NICHD and WHO Fetal studies, while INTERGROWTH results were reported for completed weeks (eg, 16 weeks = 16 weeks 0 days to 16 weeks 6 days).

Study findings

EFW comparison among the 3 studies is presented in [Figure 2](#) and [Table 1](#) (no statistical testing was performed). EFW was plotted for the published estimated third, 50th, and 97th percentiles for INTERGROWTH and NICHD; WHO Fetal published the 2.5th and 97.5th percentiles to approximate ± 2 SD. Despite all 3 studies including women with a low-risk status, the percentiles for fetal biometrics and EFW varied among the studies.

Starting at 26 weeks of gestation and continuing through 40 weeks of gestation, the 50th percentile EFW for INTERGROWTH was smaller than the 50th percentile EFW for WHO Fetal and all racial/ethnic groups in NICHD. The 50th percentile EFW for WHO Fetal was between the NICHD EFW for white and Hispanic women. Specifically, at 39

TABLE 3
The 50th percentiles for fetal anthropometric measurements by gestational age for the 3 studies^a

Gestational age, wks ^b	Abdominal circumference (mm) 50th percentiles					
	NICHD white	NICHD Hispanic	NICHD Asian	NICHD black	INTERGROWTH	WHO Fetal
24	198	195	194	191	191	197
25	210	206	205	202	202	208
26	221	216	215	212	212	219
27	231	227	226	222	223	230
28	242	238	236	232	233	240
29	253	248	247	243	244	250
30	264	259	257	254	254	260
31	275	270	268	265	264	269
32	287	282	279	275	274	279
33	298	293	289	286	284	288
34	308	303	299	296	294	298
35	319	313	309	306	303	307
36	329	323	318	315	313	317
37	338	332	327	324	322	328
38	347	340	336	333	332	338
39	355	348	345	342	341	350
40	361	356	353	351	350	363

INTERGROWTH, INTERGROWTH-21st; NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development; WHO Fetal, World Health Organization Multicentre Growth Reference Study.

^a The NICHD Fetal Growth Studies,^{9,10} INTERGROWTH,^{11,12} and WHO Fetal^{13,14}; ^b Results were reported for the exact day (eg, 16.0 weeks) for the NICHD and WHO Fetal studies, while INTERGROWTH results were reported for completed weeks (eg, 16 weeks = 16 weeks 0 days to 16 weeks 6 days).

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weeks, the 50th percentile for EFW was 3502 g for white, 3330 g for Hispanic, 3263 g for Asian, and 3256 g for black in the NICHD Study, compared with 3186 g for the INTERGROWTH and 3403 g for the WHO Fetal.

WHO Fetal found country-specific differences similar to NICHD findings for race/ethnicity. Quantile regression with country as a covariate, and interaction terms with gestational age, demonstrated statistically significant variation in fetal growth among countries. For example, at term the fifth percentile for Norway was 3200 g, while it was 2700 g for Egypt and 2800 g using the pooled data from all countries, differences that were also apparent in birthweight. While acknowledging these differences, WHO Fetal chose to present a pooled standard with the rationale that

the primary purpose of the study was to develop fetal standards to complement the WHO MGRS¹⁷ for infants and children, aged 0–5 years.

Because differences in EFW are difficult to interpret in light of the different EFW formulas, we also compared fetal biometry among the 3 studies presented in Figures 3–5 and Tables 2–4. The differences in AC among studies paralleled that of EFW.

To directly compare the 2 EFW formulas, we used the NICHD data to calculate EFW using the Hadlock 1985 formula and INTERGROWTH formula (Figure 6). The INTERGROWTH EFW formula performed very close to the NICHD Asian racial/ethnic group but differed from the 3 other racial/ethnic groups. Additional application studies are needed in different

populations to assess whether the INTERGROWTH EFW formula outperforms the Hadlock or other EFW formulas in identifying fetuses with other signs of compromise.

We also compared the NICHD EFW standards with the Hadlock 1991 reference⁸ that is commonly used in clinical practice in the United States (Figure 7 and Table 5). Interestingly, the NICHD white 50th percentile EFW was higher than the Hadlock reference, which also was in white women, but the other 3 NICHD racial/ethnic groups had EFW 50th percentiles lower than Hadlock. The population for Hadlock was limited to predominantly middle-class, white women without a history of maternal diseases associated with abnormal fetal growth and no congenital anomalies, so perhaps some of the differences between

TABLE 4

The 50th percentiles for fetal anthropometric measurements by gestational age for the 3 studies^a

Gestational age, wks ^b	Femur length (mm) 50th percentiles					
	NICHD white	NICHD Hispanic	NICHD Asian	NICHD black	INTERGROWTH	WHO Fetal
24	43	42	42	43	42	43
25	45	45	44	46	44	46
26	48	47	47	48	47	48
27	50	49	49	50	49	50
28	52	52	51	53	51	52
29	54	54	53	55	53	54
30	56	56	56	57	56	56
31	58	58	58	59	58	59
32	60	60	60	61	60	61
33	62	62	61	63	61	63
34	64	64	63	65	63	65
35	66	66	65	67	65	67
36	68	67	67	68	66	69
37	69	69	68	70	68	70
38	71	70	70	71	69	72
39	72	71	71	73	71	73
40	73	73	72	74	72	73

INTERGROWTH, INTERGROWTH-21st; NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development; WHO Fetal, World Health Organization Multicentre Growth Reference Study.

^a The NICHD Fetal Growth Studies,^{9,10} INTERGROWTH,^{11,12} and WHO Fetal^{13,14}; ^b Results were reported for the exact day (eg, 16.0 weeks) for the NICHD and WHO studies, while INTERGROWTH results were reported for completed weeks (eg, 16 weeks = 16 weeks 0 days to 16 weeks 6 days).

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the white women could be explained by the NICHD cohort having even more restrictions and a healthier cohort, thereby including fetuses growing under more optimal conditions. Alternatively, the NICHD cohort included overweight women (body mass index [BMI] 25.0–29.9 kg/m²) and only nonsmokers, and while body mass index was not reported by Hadlock et al,⁸ the average BMI was lower in 1991 and smoking more common.^{27,28} Increased maternal BMI is associated with larger birthweights, as is nonsmoking.³ Nonetheless, perhaps the most important finding is that if the Hadlock 10th percentile is used to identify SGA in clinical practice, a larger percentage of fetuses from black, Hispanic, and Asian women would be labeled as SGA, while fewer fetuses from white women would be, compared with the NICHD standard.

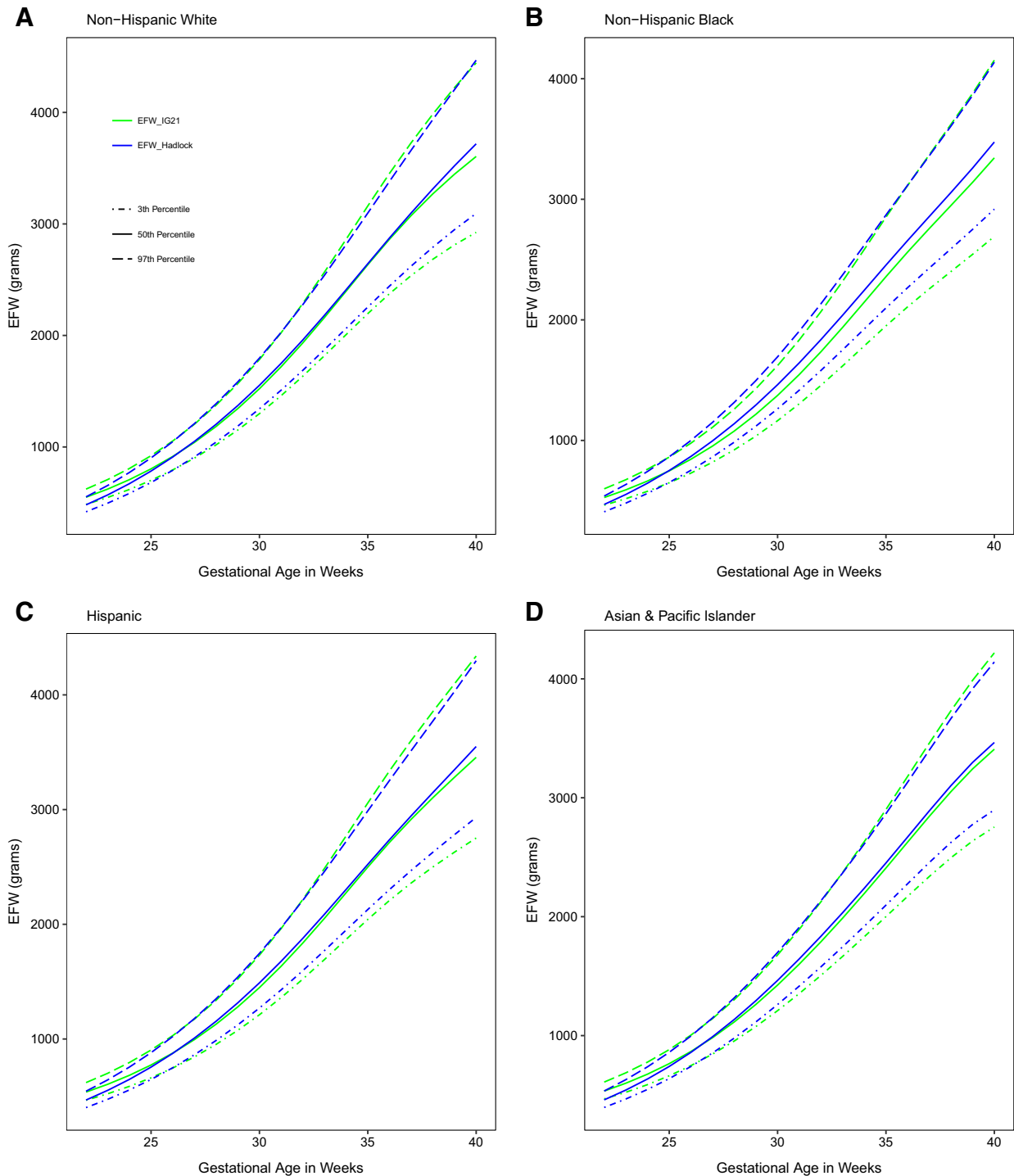
These findings are similar to the NICHD analysis, which found the percentage of fetuses classified as being below the fifth percentile for EFW when using the white standard and was substantially higher for black, Hispanic, and Asian fetuses, except for black fetuses less than 18 weeks' gestation. For example, at 35 weeks' gestation, 15%, 12%, and 14% of black, Hispanic, and Asian fetuses, respectively, would have been classified as below the fifth percentile based on the white standard.^{9,10} Therefore, an additional 10% (15% minus 5%), 7% (12% minus 5%) and 9% (14% minus 5%) of black, Hispanic, and Asian fetuses, respectively, would be classified as extreme. Findings were also similar when a pooled standard was used. These findings are also similar to the potential for misclassification using the pooled standard in INTERGROWTH as previously demonstrated.

Implications

Despite having extensive inclusion and exclusion criteria aimed at enrolling healthy women with uncomplicated pregnancies, allowing for optimal fetal growth, none of the 3 studies observed consistent standards for population subgroups. INTERGROWTH observed country-of-origin level differences in maternal height and weight as did WHO Fetal, while the NICHD observed both racial/ethnic differences in maternal size and fetal growth.

