Variation in fetal ultrasound biometry based on differences in fetal ethnicity

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OBJECTIVE: The objective of the study was to evaluate whether fetal ultrasound biometry is affected by variation in fetal ethnicity compared with white controls.

STUDY DESIGN: This was a retrospective observational study of ultrasound biometry in pregnant women with accurate gestational age.

RESULTS: Three hundred five white, 370 Asian, 895 part Hawaiian, 76 Pacific Islander, and 311 white Asian fetuses were analyzed. At 18 weeks gestation femur length was significantly shorter in Asian and white Asian. Humerus length was significantly shorter in Asian, part Hawaiian, and white Asian. White genetic sonogram was positive 14% for femur and 15% for humerus. The following was found: Asian 29% femur (odds ratio [OR], 2.58; 95% confidence interval [CI], 1.70-3.92), 25% humerus (OR, 1.86; 95% CI, 1.23-2.82); part Hawaiian 21% femur (OR, 1.67; 95% CI, 1.14-2.45), 23% humerus (OR, 1.64; 95% CI, 1.13-2.38); Pacific Islander 27% femur (OR, 2.37; 95% CI, 1.23-4.54), 33% humerus (OR, 2.76; 95% CI, 1.47-5.14); and white Asian 20% femur (OR, 1.56; 95% CI, 1.01-2.46), 22% humerus (OR, 1.56; 95% CI, 1.01-2.42).

CONCLUSION: Genetic sonogram was screen positive more frequently because of shorter long bone measurements in all nonwhite ethnicities.

Key words: Down syndrome, ethnicity, femur length, genetic screening, humerus length

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The second-trimester genetic sonogram is a targeted ultrasound evaluation of the fetus used to modify the patient's a priori risk for Down syndrome.[1,2] This examination is traditionally performed between 15 and 20 weeks' gestation. In addition to the usual anatomic evaluation, a specific scoring system is used comprised of various aneuploidy markers and abnormal fetal biometry for Down syndrome.[3,4] Components of the genetic sonogram include nuchal fold; pyelectasis; hyperechoic bowel; echogenic intracardiac focus; and specific structural abnormalities such as cardiac defects, duodenal atresia, and ventriculomegaly. Abnormal fetal biometry consisting of shorter femur and humerus length are also included as minor markers. This is evaluated by comparing the actual long bone measured with a calculated expected long bone measurement using published formulas.[5,6]

Initial studies suggested that the femur length was not affected by maternal ethnicity.[7,8] Many sonologists are under the impression that normal fetal femur lengths were affected by factors such as parental height or maternal ethnicity.[9] It was felt that certain ethnicities such as Asians have shorter long bones while others such as African Americans had longer long bones compared with fetuses of white mothers. A contemporary study by Shipp et al[10] found that less-than-expected fetal femur lengths were found in Asian mothers and greater-than-expected fetal femur lengths were found in African American mothers compared with femur lengths in white mothers. The authors proposed that ethnic variation in fetal femur length as a component of the genetic sonogram required further study.

Hawaii has a unique and very ethnically diverse population with many individuals who are of mixed ethnicity. Many local sonologists are under the impression that the long bone lengths of Asian fetuses are shorter compared with white fetuses. There is a perception that this may be causing an increased false-positive rate for the genetic sonogram because of shorter long bone lengths in this population. If this assumption is true, then affected individuals may choose invasive testing based on an inaccurate risk adjustment of the genetic sonogram.

Because previous studies evaluated fetal biometry based on maternal ethnicity, the question is whether these data can be extrapolated to a mixed-ethnicity fetal population. Because the maternal ethnicity represents only 50% of the fetal ethnicity, maternal ethnicity alone may not accurately represent the fetal ethnicity. The purpose of this study was to determine whether the fetal femur and humerus lengths are affected by differences in fetal ethnicity in an ethnically diverse population. The secondary outcome was to determine whether the genetic sonogram screen-positive rate for fetal biometry is affected by fetal ethnicity.

Materials and Methods

This was a retrospective observational study. All pregnant women referred for an obstetrical ultrasound at the Kaiser Permanente Hawaii Division of Maternal-Fetal Medicine from Nov. 1, 2004, to March 31, 2008, were eligible. Self-reported maternal and paternal ethnicity

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TABLE 1

Fetal biometry at 18 weeks' gestation

Fetal ethnicity	n	BPD, cm (SD)	FL, cm (SD)	HL, cm (SD)
White (reference)	94	4.26 (0.23)	2.83 (0.25)	2.82 (0.26)
Asian	121	4.24 (0.24)	2.75 (0.22)[a]	2.71 (0.23)[a]
Part Hawaiian	279	4.26 (0.25)	2.78 (0.24)	2.76 (0.24)[a]
Pacific Islander	76	4.33 (0.19)	2.80 (0.24)	2.78 (0.22)
White Asian	102	4.27 (0.27)	2.76 (0.20)[a]	2.73 (0.20)[a]

BPD, biparietal diameter; *FL*, femur length; *HL*, humerus length; *SD*, standard deviation.