Collectively, these data argue for racial/ethnic fetal growth standards. This argument is supported by the fact that size and body proportion differences are known to occur across different races/ethnicities and countries for children and adults.²⁹ Mean stature for adult populations varies, and the ratio of sitting height to height, as a measure of

FIGURE 6
Comparison of estimated fetal weight formulas



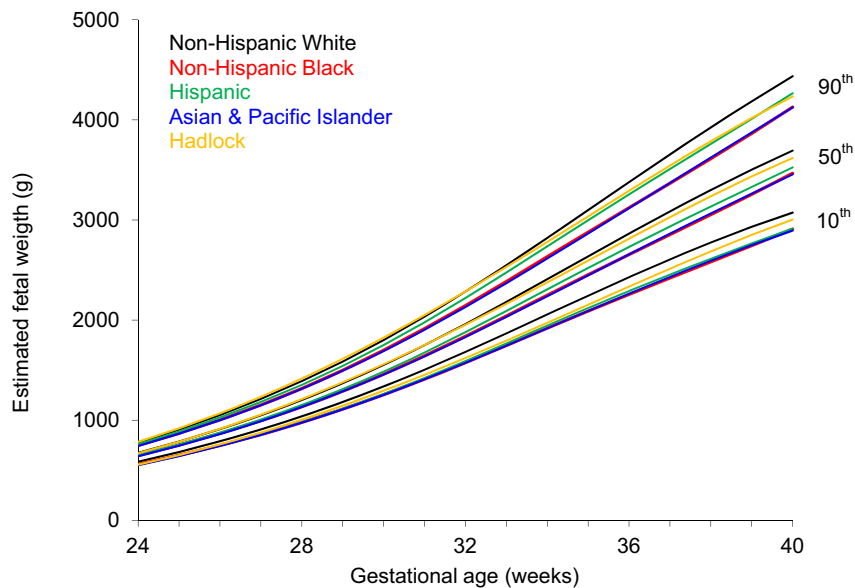
Using the NICHD Fetal Growth Study—Singleton standard data, we compared the 2 EFW formulas calculated using the Hadlock 1991 formula⁸ from HC, AC, and FL (add reference) and INTERGROWTH formula based on HC and AC. EFW was calculated using the Hadlock formula: $\text{Log}_{10} \text{ weight} = 1.326 - 0.00326 \text{ AC} \times \text{FL} + 0.0107 \text{ HC} + 0.0438 \text{ AC} + 0.158 \text{ FL}$ and INTERGROWTH-21st formula: $\text{Log}(\text{EFW}) = 5.084820 - 54.06633 \times (\text{AC}/100)^3 - 95.80076 \times (\text{AC}/100)^3 \times \log(\text{AC}/100) + 3.136370 \times (\text{HC}/100)$, and plotted across gestation.

AC, abdominal length; EFW, estimated fetal weight; FL, fetal length; HC, head circumference; INTERGROWTH, INTERGROWTH-21st; NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development; WHO Fetal, World Health Organization Multicentre Growth Reference Study.

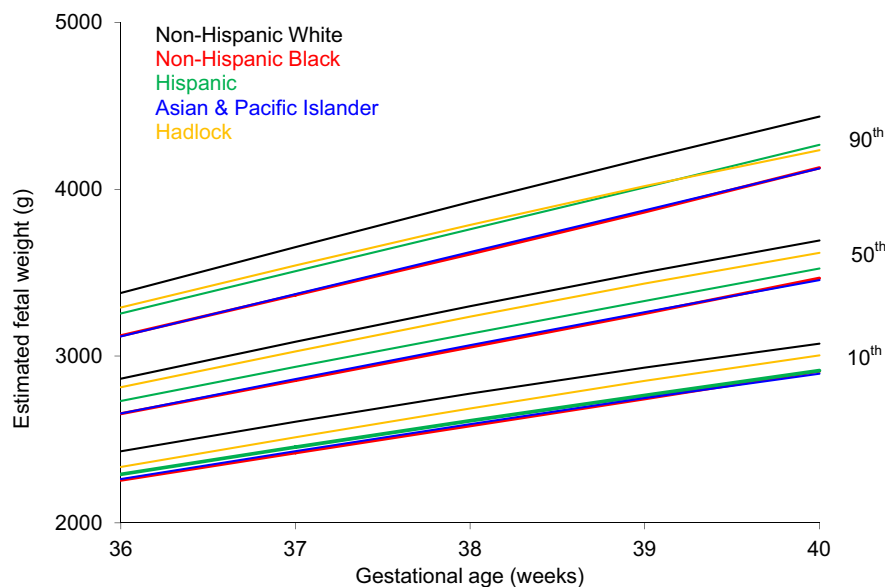
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FIGURE 7
Estimated fetal weight comparison between NICHD and Hadlock 1991

A Standards for Estimated Fetal Weight 24-40 Weeks



B Standards for Estimated Fetal Weight 36-40 Weeks



Distribution of EFW by race/ethnicity and gestation, NICHD Fetal Growth Study—Singletons, and Hadlock 1991⁸ for 24–40 weeks of gestation (A) and 36–40 weeks of gestation (B). Estimated third, 50th, and 97th percentiles are for fetal weight by study.

EFW, estimated fetal weight; NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development.
 Grantz. Fetal growth charts. *Am J Obstet Gynecol* 2018.

body proportion, has also been shown to differ across 4 geographic areas including Australia/New Zealand/Papua New Guinea, Africa, Europe, and Asia.²⁹

US blacks have been found to have a similar mean height compared with whites but are shorter in sitting height and longer in leg length.³⁰ Differences in body composition have also been found

among different Asian ethnic groups, in which for the same BMI, Asian Indians had the highest percentage body fat compared with Malaysians and then Chinese, all of which were higher than

TABLE 5

The 50th percentiles for estimated fetal weight by gestational age for the NICHD^a and Hadlock^b studies

Gestational age, wks ^b	Estimated fetal weight (g) 50th percentiles				
	NICHD white	Hadlock	NICHD Hispanic	NICHD Asian	NICHD black
24	674	670	651	640	647
25	787	785	758	745	751
26	912	913	876	862	866
27	1050	1055	1007	990	994
28	1202	1210	1151	1132	1134
29	1369	1379	1311	1287	1289
30	1552	1559	1486	1456	1459
31	1749	1751	1676	1637	1642
32	1960	1953	1879	1830	1837
33	2180	2162	2090	2031	2040
34	2408	2377	2307	2238	2247
35	2637	2595	2521	2448	2452
36	2864	2813	2731	2656	2654
37	3086	3028	2935	2862	2854
38	3299	3236	3134	3065	3054
39	3502	3435	3330	3263	3256
40	3693	3619	3525	3455	3466

NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development.

^a The NICHD Fetal Growth Studies^{9,10}; ^b Hadlock 1991.⁸

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whites.²⁵ This implies that the differences in fetal growth between the 2 international studies, INTERGROWTH and WHO Fetal, may be, to a large extent, an artifact of the international case mix (ie, maternal characteristics in the countries selected for the sample) and that, again, racial/ethnic-specific standards may improve the precision of fetal growth assessment.

In contrast to the assumption that all fetuses grow the same, INTERGROWTH found in their study of neonatal anthropometry for healthy, low-risk, term deliveries, which included 4321 neonates from the fetal growth cohort plus 20,486 newborns from a cross-sectional cohort, wide variation in birthweight and HC among the countries, consistent with differences in maternal size.³¹ For example, birthweight ranged (mean [SD]) from 2.9 (0.4) kg in India to 3.5 (0.5) kg in the

United Kingdom and HC from 33.1 (1.1) cm to 34.5 (1.3) cm in India and the United Kingdom, respectively.

These differences in body size and proportion have been hypothesized to be explained by both environmental and genetic factors.²⁹ Using twin studies, heritability of birth size has been estimated to be up to 40%, with an intergenerational study finding that fetal genetic factors explained 31% of normal variation in birthweight and birth length, and maternal genetic factors explained 22% and 19% of normal variation in these measures, respectively.^{32,33} Yet a complete knowledge of the determinants of fetal growth is not fully understood.^{33,34} It has been hypothesized that the interaction of environmental influences and genetic factors on fetal growth display developmental plasticity that explain phenotypic differences in fetal growth and birthweight,

and under this paradigm, a universal fetal growth standard is elusive.^{35,36}

In light of the many complexities underlying racial/ethnic definitions and the fact that it likely is not feasible to repeat these studies in individual populations across the world, it is important to understand how these study findings are applicable to individual populations. Ideally, a comparison of diagnostic accuracy, or misclassification rates, of SGA and LGA in relation to morbidity and mortality using different criteria is necessary to make recommendations and remains an important data gap. Identification for the appropriate percentiles is needed in local populations, depending on which standard is used.

Conclusion

Three recently completed longitudinal observational cohort studies, NICHD,

INTERGROWTH and WHO Fetal,^{9-11,13,14} have developed intrauterine fetal growth charts. The percentile cutpoints for SGA and LGA varied among the studies. For example, starting at 28 weeks of gestation and onward, the third percentile for INTERGROWTH was below all individual races/ethnicities in the NICHD study and the pooled sample in WHO Fetal study.

When applying these standards to pregnant women under clinical management, it is important to be aware that different percentages of SGA and LGA will be identified and that the percentiles are not interpreted in the same manner as a reference. It might be helpful to use all tools on the belt, in which a simple application could be created to calculate the percentiles (or SD scores) for comparison among the 3 charts.

Also, the assessment of fetal growth with a 1-time measurement (ie, EFW below the 10th percentile at a given gestational age) remains standard clinical practice, despite recognition that a single measurement can indicate only size. At least 2 measurements separated in time are needed to estimate a trajectory, and perhaps one of the greater contributions of these prospective studies will be the ability to estimate fetal growth velocity. Ultimately, it is knowledge about fetal growth in addition to other factors (signs of placental dysfunction or maternal complications) and clinical judgment that should trigger intervention.¹

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REFERENCES

- American College of Obstetricians and Gynecologists. Fetal growth restriction. ACOG Practice bulletin no. 134. *Obstet Gynecol* 2013;121:1122-33.
- Zhang J, Merialdi M, Platt LD, Kramer MS. Defining normal and abnormal fetal growth: promises and challenges. *Am J Obstet Gynecol* 2010;202:522-8.
- American College of Obstetricians and Gynecologists. Fetal Macrosomia. ACOG Practice bulletin no. 173. *Obstet Gynecol* 2016;128:e195-209.
- Battaglia FC, Lubchenco LO. A practical classification of newborn infants by weight and gestational age. *J Pediatr* 1967;71:159-63.
- Barel O, Vaknin Z, Tovbin J, Herman A, Maymon R. Assessment of the accuracy of multiple sonographic fetal weight estimation formulas: a 10-year experience from a single center. *J Ultrasound Med* 2013;32:815-23.
- Gardosi JO. Prematurity and fetal growth restriction. *Early human development* 2005;81:43-9.
- Zhang J, Sun K. Invited commentary: the incremental value of customization in defining abnormal fetal growth status. *Am J Epidemiol* 2013;178:1309-12.
- Hadlock FP, Harrist RB, Martinez-Poyer J. In utero analysis of fetal growth: a sonographic weight standard. *Radiology* 1991;181:129-33.
- Buck Louis GM, Grewal J, Albert PS, et al. Racial/ethnic standards for fetal growth: the NICHD Fetal Growth Studies. *Am J Obstet Gynecol* 2015;213:449.e1-41.
- Buck Louis GM, Grewal J. Clarification of estimating fetal weight between 10–14 weeks gestation, NICHD fetal growth studies. *Am J Obstet Gynecol* 2017;217:96-101.
- Papageorgiou AT, Ohuma EO, Altman DG, et al. International standards for fetal growth based on serial ultrasound measurements: the Fetal Growth Longitudinal Study of the INTERGROWTH-21st Project. *Lancet* 2014;384:869-79.
- Stirnemann J, Villar J, Salomon LJ, et al. International estimated fetal weight standards of the INTERGROWTH-21st Project. *Ultrasound Obstet Gynecol* 2017;49:478-86.
- Kiserud T, Piaggio G, Carroli G, et al. The World Health Organization fetal growth charts: a multinational longitudinal study of ultrasound biometric measurements and estimated fetal weight. *PLoS Med* 2017;14:e1002220.
- Kiserud T, Piaggio G, Carroli G, et al. Correction: The World Health Organization fetal growth charts: a multinational longitudinal study of ultrasound biometric measurements and estimated fetal weight. *PLoS Med* 2017;14:e1002284.
- Villar J, Altman DG, Purwar M, et al. The objectives, design and implementation of the INTERGROWTH-21st Project. *BJOG* 2013;120(Suppl 2):9-26. v.
- Merialdi M, Widmer M, Gulmezoglu AM, et al. WHO multicentre study for the development of growth standards from fetal life to childhood: the fetal component. *BMC Pregnancy Childbirth* 2014;14:157.
- World Health Organization. WHO Child Growth Standards based on length/height, weight and age. *Acta Paediatr Suppl* 2006;450:76-85.
- de Onis M, Garza C, Victora CG, Onyango AW, Frongillo EA, Martinez J. The WHO Multicentre Growth Reference Study: planning, study design, and methodology. *Food Nutr Bull* 2004;25:S15-26.
- WHO Multicentre Growth Reference Study Group. Assessment of differences in linear growth among populations in the WHO Multicentre Growth Reference Study. *Acta Paediatr Suppl* 2006;450:56-65.
- Villar J, Papageorgiou AT, Pang R, et al. The likeness of fetal growth and newborn size across non-isolated populations in the INTERGROWTH-21st Project: the Fetal Growth Longitudinal Study and Newborn Cross-Sectional Study. *Lancet Diabetes Endocrinol* 2014;2:781-92.
- Natale V, Rajagopalan A. Worldwide variation in human growth and the World Health Organization growth standards: a systematic review. *BMJ Open* 2014;4:e003735.
- Albert PS, Grantz KL. Fetal growth and ethnic variation. *Lancet Diabetes Endocrinol* 2014;2:773.
- Grewal J, Grantz KL, Zhang C, et al. Cohort Profile: NICHD Fetal Growth Studies—Singletons and Twins. *Int J Epidemiol* 2017 Sep 8. <https://doi.org/10.1093/ije/dyx161>. [Epub ahead of print].
- Malina RM, Brown KH, Zavaleta AN. Relative lower extremity length in Mexican American and in American black and white youth. *Am J Physical Anthropol* 1987;72:89-94.
- Wulan SN, Westertep KR, Plasqui G. Ethnic differences in body composition and the associated metabolic profile: a comparative study between Asians and Caucasians. *Maturitas* 2010;65:315-9.
- Hadlock FP, Harrist RB, Sharman RS, Deter RL, Park SK. Estimation of fetal weight with the use of head, body, and femur measurements—a prospective study. *Am J Obstet Gynecol* 1985;151:333-7.
- Ogden C, Carroll M. Prevalence of overweight, obesity, and extreme obesity among adults: United States, trends 1960–1962 through 2007–2008. National Center for Health Statistics, 2010. Available at: cdc.gov/nchs/data/series/. Accessed August 21, 2017.
- Centers for Disease Control and Prevention. Trends in current cigarette smoking among high school students and adults, United States, 1965–2014, Atlanta (GA): Centers for Disease Control and Prevention; 2016.
- Bogin B, Varela-Silva MI. Leg length, body proportion, and health: a review with a note on beauty. *Int J Environ Res Public Health* 2010;7:1047-75.
- Heymsfield SB, Peterson CM, Thomas DM, Heo M, Schuna JM Jr. Why are there race/ethnic differences in adult body mass index-adiposity relationships? A quantitative critical review. *Obes Rev* 2016;17:262-75.
- Villar J, Cheikh Ismail L, et al. International standards for newborn weight, length, and head circumference by gestational age and sex: the Newborn Cross-Sectional Study of

the INTERGROWTH-21st Project. *Lancet* 2014;384:857-68.

32. Clausson B, Lichtenstein P, Cnattingius S. Genetic influence on birthweight and gestational length determined by studies in offspring of twins. *BJOG* 2000;107:375-81.

33. Lunde A, Melve KK, Gjessing HK, Skjaerven R, Irgens LM. Genetic and

environmental influences on birth weight, birth length, head circumference, and gestational age by use of population-based parent-offspring data. *Am J Epidemiol* 2007;165:734-41.

34. Kramer MS. Determinants of low birth weight: methodological assessment and meta-analysis. *Bull World Health Organ* 1987;65:663-737.

35. Hanson MA, Gluckman PD. Early developmental conditioning of later health and disease: physiology or pathophysiology? *Physiol Rev* 2014;94:1027-76.

36. Hanson M, Kiserud T, Visser GH, Brocklehurst P, Schneider EB. Optimal fetal growth: a misconception? *Am J Obstet Gynecol* 2015;213:332.e1-4.

SUPPLEMENTAL TABLE 1**Race/ethnic-specific percentiles for fetal anthropometric measurements by gestational age, NICHD fetal growth studies**

Gestational age, wks	Biparietal diameter, mm, white						
	Third	Fifth	10th	50th	90th	95th	97th
10	10.4	10.6	10.9	12.1	13.5	13.9	14.2
11	13.4	13.6	14.0	15.5	17.2	17.7	18.0
12	16.6	16.9	17.4	19.2	21.1	21.7	22.1
13	20.0	20.3	20.9	22.9	25.2	25.9	26.3
14	23.3	23.7	24.3	26.7	29.2	30.0	30.5
15	26.6	27.1	27.7	30.3	33.0	33.9	34.4
16	29.8	30.3	31.0	33.7	36.7	37.6	38.2
17	32.8	33.3	34.1	37.0	40.1	41.0	41.7
18	35.8	36.3	37.1	40.1	43.4	44.3	45.0
19	38.7	39.2	40.0	43.2	46.6	47.6	48.3
20	41.6	42.2	43.0	46.3	49.8	50.9	51.5
21	44.6	45.2	46.1	49.4	53.1	54.1	54.9
22	47.6	48.2	49.1	52.6	56.3	57.4	58.2
23	50.5	51.2	52.1	55.7	59.6	60.7	61.5
24	53.5	54.1	55.1	58.9	62.8	64.0	64.8
25	56.4	57.1	58.1	61.9	66.0	67.2	68.0
26	59.3	60.0	61.0	65.0	69.2	70.4	71.2
27	62.1	62.8	63.9	68.0	72.3	73.5	74.4
28	64.8	65.5	66.7	70.8	75.3	76.6	77.5
29	67.4	68.2	69.4	73.6	78.2	79.6	80.4
30	70.0	70.7	71.9	76.4	81.0	82.4	83.3
31	72.4	73.2	74.4	78.9	83.7	85.2	86.1
32	74.6	75.4	76.7	81.4	86.3	87.7	88.7
33	76.7	77.6	78.8	83.6	88.6	90.1	91.1
34	78.6	79.5	80.8	85.6	90.8	92.3	93.3
35	80.3	81.2	82.5	87.4	92.7	94.2	95.2
36	81.7	82.6	84.0	89.0	94.3	95.9	96.9
37	83.0	83.9	85.3	90.3	95.7	97.3	98.3
38	84.1	85.0	86.3	91.5	96.9	98.5	99.5
39	85.0	85.9	87.3	92.4	97.9	99.5	100.6
40	85.7	86.6	88.0	93.3	98.8	100.4	101.5

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SUPPLEMENTAL TABLE 2**Race/ethnic-specific percentiles for fetal anthropometric measurements by gestational age, NICHD fetal growth studies**

Gestational age, wks	Head circumference, mm, white						
	Third	Fifth	10th	50th	90th	95th	97th
10	41.4	42.1	43.1	47.1	51.3	52.6	53.5
11	52.2	53.0	54.3	59.0	64.2	65.7	66.8
12	63.9	64.9	66.3	71.9	77.9	79.6	80.8
13	76.1	77.2	78.9	85.1	91.9	93.9	95.3
14	88.4	89.6	91.5	98.5	106.0	108.2	109.7
15	100.7	102.0	104.0	111.6	119.7	122.1	123.7
16	112.7	114.1	116.3	124.3	132.9	135.4	137.1
17	124.4	125.8	128.1	136.6	145.6	148.2	150.0
18	135.8	137.3	139.7	148.5	157.8	160.6	162.4
19	147.1	148.7	151.2	160.3	169.9	172.7	174.6
20	158.6	160.3	162.8	172.2	182.1	185.0	186.9
21	170.2	171.9	174.5	184.1	194.2	197.2	199.2
22	181.7	183.5	186.2	196.0	206.4	209.4	211.4
23	193.2	195.0	197.7	207.8	218.4	221.5	223.5
24	204.4	206.3	209.1	219.4	230.2	233.4	235.5
25	215.4	217.3	220.2	230.8	241.8	245.1	247.2
26	226.1	228.0	231.0	241.8	253.1	256.4	258.6
27	236.3	238.3	241.3	252.5	264.1	267.5	269.7
28	246.1	248.1	251.3	262.7	274.7	278.2	280.5
29	255.3	257.4	260.7	272.5	284.8	288.4	290.8
30	264.0	266.2	269.5	281.8	294.5	298.2	300.7
31	272.1	274.3	277.8	290.4	303.7	307.5	310.0
32	279.5	281.8	285.4	298.5	312.2	316.2	318.8
33	286.2	288.6	292.3	305.9	320.1	324.2	326.9
34	292.1	294.6	298.5	312.5	327.2	331.5	334.3
35	297.3	299.8	303.8	318.4	333.6	338.0	341.0
36	301.7	304.3	308.5	323.5	339.2	343.8	346.9
37	305.4	308.2	312.4	327.9	344.2	348.9	352.1
38	308.6	311.4	315.8	331.8	348.5	353.4	356.7
39	311.2	314.1	318.6	335.1	352.4	357.4	360.8
40	313.4	316.4	321.0	338.0	355.8	361.1	364.5

NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development.

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SUPPLEMENTAL TABLE 3**Race/ethnic-specific percentiles for fetal anthropometric measurements by gestational age, NICHD fetal growth studies**

Gestational age, wks	Abdominal circumference, mm, white						
	Third	Fifth	10th	50th	90th	95th	97th
10	30.5	31.1	32.1	35.8	40.0	41.3	42.1
11	38.8	39.6	40.8	45.4	50.5	52.0	53.0
12	48.1	49.0	50.4	55.9	61.9	63.8	65.0
13	58.1	59.2	60.9	67.2	74.2	76.3	77.7
14	68.7	69.9	71.8	79.0	86.9	89.3	90.9
15	79.7	81.0	83.2	91.2	99.9	102.6	104.3
16	90.8	92.3	94.7	103.4	112.9	115.8	117.7
17	102.0	103.6	106.2	115.6	125.8	128.9	131.0
18	113.2	114.9	117.6	127.7	138.6	141.8	144.0
19	124.4	126.2	129.1	139.7	151.2	154.6	156.9
20	135.6	137.6	140.6	151.7	163.7	167.3	169.7
21	146.8	148.9	152.0	163.6	176.2	179.9	182.4
22	157.9	160.0	163.3	175.4	188.4	192.3	194.8
23	168.9	171.0	174.4	187.0	200.5	204.5	207.1
24	179.6	181.8	185.4	198.4	212.3	216.4	219.2
25	190.1	192.4	196.1	209.6	224.0	228.2	231.0
26	200.4	202.8	206.6	220.6	235.5	239.9	242.8
27	210.5	213.0	217.0	231.4	246.9	251.5	254.5
28	220.5	223.1	227.2	242.3	258.4	263.1	266.3
29	230.5	233.2	237.5	253.2	270.0	274.9	278.2
30	240.5	243.4	247.8	264.3	281.8	287.0	290.4
31	250.5	253.5	258.2	275.4	293.8	299.3	302.9
32	260.3	263.4	268.4	286.5	305.9	311.6	315.4
33	269.9	273.2	278.4	297.5	318.0	324.0	328.0
34	279.2	282.7	288.1	308.3	329.9	336.3	340.5
35	288.0	291.7	297.5	318.8	341.6	348.3	352.8
36	296.4	300.2	306.3	328.8	352.9	360.1	364.8
37	304.0	308.1	314.5	338.2	363.7	371.2	376.2
38	310.9	315.2	321.9	346.9	373.8	381.8	387.0
39	316.8	321.4	328.4	354.7	383.0	391.4	397.0
40	321.7	326.4	333.8	361.4	391.2	400.1	406.0

NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development.

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Grantz. *Fetal growth charts. Am J Obstet Gynecol* 2018.