[a] $P \leq .05$.

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was obtained via an existing structured genetic screening questionnaire used as part of the genetic risk screening for all patients evaluated in the department.

Individual ethnicities were categorized as white, African American, American Indian/Eskimo, Ashkenazi Jewish, Latino, East Indian, Filipino, Chinese, Japanese, Korean, Laotian, Vietnamese, Thai, Middle Eastern/Arabic, Puerto Rican, Hawaiian, Marshallese, Micronesian, Samoan, Tongan/Tahitian, Guamanian, other Southeast Asian, other Pacific Islander, other, and unknown.

Fetal ethnicity was determined by combining ethnicities of both parents. Fetal ethnicities were then grouped into white (including Ashkenazi Jewish), Asian (Filipino, Chinese, Japanese, Korean, Laotian, Vietnamese, Thai and other Southeast Asian), part Hawaiian (Hawaiian and any other ethnicity), white Asian (white and any Asian), and Pacific Islander (Marshallese, Micronesian, Samoan, Tongan/Tahitian, Guamanian, and other Pacific Islander). The white ethnicity was used as the control group.

Gestational age was determined by a definite last menstrual period and/or first-trimester ultrasound performed at 12 weeks' gestation or less. Pregnancies that did not meet dating criteria were excluded. Pregnancies with a known or suspected fetal anomaly, chromosomal aneuploidy, multiple gestation, hypertensive disorders, diabetes, and gestational diabetes were excluded.

Ultrasound examinations were performed transabdominally using an Acuson Sequoia 512 (Siemens Medical Solutions USA, Inc, Malvern, PA). Standard biometric data, exclusion, and dating criteria were performed and recorded as part of the routine examination. All scans were done in accordance with the minimum standards described by the American College of Obstetricians and Gynecologists and the American Institute of Ultrasound in Medicine with the addition of cardiac outflow tracts, hands, and feet.[11,12] Karyotype abnormalities were identified if performed. Follow-up of unidentified anomalies and skeletal dysplasias was based on newborn examination.

A gestational age of 18 weeks was used to compare fetal biometry. Biparietal diameter and humerus and femur length were used for analysis. A gestational age between 15 and 20 weeks was used for the genetic sonogram analysis. Calculation of the expected femur and humerus length for the genetic sonogram was determined using published formulas.[5,6] The expected humeral length was -7.9404 + 0.8492 × biparietal diameter (BPD). The humerus was considered shorter than expected if the actual overexpected ratio was less than 0.90. The expected femur length was -9.3105 + 0.9028 × BPD. The femur was considered shorter than expected if the actual overexpected ratio was less than or equal to 0.91. Statistical analysis of continuous variables was done using the 2 tailed Student *t* test. Categorical variables were evaluated by χ^2 analysis. $P < .05$ was considered statistically significant.

Results

During the study period, 8619 studies with ethnicity data were available. Biometric data were available for 4029 studies. After exclusion, a total of 1983 met entry criteria. There were 305 white, 370 Asian, 895 part Hawaiian, 76 Pacific Islander, and 311 white Asian fetuses. There was insufficient numbers of other ethnicities for meaningful statistical analysis. The maternal age of the groups was as follows: white 31.5 (6.2) years, Asian 31.0 (5.8) years, part Hawaiian 26.7 (6.4) years, Pacific Islander 29.2 (6.8) years, and white Asian 30.8 (6.1) years. The maternal age of part Hawaiian ($P \leq .01$) and Pacific Islander ($P = .01$) fetuses was significantly younger compared with whites.

The majority of patients were referred for an ultrasound evaluation requesting either a routine anatomic survey or for maternal age over 35 years. Part Hawaiian, Pacific Islanders, and white Asian fetuses were more frequently referred for an anatomic survey ($P < .01$) compared with whites. Asians demonstrated a similar trend, but it was not statistically significant ($P = .08$). Other less frequent indications included referral for a positive quad marker serum screen, follow-up study, and vaginal bleeding. There were no statistical differences for these other indications among the groups.

Fetal biometry data at 18 weeks' gestation are summarized in Table 1. There was no statistical difference between biparietal diameter measurements for all ethnic groups. The femur length was significantly shorter in Asian and white Asian fetuses compared with white controls ($P \leq .01$). The humerus length was significantly shorter in Asian, part Hawaiian, and white Asian fetuses compared with white controls ($P \leq .05$). The genetic sonogram actual overexpected fetal long bone ratio was calculated for each group from 15 to 20 weeks' gestation and is summarized in Table 2. The white group had a screen-positive rate for a shorter-than-expected long bone length of 14% for femur and 15% for the humerus. There was a statistically significant increased screen-positive rate for