SUPPLEMENTAL TABLE 4**Race/ethnic-specific percentiles for fetal anthropometric measurements by gestational age, NICHD fetal growth studies**

Gestational age, wks	Femur length, mm, white						
	Third	Fifth	10th	50th	90th	95th	97th
10	1.7	1.8	1.9	2.4	3.0	3.2	3.3
11	2.9	3.1	3.2	4.0	5.0	5.3	5.5
12	4.7	4.9	5.1	6.3	7.7	8.2	8.5
13	6.9	7.1	7.5	9.1	11.0	11.6	12.0
14	9.5	9.8	10.3	12.3	14.8	15.5	16.0
15	12.4	12.8	13.4	15.8	18.7	19.6	20.2
16	15.3	15.8	16.5	19.3	22.5	23.5	24.2
17	18.3	18.8	19.6	22.6	26.1	27.2	28.0
18	21.1	21.7	22.5	25.7	29.5	30.6	31.4
19	23.9	24.5	25.4	28.7	32.6	33.7	34.5
20	26.7	27.3	28.2	31.7	35.6	36.8	37.5
21	29.5	30.1	31.0	34.6	38.5	39.7	40.5
22	32.3	32.9	33.8	37.4	41.3	42.5	43.3
23	35.0	35.6	36.5	40.1	44.0	45.2	46.0
24	37.5	38.2	39.1	42.7	46.6	47.8	48.5
25	40.0	40.6	41.6	45.2	49.1	50.2	51.0
26	42.3	43.0	43.9	47.5	51.4	52.6	53.4
27	44.6	45.2	46.2	49.8	53.7	54.9	55.7
28	46.7	47.3	48.3	52.0	56.0	57.2	57.9
29	48.7	49.3	50.4	54.1	58.2	59.4	60.2
30	50.6	51.3	52.4	56.3	60.4	61.7	62.5
31	52.5	53.2	54.3	58.4	62.7	64.0	64.8
32	54.4	55.1	56.2	60.4	64.9	66.2	67.1
33	56.1	56.9	58.1	62.4	67.0	68.4	69.3
34	57.8	58.6	59.8	64.3	69.1	70.5	71.4
35	59.4	60.2	61.5	66.1	71.0	72.5	73.4
36	60.9	61.7	63.0	67.7	72.8	74.3	75.3
37	62.3	63.1	64.4	69.3	74.5	76.0	77.0
38	63.5	64.4	65.7	70.6	75.9	77.5	78.5
39	64.6	65.4	66.8	71.8	77.2	78.8	79.9
40	65.4	66.3	67.7	72.8	78.3	79.9	81.0

NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development.

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SUPPLEMENTAL TABLE 5

Race/ethnic-specific percentiles for fetal anthropometric measurements by gestational age, NICHD fetal growth studies

Gestational age, wks	Humerus length, mm, white						
	Third	Fifth	10th	50th	90th	95th	97th
10	1.8	1.9	2.0	2.5	3.1	3.3	3.4
11	3.2	3.3	3.5	4.2	5.2	5.5	5.7
12	5.0	5.2	5.5	6.6	8.0	8.5	8.8
13	7.4	7.6	8.0	9.6	11.5	12.1	12.5
14	10.1	10.4	10.9	12.9	15.3	16.0	16.5
15	13.0	13.3	14.0	16.3	19.1	20.0	20.6
16	15.9	16.3	17.0	19.7	22.8	23.8	24.5
17	18.6	19.1	19.9	22.8	26.2	27.2	27.9
18	21.2	21.7	22.5	25.6	29.1	30.2	30.9
19	23.7	24.2	25.0	28.2	31.8	32.9	33.6
20	26.1	26.6	27.5	30.8	34.4	35.5	36.2
21	28.5	29.1	29.9	33.2	36.9	38.0	38.7
22	30.9	31.4	32.3	35.6	39.2	40.3	41.1
23	33.1	33.7	34.6	37.9	41.5	42.6	43.3
24	35.3	35.9	36.7	40.0	43.6	44.7	45.4
25	37.3	37.9	38.8	42.1	45.7	46.8	47.5
26	39.3	39.8	40.7	44.0	47.6	48.7	49.4
27	41.1	41.6	42.5	45.9	49.5	50.6	51.3
28	42.8	43.4	44.3	47.6	51.3	52.4	53.1
29	44.4	45.0	45.9	49.4	53.1	54.2	54.9
30	45.9	46.5	47.5	51.0	54.8	55.9	56.7
31	47.4	48.0	49.0	52.6	56.5	57.7	58.4
32	48.8	49.5	50.5	54.2	58.2	59.4	60.2
33	50.2	50.9	51.9	55.7	59.8	61.1	61.9
34	51.5	52.2	53.2	57.2	61.4	62.7	63.5
35	52.7	53.4	54.5	58.6	62.9	64.2	65.1
36	53.9	54.6	55.8	59.9	64.4	65.7	66.6
37	55.0	55.7	56.9	61.1	65.7	67.0	67.9
38	56.0	56.7	57.9	62.2	66.9	68.3	69.2
39	56.8	57.6	58.8	63.2	67.9	69.3	70.2
40	57.4	58.2	59.4	63.9	68.7	70.2	71.1

NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development.

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Grantz. Fetal growth charts. *Am J Obstet Gynecol* 2018.

SUPPLEMENTAL TABLE 6**Race/ethnic-specific percentiles for fetal anthropometric measurements by gestational age, NICHD fetal growth studies**

Gestational age, wks	Head circumference/abdominal circumference, white						
	Third	Fifth	10th	50th	90th	95th	97th
10	1.219	1.231	1.250	1.317	1.388	1.409	1.422
11	1.209	1.220	1.238	1.304	1.373	1.393	1.406
12	1.194	1.206	1.223	1.287	1.354	1.374	1.387
13	1.177	1.188	1.205	1.267	1.333	1.352	1.365
14	1.158	1.168	1.185	1.246	1.310	1.329	1.341
15	1.138	1.148	1.165	1.224	1.286	1.305	1.317
16	1.118	1.128	1.144	1.202	1.263	1.281	1.293
17	1.099	1.109	1.125	1.182	1.241	1.259	1.270
18	1.083	1.092	1.108	1.163	1.222	1.239	1.250
19	1.068	1.078	1.093	1.148	1.205	1.222	1.233
20	1.057	1.066	1.081	1.135	1.192	1.209	1.220
21	1.047	1.057	1.072	1.126	1.182	1.199	1.210
22	1.040	1.049	1.064	1.118	1.174	1.191	1.202
23	1.034	1.043	1.058	1.112	1.168	1.185	1.196
24	1.028	1.037	1.052	1.106	1.163	1.180	1.190
25	1.023	1.032	1.047	1.101	1.158	1.175	1.186
26	1.017	1.027	1.042	1.096	1.154	1.171	1.182
27	1.011	1.021	1.036	1.091	1.149	1.166	1.177
28	1.004	1.013	1.029	1.084	1.143	1.160	1.171
29	0.995	1.004	1.020	1.076	1.135	1.152	1.164
30	0.984	0.994	1.009	1.066	1.126	1.143	1.155
31	0.972	0.982	0.997	1.055	1.115	1.133	1.144
32	0.958	0.968	0.984	1.042	1.103	1.121	1.133
33	0.944	0.954	0.970	1.028	1.090	1.109	1.121
34	0.928	0.938	0.955	1.014	1.077	1.095	1.108
35	0.912	0.922	0.939	0.999	1.063	1.082	1.094
36	0.896	0.906	0.923	0.984	1.049	1.068	1.081
37	0.880	0.890	0.907	0.969	1.036	1.055	1.068
38	0.865	0.876	0.893	0.956	1.024	1.044	1.057
39	0.851	0.862	0.880	0.945	1.014	1.035	1.048
40	0.839	0.851	0.869	0.935	1.007	1.029	1.043

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SUPPLEMENTAL TABLE 7**Race/ethnic-specific percentiles for fetal anthropometric measurements by gestational age, NICHD fetal growth studies**

Gestational age, wks	Biparietal diameter, mm, black						
	Third	Fifth	10th	50th	90th	95th	97th
10	10.3	10.5	10.8	11.9	13.3	13.7	13.9
11	13.3	13.5	13.9	15.4	17.0	17.5	17.8
12	16.5	16.8	17.3	19.1	21.0	21.6	22.0
13	19.9	20.3	20.8	22.8	25.1	25.7	26.2
14	23.3	23.7	24.3	26.6	29.1	29.8	30.3
15	26.5	27.0	27.6	30.2	32.9	33.7	34.3
16	29.7	30.1	30.9	33.6	36.5	37.4	38.0
17	32.7	33.1	33.9	36.8	39.9	40.8	41.5
18	35.6	36.1	36.9	39.9	43.2	44.2	44.8
19	38.5	39.0	39.9	43.0	46.5	47.5	48.1
20	41.4	42.0	42.9	46.2	49.7	50.8	51.5
21	44.4	45.0	45.9	49.3	53.0	54.1	54.8
22	47.3	47.9	48.9	52.5	56.3	57.4	58.2
23	50.2	50.8	51.8	55.5	59.5	60.7	61.5
24	53.1	53.7	54.8	58.6	62.7	63.9	64.7
25	55.9	56.6	57.6	61.6	65.8	67.0	67.9
26	58.6	59.3	60.4	64.5	68.8	70.1	71.0
27	61.3	62.0	63.1	67.3	71.8	73.1	74.0
28	63.8	64.6	65.8	70.1	74.7	76.1	77.0
29	66.4	67.1	68.3	72.8	77.5	78.9	79.9
30	68.8	69.6	70.8	75.4	80.2	81.7	82.6
31	71.0	71.8	73.1	77.8	82.8	84.3	85.3
32	73.1	74.0	75.3	80.1	85.2	86.7	87.7
33	75.0	75.9	77.2	82.1	87.4	88.9	89.9
34	76.7	77.6	79.0	84.0	89.3	90.8	91.9
35	78.2	79.1	80.4	85.5	90.9	92.5	93.6
36	79.4	80.3	81.7	86.8	92.3	93.9	95.0
37	80.5	81.4	82.8	88.0	93.5	95.2	96.2
38	81.4	82.3	83.8	89.1	94.7	96.3	97.4
39	82.4	83.3	84.7	90.1	95.8	97.4	98.5
40	83.3	84.2	85.7	91.2	97.0	98.7	99.8

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SUPPLEMENTAL TABLE 8**Race/ethnic-specific percentiles for fetal anthropometric measurements by gestational age, NICHD fetal growth studies**

Gestational age, wks	Head circumference, mm, black						
	Third	Fifth	10th	50th	90th	95th	97th
10	40.6	41.2	42.2	46.1	50.3	51.6	52.4
11	51.7	52.5	53.7	58.4	63.6	65.1	66.1
12	63.6	64.5	66.0	71.6	77.6	79.4	80.6
13	75.9	77.0	78.7	85.1	92.0	94.0	95.4
14	88.3	89.5	91.4	98.5	106.2	108.5	110.0
15	100.5	101.8	103.9	111.6	120.0	122.4	124.1
16	112.3	113.7	116.0	124.2	133.1	135.7	137.5
17	123.7	125.3	127.6	136.4	145.7	148.5	150.3
18	135.0	136.6	139.1	148.2	157.9	160.8	162.7
19	146.3	148.0	150.6	160.0	170.1	173.1	175.0
20	157.7	159.4	162.1	171.9	182.3	185.3	187.3
21	169.1	170.9	173.6	183.7	194.3	197.4	199.5
22	180.4	182.2	185.0	195.3	206.2	209.4	211.5
23	191.5	193.3	196.2	206.8	217.9	221.2	223.3
24	202.3	204.2	207.2	218.0	229.3	232.7	234.8
25	212.8	214.8	217.8	228.9	240.4	243.8	246.1
26	223.0	225.0	228.1	239.4	251.2	254.7	257.0
27	232.8	234.8	238.0	249.6	261.7	265.2	267.5
28	242.2	244.3	247.5	259.4	271.7	275.4	277.7
29	251.1	253.3	256.6	268.8	281.5	285.2	287.6
30	259.6	261.8	265.2	277.7	290.8	294.6	297.1
31	267.4	269.7	273.2	286.1	299.6	303.5	306.1
32	274.6	276.9	280.6	293.9	307.8	311.9	314.6
33	280.9	283.4	287.2	300.9	315.3	319.5	322.3
34	286.5	289.0	292.9	307.1	322.0	326.3	329.2
35	291.1	293.7	297.7	312.4	327.8	332.3	335.2
36	294.9	297.6	301.7	316.9	332.8	337.5	340.5
37	298.1	300.9	305.2	320.8	337.3	342.1	345.3
38	300.9	303.8	308.2	324.4	341.4	346.4	349.7
39	303.5	306.5	311.1	327.8	345.4	350.6	354.0
40	306.1	309.2	313.9	331.3	349.7	355.1	358.6

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SUPPLEMENTAL TABLE 9**Race/ethnic-specific percentiles for fetal anthropometric measurements by gestational age, NICHD fetal growth studies**

Gestational age, wks	Abdominal circumference, mm, black						
	Third	Fifth	10th	50th	90th	95th	97th
10	30.8	31.4	32.4	35.9	39.7	40.9	41.7
11	39.2	39.9	41.1	45.3	50.0	51.4	52.4
12	48.5	49.3	50.6	55.7	61.2	62.9	64.0
13	58.4	59.4	60.9	66.8	73.1	75.1	76.3
14	68.8	69.9	71.6	78.2	85.5	87.6	89.0
15	79.4	80.7	82.6	89.9	97.9	100.3	101.9
16	90.1	91.5	93.7	101.7	110.4	113.0	114.7
17	100.9	102.3	104.7	113.3	122.7	125.5	127.3
18	111.5	113.1	115.6	124.9	134.8	137.8	139.8
19	122.2	123.9	126.6	136.4	146.9	150.1	152.2
20	132.8	134.6	137.4	147.8	158.9	162.2	164.4
21	143.2	145.1	148.1	159.0	170.7	174.2	176.5
22	153.5	155.4	158.5	170.0	182.3	185.9	188.3
23	163.4	165.5	168.8	180.8	193.6	197.4	199.9
24	173.1	175.3	178.7	191.3	204.7	208.7	211.4
25	182.6	184.9	188.5	201.6	215.7	219.9	222.6
26	191.9	194.3	198.1	211.8	226.6	230.9	233.8
27	201.2	203.7	207.6	222.0	237.5	242.0	245.1
28	210.4	213.0	217.2	232.3	248.5	253.3	256.5
29	219.8	222.6	226.9	242.8	259.9	264.9	268.3
30	229.4	232.3	236.8	253.6	271.6	276.9	280.4
31	239.0	242.1	246.8	264.5	283.5	289.1	292.8
32	248.5	251.7	256.8	275.4	295.4	301.3	305.3
33	257.8	261.2	266.5	286.1	307.2	313.4	317.6
34	266.6	270.2	275.8	296.4	318.6	325.2	329.5
35	274.9	278.6	284.5	306.1	329.4	336.4	340.9
36	282.7	286.6	292.7	315.4	339.8	347.1	351.9
37	290.1	294.2	300.6	324.3	349.9	357.5	362.5
38	297.3	301.6	308.3	333.1	359.9	367.9	373.1
39	304.6	309.1	316.0	342.0	370.1	378.5	384.0
40	312.0	316.7	324.0	351.3	380.9	389.7	395.6

NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development.

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Grantz. *Fetal growth charts. Am J Obstet Gynecol* 2018.

SUPPLEMENTAL TABLE 10**Race/ethnic-specific percentiles for fetal anthropometric measurements by gestational age, NICHD fetal growth studies**

Gestational age, wks	Femur length, mm, black						
	Third	Fifth	10th	50th	90th	95th	97th
10	1.7	1.8	1.9	2.4	3.1	3.3	3.4
11	3.1	3.2	3.4	4.2	5.3	5.7	5.9
12	4.9	5.1	5.4	6.7	8.3	8.8	9.2
13	7.3	7.6	8.0	9.8	12.0	12.7	13.1
14	10.0	10.4	10.9	13.2	16.0	16.9	17.4
15	12.9	13.3	14.0	16.8	20.0	21.1	21.8
16	15.8	16.3	17.1	20.2	23.9	25.1	25.8
17	18.6	19.2	20.0	23.4	27.4	28.7	29.5
18	21.3	21.9	22.8	26.4	30.6	31.9	32.8
19	24.0	24.6	25.6	29.4	33.7	35.0	35.9
20	26.7	27.4	28.4	32.3	36.7	38.0	38.9
21	29.5	30.1	31.2	35.1	39.6	40.9	41.8
22	32.2	32.8	33.9	37.9	42.3	43.7	44.6
23	34.8	35.5	36.6	40.6	45.0	46.3	47.2
24	37.4	38.1	39.2	43.2	47.6	48.9	49.8
25	39.9	40.6	41.7	45.6	50.0	51.3	52.2
26	42.3	43.0	44.1	48.0	52.3	53.6	54.5
27	44.6	45.3	46.4	50.3	54.6	55.9	56.7
28	46.8	47.5	48.6	52.5	56.8	58.1	58.9
29	49.0	49.7	50.7	54.7	59.0	60.3	61.1
30	51.1	51.8	52.9	56.9	61.2	62.5	63.4
31	53.1	53.8	54.9	59.0	63.4	64.7	65.6
32	55.0	55.7	56.9	61.1	65.6	66.9	67.8
33	56.8	57.6	58.7	63.0	67.7	69.0	69.9
34	58.5	59.3	60.5	64.9	69.6	71.0	72.0
35	60.0	60.8	62.1	66.6	71.5	72.9	73.9
36	61.4	62.2	63.5	68.2	73.2	74.7	75.6
37	62.8	63.6	64.9	69.7	74.8	76.3	77.3
38	64.0	64.9	66.2	71.1	76.4	77.9	79.0
39	65.3	66.2	67.5	72.6	78.0	79.6	80.6
40	66.5	67.4	68.8	74.1	79.7	81.4	82.5

NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development.

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Grantz. *Fetal growth charts. Am J Obstet Gynecol* 2018.

SUPPLEMENTAL TABLE 11**Race/ethnic-specific percentiles for fetal anthropometric measurements by gestational age, NICHD fetal growth studies**

Gestational age, wks	Humerus length, mm, black						
	Third	Fifth	10th	50th	90th	95th	97th
10	2.0	2.1	2.2	2.6	3.1	3.2	3.3
11	3.6	3.7	3.9	4.5	5.3	5.6	5.7
12	5.7	5.9	6.1	7.1	8.3	8.6	8.9
13	8.3	8.6	8.9	10.3	11.8	12.3	12.6
14	11.3	11.6	12.0	13.7	15.7	16.3	16.7
15	14.4	14.7	15.2	17.2	19.5	20.2	20.7
16	17.3	17.7	18.3	20.6	23.1	23.9	24.4
17	20.1	20.5	21.1	23.6	26.3	27.1	27.7
18	22.6	23.1	23.7	26.3	29.2	30.0	30.6
19	25.1	25.5	26.2	28.9	31.9	32.8	33.4
20	27.5	28.0	28.7	31.5	34.5	35.4	36.0
21	29.8	30.3	31.1	33.9	37.0	38.0	38.6
22	32.0	32.5	33.3	36.3	39.5	40.4	41.1
23	34.2	34.7	35.5	38.5	41.8	42.8	43.5
24	36.1	36.7	37.5	40.7	44.0	45.1	45.7
25	38.0	38.6	39.4	42.7	46.2	47.2	47.9
26	39.7	40.3	41.2	44.6	48.2	49.3	50.0
27	41.4	42.0	42.9	46.4	50.1	51.2	52.0
28	42.9	43.6	44.5	48.1	52.0	53.2	53.9
29	44.4	45.1	46.1	49.8	53.9	55.1	55.9
30	45.9	46.6	47.6	51.5	55.7	56.9	57.8
31	47.4	48.1	49.2	53.2	57.5	58.8	59.6
32	48.8	49.5	50.6	54.7	59.2	60.5	61.4
33	50.1	50.9	52.0	56.2	60.8	62.2	63.1
34	51.4	52.2	53.3	57.7	62.3	63.7	64.7
35	52.6	53.3	54.5	59.0	63.7	65.2	66.1
36	53.7	54.5	55.7	60.2	65.0	66.5	67.5
37	54.8	55.5	56.8	61.4	66.3	67.8	68.8
38	55.8	56.6	57.9	62.6	67.7	69.2	70.2
39	56.9	57.8	59.1	63.9	69.1	70.7	71.7
40	58.1	59.0	60.3	65.4	70.9	72.5	73.6

NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development.

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Grantz. *Fetal growth charts. Am J Obstet Gynecol* 2018.

SUPPLEMENTAL TABLE 12**Race/ethnic-specific percentiles for fetal anthropometric measurements by gestational age, NICHD fetal growth studies**

Gestational age, wks	Head circumference/abdominal circumference, black						
	Third	Fifth	10th	50th	90th	95th	97th
10	1.182	1.195	1.215	1.291	1.372	1.395	1.411
11	1.183	1.196	1.217	1.291	1.371	1.394	1.409
12	1.178	1.191	1.211	1.285	1.363	1.386	1.401
13	1.167	1.180	1.200	1.273	1.350	1.372	1.387
14	1.153	1.166	1.185	1.257	1.332	1.355	1.369
15	1.137	1.149	1.169	1.239	1.313	1.335	1.350
16	1.120	1.132	1.151	1.220	1.293	1.315	1.329
17	1.104	1.116	1.134	1.202	1.274	1.295	1.309
18	1.089	1.101	1.119	1.186	1.257	1.278	1.292
19	1.077	1.088	1.107	1.173	1.244	1.265	1.278
20	1.067	1.079	1.097	1.163	1.233	1.254	1.268
21	1.060	1.071	1.089	1.155	1.226	1.246	1.260
22	1.053	1.065	1.083	1.149	1.219	1.240	1.254
23	1.048	1.060	1.078	1.144	1.215	1.235	1.249
24	1.043	1.055	1.073	1.140	1.210	1.231	1.245
25	1.038	1.050	1.068	1.135	1.206	1.227	1.241
26	1.033	1.045	1.063	1.130	1.201	1.223	1.236
27	1.026	1.038	1.056	1.124	1.196	1.217	1.231
28	1.018	1.030	1.048	1.116	1.188	1.210	1.224
29	1.008	1.020	1.038	1.106	1.179	1.200	1.214
30	0.996	1.008	1.026	1.095	1.167	1.189	1.203
31	0.982	0.994	1.013	1.081	1.154	1.176	1.190
32	0.968	0.980	0.998	1.067	1.140	1.162	1.176
33	0.952	0.964	0.983	1.052	1.125	1.147	1.161
34	0.937	0.949	0.967	1.036	1.110	1.131	1.146
35	0.921	0.933	0.951	1.020	1.094	1.116	1.130
36	0.905	0.917	0.935	1.005	1.079	1.101	1.115
37	0.889	0.901	0.919	0.989	1.064	1.086	1.101
38	0.873	0.885	0.904	0.974	1.049	1.072	1.087
39	0.857	0.869	0.888	0.959	1.035	1.058	1.073
40	0.841	0.854	0.873	0.945	1.022	1.045	1.060

NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development.

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SUPPLEMENTAL TABLE 13**Race/ethnic-specific percentiles for fetal anthropometric measurements by gestational age, NICHD fetal growth studies**

Gestational age, wks	Biparietal diameter, mm, Hispanic						
	Third	Fifth	10th	50th	90th	95th	97th
10	10.2	10.4	10.7	12.0	13.5	13.9	14.2
11	13.1	13.3	13.8	15.4	17.1	17.7	18.0
12	16.2	16.5	17.0	18.9	21.1	21.7	22.1
13	19.5	19.8	20.4	22.6	25.1	25.8	26.3
14	22.7	23.2	23.8	26.3	29.1	29.9	30.4
15	26.0	26.4	27.2	29.9	32.9	33.8	34.4
16	29.1	29.6	30.4	33.3	36.6	37.5	38.2
17	32.1	32.6	33.4	36.6	40.0	41.0	41.7
18	35.0	35.5	36.4	39.7	43.3	44.4	45.1
19	37.8	38.4	39.4	42.8	46.5	47.6	48.4
20	40.8	41.4	42.3	45.9	49.8	50.9	51.7
21	43.7	44.4	45.4	49.1	53.1	54.2	55.0
22	46.7	47.4	48.4	52.2	56.3	57.5	58.4
23	49.7	50.4	51.4	55.3	59.6	60.8	61.7
24	52.6	53.3	54.4	58.5	62.8	64.1	64.9
25	55.6	56.3	57.4	61.5	65.9	67.3	68.1
26	58.4	59.1	60.3	64.5	69.0	70.4	71.3
27	61.2	62.0	63.1	67.5	72.1	73.4	74.3
28	63.9	64.7	65.9	70.3	75.0	76.4	77.3
29	66.5	67.3	68.5	73.0	77.8	79.3	80.2
30	69.0	69.8	71.0	75.7	80.6	82.0	83.0
31	71.3	72.2	73.4	78.1	83.1	84.6	85.6
32	73.5	74.4	75.7	80.4	85.5	87.0	88.0
33	75.5	76.4	77.7	82.6	87.8	89.3	90.3
34	77.3	78.2	79.5	84.5	89.8	91.3	92.3
35	78.8	79.7	81.1	86.1	91.5	93.1	94.1
36	80.2	81.1	82.5	87.6	93.0	94.6	95.7
37	81.3	82.2	83.6	88.8	94.4	96.0	97.1
38	82.4	83.3	84.7	90.0	95.6	97.3	98.4
39	83.3	84.3	85.7	91.1	96.8	98.5	99.6
40	84.3	85.3	86.8	92.2	98.0	99.8	100.9

NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development.

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SUPPLEMENTAL TABLE 14**Race/ethnic-specific percentiles for fetal anthropometric measurements by gestational age, NICHD fetal growth studies**

Gestational age, wks	Head circumference, mm, Hispanic						
	Third	Fifth	10th	50th	90th	95th	97th
10	38.7	39.5	40.7	45.5	50.8	52.4	53.5
11	49.2	50.2	51.7	57.5	64.0	65.9	67.2
12	60.7	61.8	63.6	70.5	78.0	80.3	81.8
13	72.7	74.0	76.1	83.9	92.5	95.1	96.8
14	84.9	86.4	88.7	97.4	106.9	109.8	111.7
15	97.0	98.6	101.2	110.6	121.0	124.1	126.2
16	108.9	110.6	113.3	123.5	134.5	137.8	140.0
17	120.4	122.2	125.1	135.8	147.4	150.9	153.2
18	131.7	133.6	136.6	147.7	159.8	163.3	165.7
19	142.9	144.9	148.0	159.5	171.9	175.6	178.0
20	154.2	156.2	159.4	171.3	184.0	187.8	190.2
21	165.6	167.7	170.9	183.1	196.1	199.9	202.4
22	176.9	179.0	182.4	194.8	208.0	211.9	214.5
23	188.1	190.3	193.8	206.4	219.8	223.8	226.4
24	199.2	201.4	204.9	217.7	231.3	235.4	238.0
25	209.9	212.2	215.8	228.8	242.6	246.7	249.4
26	220.4	222.7	226.3	239.6	253.6	257.7	260.4
27	230.5	232.8	236.5	250.0	264.2	268.4	271.1
28	240.1	242.5	246.3	260.0	274.4	278.7	281.4
29	249.3	251.8	255.6	269.5	284.3	288.6	291.4
30	258.0	260.5	264.4	278.7	293.7	298.1	301.0
31	266.1	268.6	272.6	287.2	302.6	307.1	310.1
32	273.5	276.1	280.2	295.2	310.9	315.6	318.6
33	280.2	282.9	287.1	302.5	318.6	323.4	326.5
34	286.1	288.9	293.2	309.0	325.6	330.4	333.6
35	291.2	294.1	298.5	314.6	331.7	336.7	339.9
36	295.5	298.4	302.9	319.5	337.0	342.1	345.5
37	299.0	302.0	306.6	323.6	341.6	346.8	350.3
38	301.9	305.0	309.7	327.1	345.5	350.9	354.4
39	304.3	307.4	312.3	330.1	348.9	354.5	358.1
40	306.2	309.4	314.4	332.7	352.0	357.7	361.4

NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development.

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SUPPLEMENTAL TABLE 15**Race/ethnic-specific percentiles for fetal anthropometric measurements by gestational age, NICHD fetal growth studies**

Gestational age, wks	Abdominal circumference, mm, Hispanic						
	Third	Fifth	10th	50th	90th	95th	97th
10	30.5	31.2	32.2	35.9	40.1	41.3	42.2
11	38.7	39.4	40.6	45.2	50.3	51.8	52.8
12	47.7	48.6	50.1	55.5	61.5	63.4	64.6
13	57.5	58.5	60.2	66.6	73.6	75.7	77.1
14	67.8	69.0	70.9	78.2	86.2	88.6	90.2
15	78.5	79.8	82.0	90.1	99.1	101.8	103.5
16	89.3	90.8	93.2	102.2	112.0	115.0	116.9
17	100.2	101.9	104.5	114.2	124.9	128.1	130.2
18	111.1	112.9	115.7	126.2	137.6	141.0	143.3
19	121.9	123.8	126.8	138.0	150.2	153.8	156.2
20	132.8	134.8	138.0	149.8	162.6	166.4	169.0
21	143.5	145.6	149.0	161.4	174.9	178.9	181.6
22	154.0	156.3	159.8	172.8	186.9	191.1	193.9
23	164.4	166.7	170.4	184.0	198.7	203.1	206.0
24	174.5	177.0	180.8	195.0	210.2	214.8	217.8
25	184.5	187.0	191.0	205.7	221.6	226.3	229.4
26	194.2	196.9	201.0	216.3	232.8	237.7	240.9
27	203.9	206.6	211.0	226.9	244.0	249.1	252.4
28	213.5	216.4	220.9	237.5	255.3	260.5	264.0
29	223.3	226.3	231.0	248.2	266.8	272.3	275.9
30	233.2	236.3	241.2	259.3	278.7	284.4	288.2
31	243.1	246.4	251.5	270.4	290.8	296.8	300.8
32	253.0	256.4	261.8	281.6	303.0	309.3	313.5
33	262.5	266.1	271.8	292.6	315.0	321.7	326.1
34	271.7	275.5	281.4	303.2	326.8	333.8	338.5
35	280.2	284.2	290.4	313.3	338.1	345.4	350.3
36	288.0	292.2	298.7	322.7	348.8	356.5	361.6
37	295.2	299.6	306.4	331.6	358.9	367.1	372.5
38	301.9	306.4	313.6	340.0	368.7	377.2	382.9
39	308.1	312.9	320.3	348.0	378.1	387.1	393.1
40	313.9	318.9	326.7	355.8	387.5	397.0	403.3

NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development.

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Grantz. *Fetal growth charts. Am J Obstet Gynecol* 2018.

SUPPLEMENTAL TABLE 16**Race/ethnic-specific percentiles for fetal anthropometric measurements by gestational age, NICHD fetal growth studies**

Gestational age, wks	Femur length, mm, Hispanic						
	Third	Fifth	10th	50th	90th	95th	97th
10	1.7	1.7	1.9	2.4	3.0	3.2	3.4
11	2.9	3.0	3.2	4.0	5.1	5.4	5.6
12	4.6	4.8	5.1	6.3	7.9	8.3	8.7
13	6.8	7.1	7.5	9.2	11.2	11.9	12.3
14	9.4	9.7	10.2	12.4	15.0	15.8	16.4
15	12.2	12.6	13.2	15.8	18.9	19.9	20.6
16	15.0	15.5	16.3	19.2	22.8	23.9	24.6
17	17.9	18.4	19.2	22.5	26.3	27.6	28.4
18	20.6	21.2	22.1	25.6	29.6	30.9	31.7
19	23.3	23.9	24.9	28.5	32.7	34.0	34.9
20	26.1	26.7	27.7	31.4	35.7	37.0	37.9
21	28.9	29.5	30.5	34.3	38.6	39.9	40.8
22	31.6	32.2	33.2	37.1	41.4	42.7	43.5
23	34.3	34.9	35.9	39.8	44.0	45.3	46.1
24	36.9	37.5	38.5	42.3	46.5	47.8	48.6
25	39.4	40.0	41.0	44.8	48.9	50.1	51.0
26	41.7	42.4	43.4	47.1	51.2	52.4	53.2
27	44.0	44.7	45.7	49.4	53.4	54.6	55.4
28	46.2	46.9	47.9	51.6	55.5	56.7	57.5
29	48.3	49.0	50.0	53.7	57.7	58.9	59.7
30	50.4	51.1	52.1	55.8	59.9	61.1	61.9
31	52.4	53.1	54.1	58.0	62.1	63.3	64.1
32	54.3	55.0	56.1	60.0	64.2	65.4	66.3
33	56.1	56.8	57.9	62.0	66.3	67.6	68.4
34	57.8	58.5	59.6	63.8	68.2	69.6	70.4
35	59.3	60.0	61.2	65.5	70.1	71.4	72.3
36	60.7	61.4	62.6	67.0	71.7	73.1	74.0
37	61.9	62.7	63.9	68.5	73.3	74.7	75.7
38	63.1	63.9	65.2	69.8	74.8	76.2	77.2
39	64.3	65.1	66.4	71.2	76.2	77.7	78.7
40	65.5	66.3	67.6	72.5	77.8	79.3	80.4

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Grantz. *Fetal growth charts. Am J Obstet Gynecol* 2018.

SUPPLEMENTAL TABLE 17

Race/ethnic-specific percentiles for fetal anthropometric measurements by gestational age, NICHD fetal growth studies

Gestational age, wks	Humerus length, mm, Hispanic						
	Third	Fifth	10th	50th	90th	95th	97th
10	1.7	1.8	1.9	2.4	3.0	3.2	3.3
11	3.1	3.2	3.4	4.2	5.1	5.5	5.7
12	4.9	5.1	5.4	6.6	8.1	8.5	8.8
13	7.3	7.5	8.0	9.6	11.6	12.2	12.6
14	10.0	10.3	10.9	12.9	15.4	16.2	16.8
15	12.9	13.3	13.9	16.4	19.3	20.2	20.9
16	15.7	16.1	16.9	19.7	23.0	24.0	24.7
17	18.4	18.9	19.7	22.7	26.2	27.3	28.0
18	20.9	21.4	22.2	25.4	29.1	30.2	30.9
19	23.3	23.8	24.7	28.0	31.7	32.8	33.6
20	25.7	26.3	27.1	30.5	34.2	35.3	36.1
21	28.1	28.7	29.5	32.9	36.6	37.8	38.5
22	30.4	31.0	31.9	35.2	39.0	40.1	40.8
23	32.7	33.2	34.1	37.5	41.2	42.3	43.0
24	34.8	35.4	36.3	39.6	43.3	44.4	45.1
25	36.9	37.4	38.3	41.6	45.2	46.3	47.0
26	38.8	39.4	40.2	43.6	47.1	48.2	48.9
27	40.6	41.2	42.1	45.4	49.0	50.0	50.7
28	42.3	42.9	43.8	47.1	50.7	51.8	52.5
29	43.9	44.5	45.4	48.8	52.5	53.6	54.3
30	45.4	46.0	47.0	50.4	54.2	55.3	56.0
31	46.9	47.5	48.5	52.0	55.9	57.0	57.8
32	48.2	48.9	49.9	53.6	57.5	58.7	59.5
33	49.5	50.2	51.2	55.0	59.1	60.3	61.1
34	50.8	51.5	52.5	56.4	60.6	61.9	62.7
35	51.9	52.6	53.7	57.7	62.1	63.3	64.2
36	53.0	53.7	54.8	58.9	63.4	64.7	65.6
37	54.0	54.7	55.9	60.1	64.6	66.0	66.9
38	54.9	55.7	56.8	61.1	65.8	67.2	68.1
39	55.8	56.6	57.8	62.2	66.9	68.3	69.2
40	56.6	57.4	58.6	63.1	68.0	69.4	70.4

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Grantz. Fetal growth charts. *Am J Obstet Gynecol* 2018.

SUPPLEMENTAL TABLE 18**Race/ethnic-specific percentiles for fetal anthropometric measurements by gestational age, NICHD fetal growth studies**

Gestational age, wks	Head circumference/abdominal circumference, Hispanic						
	Third	Fifth	10th	50th	90th	95th	97th
10	1.142	1.158	1.184	1.278	1.379	1.409	1.429
11	1.148	1.163	1.188	1.278	1.375	1.404	1.424
12	1.146	1.161	1.184	1.272	1.365	1.393	1.412
13	1.138	1.153	1.176	1.260	1.350	1.377	1.394
14	1.127	1.141	1.163	1.244	1.331	1.356	1.373
15	1.113	1.127	1.148	1.226	1.309	1.333	1.350
16	1.098	1.111	1.132	1.206	1.286	1.310	1.325
17	1.083	1.096	1.115	1.187	1.264	1.287	1.301
18	1.069	1.081	1.100	1.170	1.244	1.265	1.280
19	1.057	1.069	1.088	1.155	1.227	1.248	1.262
20	1.048	1.060	1.078	1.143	1.213	1.234	1.247
21	1.041	1.052	1.070	1.134	1.203	1.223	1.236
22	1.035	1.046	1.064	1.127	1.195	1.215	1.228
23	1.031	1.042	1.059	1.122	1.188	1.208	1.221
24	1.026	1.037	1.054	1.117	1.183	1.203	1.216
25	1.022	1.033	1.050	1.112	1.179	1.198	1.211
26	1.017	1.028	1.045	1.108	1.174	1.194	1.206
27	1.011	1.022	1.039	1.102	1.169	1.188	1.201
28	1.003	1.014	1.031	1.095	1.162	1.182	1.195
29	0.993	1.004	1.022	1.086	1.154	1.174	1.187
30	0.981	0.992	1.010	1.074	1.143	1.163	1.177
31	0.968	0.979	0.997	1.062	1.131	1.152	1.165
32	0.953	0.964	0.982	1.048	1.118	1.139	1.153
33	0.937	0.949	0.967	1.034	1.105	1.126	1.140
34	0.921	0.933	0.951	1.019	1.091	1.113	1.127
35	0.905	0.917	0.936	1.004	1.078	1.100	1.114
36	0.890	0.902	0.920	0.990	1.065	1.087	1.102
37	0.874	0.886	0.905	0.976	1.052	1.075	1.090
38	0.859	0.871	0.891	0.963	1.041	1.064	1.079
39	0.844	0.857	0.877	0.950	1.030	1.053	1.069
40	0.830	0.842	0.863	0.938	1.019	1.044	1.060

NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development.

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Grantz. *Fetal growth charts. Am J Obstet Gynecol* 2018.

SUPPLEMENTAL TABLE 19**Race/ethnic-specific percentiles for fetal anthropometric measurements by gestational age, NICHD fetal growth studies**

Gestational age, wks	Biparietal diameter, mm, Asian						
	Third	Fifth	10th	50th	90th	95th	97th
10	10.0	10.2	10.5	11.8	13.3	13.8	14.1
11	12.9	13.2	13.6	15.2	17.0	17.6	17.9
12	16.1	16.4	16.9	18.9	21.0	21.7	22.1
13	19.4	19.8	20.4	22.6	25.1	25.9	26.4
14	22.8	23.2	23.9	26.4	29.2	30.1	30.6
15	26.1	26.6	27.3	30.1	33.1	34.1	34.7
16	29.3	29.8	30.6	33.6	36.9	37.8	38.5
17	32.4	32.9	33.7	36.9	40.3	41.4	42.1
18	35.3	35.8	36.7	40.0	43.6	44.7	45.4
19	38.1	38.7	39.6	43.1	46.8	47.9	48.6
20	41.0	41.6	42.6	46.1	49.9	51.1	51.8
21	44.0	44.6	45.6	49.2	53.1	54.3	55.1
22	47.0	47.6	48.6	52.3	56.4	57.6	58.4
23	49.9	50.6	51.6	55.5	59.6	60.8	61.6
24	52.9	53.6	54.7	58.6	62.8	64.1	64.9
25	55.9	56.6	57.7	61.7	66.0	67.3	68.1
26	58.8	59.5	60.6	64.7	69.1	70.4	71.3
27	61.6	62.4	63.5	67.7	72.2	73.5	74.3
28	64.4	65.1	66.3	70.6	75.1	76.5	77.3
29	67.0	67.8	69.0	73.3	78.0	79.3	80.2
30	69.5	70.3	71.5	76.0	80.7	82.1	83.0
31	71.9	72.7	73.9	78.5	83.3	84.7	85.6
32	74.1	74.9	76.2	80.8	85.7	87.2	88.1
33	76.2	77.0	78.3	83.0	88.0	89.5	90.4
34	78.0	78.9	80.2	85.0	90.1	91.6	92.6
35	79.7	80.6	81.9	86.8	92.0	93.5	94.5
36	81.2	82.1	83.5	88.5	93.7	95.3	96.3
37	82.6	83.5	84.8	89.9	95.3	96.8	97.9
38	83.7	84.6	86.0	91.1	96.6	98.2	99.2
39	84.6	85.5	87.0	92.1	97.7	99.3	100.3
40	85.3	86.2	87.7	93.0	98.6	100.2	101.3

NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development.

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Grantz. *Fetal growth charts. Am J Obstet Gynecol* 2018.

SUPPLEMENTAL TABLE 20

Race/ethnic-specific percentiles for fetal anthropometric measurements by gestational age, NICHD fetal growth studies

Gestational age, wks	Head circumference, mm, Asian						
	Third	Fifth	10th	50th	90th	95th	97th
10	39.9	40.6	41.7	45.9	50.4	51.8	52.7
11	50.6	51.5	52.8	57.8	63.3	64.9	66.0
12	62.2	63.2	64.8	70.6	77.0	78.9	80.2
13	74.3	75.4	77.2	83.9	91.1	93.3	94.7
14	86.6	87.9	89.9	97.3	105.3	107.7	109.3
15	98.9	100.3	102.5	110.5	119.2	121.8	123.5
16	110.9	112.4	114.7	123.3	132.6	135.3	137.1
17	122.6	124.2	126.6	135.6	145.3	148.1	150.0
18	133.9	135.6	138.1	147.5	157.4	160.4	162.3
19	145.1	146.8	149.4	159.0	169.3	172.3	174.3
20	156.4	158.1	160.8	170.7	181.1	184.2	186.2
21	167.8	169.6	172.3	182.4	193.0	196.1	198.1
22	179.3	181.1	183.9	194.0	204.8	208.0	210.0
23	190.7	192.5	195.3	205.7	216.6	219.7	221.8
24	201.9	203.8	206.6	217.1	228.1	231.3	233.5
25	212.9	214.8	217.7	228.3	239.5	242.7	244.9
26	223.6	225.5	228.4	239.2	250.5	253.8	256.0
27	233.8	235.8	238.8	249.7	261.2	264.5	266.7
28	243.6	245.6	248.6	259.8	271.5	274.9	277.1
29	252.8	254.8	257.9	269.3	281.3	284.7	287.0
30	261.3	263.4	266.6	278.3	290.6	294.1	296.5
31	269.2	271.3	274.7	286.7	299.3	303.0	305.4
32	276.4	278.6	282.1	294.5	307.5	311.3	313.8
33	282.9	285.2	288.8	301.7	315.2	319.1	321.7
34	288.8	291.2	294.9	308.3	322.3	326.4	329.0
35	294.0	296.5	300.3	314.2	328.8	333.0	335.8
36	298.5	301.1	305.0	319.5	334.7	339.1	342.0
37	302.3	304.9	309.0	324.1	339.8	344.4	347.5
38	305.2	308.0	312.2	327.8	344.2	349.0	352.1
39	307.3	310.1	314.5	330.7	347.7	352.7	355.9
40	308.3	311.3	315.9	332.6	350.3	355.4	358.8

NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development.

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Grantz. Fetal growth charts. *Am J Obstet Gynecol* 2018.

SUPPLEMENTAL TABLE 21

Race/ethnic-specific percentiles for fetal anthropometric measurements by gestational age, NICHD fetal growth studies

Gestational age, wks	Abdominal circumference, mm, Asian						
	Third	Fifth	10th	50th	90th	95th	97th
10	30.9	31.5	32.4	36.0	40.0	41.2	42.0
11	39.2	39.9	41.1	45.4	50.1	51.6	52.5
12	48.4	49.2	50.6	55.7	61.3	63.0	64.1
13	58.3	59.3	60.9	66.8	73.3	75.2	76.5
14	68.8	70.0	71.8	78.4	85.7	87.9	89.4
15	79.7	81.0	83.0	90.4	98.5	100.9	102.5
16	90.8	92.2	94.3	102.5	111.3	113.9	115.6
17	101.8	103.3	105.7	114.5	123.9	126.8	128.6
18	112.9	114.5	117.0	126.3	136.4	139.4	141.4
19	123.8	125.5	128.1	138.0	148.7	151.8	153.9
20	134.6	136.4	139.2	149.6	160.8	164.1	166.3
21	145.3	147.2	150.2	161.1	172.8	176.3	178.6
22	155.9	157.9	161.0	172.4	184.6	188.2	190.6
23	166.2	168.3	171.5	183.4	196.2	200.0	202.5
24	176.3	178.4	181.8	194.3	207.6	211.5	214.1
25	186.1	188.4	191.9	204.9	218.8	222.9	225.6
26	195.7	198.1	201.8	215.4	229.9	234.2	237.0
27	205.2	207.6	211.5	225.8	241.0	245.5	248.4
28	214.5	217.1	221.2	236.1	252.1	256.8	259.9
29	223.9	226.7	230.9	246.7	263.4	268.4	271.7
30	233.4	236.3	240.8	257.3	275.0	280.3	283.7
31	242.8	245.8	250.5	268.0	286.7	292.3	295.9
32	252.0	255.2	260.2	278.7	298.5	304.3	308.2
33	260.9	264.3	269.6	289.1	310.1	316.3	320.4
34	269.5	273.1	278.7	299.3	321.4	328.0	332.3
35	277.6	281.4	287.3	309.0	332.4	339.3	343.9
36	285.2	289.2	295.4	318.3	342.9	350.3	355.1
37	292.4	296.6	303.1	327.2	353.2	360.9	366.0
38	299.4	303.7	310.6	335.9	363.2	371.4	376.8
39	306.2	310.7	317.9	344.5	373.4	382.0	387.7
40	312.9	317.7	325.2	353.3	383.8	392.9	398.9

NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development.

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Grantz. Fetal growth charts. *Am J Obstet Gynecol* 2018.

SUPPLEMENTAL TABLE 22

Race/ethnic-specific percentiles for fetal anthropometric measurements by gestational age, NICHD fetal growth studies

Gestational age, wks	Femur length, mm, Asian						
	Third	Fifth	10th	50th	90th	95th	97th
10	1.6	1.7	1.8	2.2	2.6	2.8	2.9
11	2.9	3.0	3.2	3.8	4.6	4.8	5.0
12	4.7	4.9	5.1	6.1	7.2	7.6	7.8
13	7.0	7.3	7.6	8.9	10.5	11.0	11.3
14	9.8	10.0	10.5	12.2	14.2	14.8	15.3
15	12.7	13.1	13.6	15.7	18.1	18.8	19.3
16	15.7	16.1	16.8	19.1	21.9	22.7	23.3
17	18.7	19.1	19.8	22.4	25.4	26.3	26.9
18	21.4	21.9	22.6	25.4	28.5	29.5	30.1
19	24.1	24.6	25.3	28.2	31.5	32.4	33.1
20	26.7	27.2	28.0	31.0	34.3	35.3	36.0
21	29.4	29.9	30.7	33.8	37.1	38.1	38.8
22	32.1	32.6	33.4	36.5	39.9	40.9	41.5
23	34.7	35.2	36.0	39.1	42.5	43.6	44.2
24	37.2	37.7	38.6	41.7	45.1	46.2	46.8
25	39.6	40.2	41.0	44.2	47.7	48.7	49.4
26	42.0	42.5	43.4	46.6	50.1	51.2	51.8
27	44.2	44.8	45.7	49.0	52.5	53.5	54.2
28	46.3	46.9	47.8	51.2	54.8	55.9	56.6
29	48.4	49.0	49.9	53.4	57.1	58.2	58.9
30	50.4	51.0	51.9	55.5	59.3	60.4	61.1
31	52.3	52.9	53.9	57.5	61.4	62.6	63.4
32	54.1	54.7	55.7	59.5	63.5	64.7	65.5
33	55.8	56.5	57.5	61.4	65.6	66.8	67.6
34	57.5	58.1	59.2	63.2	67.5	68.8	69.6
35	59.0	59.8	60.9	65.0	69.4	70.7	71.5
36	60.6	61.3	62.4	66.7	71.2	72.5	73.4
37	62.0	62.7	63.9	68.3	72.9	74.2	75.1
38	63.3	64.1	65.3	69.7	74.5	75.9	76.8
39	64.5	65.3	66.6	71.1	76.0	77.4	78.3
40	65.6	66.4	67.7	72.4	77.4	78.9	79.9

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Grantz. *Fetal growth charts. Am J Obstet Gynecol* 2018.

SUPPLEMENTAL TABLE 23**Race/ethnic-specific percentiles for fetal anthropometric measurements by gestational age, NICHD fetal growth studies**

Gestational age, wks	Humerus length, mm, Asian						
	Third	Fifth	10th	50th	90th	95th	97th
10	1.8	1.8	1.9	2.3	2.8	3.0	3.1
11	3.2	3.3	3.4	4.1	4.8	5.1	5.2
12	5.1	5.2	5.5	6.4	7.6	7.9	8.2
13	7.5	7.7	8.1	9.4	10.9	11.4	11.7
14	10.3	10.6	11.0	12.7	14.6	15.2	15.6
15	13.3	13.6	14.1	16.1	18.4	19.1	19.6
16	16.2	16.6	17.2	19.4	22.0	22.8	23.3
17	19.0	19.4	20.0	22.5	25.3	26.1	26.7
18	21.5	22.0	22.6	25.2	28.1	29.0	29.5
19	23.9	24.3	25.0	27.7	30.6	31.5	32.1
20	26.2	26.6	27.4	30.0	33.0	33.9	34.5
21	28.5	28.9	29.7	32.4	35.4	36.3	36.9
22	30.7	31.2	31.9	34.7	37.7	38.6	39.2
23	32.9	33.4	34.1	36.9	39.9	40.8	41.4
24	35.0	35.5	36.3	39.1	42.1	43.0	43.6
25	37.0	37.5	38.3	41.2	44.2	45.2	45.8
26	38.9	39.4	40.2	43.1	46.3	47.2	47.8
27	40.6	41.2	42.0	45.0	48.3	49.2	49.9
28	42.3	42.8	43.7	46.8	50.1	51.1	51.8
29	43.8	44.4	45.3	48.5	52.0	53.0	53.7
30	45.3	45.8	46.8	50.1	53.7	54.8	55.5
31	46.6	47.2	48.2	51.6	55.4	56.5	57.2
32	47.9	48.5	49.5	53.1	57.0	58.2	58.9
33	49.1	49.8	50.8	54.5	58.6	59.7	60.5
34	50.3	51.0	52.0	55.9	60.1	61.3	62.1
35	51.5	52.2	53.3	57.3	61.5	62.8	63.6
36	52.7	53.4	54.5	58.6	63.0	64.3	65.1
37	53.8	54.5	55.6	59.8	64.3	65.6	66.5
38	54.8	55.5	56.7	60.9	65.5	66.9	67.8
39	55.7	56.4	57.6	61.9	66.6	68.0	68.9
40	56.4	57.1	58.3	62.7	67.5	68.9	69.8

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Grantz. *Fetal growth charts. Am J Obstet Gynecol* 2018.

SUPPLEMENTAL TABLE 24**Race/ethnic-specific percentiles for fetal anthropometric measurements by gestational age, NICHD fetal growth studies**

Gestational age, wks	Head circumference/abdominal circumference, Asian						
	Third	Fifth	10th	50th	90th	95th	97th
10	1.198	1.209	1.227	1.293	1.362	1.382	1.395
11	1.192	1.203	1.221	1.284	1.350	1.370	1.383
12	1.181	1.192	1.209	1.271	1.336	1.355	1.368
13	1.167	1.178	1.194	1.255	1.319	1.338	1.351
14	1.150	1.161	1.177	1.238	1.301	1.319	1.332
15	1.132	1.143	1.159	1.219	1.281	1.300	1.312
16	1.115	1.125	1.141	1.200	1.262	1.280	1.292
17	1.098	1.108	1.124	1.182	1.243	1.261	1.273
18	1.082	1.092	1.108	1.166	1.226	1.244	1.256
19	1.068	1.078	1.094	1.152	1.212	1.230	1.242
20	1.057	1.068	1.083	1.141	1.201	1.219	1.231
21	1.049	1.059	1.075	1.133	1.194	1.211	1.223
22	1.042	1.053	1.069	1.127	1.188	1.206	1.218
23	1.037	1.047	1.063	1.122	1.184	1.202	1.214
24	1.032	1.043	1.059	1.118	1.181	1.199	1.211
25	1.028	1.038	1.055	1.115	1.178	1.197	1.209
26	1.023	1.033	1.050	1.111	1.175	1.194	1.207
27	1.017	1.028	1.044	1.106	1.171	1.191	1.203
28	1.009	1.020	1.037	1.100	1.166	1.185	1.198
29	1.000	1.011	1.028	1.091	1.159	1.178	1.191
30	0.989	1.000	1.017	1.081	1.149	1.169	1.182
31	0.976	0.987	1.005	1.069	1.138	1.158	1.172
32	0.962	0.974	0.991	1.057	1.126	1.147	1.160
33	0.948	0.959	0.977	1.043	1.114	1.135	1.148
34	0.933	0.945	0.963	1.030	1.101	1.123	1.136
35	0.919	0.931	0.949	1.017	1.089	1.111	1.125
36	0.905	0.916	0.935	1.004	1.077	1.099	1.114
37	0.890	0.902	0.921	0.990	1.065	1.087	1.102
38	0.874	0.886	0.905	0.976	1.052	1.075	1.090
39	0.857	0.870	0.889	0.960	1.038	1.061	1.076
40	0.839	0.851	0.871	0.943	1.022	1.046	1.061

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Grantz. *Fetal growth charts. Am J Obstet Gynecol* 2018.

SUPPLEMENTAL TABLE 25

Race/ethnic-specific percentiles for estimated fetal weight by gestational age, NICHD fetal growth studies

Gestational age, wks	Estimated fetal weight, g, white						
	Third	Fifth	10th	50th	90th	95th	97th
10	29	30	31	36	41	43	44
11	36	37	38	44	51	53	54
12	45	46	48	55	63	66	68
13	56	58	60	69	80	83	85
14	71	73	76	88	101	105	108
15	90	93	96	111	127	133	136
16	114	117	122	140	161	167	172
17	143	147	153	176	202	211	216
18	179	184	191	220	253	263	270
19	222	227	237	272	313	325	334
20	271	278	289	333	383	398	409
21	328	336	350	403	464	482	495
22	393	403	419	483	556	578	593
3	466	478	497	573	660	687	705
24	547	562	585	674	777	808	830
25	638	655	682	787	907	944	970
26	739	758	790	912	1052	1096	1125
27	849	872	908	1050	1213	1263	1297
28	970	997	1039	1202	1390	1449	1488
29	1103	1133	1181	1369	1586	1653	1699
30	1247	1282	1337	1552	1801	1878	1930
31	1402	1441	1504	1749	2034	2123	2182
32	1566	1610	1682	1960	2284	2385	2453
33	1736	1786	1866	2180	2547	2662	2739
34	1909	1965	2055	2408	2821	2950	3037
35	2081	2144	2244	2637	3099	3244	3342
36	2248	2318	2429	2864	3378	3539	3648
37	2408	2484	2606	3086	3653	3832	3953
38	2559	2642	2774	3299	3923	4120	4254
39	2697	2787	2931	3502	4184	4401	4547
40	2821	2918	3074	3693	4436	4673	4833

NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development.

Estimated fetal weight was calculated from head circumference, abdominal circumference, and femur length using the Hadlock 1985 formula (Hadlock²⁶). Reproduced, with permission, from Buck Louis and Grewal J.¹⁰

Grantz. Fetal growth charts. *Am J Obstet Gynecol* 2018.

SUPPLEMENTAL TABLE 26

Race/ethnic-specific percentiles for estimated fetal weight by gestational age, NICHD fetal growth studies

Gestational age, wks	Estimated fetal weight, g, black						
	Third	Fifth	10th	50th	90th	95th	97th
10	29	30	31	36	41	43	44
11	36	37	39	44	51	53	55
12	46	47	49	56	64	67	69
13	57	59	61	71	81	84	87
14	73	75	78	89	103	107	110
15	92	94	98	113	130	135	138
16	115	118	123	142	163	170	174
17	144	148	154	177	204	213	218
18	179	184	191	220	254	264	271
19	220	225	235	270	311	324	333
20	266	273	285	328	378	394	404
21	320	328	342	394	455	474	486
22	380	390	406	469	541	564	579
23	448	460	479	553	639	665	683
24	523	537	560	647	748	779	800
25	606	623	649	751	869	906	930
26	699	718	748	866	1003	1046	1075
27	800	822	857	994	1152	1201	1234
28	912	937	977	1134	1316	1373	1411
29	1034	1063	1110	1289	1498	1563	1607
30	1168	1201	1254	1459	1697	1772	1822
31	1313	1350	1410	1642	1914	1998	2055
32	1465	1507	1575	1837	2144	2240	2304
33	1623	1670	1746	2040	2385	2493	2566
34	1782	1835	1919	2247	2632	2752	2833
35	1939	1997	2089	2452	2878	3012	3102
36	2091	2155	2256	2654	3122	3270	3369
37	2240	2309	2420	2854	3366	3527	3636
38	2387	2462	2582	3054	3612	3788	3907
39	2533	2614	2744	3256	3864	4056	4186
40	2681	2769	2910	3466	4128	4338	4480

NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development.

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SUPPLEMENTAL TABLE 27

Race/ethnic-specific percentiles for estimated fetal weight by gestational age, NICHD fetal growth studies

Gestational age, wks	Estimated fetal weight, g, Hispanic						
	Third	Fifth	10th	50th	90th	95th	97th
10	28	29	30	35	41	42	44
11	35	36	38	44	50	53	54
12	44	45	47	55	63	66	68
13	55	57	59	69	80	83	86
14	70	72	75	87	101	105	108
15	88	90	94	110	128	133	137
16	111	114	119	138	161	168	173
17	139	143	149	174	202	211	217
18	173	178	186	216	252	263	271
19	213	219	229	267	311	325	334
20	260	267	279	325	380	397	408
21	313	322	336	393	458	479	493
22	373	384	401	469	548	572	589
23	441	454	474	555	649	678	698
24	517	532	556	651	761	796	820
25	601	618	647	758	887	928	955
26	694	714	747	876	1027	1074	1106
27	796	820	858	1007	1182	1236	1273
28	909	936	980	1151	1352	1416	1458
29	1033	1064	1114	1311	1542	1614	1663
30	1169	1204	1262	1486	1750	1833	1889
31	1315	1356	1421	1676	1977	2072	2136
32	1471	1517	1590	1879	2220	2327	2400
33	1632	1684	1766	2090	2474	2596	2677
34	1795	1853	1945	2307	2736	2872	2963
35	1956	2019	2121	2521	2998	3148	3250
36	2110	2179	2291	2731	3255	3422	3534
37	2257	2333	2454	2935	3509	3691	3815
38	2398	2480	2612	3134	3760	3959	4094
39	2534	2622	2764	3330	4011	4228	4375
40	2665	2760	2913	3525	4266	4503	4664

NICHD, Eunice Kennedy Shriver National Institute of Child Health and Human Development.

Estimated fetal weight was calculated from head circumference, abdominal circumference, and femur length using the Hadlock 1985 formula (Hadlock²⁶). Reproduced, with permission, from Buck Louis and Grewal.¹⁰

Grantz. Fetal growth charts. *Am J Obstet Gynecol* 2018.

SUPPLEMENTAL TABLE 28**Race/ethnic-specific percentiles for estimated fetal weight by gestational age, NICHD fetal growth studies**

Gestational age, wks	Estimated fetal weight, g, Asian						
	Third	Fifth	10th	50th	90th	95th	97th
10	27	28	29	34	40	41	43
11	34	35	36	43	50	52	54
12	43	44	46	54	63	66	68
13	55	56	59	68	80	83	86
14	69	71	74	87	101	106	109
15	87	90	94	109	128	133	137
16	110	113	118	138	160	167	172
17	137	141	148	172	200	209	215
18	171	176	183	214	249	260	267
19	210	216	226	263	306	319	328
20	256	264	275	320	372	388	399
21	309	318	332	386	448	468	481
22	370	380	396	461	535	558	574
23	438	450	469	545	633	660	679
24	514	528	551	640	743	775	796
25	599	615	642	745	865	902	927
26	693	712	742	862	1000	1043	1072
27	796	818	853	990	1149	1199	1232
28	910	935	975	1132	1314	1370	1408
29	1034	1063	1108	1287	1494	1559	1602
30	1168	1201	1253	1456	1691	1765	1814
31	1312	1349	1408	1637	1904	1987	2043
32	1464	1506	1572	1830	2130	2224	2287
33	1622	1668	1743	2031	2368	2473	2544
34	1783	1834	1917	2238	2614	2732	2811
35	1943	2000	2091	2448	2865	2996	3084
36	2099	2162	2263	2656	3118	3262	3360
37	2252	2320	2430	2862	3371	3530	3638
38	2397	2472	2592	3065	3623	3799	3918
39	2536	2617	2748	3263	3874	4067	4198
40	2664	2753	2894	3455	4125	4337	4481

Estimated fetal weight was calculated from head circumference, abdominal circumference, and femur length using the Hadlock 1985 formula (Hadlock²⁶). Reproduced, with permission, from Buck Louis and Grewal J.¹⁰

Grantz. *Fetal growth charts. Am J Obstet Gynecol* 2018.